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Prosesskriv til Borgarting lagmannsrett

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• • •

1 INNLEDNING

Jeg viser til rettsboka fra planmøte der det ble bedt om diverse avklaringer.

2 STATENS PRINSIPALE ANFØRSEL

Staten er bedt om å redegjøre nærmere for statens prinsipale anførsel knyttet til betydningen av at det på vedtakstidspunktet i 2016 ennå ikke forelå en godkjent forvaltningsplan iht. vannforskriften § 29.

Staten vil understreke at Norge hele tiden ment at gjennomføringen i norsk rett i vannforskriften § 12 oppfyller vanndirektivets krav. På vedtakstidspunktet var Norge imidlertid ennå ikke forpliktet etter direktivet til å ha godkjente forvaltningsplaner. Dermed gjaldt ikke plikten til å forebygge forringelse etter direktivet artikkel 4 nr.1 bokstav a, og følgelig var det ikke noe krav om at tillatelsen måtte oppfylle unntaksvilkårene i artikkel 4 nr. 7. Det var heller ikke i strid med EØS-retten å gi en slik tillatelse i denne «mellomfasen», jf. EU-domstolens uttalelser i C-43/10 *Nomarchiaki Aftodioikisi Aitoloakarnanias* avsnitt 57-60 og C-346/14 *Kommisjonen mot Østerrike* avsnitt 50-51.

Ved gyldighetsprøvingen lagmannsretten skal foreta, må man derfor falle tilbake på en alminnelig tolkning av vannforskriftens krav, uten at tolkningen av direktivets art. 4 nr 1 og nr. 7 skal trekkes inn som tolkningsfaktor som kan begrunne at handlingsrommet etter forskriften er snevrere.

Under ankeforhandlingen vil det aller meste av tiden bli brukt for å begrunne statens synspunkt om at tillatelsen uansett *er* i samsvar med vannforskriften § 12, tolket i lys av direktivets art. 4 nr. 7, der EFTA-domstolens tolkningsuttalelse utgjør det naturlige startpunktet for lagmannsrettens vurdering. Får staten medhold i sitt syn, vil ikke den prinsipale anførselen komme på spissen.

3 EFTA-DOMSTOLENS TOLKNINGSUTTALELSE

Staten er bedt om å avklare om staten vil argumentere for at EFTA-domstolens tolkningsuttalelse skal fravikes, eller om det er en tolkning som gjøres gjeldende. Som nevnt i statens prosesskriv 7. april 2025 tar staten til etterretning EFTA-domstolens syn om at «rent økonomiske hensyn, som å fremme nasjonaløkonomiske eller nasjonaløkonomiens funksjon» ikke kan begrunne at det foreligger «overriding public interest». Staten vil ikke argumentere mot dette utgangspunktet i seg selv. Tolkningsuttalelsen er imidlertid både uklar og uten nevneverdig rettslig forankring når det gjelder hva «mer» som skal til, jf. avsnitt 41-43 i uttalelsen og punkt 2.3 i statens prosesskriv, særlig når dette leses i lys av de generelle utgangspunktene som trekkes opp i avsnitt 33-36, jf. statens prosesskriv punkt 2.1. I tillegg har staten i prosesskrivet pekt på at også EFTA-domstolens uttalelser om adgangen til å vektlegge sysselsettingshensyn og hensynet til mineraltilgang mv. etterlater rom for tolkning og supplering. Slik staten forstår tolkningsuttalelsen, er det altså ikke behov for å problematisere i hvilken grad tolkningsuttalelsen kan *fravikes*.

4 SAKSFREMSTILLINGEN

Staten er bedt om å gi eventuelle bemerkninger til at saksfremstillingen innledningsvis i tingrettens dom og i henvisningsskrivet legges til grunn. Staten har i anketilsvaret sluttet seg til tingrettens dom i begrunnelse og resultat. Tingrettens saksfremstilling på side 2-6 i dommen kan legges til grunn. I utgangspunktet gjelder det samme for saksfremstillingen i lagmannsrettens henvisningsskriv til EFTA-domstolen punkt 3, men se noen merknader og suppleringer i statens skriftlig innlegg til EFTA-domstolen punkt 2, bl.a. avsnitt 14 flg., avsnitt 20, samt avsnitt 21 og 23.

5 BEVISFØRSELEN

5.1 Hva er relevant for lagmannsrettens gyldighetsprøving

Slik saken nå står for lagmannsretten, er det sentrale spørsmålet lagmannsretten skal ta stilling til om tillatelsen som ble gitt i 2016 ligger utenfor handlingsrommet Norge har etter EØS-retten.

Som forklart i statens prosesskriv 7. april 2025 (med videre henvisning til tidligere prosesskriv), er statens syn at lagmannsretten ved gyldighetsprøvingen ikke er bundet til å *kun* prøve de momenter som er eksplisitt fremhevet i vedtakets begrunnelse. EU-domstolens avgjørelse i C-3/17 *Sporting Odds LTD,* særlig avsnitt 61-65 underbygger dette.

Staten er bedt om å avklare om utviklingen etter vedtakstidspunktet er relevant. Etter statens syn kan det ikke være tvilsomt at utviklingen er *relevant*. Statens syn er samtidig at utviklingen ikke er *avgjørende* for å kunne konkludere med at vedtaket er gyldig.

De faktiske forholdene som forelå på vedtakstidspunktet, er tilstrekkelig for å konstatere at det forelå en (eller flere) «overriding public interest».

For sysselsettingshensynet siktes det her særlig til befolkningsutviklingen og prognosene om fremtidig utvikling med og uten Engebø-prosjektet som forelå allerede i 2016.

For hensynet til å sikre forsyning av/tilgang til viktige mineraler (rutil), siktes det særlig til (i) naturgitte omstendigheter ved selve forekomsten (størrelsen, fordelaktige egenskaper ved forekomsten og prosjektet), (ii) forsyningssituasjonen i EØS (for hele verdikjeden fra råvare til ferdig produkt) og (iii) alternative forsyningskilder i EØS. Allerede i 2016 var klart at Engebø-forekomsten var så stor, og hadde fordelaktige egenskaper for øvrig, som tilsa at prosjektet kunne dekke etterspørselen etter rutil på verdensmarkedet (herunder EØS) i mange år, og dermed også at prosjektet ville bidra positivt til forsyningssituasjonen i EØS-landene. Utviklingen i tiden etter vedtakstidspunktet, bl.a. foranlediget av Russlands fullskalainvasjon av Ukraina, innebærer at hensynet er forsterket og har aktualisert seg ytterligere, illustrert blant annet ved vedtakelsen av CRMA. Denne utviklingen representerer etter statens syn imidlertid ikke noe som i seg selv er avgjørende for vedtakets gyldighet.

For lagmannsretten vil statens bevisførsel bestå av dokumentasjon utarbeidet både før og etter vedtakstidspunktet. I sistnevnte tilfelle mener staten dette er etterfølgende *bevisfakta* som fritt kan fremlegges. Dersom lagmannsretten skulle mene at noe av dette er nytt *rettsfakta*, oppstår problemstillingen om det kan legges vekt på dette. Utgangspunktet i norsk rett er at det er rettsfakta på vedtakstidspunktet som er avgjørende dersom domstolene skal kjenne et vedtak ugyldig. Etter statens syn kan det, i alle fall i en sak som vår, stilles spørsmål ved om dette utgangspunktet gjelder fullt ut når spørsmålet er om en etterfølgende utvikling kan brukes som argument for å *opprettholde* et vedtak som gyldig. Staten viser særlig til at tvistepunktet i saken er Norges handlingsrom etter EØS-retten og at det etter EØS-retten er slik at prøvingen skjer ut fra det materiale som forelegges for domstolen, jf. bl.a. C-3/17 *Sporting Odds*. Fordelen vil være at domstolsprøvingen skjer opp mot det som er sakens springende punkt *i dag*, over ni år etter at tillatelsen ble gitt. Staten

har hittil ikke sett det nødvendig å ta et endelig standpunkt til dette all den tid statens syn er at den etterfølgende utviklingen ikke er avgjørende for domstolens gyldighetsprøving.

5.2 Sysselsettingshensynet

Det er så langt ikke planlagt vitneførsel omkring sysselsettingshensynet. Hensynet er godt belyst i sakens dokumenter og staten vil om nødvendig inngi noe supplerende dokumentasjon.

5.3 Hensynet til mineraltilgang mv.

Når det gjelder Engebø-forekomstens betydning for dette hensynet vil staten supplere bevisførselen fra tingretten med dokumentbevis. Det tas forbehold om å ytterligere bevis.

Supplerende bevisførsel om Engebø-prosjektet:

Bilag 1: Titanlandet Norge | Tu.no Teknisk Ukeblad, 13. februar 2009

Bilag 2: Nordic Mining ANNUAL REPORT 2015

Bilag 3: Nordic Mining INTERIM REPORT Per 31 December 2024

Bilag 4: Nordic Mining ANNUAL REPORT 2024

Supplerende bevisførsel om titan og forsyningskjedene av titanmetall og titanråstoff:

Bilag 5: Utskrift fra NGU: Geologiske ressurser, Titan (udatert – utskrift 30. april 2025)

Bilag 6: Russia: Europe imports €13 billion of 'critical' metals in sanctions blindspot Ivestigate Europe, 24. oktober 2023

Bilag 7: Impact assessment report, Commission staff working document, 16. mars 2023

Bilag 8: Titanium metal in the EU: Strategic relevance and circularity potential, European Comission, Joint Research Centre, 2025

Bilag 9: Closing the loop on the EU's titanium supply chain - European Commission pressemelding 23. januar 2025

Supplerende bevisførsel om forsyningssikkerhet av råstoff, herunder titan:

Bilag 10: Strategi for mineralnæringen Nærings- og handelsdepartementet, 2013

Bilag 11: Joint Statement from the United States and Norway on Cooperation on High-Standard, Market-Oriented Trade of Critical Minerals 17. April 2024

Bilag 12: Norge og USA enige om å inngå strategisk mineralsamarbeid, pressemelding 18. april 2024

Bilag 13: NATO releases list of 12 defence-critical raw materials, pressemelding 11. desember 2024

Bilag 14: Commission selects 47 Strategic Projects to secure and diversify access to raw materials in the EU, pressemelding 25. Mars 2025

Bilag 15: Regjeringen vil innlemme EUs regelverk for kritiske råvarer i EØS-avtalen, Pressemelding 28. mars 2025

Det arbeides med å avklare om det vil være behov for vitneførsel om hensynet til mineraltilgang mv., og ev. vitne vil bli meldt så snart dette er avklart.

5.4 Vitne fra Miljødirektoratet

Staten vil føre Harald Sørby som vitne. Han er seksjonsleder i Miljødirektoratet og forklarte seg også for tingretten. Forklaringen vil belyse relevante deler fra Miljødirektoratets involvering i utredningen av saken, herunder direktoratets praksis i lignende saker.

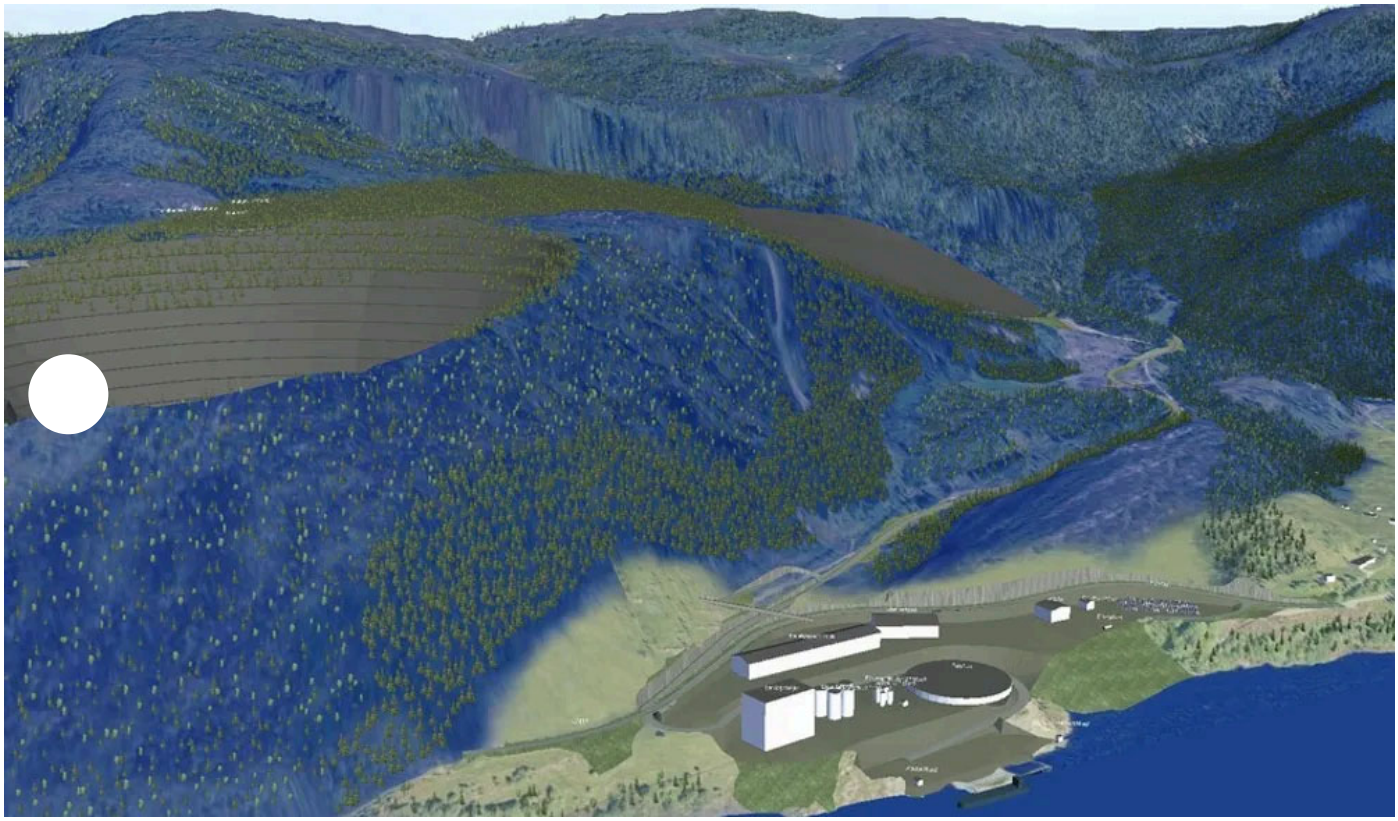
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REGJERINGSADVOKATEN

Asgeir Nygård
advokat

INNSIKTBYGG

Titanlandet Norge



Del Kommenter



Odd Richard Valmot Journalist

TU Daglig | Nyhetsbrev

Få de viktigste teknologinyhetene direkte i din innboks.

Mye norsk kompetanse

- I Norge har vi drevet med titanoksid i hundre år og med gruvedrift og

Vis mer

Norge er godt forspent med titanressurser.

Gjennom den gigantiske forekomsten av ilmenitt i Hauge i Dalane og videreforedlingen til titanoksid ved Kronos Titan i Fredrikstad er vi en betydelig internasjonal aktør.

ARTIKKELEN FORTSETTER ETTER ANNONSEN

ANNONSØRINNHOLD

computas



De viktigste nyhetene fra Google Cloud Next i Las Vegas

Norge har en av de største titanmalmreservene i verden og er helt dominerende i Europa.

Interessen for titan er veldig stor over hele verden, og metallet regnes som strategisk viktig.

Europa er nettoimportør av titan og titanoksider, og EU begynner å bli bekymret for leveransene. Svært mye industri er avhengig av slike råstoffer.

Titanhvitt

Det er hundre år siden man oppdaget de optiske egenskapene til titanoksid som har gjort mineralet så utbredt. I 1909 fikk professor P. Farup patent på bruk av titanoksid til pigment, og sammen med dr. G.

Jebsen utviklet de metoder for fremstilling av såkalt titanhvitt fra titanoksid.

Frem til da, og for den saks skyld lenge etter, brukte man bly for å fremstille hvitt pigment, noe som ikke er spesielt helsefremmende.

I dag er titanoksid helt dominerende som pigment og brukes i alt fra maling og farge til tannpasta og papir. Titanoksid er ikke giftig eller helseskadelig.

Selv om titanoksid er mørkt i vanlig kornstørrelse, skifter mineralet farge og blir kritthvitt når kornstørrelsen blir liten nok. Da har det større reflektivitet enn diamant.

ARTIKKELEN FORTSETTER ETTER ANNONSEN

Den årlige produksjonen av titanoksid er på rundt 6 millioner tonn. Norge står for rundt åtte prosent av denne produksjonen.

Det er fremdeles behovet for titanoksid som dominerer titanindustrien, og over 90 prosent brukes til dette formålet. Men den videre bearbeiding til titan i metallform får stadig større betydning.

Behovet for titan øker kraftig, spesielt i fly- og oljeindustrien, men andre industrier har også fått øynene opp for dette metallet.

Titan er mye mer syrefast enn såkalt syrefast stål og kan garantere minst 50 års holdbarhet, i stedet for 25 år som er vanlig med syrefast stål i dag.

Mineraler

I Norge har vi utvunnet titanoksid fra ilmenitt. Forekomsten som Titania driver har reserver på over 400 millioner tonn og er verdens største ilmenittforekomst. Det tas ut ca. 7 millioner tonn malm årlig ved Titania.

Ilmenitt har en kjemisk formel $TiFeO_3$. Det betyr at titanmetallet er bundet til både jern og oksygen, og derfor trengs det en kjemisk prosess for å fremstille rent titanoksid, TiO_2.

Selv om den langt største delen av verdens titanoksid kommer fra produksjon av ilmenitt, kommer også en del fra rutil. Rutil er et mineral som består av rent titanoksid og som derfor ikke har behov for den kostbare kjemiske behandlingen for å fjerne jernet i mineralet.

ARTIKKELEN FORTSETTER ETTER ANNONSEN

ANNONSE



22 prosent energibesparelser gjennom tilstedeværelsesbasert styring av møterom

Dette har betydning for prisen, og mens ilmenitt har en verdi på rundt 500 kroner per tonn, oppnås det samme beløpet i dollar for rutil.

Norge har også veldig store forekomster av rutil. Den største forekomsten vi kjenner til ligger i Engebøfjellet inne i Førdefjorden.

Titanfjellet

Rutilforekomsten i Engebø er ideell på mange områder. For det første er den svært stor. Så langt er det konstatert rundt 380 millioner tonn malm. Av dette regnes rundt 200 millioner tonn å være utvinnbart, men slike anslag varierer med prisene.

Den malmførende strukturen fortsetter ned i dypet og er sannsynligvis vesentlig større. Titanet opptrer i bergarten eklogitt, som er valgt til en av Norges til «nasjonalbergarter». En fordel med forekomsten i Engebøfjellet er at den ikke inneholder radioaktive elementer som ellers ville skapt vanskeligheter i produksjonen.

Fordi forekomsten ligger ved sjøen, blir transportkostnadene små. I tillegg ligger den nært markedet i forhold til konkurrerende forekomster.

Eklogitten i Engebø inneholder også betydelige mengder granat. Det er et spesielt hardt mineral som benyttes til sandblåsing og som slipemiddel, og som kan bli et verdifullt biprodukt.

Titangruve

Det norske gruveselskapet Nordic Mining har planer om gruvedrift i Engebøfjellet. Hvis de får de nødvendige tillatelsene, kan det bli drift i løpet av 2013. Selskapet vil åpne et dagbrudd og ta ut mellom tre og fire millioner tonn malm årlig uten å endre formen på fjellet.

ARTIKKELEN FORTSETTER ETTER ANNONSEN

Ledige stillinger hos teknologibedrifter Tekjobb



Avinor

Driftsingeniør automasjon, vann og avløp

Det er nok malm til å drive dagbruddet i 15 år. Etter det vil de gå over til underjordsdrift og øke uttaket til mellom fire og seks millioner tonn.

Granatproduksjonen vil komme opp i rundt 100 000 tonn årlig. I tillegg kan det være aktuelt å eksportere en del gråberg som pukk på grunn av den korte veien til kaianlegget.

Det vil bli bygget oppredningsanlegg nede ved sjøen som kan produsere konsentrerte produkter. Avgangen er planlagt med et sjødeponi i den over 300 meter dype fjorden.

Siden avgangen er inert og er fri for tungmetaller, og bunnen i fjorden er helt flat og dekket av sedimenter fra istiden, ligger forholdene godt til rette for en slik løsning.

For å etablere gruven vil det bli investert mellom 1,5 og 2 milliarder kroner, og aktiviteten vil skape rundt 170 arbeidsplasser i minst 50 år fremover. Verdien av den årlige eksporten er beregnet til rundt 450 millioner kroner.

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Derfor er kraftnettet i Norge mindre sårbart for blackout



På tide å flytte Norge opp i skyen!

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ANNUAL REPORT **2015**

NORDIC MINING



SAFETY – ENVIRONMENT – INNOVATION



A forward-looking resource company with integrated operations in exploration, extraction and production of high-end minerals and metals.



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CEO'S REPORT

Dear shareholder,

Last year brought a significant milestone for Nordic Mining and for us as shareholders. After almost 8 years of uncertainty, the Norwegian Government approved the industrial area plan and granted the discharge permit for the Engebø rutile project. We hope that this also marks a general turning point for the Norwegian mining industry, which has a large unresolved potential for further growth. I take this opportunity to thank all of you for your endurance and support which made it possible to carry on and reach this major milestone.

The natural resource industry is cyclical and for the last years raw materials have experienced a dramatic downturn that still prevails. However, we remain confident that the fundamental drivers will remain in our favor over time. Despite financial uncertainties, wars and social conflicts, the world will regain its path towards further growth. As market factors balance out, our assets hold a significant potential, and will prove their value through further development.

The team is strengthened

As a result of the Engebø permits, we have decided to strengthen our team. The recent core drilling operation at Engebø turned out to be a tough test for the team, but everyone performed remarkably. The whole drilling and inspection operation is crucial, as every meter of drill core brings valuable information that will contribute to the basis for a commercial realisation of the project. The team effort and cooperation has been vital to secure this workflow.

Minerals for a sustainable future

When starting the core drilling program at Engebø, Nordic Rutile experienced a challenging situation due to illegal actions. However, despite the media attention, I believe that this triggered a stronger public interest in our minerals. What role do the minerals play in our society? Is there a connection between sustainability and the need for minerals? Last year showed that the global shift towards sustainable energy production is evolving faster and broader than ever before. This leads to a higher focus on minerals that are critical to facilitate this change. We encourage everyone that are sceptic to the mining industry to be constructive on how they can contribute to our common responsibility for a sustainable supply of required minerals.



The future is electric

After thorough exploration work and core drilling operations, Keliber has finalised its Pre-feasibility Study giving clear perspectives of a good and profitable project. In fact, Keliber will make history by being the first European producer of high grade lithium carbonate for the battery industry. Lithium proved counter-cyclical last year as increased demand created a tighter supply situation and a surge in prices.

Seabed minerals, a brave outlook

Through the Norwegian Research Council, the MarMine project, headed by NTNU, was granted almost USD 3 million in funding for carrying out a research project on seabed minerals within Norwegian waters. MarMine is a pioneering project by nature and reflects a wish to explore unknown opportunities. This is all due to NORA's initiative back in 2008 when we kicked off the dialogue with the authorities, and later applied for licenses. Over time, a move from land to sea is inevitable, for minerals as previously for oil, and may foster complete new business scenarios for mining.

Our assets, a platform for further growth

Nordic Mining's asset portfolio brings a clearer message than ever before; we count on minerals being of ever increasing importance to the society over time. As the public awareness grows, the value proposal will take momentum and aid Nordic Mining on its path to a more robust company. Our recent participation at the PDAC conference in Toronto confirmed that our profile is well received also outside the Nordic countries. The Engebø permits give us reason to be more confident in the development ahead.

Let us align with the EU strategy

Several years ago the EU politicians carved out a three pillar strategy for minerals:

- Ensure level playing field in access to resources
- Foster sustainable supply from European sources
- Boost resource efficiency and recycling

The EU "Raw Materials Initiative" has been an inspiration for Nordic Mining, and we hope to enjoy an even closer relation with the EU in the efforts to grow the Norwegian mineral industry. We have a lot to learn from EU with regards to actions to boost resource planning and facilitate industrial development. Europe has had the boots on for a while. We can adopt much from Europe and adjust to Norwegian priorities.

Oslo, 19 April 2016



Ivar S. Fossum
CEO

OPERATIONS

NORDIC RUTILE – rutile (titanium dioxide)



Nordic Rutile holds the rights to a significant rutile deposit at Engebø in Naustdal municipality in Norway. Rutile is a titanium feedstock, high in demand and used in the production of pigments, titanium metal and welding rods. The planned rutile production at Engebø will significantly increase economic activity and value creation in Naustdal and in the surrounding region.

On 17 April 2015, the industrial area plan (zoning plan) and the discharge permit for the project were approved by the Ministry of Local Government and Modernisation and the Ministry of Climate and Environment. An appeal related to the discharge permit was dismissed by the King in Council in February 2016. The granted permits are therefore final and without further possibility for appeal.

The Engebø Project

Through the wholly owned subsidiary Nordic Rutile, Nordic Mining will establish industrial production of rutile concentrate (TiO_2) based on its rutile deposit at Engebø in Naustdal municipality in Norway. The Engebø rutile deposit is one of the largest unexploited rutile deposits in the world and has the highest in situ grade of rutile compared to current rutile producers and development projects. Nordic Mining's internal estimate for the NPV of the Engebø project is USD 466 million after tax based on a long-term rutile price of USD 1,000 per tonne and an 8% discount rate.

The mineral deposit at Engebø also contains significant quantities of garnet, and Nordic Mining plans to produce high quality garnet as a by-product. Garnet has various industrial applications and can replace silica containing sand which is harmful for health.

Thomas B. Addison, a mining engineer from the Norwegian University of Science and Technology (NTNU) with broad industrial experience, has been employed as Managing Director for Nordic Rutile. He took up the position with effect from 1 February 2016. Addison will manage and coordinate the development of the Engebø rutile project.

In January 2016, Nordic Rutile established an office with technical facilities in Naustdal. The company will gradually manage the project development, stakeholder contacts and public relations from this location.

Environmentally friendly products and solutions

Rutile is an environmentally friendly mineral and an important titanium feedstock. It is considered a strategic mineral by the EU. Rutile is a high-end raw material used in the production of environmentally friendly pigments for paints, plastics and paper, and in the production of titanium metal and welding rods. Rutile is of major industrial importance and has a number of applications within health and medicine, environmental technologies and consumer products. Due to its high bio-compatibility titanium is particularly suitable and demanded for prostheses and implants in the human body.

Also in other applications, titanium-based products and materials from rutile contribute to environmental advantages, e.g. weight reduction, lower fuel consumption and reduced greenhouse gas emission in modern airplanes. Further, titanium dioxide has a photocatalytic effect that in various surface products removes NOx pollution from the air.

Nordic Mining will ensure environmentally friendly extraction, production and shipping, as well as a sustainable solution for disposing of mineral tailings. Calculations indicate that shipping of rutile from Engebø to customers in Europe will reduce CO_2 emission by 80% compared with long-distance supply from i.a. South Africa. The moderate internal transportation at Engebø will also contribute to a low CO_2 footprint for the project.

Industrial area plan (zoning plan) and discharge permit approved

On 17 April 2015, the Ministry of Local Government and Modernisation approved the industrial area plan (zoning plan) for the Engebø rutile project. At the same time, a discharge permit for the project was granted by the Ministry of Climate and Environment. An appeal related to the discharge permit was dismissed by the King in Council in February 2016. The granted permits are therefore final and without further possibility for appeal.

The industrial area plan (zoning plan) includes the areas for mining operation, processing plant, harbor facilities, relocation of the county road, and a disposal site for waste rock in Naustdal municipality. In addition, the plan includes an area in the Førdefjord in Naustdal and Askvoll municipalities for deposition of tailings during the estimated 50 year life of mine period.

The discharge permit for the Engebø operation is in accordance with the Norwegian Pollution Control Act and based on a recommendation from the Environment Agency. The permit has various conditions with a purpose to minimise effects from blasting, noise and dust, use and emission of processing chemicals, as well as conditions regarding possible back-filling and alternative use of tailings. The discharge permit also includes conditions related to distribution of particles from the sea disposal and monitoring of the disposal area and the biodiversity including i.a. monitoring of emigrating smolt.



Inspection and logging of drill cores at the Naustdal premises.



RUTILE

Titanium	Oxygen
22	8
Ti	O

PROPERTIES

The mineral rutile is composed of titanium and oxygen, and is a titanium dioxide (TiO_2). Rutile has among the highest refractive indices of any known mineral. Natural rutile is often found as deep reddish brown crystals. Rutile is used to produce titanium metal.



Core drilling at the Engebø deposit.

Commercial outlook

Europe has a significant supply deficit of titanium feedstock. Currently, the main volumes of rutile and other feedstock into Europe come from Australia, Africa and North-America. For industrial customers in Europe supply from Engebø will represent a substantial logistical advantage compared to overseas alternatives. Future global demand for rutile is expected to be higher than the supply as new production capacity is expected to be restricted. Overall this provides basis for a positive long-term market outlook.

Applications for mineral tailings and wall rock

Nordic Mining is assessing potential products and applications for the tailings from the production process at Engebø. The tailings are inert minerals with background levels of heavy metals and radio-active elements, and have been approved as capping material for contaminated sediments, e.g. in harbours and other polluted areas. Further, the wall rock is considered in various applications for concrete, as a soil conditioner, and as raw material for various construction purposes. The deep water port facilities at Engebø and the short distance to the European markets represent a logistical advantage also for the commercial use of the tailings and the wall rock. In the future, various by-products from tailings and wall rock may represent an important additional value for the project, both financially and with regard to new industrial activity. As a consequence, the need for disposal of tailings would be reduced.

Project development

A core drilling program was started at Engebø in February and completed in April 2016. Approximately 6,400 meters has been drilled, mainly in the open pit part of the deposit. The drill cores are studied and sampled by geologists. Samples are sent to laboratories for chemical and mineralogical analysis to determine rutile grade and to assess garnet quantity and other rock characteristics. When all analytical tests are completed, the Qualified Person, Mr. Adam Wheeler will assess the information as a part of the update of the mineral resource estimates and classifications in accordance with the JORC Code. The revised resource model is expected to be finalised in Q3 2016. The revised mineral resource estimates will be used in connection with the upcoming pre-feasibility study for the project.

Also planning of process test work and activities related to supply of process water and power are ongoing as part of the upcoming pre-feasibility study.





OPERATIONS

NORDIC QUARTZ – high-purity quartz



Nordic Quartz has the exclusive rights for investigation and development of a quartz deposit in Kvinnherad municipality in Norway. Extensive analysis and processing tests show that the quartz has a low content of contaminants and therefore can be regarded as high-purity type of quartz (HPQ) suitable for various advanced products and applications.

In 2015, a drilling program was carried out at the quartz deposit. Subsequent of the drilling, independent qualified persons have assessed the data and estimated significant quartz-containing mineral resources in the inferred and indicated categories in accordance with the JORC Code. The quartz content varies in the deposit with a substantial part in the massive zone category (>95% quartz content).

Geological overview and resource estimates

The Kvinnherad deposit consists of hydrothermal quartz situated in Proterozoic basement rocks south of the Hardanger Fault Zone. The deposit is an approximately 600 meter long quartz vein situated about 300 meters above sea level. Surface mapping shows that the vein has a width varying between 10 to 45 meters. The centre of the vein generally contains massive pure quartz, while a greater degree of mixing with the host gneiss rock is seen towards the contact. The deposit is outcropping on the surface and detailed field mapping has been carried out. An exposure of the vein in the hillside shows that the vein continues to at least 150 meters depth.

A drilling program was executed in September/October 2015 for further definition of the deposit. Significant zones with substantial quartz content were intersected in all of the 6 drill holes.

In February 2016, an independent assessment was completed based the results from the core drilling and information from previous exploration work. The Qualified Persons have estimated a quartz-containing mineral resource of 2.92 million tonnes in the indicated category and 1.34 million tonnes in the inferred category. The quartz content of the deposit is on average 65%.

Three zones of quartz have been specified with increasing amount of quartz; transition zone, semi-massive zone and massive quartz zone. The table below shows the average quartz content in each zone and the overall estimated content of quartz in the deposit. The resource estimates are summarised in the following:

	Tonnage (tonnes)	Hydrothermal quartz (%)	Hydrothermal quartz content (tonnes)
Indicated resources			
Transition zone	1 467 000	40	587 000
Semi-massive zone	631 000	80	505 000
Massive quartz zone	849 000	95	807 000
	2 922 000	65	1 899 000
Inferred resources			
Transition zone	645 000	41	264 000
Semi-massive zone	199 000	79	157 000
Massive quartz zone	497 000	95	472 000
	1 341 000	66	893 000

The extension of the quartz deposit towards depth is still unknown, and further core drilling may be carried out at a later stage. A model of the quartz deposit has been developed according to international standards and practice. The resource estimates are in accordance with the JORC Code.

The Competent Person responsible for the assessments and the statement regarding estimation of mineral resources is Lars-Åke Claesson, a titled European Geologist in accordance with the Federation of European Geologists. A resource estimation report has been compiled by B.Sc. Johan Camitz, designated by the Fennoscandian Review Board as accredited Qualified Person.

Processing tests demonstrate homogenous HPQ

Comprehensive analysis and processing tests has previously been carried out at Dorfner Anzaplan's laboratory in Germany. Dorfner Anzaplan is an internationally accredited consultancy company specialised in high-purity quartz processing and analysis. Dorfner Anzaplan has documented that the Kvinnherad quartz can be processed to HPQ products. The processing tests indicate that the quartz will satisfy the requirements in the main application areas for HPQ, e.g. optical glass, high temperature light bulbs, crucibles, semiconductors and microelectronics.

Scoping Study outlines a viable and profitable project

A Scoping Study of the quartz project was done in 2012. The study outlines an industrial base case with mine life assumption of 30 years, estimated investments of approximately USD 50 million, a preliminary net present value after tax of USD 60 million based on 8% discount rate, and an undiscounted payback period of 4.3 years. Consequently, the results from the study clearly indicate the potential of a viable and profitable industrial project.

International commercial potential

Nordic Mining considers the long-term outlook positive for HPQ products in advanced technical and industrial applications and intends to position the Kvinnherad quartz project internationally. Dialogues continue with international companies with commercial interests in the quartz value chain. The purpose is to explore various scenarios for development of the deposit and investigate partnership models and financing options including grant schemes in order to progress the project.



QUARTZ

Silicon	Oxygen
14	8
Si	O

PROPERTIES

Quartz is a hard mineral composed of silicon and oxygen (SiO_2). Common quartz is white (milky quartz) or colourless (rock crystal). Quartz also occurs in a number of other colours.

OPERATIONS

KELIBER – lithium/lithium carbonate



Nordic Mining's associated company Keliber in Finland develops deposits of high quality lithium mineral (spodumene pegmatite) suitable for extraction and production of high-purity lithium carbonate. Lithium carbonate has a variety of industrial applications, i.a. for advanced batteries which takes up an increasing share of the total global lithium consumption. Keliber has made significant progress on exploration, processing test work and environmental impact assessments and completed a pre-feasibility study (PFS) for the project in March 2016. The study indicates a significant economic potential from production of high-quality lithium carbonate.

Background

Nordic Mining owns approximately 25% of the share capital and is the largest shareholder in Keliber. Other shareholders are i.a. Finnish Industry Investment Ltd., Ab Mine Invest Oy and Ilmarinen Mutual Pension Insurance Company with approximately 20%, 9.2% and 8.6%, respectively. Keliber has a mining license for the Länttä lithium deposit and permits for mining, operation and waste disposal for Länttä and for production of lithium carbonate at its planned processing plant at Kalavesi in Kaustinen municipality.

Significantly improved resource base

During the winter season 2014/2015, Keliber drilled approximately 2,700 meters at the Rapasaari deposit. Revised resource estimates were published in April 2015. The mineral resource estimates were reviewed in connection with the Pre-Feasibility Study. As per 14 March 2016, Keliber's total JORC compliant mineral resource and ore reserves estimates are as follows:

Deposit	Resource class	Tonnage (mill. tonnes)	Li_2O %	Reserve class	Tonnage (mill. tonnes)	Li_2O %
Syväjärvi	Indicated	1.53	1.35	Probable	1.48	1.19
	Inferred	0.19	1.32			
Rapasaari	Indicated	1.81	1.25	Probable	1.75	1.09
	Inferred	0.16	1.30			
Länttä	Measured	0.44	1.10	Proven	0.47	0.95
	Indicated	0.91	1.04	Probable	0.54	0.93
	Meas. + Ind.	1.35	1.06	Prov. + Prob.	1.01	0.94
Outovesi	Indicated	0.28	1.40	Probable	0.25	1.20

The Competent Persons responsible for the estimations are Markku Meriläinen (MAusIMM) and Pekka Lovén (MAusIMM), Outotec (Finland) Ltd. No inferred mineral resources are used in the estimation of ore reserves. The ore reserves are the portion of the mineral resources that have been identified as mineable within a design pit.

The mineral resources and ore reserves have been estimated using a 0.5% Li_2O cut-off grade. Ore loss is assumed at 5% and waste rock dilution 15% for the estimated ore reserves. Keliber's mining operations will consist of open pit mining only, and all deposits are located within a 20 km distance from the planned processing plant at Kalavesi.

Pre-Feasibility Study indicates significant economic potential

In March 2016, Keliber completed a Pre-Feasibility Study (PFS) for the lithium project. Sweco Industry Oy, with responsible project manager Tomi Keskinen, has coordinated the PFS process.

The following key figures have been estimated for two different lithium carbonate production scenarios:

	6,000 tonnes per year	9,000 tonnes per year
Basic investments	EUR 152 million	EUR 164 million
Operating time	16.2 years	11.2 years
Payback time from start-up	Approx. 7 years	Approx. 4 years
NPV @ 8% discount rate	EUR 51 million	EUR 97 million
IRR	13%	21%

Based on the current assumptions, both production scenarios indicate a profitable project. Due to higher profitability and expected potential from mineral exploration to further extend the operating time for the project, the 9,000 tonnes per year scenario will be basis for the forthcoming Bankable Feasibility Study.

Mineral processing test work in connection with the PFS to produce spodumene concentrate from the pegmatite ore has been conducted by GTK Mintec. Outotec has been responsible for the test work related to production of lithium carbonate from the spodumene concentrate samples. Outotec has provided the preliminary design of the technology package for lithium production. The technology package includes the material balances, process flow diagrams, equipment lists, price estimates and process descriptions for the selected unit processes.



Mineral processing test work at GTK's facilities.



LITHIUM

Lithium	Oxygen
3	8
Li	O

PROPERTIES

Lithium is a silver white metal that belongs to the alkali metal group. It is the lightest of all metals and so soft it can be cut with a knife. Lithium is highly reactive and never occurs freely in nature, but only appears in compounds.



Environmental impact studies

Environmental impact assessments in accordance with environmental legislative regulations are ongoing related to Keliber's mineral deposits. The work is expected to be completed before summer 2016, and thereafter environmental permit applications will be submitted.

First battery grade Li-producer in Europe

Keliber's goal is to be the first producer in Europe of lithium carbonate. The targeted product is high-purity lithium carbonate which is the preferred quality for batteries for electrical and hybrid vehicles. Keliber has has produced battery grade lithium carbonate (>99.5% Li_2CO_3). The purity of the lithium carbonate samples in recent production testwork has been in the range 99.67% – 99.91% Li_2CO_3.

A positive long-term market trend is expected for lithium carbonate and derived products, mainly driven by a strong growth in the battery sector. Lithium has favorable properties in combinations with other minerals/materials in modern batteries, and extensive product development is ongoing. Lithium carbonate and lithium minerals are also used in other applications, including lubricants, various glasses and in melting industries. Since the second half of 2015 lithium prices have increased, indicating a tightening supply/demand balance going forward.

OPERATIONS

REINFJORD – mineral exploration



Nordic Mining's exploration work in Reinfjord on the Øksfjord Peninsula provides insight to a prospective geological province, the "Seiland Igneous Province". A new type of nickel, palladium and platinum mineralisation has been discovered in the Reinfjord intrusion. In 2015, field-mapping and geological assessments have continued, however, on a limited note reflecting the Company's prioritisation of its key projects.

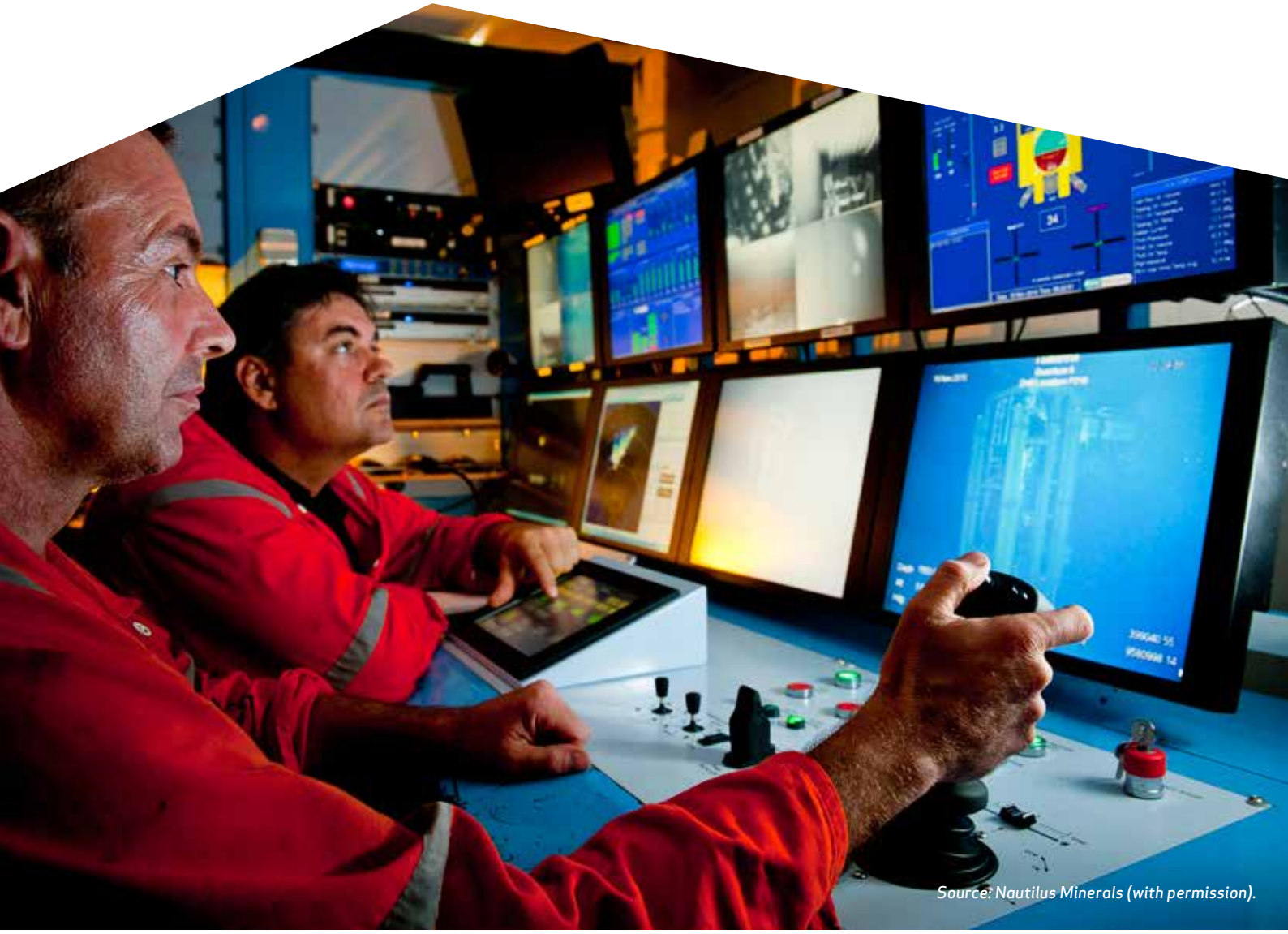
Nordic Mining has previously executed geophysical measurements in Reinfjord. The measurements indicated a metalliferous mineralisation present at approximately 100 meters depth within the Reinfjord intrusion.

Exploration drilling of four drill holes has been carried out with two holes in 2012 and two holes in 2014. Chemical analyses of the drill cores show that zones carrying elevated levels of nickel, copper and platinum type elements where intersected in all drill holes at approximately the same stratigraphic level as the conductor. The highest grades intersected yield 0.38% nickel, 0.16% copper and 0.64 g/t palladium, platinum and gold.

The Reinfjord intrusion, and the Seiland Province in general, is regarded a prosperous geological area. Nordic Mining will consider partnership models related to further exploration in the Reinfjord area.

OPERATIONS

NORDIC OCEAN RESOURCES



Source: Nautilus Minerals (with permission).

Nordic Ocean Resources (NORA) is a first-mover initiative related to seabed mineral exploration in Norway. Current assessments indicate a substantial potential for discovery of metallic ore deposits along the Mid-Atlantic Ridge (MAR) and possible significant economic values within Norway's Exclusive Economic Zone (EEZ). NORA has applied for mineral exploration licenses in specific promising areas within the Norwegian jurisdiction.

In 2015, NORA, together with NTNU and other industrial parties and knowledge institutions, initiated "MarMine", a comprehensive research project on marine mineral resources. The project has been granted NOK 25 million in financial support from the Norwegian Research Council. An exploration campaign on the MAR will be executed in 2016 with mineral sampling, analytical assessments and process test work.

NORA is a pioneer in Norway in terms of seabed minerals. The company intends to be a front-runner in building a strong competence on marine mineral resources in collaboration with other companies and research institutions. NORA has applied for exploration rights for SMS deposits on the Norwegian MAR. The application, updated last time in 2015, is being considered by the Ministry of Trade, Industry and Fisheries. A granting of submarine mineral exploration rights will anchor NORA's industrial position as a seabed mineral exploration company.

Globally, the interest for marine mineral resources is increasing, and several countries and industrial companies have launched strategies and initiatives to secure exploration rights and to develop marine mining technology. The Norwegian continental shelf, and in particular the areas located along the MAR, is interesting in terms of possible Seabed Massive Sulfide (SMS) deposits. In addition, the Norwegian oil and gas industry has developed advanced technology for subsea operations which can be applicable for mineral exploration and extraction. This can put Norway in a good position to make seafloor mining technically feasible and economically viable.

In 2013, NORA and the Norwegian University of Science and Technology (NTNU) with the support from Statoil ASA carried out analysis and interpretations of seabed topography, structures and geo-morphology within the Norwegian EEZ in order to discover promising areas for formation of SMS deposits. Based on these data, a statistical calculation for metal resource potential within the Norwegian zone was done using a method that has been developed for estimation of oil and gas resource potential. The calculations gave an estimated value of NOK 430 billion. The assessment further indicated that the value potential could be more than NOK 1,000 billion.

In 2015, the Norwegian Research Council granted NOK 25 million to "MarMine", a comprehensive new 5-year research project on marine mineral resources. The project is coordinated by NTNU and has a strong industrial basis and participation, including NORA. An exploration campaign is planned on the Norwegian continental shelf in the summer of 2016. The campaign will explore for sulfide deposits within selected areas on the MAR. The work will involve sampling using a remotely operated underwater vehicle. Analysis and assessments will be done related to technical and environmental aspects of marine mineral operations.

Nordic Mining will explore strategic options related to NORA and the seabed minerals initiative.

OPERATIONS

TECHNOLOGY DEVELOPMENT – alumina

Nordic Mining has together with Institute for Energy Technology (IFE) developed a new technology for production of alumina. The technology is an innovative solution for production of alumina from alumina-/calcium-rich mineral sources such as anorthosite, with the integrated use and storage of CO_2. A patent was granted in the fall of 2015.

Today's alumina production is mainly based on bauxite resources which are processed through the Bayer process. With the new technology, alumina can be produced from alternative sources and in a more environmentally friendly manner.

The new production technology has been tested and developed at IFE's laboratory at Kjeller. The leaching process has been tested in a larger scale reactor at Herøya Industry Park in Porsgrunn. The results have showed that anorthosite can be effectively leached under moderate process conditions. In addition to alumina, precipitated calcium carbonate (PCC) and silica are produced as by-products. PCC is a commercial commodity used as filler in paper, plastics and paint. Silica can be used as filler in tires and plastics, and in the production of cement.

The new multi-product process gives potential for almost full utilisation of the mineral resource. Further, the process consumes 500,000 tonnes of CO_2 per million tonne of alumina. This corresponds to the CO_2 emission from a medium sized oil and gas platform. The CO_2 can either be stored safely and/or utilised as part of a commercial production of PCC. The new technology has substantial environmental advantages both in terms of CO_2 consumption and waste production. The process is theoretically almost waste free since nearly all of the components of the anorthosite are potential saleable products.

A preliminary techno-economic study by the Norwegian R&D institute Tel-Tek has shown that the new technology is economically and technically feasible. Preliminary project financials were calculated for production of approximately 1 million tonne of alumina from anorthosite. The study gives indication of a positive NPV of around NOK 2.7 billion with moderate sales of PCC and silica based on a 7.5% discount rate.

The patent for the new technology was granted by the Norwegian Patent Authority in the fall of 2015.

BOARD OF DIRECTORS' REPORT

Nordic Mining's main assets comprise the following subsidiaries and projects:

- Nordic Rutile AS (100%) – developing the Engebø rutile project
- Nordic Quartz AS (100%) – developing the Kvinnherad high-purity quartz project
- Nordic Ocean Resources AS (80%) – exploring opportunities related to subsea minerals
- Keliber Oy (25%) – associated company developing a lithium project in Finland
- Alumina technology – development project together with the Institute for Energy Technology

The Company's project portfolio is of a high international standard and diversified across several attractive industrial minerals with largely uncorrelated end-user markets. Current estimates of Nordic Mining's net economic interests in Nordic Rutile AS, Nordic Quartz AS and Keliber Oy represent a cumulative net present value in excess of USD 550 million. In addition to this, the Company holds potential resource upside through Nordic Ocean Resources AS, and technical upside through the new patented technology for extraction of alumina from alumina/calcium-rich minerals. Compared to Nordic Mining's current market capitalisation of c. USD 35 million, the asset portfolio represents significant economic upside. Having also received the regulatory permits for its Engebø flagship project, the Company is now well placed to exploit its full potential through, amongst other, taking more advantage of international industrial and financial relations.

The Group's development projects are described in this annual report, and the Board refers to relevant sections of the report for further information.

Important events in 2015 and year-to-date

- The main focus for the Group in 2015 has been the Engebø rutile project. A major milestone was reached in April when the Norwegian government approved the industrial area plan (zoning plan) and granted a discharge permit for the project.
- A rights issue with gross proceeds of approximately NOK 35 million was successfully completed in October for financing of project development activities, including a drilling program at Engebø which was completed in April 2016.
- With few exceptions, the markets for mineral and metals, including rutile and other titanium feedstock, have been subdued in 2015. However, lithium carbonate, to be produced by the associated company Keliber, has experienced an increased demand and a positive price development which has continued through the first part of 2016.

Nordic Rutile (100%)

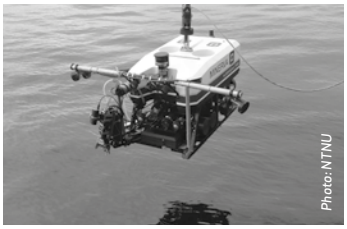
- On 17 April 2015, the Ministry of Local Government and Modernisation approved the industrial area plan (zoning plan) for the Engebø rutile project. At the same time, the Ministry of Climate and Environment granted a discharge permit for the project. These important approvals provide a solid foundation for the development of Nordic Rutile AS.
- On 19 February 2016, the King in Council dismissed an appeal related to the discharge permit. Consequently, the discharge permit is final and without further possibility for appeal. The zoning plan was final and without possibility for appeal directly following the Ministry's approval in April 2015.
- Thomas B. Addison, a mining engineer with broad experience from the mining industry, was appointed Managing Director for Nordic Rutile and took up the position 1 February 2016.
- A core drilling program at Engebø was completed in early April 2016. Approximately 6,400 meters has been drilled, mainly in the open pit part of the deposit. Core logging is proceeding, and the program is progressing according to plan with regards to logging, sampling and analysis. The results in the form of a revised resource model with updated resource estimates and classifications in accordance with the JORC Code will be ready in Q3 2016.
- Nordic Mining's internal estimate for the net present value of the Engebø project is USD 466 million after tax based on a long-term rutile price of USD 1,000 per tonne and an 8% discount rate. The estimated payback period is 4.5 years.

Nordic Quartz (100%)

- A drilling program was executed in September/October 2015 at the Kvinnherad quartz deposit. Significant zones with substantial quartz content were intersected in all of the 6 drill holes.
- In February 2016, an independent assessment was completed based the results from the core drilling and information from previous exploration work. The Qualified Persons have estimated a quartz-containing mineral resource of 2.92 million tonnes in the indicated category and 1.34 million tonnes in the inferred category. The quartz content of the deposit is on average 65%, with a substantial part in the massive zone. The estimations which are in accordance with the JORC Code, confirm that the Kvinnherad deposit is a sizeable quartz deposit.
- High Purity Quartz remains an attractive industrial segment with a broad spectre of applications in advanced products and technologies, i.a. optical glass, high temperature light bulbs, crucibles, semiconductors and microelectronics.
- The 2012 scoping study estimate for the net present value of the Kvinnherad quartz project is USD 60 million after tax and based on an 8% discount rate. The estimated payback period is 4.3 years.
- Various development scenarios will be explored, including partnership models in order to progress the project.



Ni, Cu, Pt, Pd



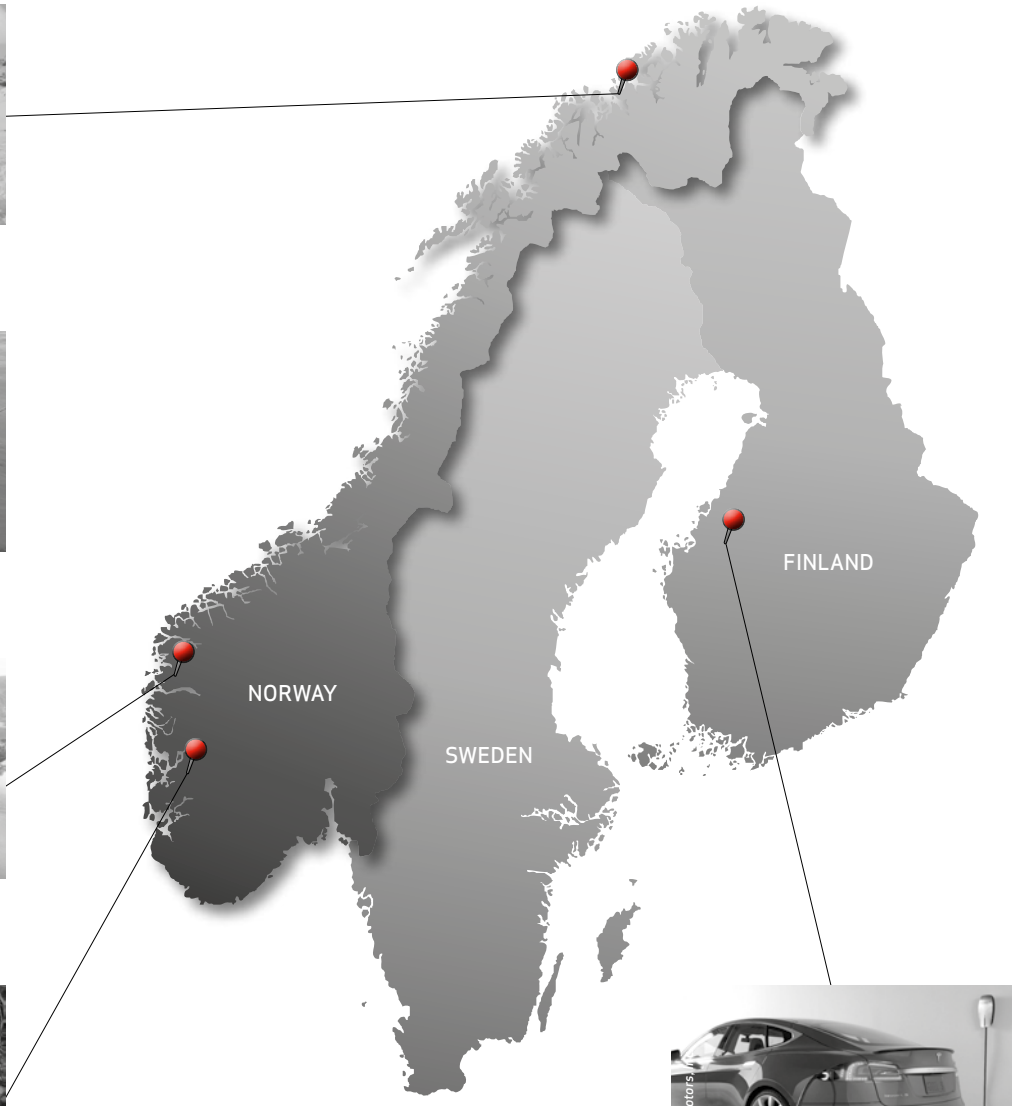
Nordic Ocean Resources



Rutile



High-purity quartz





Lithium

Nordic Ocean Resources (80%)

- Nordic Ocean Resources (NORA) is a pioneer in Norway in terms of seabed minerals.
- NORA has applied for exploration rights for seabed massive sulphide deposits on the Norwegian part of the Mid-Atlantic Ridge (MAR). The application, updated last time in December 2015, is being considered by the Ministry of Trade, Industry and Fisheries.
- NORA, together with NTNU and 13 other industrial and knowledge-oriented parties have established a new research project on marine mineral resources, MarMine. The project has been granted NOK 25 million from the Norwegian Research Council. An exploration campaign on the Norwegian part of the Mid-Atlantic Ridge, with mineral sampling and subsequent analyses and processing test work, will be carried out in 2016.

Keliber (25%)

- Over the last months, lithium carbonate prices have increased, in particular in the Chinese spot market. Prices for battery grade lithium carbonate (>99.5% Li_2CO_3) have been reported above USD 20,000 per tonne, compared with a previous price level of USD 6,800 – 7,500 per tonne. The recent development indicates a tightening supply/demand balance for lithium carbonate.

- Updated and significantly increased mineral resource estimates in accordance with the JORC Code were presented in April 2015. In total, Keliber's estimated mineral resources in the measured and indicated categories now exceed 6.2 million tonnes at an average grade of 1.26% Li_2O.
- Environmental impact assessments of Keliber's mineral deposits in accordance with environmental legislative regulations are almost finalised.
- Comprehensive process optimisation studies and test work have been executed in 2015. Analytical results indicate that high-purity lithium carbonate, including qualities exceeding 99.9% purity, can be produced using the developed process technology.
- The pre-feasibility study for the lithium project was completed in March 2016. A preliminary net present value of EUR 97 million based on an 8% discount rate and with a payback period of approximately 4 years have been estimated based on an annual lithium carbonate production of 9,000 tonnes.
- Subsequent of the PFS, Keliber has executed a rights issue with total proceeds of approximately EUR 2.9 million. Nordic Mining participated pro rata to its 25% shareholding.

Other project activity

Technology development

- Nordic Mining's and Institute for Energy Technology's (IFE) new technology for extraction of alumina from alumina/calcium-rich minerals was approved for patent in 2015.

Financial performance

For comparison, numbers in brackets relate to the comparable period in 2014.

The Group is developing mineral projects and had no sales revenues in 2015. The Group's operating loss in 2015 was NOK -12.7 million (NOK -16.9 million) and in accordance with planned activities, mainly related to the Engebø rutile project and general corporate matters. In 2015, the Group has capitalised costs in connection with drilling at the Kvinnherad quartz deposit and planning of a drilling program at Engebø at a total amount of NOK 2.7 million (NOK 0 million).

The Group's investment in Keliber is classified as shares in an associated company. Nordic Mining's shareholding in Keliber is approximately 25%. The net loss from the associated company in 2015 was NOK -6.6 million (NOK -5.8 million). Keliber's loss was mainly related to costs for environmental impact assessments, process optimisation test work and the recently published pre-feasibility study, as well as general corporate expenses. The carrying amount for the investment in Keliber as per 31 December 2015 was NOK 6.2 million (11.1 million).

Total net loss for the Group in 2015 was NOK -19.2 million (NOK -23.4 million).

Cash flow from the Group's operating activities was negative in 2015 with NOK -11.9 million (NOK -15.7 million). Net cash used in investment activities was NOK -4.5 million (NOK -0.3 million). The investments were related to the Engebø rutile project and drilling of the Kvinnherad quartz deposit, as well as purchase of shares in Keliber in connection with a rights issue; NOK -1.3 million.

In October 2015, Nordic Mining completed a rights issue of 77 million shares at a subscription price of NOK 0.45 per share. The gross proceeds from the rights issue were approximately NOK 35 million. For further information regarding the equity issue please see note 15 in the consolidated financial statements.

Nordic Mining's total assets as of 31 December 2015 were NOK 46.9 million (NOK 34.4 million), and the Group's total equity amounted to NOK 43.2 million (NOK 30.8 million). This gives an equity ratio of 92% (90%).

As per 31 December 2015, the Group's cash and cash equivalents amounted to NOK 29.8 million (NOK 14.4 million).

The Board confirms that the financial statements have been prepared on the basis of a going concern assumption and in accordance with section 3-3a of the Accounting Act. The Board emphasises that there are elements of risk related to the long-term financing and consequently to the long-term ability to continue as a going concern. The Board expects that the positive clarification of regulatory matters for the Engebø project which was received in 2015 and the good progress for ongoing development activities will be positive for the Group's financial flexibility going forward. For further comments, the Board also refers to the liquidity risk section on the following page.

Risk management

The Group's operations are exposed to various forms of risk associated with regulatory, market, operational and financial factors. In the opinion of the Board, the Company has established management systems that address the need for satisfactory risk management and internal control.

Regulatory risk

Nordic Mining depends on permits and licenses from various authorities. On 17 April 2015, the industrial area plan (zoning plan) and the waste disposal permit for the Engebø rutile project were approved by the Norwegian government.

Also the Kvinnherad quartz project, the Keliber lithium project and other projects will depend on governmental approvals regulating mining operations and environmental matters. Nordic Mining and Keliber will prepare applications for permits in accordance with development plans for the projects. Whether and when such permits will be granted, and the terms stipulated in connection with regulatory matters, are beyond the Company's control.

Financial risk

Financing, accounts and monitoring of the Group's liquidity situation is coordinated by the Company's CFO with the assistance of TMF Group AS which has been hired to provide accounting services. The Board has established rules governing the authority of the CEO, and the CEO has established rules governing the authority of the CFO.

Nordic Mining's cash holdings are placed in bank accounts in Norwegian Kroner (NOK).

Nordic Mining will require further financing in order to continue its development and exploration activities. The progress of the development of the Group's projects can be affected by financing factors. The Board refers to comments above (see "Financial performance") with regard to further financing.

The development of the Group's properties, licenses and exploration rights depends on the Company's ability to obtain financing through equity financing, debt financing, project financing or other means. There is no assurance that the Company will be successful in obtaining the required financing.

Liquidity risk
The liquidity risk is the risk that the Group will not be able to pay financial obligations on their due date. The Group has to a large extent used equity financing in order to meet liquidity requirements related to financial obligations, to cover operational losses, and for investments.

All of the Group's liabilities as of 31 December 2015; approximately NOK 1.4 million, matures within 6 months from the balance sheet date.

The Group has sufficient cash to be able to settle liabilities as at 31 December 2015 and expects also to have sufficient cash for the estimated operating losses until the second half of 2016. The Board therefore emphasises that strategies for further financing will be important going forward. Nordic Mining will evaluate alternatives to ensure adequate liquidity for its prioritised projects and to provide for future financial strength and flexibility. Consequently, the Group will need either to raise more equity, issue debt instruments or divest assets depending on the development of ongoing projects.

Neither the approved industrial area plan (zoning plan) nor the discharge permit for the Engebø rutile project contains financial obligations for the Group prior to the investment decision.

Market risk
Mineral prices, which can be affected by a number of factors such as the development of the global economy, practical factors, etc., are beyond the Group's control. Strategies for mitigating this type of risk, e.g. hedging through use of financial instruments or physical offtake agreements, will be evaluated at a later stage when each of the Company's mining assets gets closer to production.

Operational risk
Mineral extraction is a high risk activity and only a few of the areas investigated will subsequently be developed into producing mining operations. Long-term returns in Nordic Mining depend on the costs and success rates of the Group's exploration and development activities.

Nordic Mining is exposed to normal business risk associated with contracts with various suppliers.

Corporate governance

Corporate governance in Nordic Mining is defined as processes and control measures established to protect the interests of the Company's shareholders and other stakeholders. Nordic Mining's corporate governance policy is founded on prevailing statutory and regulatory requirements. The Company's principles will be revised in accordance with prevailing laws and regulations.

The Company has established principles for corporate governance, ethical guidelines and a general management structure based on the principles of "The Norwegian Code of Practice for Corporate Governance". The Board has provided a detailed report on corporate governance pursuant to the Code of Practice in this annual report; please refer page 26–31 for further information.

The Company has assessed its relations with and payments to and from governmental institutions in accordance with section 3-3d of the Accounting Act. The Board refers to note 22 in the consolidated financial statements for further information.

Sustainability

Nordic Mining assumes responsibility for how the core operations of the Group may impact social, environmental and financial aspects of local communities and internal and external stakeholders. Corporate responsibility in Nordic Mining is established in the corporate structure through the Board of Directors and the executive management team and founded on four main pillars:

- Environmental responsibility
- Value creation in a social context
- High standards for health and safety
- Strict regulations regarding anti-corruption

The Company endeavours to maintain a high standard of corporate governance with an emphasis on integrity, ethical guidelines and respect for people and the environment.

In the current stage of development, neither the Company nor the Group has any particular issues with regard to human rights, labour rights and social conditions, anti-corruption or environmental footprint.

Environmental responsibility
Nordic Mining and its subsidiaries strive to ensure that all activities are within the scope of the environmental responsibilities. Nordic Mining aims to be a positive, active and contributing force in ensuring sustainable local communities and environment.

Environmental protection is exercised throughout the extractive process, and the surveying, excavation and processing of minerals will be conducted in an environmental and safe way. Excess material will be disposed according to regulatory guidelines and sustainable principles to minimise negative effects.

Nordic Mining will, where possible, pursue mineral processing locally. This is cost efficient and enables shorter chains of transportation, which in turn saves the infrastructure and the environment. The majority of the minerals planned to be mined by Nordic Mining are destined for European markets. When possible, the Company will pursue sea transport through deep-water ports to enable shorter, cost efficient and environmental friendly logistics. In connection

with the Engebø rutile project, calculations executed by the consultancy company Global & Local Environmental Management indicate that shipping of rutile from Engebø to customers in Europe will reduce CO_2 emission by 80% compared with long-distance shipment from i.a. South Africa. The moderate internal transportation at Engebø will also contribute to a low CO_2 footprint for the project.

The environmental effect of the mining process on local communities will be limited and temporary. Nordic Mining will utilise advanced technology and methods for safe and environmentally friendly extraction of minerals, in order to minimise environmental footprint.

At Engebø, the Group will utilise the extracted mineral as well as by-products and side rock. Rutile is used in various environmentally friendly and "green tech" applications, and the by-product garnet is used in the production of environmentally friendly industrial sands which benefit health and environment while replacing products which are harmful to the human body. High-purity quartz is used in various technical and industrial applications related to i.a. production of renewable energy, advanced electronics and optical lenses. The associated company Keliber will produce lithium carbonate for batteries in hybrid and electric cars, cell phones and laptops, as well as for energy storage in connection with renewable energy production. The demand for lithium has increased significantly over the last years, and the use of rechargeable batteries in high-tech applications and vehicles results in a positive environmental benefit.

In the ongoing project development work, in particular with regard to the Engebø project, environmental issues are thoroughly addressed in order to secure sustainable future operations and a responsible realisation of the substantial values that the project will bring to the society. The Norwegian government's approval of the project confirms the importance of the project in a regional and national context. The project will be developed and operated according to the highest environmental standards and regulations.

Value creation in a social context

The social responsibility for Nordic Mining is closely linked to the local communities on the west coast of Norway where the Group operates. Minerals are often found in scattered populated areas and long term mineral production will open new opportunities for local activity and value creation.

Nordic Mining aims to create value, both directly and indirectly, in the regions where the Group operates. Directly, the shareholders will receive dividend, while local authorities will receive tax payment in form of income and real estate taxes. The Group will further add to local value creation through local job opportunities and purchase of products and services. Where practical and possible, Nordic Mining uses local suppliers and contractors to buy services and goods. Ahead of new projects, Nordic Mining engages independent research institutions and reports in order to analyse the consequences, benefits and possibilities for local value creation resulting from a specific project.

Nordic Mining relates and engages local communities in open dialogue throughout the lifecycle of the project. Local authorities and stakeholders are invited to dialogue meetings to maintain an open line of communication between the Company and the community.

The rutile development at Engebø will have a substantial impact on the regional activity level during the construction phase and generate a total of 170 local job positions when the production starts. A further 330 positions are indicated nationally as an indirect effect of the mineral production. From the start of the project development process, Nordic Mining has been active in the dialogue with industrial and commercial parties in the region with the purpose to explore regional opportunities.

High standards for health and safety

The employees in the Nordic Mining Group are the Group's most important resource. A pro-active approach in health and safety matters will be a prioritised matter in the Group's onward operation.

Strict regulations regarding anti-corruption

Nordic Mining's ethical guidelines entail a set of guiding principles for the employees of the Group in the day-to-day operations. The ethical guidelines are established to ensure that the staff does not engage in, or participate in corruption or bribery.

Goals and further work

Nordic Mining's work on sustainability and corporate governance is a dynamic process which will be developed in accordance with the Group's growth and progress going forward.

Organisational matters

In 2015, Nordic Mining had 3 employees. At the date of this report, the Group has 5 employees; 2 in Nordic Rutile and 3 in the Company.

The Board of Nordic Mining consists of three men and two women. Tarmo Tuominen has been Chairman of the Board since 2011. The composition of the Board will be evaluated in connection with the annual general meeting in line with normal procedures.

The Company facilitates equal opportunities for professional and personal development regardless of gender. The Company has a reasonable gender balance in its organisation and strives to maintain a good working environment. The sick absence rate in 2015 was less than 0.5%, and no safety issues have been registered.

Shareholders and capital situation

The Company has one class of shares, each with a nominal value of NOK 0.10. The shares are listed on Oslo Axess and may be traded without restrictions. The Company has around 3,590 shareholders. As per 18 April 2016, around 18% of the Company's shares were held by shareholders domiciled outside Norway.

In May 2015, the annual general meeting gave an authorisation to the Board to increase the share capital by issuing up to 77 million new shares. The Board used the authorisation in October 2015 in connection with a rights issue where 77 million new shares were issued at a price of NOK 0.45 per share. As a result, the number of shares in the Company increased to 385,504,805, which is the number of shares as per the date of this report.

In May 2014, the annual general meeting approved a share-based incentive program for leading employees and qualified resource persons. The Board was authorised to award options that in total gives the right to subscribe to up to 14 million new shares in Nordic Mining. In 2014 and early 2016, the Board has awarded options for 12,750,000 shares to leading employees and resource persons. 10,250,000 options have been awarded at an exercise price of NOK 0.90 per share and 2,500,000 options have been awarded at an exercise price of NOK 1.80 per share. The option agreements can be exercised until 18 May 2016.

An Extraordinary General Meeting in February 2016 approved an authorisation to the Board to issue up to 170 million new shares in connection with possible equity issues to raise capital to the Company, or for consideration, in whole or in part, in connection with investment in other businesses. The authorisation is valid till 30 June 2016. As per the date of this report, the authorisation is not utilised.

Parent company financial result

The net loss for the parent company Nordic Mining ASA for 2015 was NOK -1.8 million (NOK -12.9 million). As per 31 December 2015, the total equity for the parent company amounted to NOK 135.5 million (NOK 106.2 million).

The Board proposes that the year's loss of NOK 1,836,597 in Nordic Mining ASA be transferred to retained losses.

Nordic Mining ASA had no distributable equity as per 31 December 2015.

Oslo, 19 April 2016
The Board of Directors of Nordic Mining ASA

Tarmo Tuominen
Chairman

Kjell Roland
Deputy chairman

Hilde Myrberg
Board member

Mari Thjømøe
Board member

Tore Viana-Rønningen
Board member

Ivar S. Fossum
CEO

THE BOARD OF DIRECTORS



Tarmo Tuominen
Chairman

Tuominen is Chief Supply Chain Officer (CSCO) in the Finnish mineral group Nordkalk. He is a geologist from Åbo Academy in Finland and has held various managerial positions in the Nordkalk Group, including geologist, mining engineer, general manager of subsidiaries, and business area manager. Tuominen is chairman of the Geological Survey of Finland (GTK).



Kjell Roland
Deputy chairman

Roland is CEO of Norfund, the Norwegian Investment Fund for Developing Countries, with approximately NOK 15 billion under management. Roland holds a Master of Science in Economics from the University of Oslo, Norway. Roland previously worked as a partner and CEO in ECON Management AS and ECON Analysis. As consultant, he has worked on macro-economics, energy and environmental issues for private and public clients, in Norway and internationally.



Hilde Myrberg
Board member

Myrberg is a lawyer from the University of Oslo, Norway and has a MBA from INSEAD in France. Myrberg has held various managerial positions in Norsk Hydro and Orkla, and she has extensive experience from various board memberships. She is a board member of Norges Bank, the central bank of Norway, Petoro, the manager of the Norwegian government's holdings in oil and gas licences on Norway's continental shelf, and CGG SA. Myrberg is a facilitator in the EGN Global Executives Network for Legal Directors in Norway.



Mari Thjømøe
Board member

Thjømøe holds a Master of Science in Business Administration from the Norwegian School of Management (BI) and is a chartered financial analyst from the Norwegian School of Economics (NHH) in Bergen, Norway. She has completed the Senior Executive Programme at London Business School. Thjømøe has held positions as CFO and acting CEO in Norwegian Property, CFO in KLP Insurance, SVP in Statoil and various positions in Norsk Hydro. Thjømøe is currently running a consultancy business and is a board member of i.a. Tryg, Sevan Marine, E-CO Energi, Avinor, SINTEF and Scatec Solar.



Tore Viana-Rønningen
Board member

Viana-Rønningen holds a Master of Science in Economics and Business Administration from the Norwegian School of Economics (NHH) in Bergen, Norway. He has experience in corporate finance and risk management from Barclays Capital and in private equity investments in the area of upstream and midstream natural resources from Barclays Natural Resource Investments in London, UK. Viana-Rønningen is a VP in Dag Dvergsten AS, CEO of CellCura ASA, Deputy Managing Director of Atlantic Marine Services BV and non-executive director of Dentales AS.

THE MANAGEMENT TEAM



Ivar S. Fossum
CEO

Fossum holds a Master of Science in Mechanical Engineering from the University of Science and Technology (NTNU) in Trondheim, Norway. He has previously held various managerial positions in the Norsk Hydro Group, within the oil and gas industry and the fertilizer industry, and in FMC Technologies. Fossum has a broad international background and has been general manager of Norsk Hydro East Africa Ltd in Nairobi, Kenya.



Mona Schanche
Exploration Manager

Schanche holds a Master of Science in Resource Geology from the University of Science and Technology (NTNU) in Trondheim, Norway. She has broad experience from working in the mining industry with various exploration and mine development projects. Schanche has previously worked as geologist for the Norwegian company Titania AS (Kronos Group), a major producer of feedstock for titanium pigment production.



Lars K. Grøndahl
CFO

Grøndahl holds a Master of Science in Economics and Business Administration from the Norwegian School of Economics (NHH) in Bergen, Norway. He has previously held various managerial positions in Aker, Scancem and HeidelbergCement, within the cement and building materials industries. Grøndahl has been Deputy COO of Heidelberg Cement's operations in Africa. Further, he has been Head of Department in the Norwegian Ministry of Industry.



Thomas B. Addison
Managing Director, Nordic Rutile AS

Addison holds a Master of Science in Mining Engineering from the University of Science and Technology (NTNU) in Trondheim, Norway. Addison has 30 years of experience within mining and mineral processing, and he has held various positions in Elkem, SNSK, Orkla Exolon, Hanson Quarry Products Europe and Franzefoss Minerals.

CORPORATE GOVERNANCE

Nordic Mining's corporate governance principles are of key importance for ensuring confidence in the Company and to provide a basis for long-term value creation for shareholders, employees and the society as a whole.

Nordic Mining's objective is to secure the long-term value creation through exploration, extraction and processing of high-end industrial minerals and metals. In order to attain this objective, the Company shall endeavor to maintain a high standard of corporate governance with an emphasis on integrity, ethical guidelines and respect for people and the environment.

The parent company Nordic Mining ASA ("Nordic Mining" or "the Company") owns 100% of the shares in the subsidiaries Nordic Rutile AS and Nordic Quartz AS, together with 80% of the shares in Nordic Ocean Resources AS. Further, Nordic Mining ASA owns approximately 25% of the shares in Keliber Oy which is an associated company in the Nordic Mining Group ("the Group").

Implementation and reporting on corporate governance

Nordic Mining's corporate governance policy is founded on prevailing statutory and regulatory requirements. The Company establishes its routines in line with laws and regulations that are in force at any given time. The Company's guidelines are based on the principles recommended in the 'Norwegian Code of Practice for Corporate Governance', as most recently amended on 30 October 2014 ("the Code of Practice").

In the opinion of the Board, Nordic Mining's operations in 2015 complied with the Code of Practice.

This report provides a point-by-point review of how the Company and the Group have conformed to the 15 main themes in the Code of Practice, and how the Company and the Group comply with the recommendations.

Nordic Mining has prepared its own guidelines concerning corporate, social and ethical conduct. These are available on the Company's website (www.nordicmining.com) under 'Investors' and 'Corporate Governance'.

Business

Nordic Mining's objectives are defined in the Company's articles of association: "The object of the Company is to carry out exploration for coal, minerals and ores, mining activity, technology development, activities that may be associated herewith, and participate in other companies anywhere in the world."

The articles of association are reproduced in full on page 74 of the annual report and are also available on the Company's website.

Objectives and strategies are drawn up for each individual company/project and for the Group as a whole. The key strategies related to Nordic Mining's projects can be summarised as follows:
Establish profitable production of rutile concentrate (TiO_2) and garnet from the Engebø deposit

- Establish profitable production of high-purity quartz from the Kvinnherad deposit
- Establish profitable production of lithium carbonate through Keliber in Finland
- Investigate the potential for a new technology related to production of aluminia from anorthosite
- Establish a sound knowledge platform related to marine mineral resources and possible subsequent exploration and development

Nordic Mining aims to participate in structural changes within the industrial minerals and metals sector with a view to growth and long-term value creation. This also includes evaluation of partnership models for the Group's projects in order to progress with value increasing activities.

Equity and dividends

The Group's equity as per 31 December 2015 amounts to NOK 43.2 million, i.e. 92% of the Group's total assets. On a continuous basis, Nordic Mining is evaluating alternatives to ensure adequate liquidity for its prioritised project activities and to provide for financial strength and flexibility in a longer perspective.

Nordic Mining aims to adhere to a dividend policy that is favourable to its shareholders. Distribution of dividends will be adjusted in accordance with investment requirements and other financial circumstances for the Company.

Nordic Mining has so far not paid any dividends. As per 31 December 2015 the Company has no distributable equity that could be distributed as dividends to shareholders, or used to purchase its own shares. The Board has no authorisation to purchase treasury shares.

On 19 May 2015, the annual general meeting adopted a resolution authorising the Board to increase the share capital by issuing up to 77 million new shares. The authorisation was valid for one year. The Board used the authorisation to carry out a rights issue in October 2015 in which 77 million new shares were issued.

The annual general meeting held on 27 May 2014 authorised the Board to issue up to 14 million shares in connection with an option program for leading employees and qualified resource persons. This


2,40
5,40
8,40
EN16-002 L-2

authorisation deviates from the recommendation of the Code of Practice in that it was granted for two years, until 27 May 2016. In the opinion of the Board, it is in the Company's best interests to have certain flexibility with regard to duration of the incentive program.

Equal treatment of shareholders and transactions with related parties

Nordic Mining has one class of share and each share entitles the holder to one vote at the general meeting. The articles of association do not place any restrictions on shareholders' voting rights. All shareholders are equal and shall be treated equally.

In the opinion of the Board, satisfactory arguments and information have been provided in connection with deviations from existing shareholders' priority rights in connection with equity issues by the Company.

The Group reports transactions with related parties on a quarterly basis. All transactions with related parties comply with the 'arm's length principle'. The Group's transactions with related parties in 2015 are described in note 20 to the financial statements.

The Company's ethical guidelines include rules intended to avoid conflicts of interest and establish that anyone who acts on behalf of Nordic Mining shall act honestly and in line with the principles for good business ethics. Nordic Mining's guidelines provide that board members and senior employees must notify the Board in the event that they either directly or indirectly have a material interest in a contract being signed by the Company. The Board is of the opinion that it is important to exercise transparency and caution in connection with transactions involving related parties.

Freely negotiable shares

All Nordic Mining shares carry equal rights and are freely negotiable. No restrictions on transactions are contained in Nordic Mining's articles of association.

General meetings

The Board of Directors seeks to ensure that as many shareholders as possible are able to participate in, and exercise their rights, at general meetings. The shareholders exercise supreme authority in Nordic Mining through the general meeting. It is important for the Company that the general meeting provides an effective forum for the shareholders and the Board.

The Company's articles of association and the provisions of the Norwegian Public Limited Companies Act assign the following functions to the general meeting:

- Election of members of the nomination committee
- Election of the external auditor and determination of the auditor's remuneration
- Approval of the annual report as required by Norwegian law, as well as the financial statements and any distribution of dividend recommended by the Board
- Consideration of any other items listed on the agenda attached to the notice of the general meeting

Nordic Mining's annual general meeting in 2015 was held on 19 May 2015. The date of the Company's forthcoming annual general meeting is 18 May 2016.

Notices of general meetings will be published in stock exchange releases and on the Company's website at least 21 days before a general meeting. The Company's annual report will be published on Nordic Mining's website at least 21 days prior to the general meeting. General meeting notices are distributed in Norwegian with an English translation to foreign shareholders. Shareholders have the right to submit proposals to the general meeting and attend and vote in the general meeting, either in person or by proxy. The deadline for notifying attendance is normally five days before the date of the general meeting.

The nomination committee's recommendation concerning the election of board members and members of the nomination committee is published together with the notice of the general meeting. In line with the Company's guidelines, the general meeting will vote on each candidate separately.

Nordic Mining has approximately 3,590 shareholders who are widely distributed geographically. By means of a separate information section in the summons for a general meeting and a separate proxy form, the Company provides its shareholders with the opportunity to vote on every item on the agenda, even if they are unable to attend the meeting in person. The Company's share registrar, DNB Verdipapirservice assists in connection with preparations for and practical matters in relation to the arrangement of the general meeting. This helps to ensure that general meetings are conducted professionally and impartially.

Representatives of the Board and executive management are always represented at the general meetings. Normally, the Company's auditor and legal advisor are also present. The general meeting is normally chaired by the chairman or the deputy chairman of the Board. In the event of disagreement as regards specific agenda items where the chairman of the meeting either supports one of the factions or for other reasons cannot be considered impartial, Nordic Mining has procedures to ensure that the meeting is chaired impartially. In such cases the general meeting will have an opportunity to appoint an alternative chairman to ensure impartiality in relation to the items on the agenda.

Nomination committee

Pursuant to the articles of association, Nordic Mining's nomination committee consists of three members, all elected by the general meeting. The committee is independent of the Company's Board and executive management. The remuneration of the members of the nomination committee is determined by the general meeting.
The members of the nomination committee are elected for terms of two years. The guidelines for the nomination committee are available on Nordic Mining's website under 'Investors' and 'Corporate Governance'.

The nomination committee's duties are to:
- Provide reasoned recommendations to the general meeting concerning the election of members of the Company's Board of Directors
- Provide a reasoned proposal to the general meeting regarding the remuneration of the board members

As of 31 December 2015, the nomination committee of Nordic Mining has the following members:
- Ole G. Klevan (chairman); lawyer with the law firm Schjødt
- Hans Olav Kvalvåg (member); employed in Ard Group AS
- Bent Nordbø (member); employed in Dag Dvergsten AS

Ole G. Klevan and Hans Olav Kvalvåg have no relationships with board members or the management in Nordic Mining. Bent Nordbø is employed in Dag Dvergsten AS, which also employs the Company's board member Tore Viana-Rønningen.

Corporate assembly and Board of Directors; composition and independence

Pursuant to the Public Limited Liability Companies Act, Nordic Mining is not required to have a corporate assembly.

As per 31 December 2015, the Board of Directors of Nordic Mining has five members. The management team is not represented on the Board. The Chairman of the Board and the other board members are elected by the general meeting for terms of two years following the recommendation of the nomination committee. All board members are independent of Nordic Mining's major shareholders.

Relevant information concerning the individual board members is available in the annual report and on the Company's website. Information about candidates recommended by the nomination committee is contained in the documents accompanying the notice of the general meeting which is published on the website.

Information about board members' remuneration, the number of shares held in Nordic Mining etc. is provided in the notes in the consolidated financial statements, ref. note 20.

As of 31 December 2015 and the date of this report, the Board of Nordic Mining has the following members:
- Tarmo Tuominen, chairman
- Kjell Roland, deputy chairman
- Mari Thjømøe, board member
- Hilde Myrberg, board member
- Tore Viana-Rønningen, board member

The work of the Board of Directors

The Board of Nordic Mining has the overall responsibility for managing Nordic Mining, which includes guiding the Company and the Group in its implementation of goals and strategy. In addition, the Board is responsible for monitoring and controlling Nordic Mining's operations with a view to ensuring the highest possible level of value creation for the Company and its shareholders.

At the start of each calendar year, the Board schedules board meetings for the coming year, with an outline of the main points on the agenda for each meeting. The agenda items reflect the Board's main duties for the overall governance of the Group and for the general monitoring of the Group's activities. Goals/milestones are established for the coming year of operations as well as plans for how to achieve them. The status of the milestone plan is reported to the Board by the management and is regularly discussed by the Board.

The Board has established instructions for the Board and the CEO, and the CEO has established instructions for the CFO and the managing directors of the subsidiaries. These instructions cover issues concerning the Board's duties and responsibilities, the CEO's duty to inform the Board, and procedural rules for the Board's and the management's work. The Board is aware of its responsibilities when dealing with items in which a board member is, or has been, actively involved.

The Board has considered the establishment of an audit committee, but has concluded that at present there is no such need. An audit committee will be established when the Company fulfils the applicable criteria. Further, the Board has decided that at present there is no need to establish a separate compensation committee. In the Board's opinion, evaluations linked to the remuneration of senior management are undertaken most appropriately, given the Company's current phase of development, by the Board acting as a whole.

The Board regularly reviews its work and the need for competence in the Company and the Group. The Board has so far not deemed it appropriate to produce a special annual report on the Board's work. When required, the Board discusses matters related to the Board's work with the nomination committee.

Risk management and internal control

The Board is responsible for ensuring that the Company has good internal control and a well-functioning system for risk management. The Board's annual plan includes a review of the Company's risk areas and internal control system. In the Board's opinion, the current governance systems satisfactorily address the need for risk management and internal control.

The management of Nordic Mining is responsible for establishing and maintaining an adequate level of internal control with regard to the Group's financial reporting. Internal control with regard to financial reporting is a process that is designed to provide reasonable certainty that financial reporting is reliable and that financial statements for external purposes are prepared in accordance with the International Financial Reporting Standards (IFRS), as adopted by the EU. The accounting principles applied by the Group conform to the IFRS as published by the International Accounting Standards Boards (IASB). A summary of significant accounting principles as well as discussion of risk factors are included in note 2 and note 17, respectively, in the consolidated financial statements.

The Company has hired TMF Norway AS as the Group's accountants. Routines have been established for accounting work and reporting.

Some types of risk are insured with external insurers. Nordic Mining has agreed various policies to insure both people and property, together with liability insurance for the board members.

Remuneration of the Board of Directors

Remuneration of the board members is fixed annually on a retrospective basis by the general meeting following recommendations from the nomination committee. The level of remuneration shall reflect the individual board member's responsibilities, competence, and time spent, as well as the complexity of the business. The remuneration does not depend on Nordic Mining's financial performance.

No option agreements have been entered into with board members.

Information concerning remuneration and fees paid to board members in 2015 is presented in note 20 in the consolidated financial statements.

Remuneration of executive personnel

Pursuant to section 6-16a of the Public Limited Liability Companies Act, the Board prepares an annual statement on the setting of salaries and other remuneration for the senior management. The statement is presented to and considered by the general meeting. The key principles underlying the remuneration of senior management for 2015 have been that the total packages should reflect the responsibilities and duties undertaken by each individual in the executive management, and that the employee should contribute to the long-term value creation in the Group. In the opinion of the Board, it is crucial for Nordic Mining to offer competitive salaries and conditions in order to attract the qualities and expertise necessary to promote the strategic development of the Group.

In addition to regular salaries, share option agreements have been entered into with the members of the management team. The option agreements entitle the holders to purchase a limited number of shares at a fixed price (NOK 0.90 or NOK 1.80 per share). The share price on the allocation date for the bulk of the granted options was NOK 1.04 per share. The Company's option program was approved by the annual general meeting on 27 May 2014 and is a continuation of programs the Company has operated since its establishment in 2006. The current option program will continue until 18 May 2016.

Information concerning remuneration paid to senior management in 2015 is presented in note 20 in the consolidated financial statements.

Information and communications

Nordic Mining has adopted guidelines designed to ensure that its information policy is based on the principles of openness and the equal treatment of all shareholders and participants in the securities market. The objective is to have accounting and financial reporting systems in which investors have confidence.

The Company's management is responsible for communication with the capital markets and for the relations between the Company and the shareholders and potential new investors. In some cases, also board members participate in the dialogue with investors. Nordic Mining's annual and interim reports provide comprehensive information about the Group's operations.

The financial reports and other information are published electronically and simultaneously to all target audiences. All shareholders are treated equally in relation to access to financial information. All reports, press releases, presentations etc. are available on Nordic Mining's website.

The Company's financial calendar is published on the website and is included on page 74 in the annual report.

Take-overs

Nordic Mining's articles of association do not set any restrictions on acquisition of the shares in the Company. In the event of a take-over bid for Nordic Mining, the Board will follow the overriding principle of equal treatment of all shareholders. Further, the Board will strive to ensure that the Company's business activities are not unnecessarily disrupted. The Board will strive to ensure that the shareholders are given sufficient information and time to assess the offer.

The Board will not seek to prevent any take-over bids unless it believes that the interests of the Company and the shareholders justify such actions. The Board will not exercise mandates or pass any resolutions with the intention of obstructing any take-over bid unless it is approved by the general meeting following the announcement of the bid.

The Board will issue a statement in accordance with statutory requirements and the recommendations in the Code of Practice, including considering to obtain a valuation from an independent expert.

Transactions that in effect have as a consequence a sale of Nordic Mining's business as a whole will be subject to approval by the general meeting.

Auditor

Nordic Mining's auditor is elected by the general meeting and is independent in relation to the Company.

The auditor's work is based on a plan that is presented to the Board on an annual basis. The auditor attends board meetings that discuss and approve the Group's and the Company's annual reports. At such meetings the auditor gives a statement of any material changes to Nordic Mining's accounting principles and provides an assessment of material accounting estimates, as well as a complete account of any situation where there has been disagreement between the auditor and the management. The auditor presents to the Board a review of the Company's control routines and potential areas of improvement in relation to accounting. When required and at least once a year, the auditor meets with the Board with no members of the management present. The Board also has contact with the auditor when required outside the situations mentioned above.

The Board is of the opinion that it enjoys good communications with the auditor.

Nordic Mining has to a very limited extent assigned the auditor for services other than auditing. If and when required, the Board will prepare guidelines regarding the Company's use of other services from the auditor.

The auditor's remuneration is determined by the general meeting.

Information of the fees paid to the auditor in 2015, including breakdown between statutory auditing and other assistance/ service, is presented in note 6 to the consolidated financial statements.

Oslo, 19 April 2016
The Board of Directors of Nordic Mining ASA

Tarmo Tuominen
Chairman

Kjell Roland
Deputy chairman

Hilde Myrberg
Board member

Mari Thjømøe
Board member

Tore Viana-Rønningen
Board member

Ivar S. Fossum
CEO

SHAREHOLDER MATTERS

Nordic Mining ASA is a resource company with focus on high-end industrial minerals and metals in Norway and internationally. Nordic Mining's shares are listed on Oslo Axess with the ticker "NOM".

Nordic Mining has one class of share and each share entitles the holder to one vote. The share's face value is NOK 0.10. The shares are freely negotiable and have been listed on Oslo Axess since September 2007 (ticker "NOM"). The shares are registered with the Norwegian Central Securities Depository (VPS) with the identification number (ISIN) NO 0010633183.

Share capital

As per the date of the annual report, Nordic Mining's share capital amounts to NOK 38,550,480.50 divided into 385,504,805 shares. Over the last years, the Company's share capital and the number of shares have developed as shown in the table below.

The Company's annual general meeting held on 27 May 2014 authorised the Board to issue up to 14 million new shares in connection with an options program for senior management and qualified key personnel. The authorisation is valid for two years. At the date of this report, the Board has awarded options for 10,250,000 shares to employees and associated key people at an exercise price of NOK 0.90 per share. In addition, the Board has awarded options for 2,500,000 shares to senior management at an exercise price of NOK 1.80 per share. At the date of this report none of the awarded option shares have been exercised.

On 27 May 2014, the annual general meeting gave an authorisation to the Board to increase the share capital by issuing up to 28 million new shares. The Board used the authorisation in October 2015 in connection with a rights issue where 77 million new shares were issued at a price of NOK 0.45 per share. As a result, the number of shares in the Company increased to 385,504,805 which is the number of shares as per the date of this report.

On 4 February 2016, the annual general meeting gave an authorisation to the Board to issue up to 170 million new shares in connection with financing and/or investments in other businesses. At the date of this report, the authorisation has not been utilised.

The Company does not own any of its own (treasury) shares, and no authorisation exists to purchase its own shares.

Shareholders

The Company's largest shareholders as per 18 April 2016 are listed on the next page. The number of shareholders as per 18 April 2016 is around 3,590 and around 18% of the shares were held by shareholders domiciled outside Norway.

The Company's Board and management team own a total of around 2.6% of the shares in the Company.

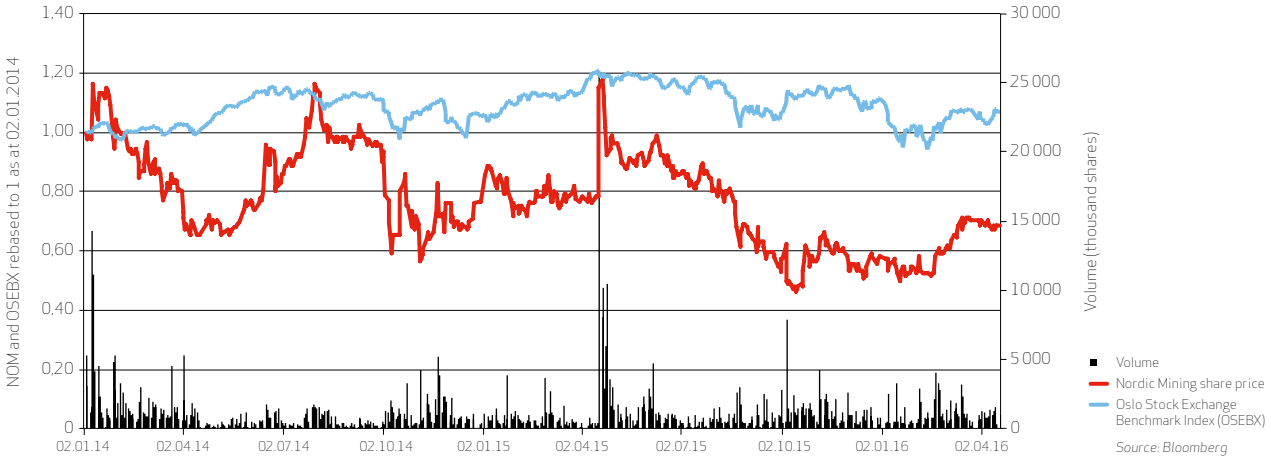
Trading of share and price development

Shares in Nordic Mining are traded on a daily basis on Oslo Axess. The trade has increased steadily over the last years. Around 386 million shares were traded in 2015. The Company has no agreement with brokers or financial institutions concerning liquidity guarantees relating to the share.

Development of the Company's share capital in the period 2012 to the date of this report

Year	Transaction	Change in share capital (NOK)	Face value per share (NOK)	Sub. price per share (NOK)	No. of shares after transaction	Share capital (NOK)
2012	Share issue	4 000 000.00	0.10	0.90	185 470 091	18 547 009.10
2013	Private placement	896 601.70	0.10	0.70	194 436 108	19 443 610.80
2013	Share issue	606 869.70	0.10	0.70	200 504 805	20 050 480.50
2013	Share issue	8 000 000,00	0.10	0.30	280 504 805	28 050 480.50
2014	Share issue	2 800 000,00	0.10	0.60	308 504 805	30 850 480.50
2015	Share issue	7 700 000,00	0.10	0.45	385 504 805	38 550 480.50

Development of Nordic Mining's share price, 1 January 2014–18 April 2016



Key figures for the Nordic Mining share in the period 2012–2015

Year	Share price as per 31.12 (NOK)	High (NOK)	Low (NOK)	No. of shares traded	Market cap. as per 31.12 (NOK)
2012	0.90	1.48	0.79	118 million	167 million
2013	1.27	1.47	0.31	490 million	356 million
2014	0.90	1.36	0.66	376 million	278 million
2015	0.63	1.28	0.40	386 million	243 million

The largest shareholders of Nordic Mining as per 18 April 2016

	Shareholder	Number of shares	% ownership
1	Nordnet Bank AB (nominee)	30 091 686	7.8%
2	Skagen Vekst	15 850 707	4.1%
3	Nordea Bank Plc Finl. Clients Acc. (nominee)	14 396 116	3.7%
4	Nordnet Livsforsikring	11 818 746	3.1%
5	Dybvad Consulting AS	9 634 366	2.5%
6	Ove Klungland Holding NIL	7 023 696	1.8%
7	Danske Bank A/S (Nominee)	6 827 577	1.8%
8	Magil AS	6 500 000	1.7%
9	Snati AS	6 000 000	1.6%
10	Citibank N.A. S/A Pohjola Bank Plc (nominee)	5 793 788	1.5%
11	Infosave AS	5 144 863	1.3%
12	Lithion AS	4 167 898	1.1%
13	Ole Kristian G. Stokken	3 736 721	1.0%
14	Audstein Dybvad	3 156 000	0.8%
15	Femcon AS	3 080 316	0.8%
16	Adurna Invest AS	3 079 993	0.8%
17	Olav Birger Sletten	3 040 000	0.8%
18	Reidar Jarl Hansen	2 772 124	0.7%
19	Jon Hovden	2 700 000	0.7%
20	Frank Molander	2 590 000	0.7%
	Top 20 shareholders	**147 404 597**	**38.2%**
	Others	238 100 208	61.8%
	Total	**385 504 805**	**100.0%**

CONSOLIDATED INCOME STATEMENTS

(Amounts in NOK thousands)	Note	2015	2014
Payroll and related costs	4, 20	(6 617)	(10 799)
Other operating expenses	6	(6 110)	(6 081)
Operating profit/(loss)		**(12 727)**	**(16 880)**
Share of result of an associate	12	(6 597)	(5 831)
Impairment of investment in associate	12	-	(817)
Financial income	7	96	96
Financial costs	7	(4)	(14)
Profit/(loss) before tax		**(19 232)**	**(23 446)**
Income tax	8	-	-
Loss for the period		**(19 232)**	**(23 446)**
PROFIT/(LOSS) ATTRIBUTABLE TO			
Equity holders of parent		(19 114)	(23 371)
Non-controlling interest		(118)	(75)
(Amounts in NOK)			
EARNINGS PER SHARE ATTRIBUTABLE TO ORDINARY SHAREHOLDERS			
Basic and diluted earnings per share	9	(0.06)	(0.08)

STATEMENTS OF COMPREHENSIVE INCOME

(Amounts in NOK thousands)	2015	2014
Net profit/(loss) for the period	**(19 232)**	**(23 446)**
OTHER COMPREHENSIVE INCOME		
Items that may be reclassified subsequently through profit or loss:		
- Currency translation differences	355	799
Items that will not be reclassified subsequently to profit or loss:		
- Changes in pension estimates	(647)	(1 763)
Other comprehensive income for the period	**(292)**	**(964)**
Total comprehensive income for the period	**(19 524)**	**(24 410)**
PROFIT/(LOSS) ATTRIBUTABLE TO		
Equity holders of parent	(19 406)	(24 335)
Non-controlling interest	(118)	(75)

CONSOLIDATED STATEMENTS OF FINANCIAL POSITION

(Amounts in NOK thousands)	Note	31.12.15	31.12.14
ASSETS			
Non-current assets			
Exploration and evaluation assets	10	9 848	6 770
Property, plant and equipment	11	84	-
Investment in associate	12	6 182	11 103
Total non-current assets		**16 114**	**17 873**
Current Assets			
Trade and other receivables	13, 17	990	2 126
Cash and cash equivalents	14	29 809	14 360
Total current assets		**30 799**	**16 486**
Total assets		**46 913**	**34 359**

CONSOLIDATED STATEMENTS OF FINANCIAL POSITION

(Amounts in NOK thousands)	Note	31.12.15	31.12.14
SHAREHOLDERS' EQUITY AND LIABILITIES			
Shareholders' equity			
Share capital	15	38 550	30 850
Share premium		263 281	239 194
Other paid-in capital		12 924	12 924
Retained losses		(273 119)	(254 005)
Other comprehensive income		1 621	1 913
Equity attributable to ordinary shareholders		43 257	30 876
Non-controlling interest		(97)	(75)
Total equity		**43 160**	**30 801**
Non-current liabilities			
Other liabilities	21	1 898	1 417
Total non-current liabilities		**1 898**	**1 417**
Current liabilities			
Trade payables	17	798	753
Other current liabilities	16, 17	1 057	1 388
Total current liabilities		**1 855**	**2 141**
Total liabilities		**3 753**	**3 558**
Total shareholders' equity and liabilities		**46 913**	**34 359**

Oslo, 19 April 2016
The Board of Directors of Nordic Mining ASA

Tarmo Tuominen *Chairman*	Kjell Roland	Tore Viana-Rønningen	Mari Thjømøe	Hilde Myrberg

Ivar S. Fossum
CEO

CONSOLIDATED STATEMENTS OF CHANGES IN EQUITY

		Attributed to equity holders of the parent							
(Amounts in NOK thousands)	Note	Share capital	Share premium	Other paid-in capital	Other compre-hensive income	Accu-mulated losses	Total	Non-controlling interest	Total equity
Equity 1 January 2014		**28 050**	**227 145**	**8 893**	**2 877**	**(230 634)**	**36 331**	**-**	**36 331**
Total comprehensive income		-	-	-	(964)	(23 371)	(24 335)	(75)	(24 410)
Share based payment	5	-	-	4 031	-	-	4 031	-	4 031
Share issue	15	2 800	14 000	-	-	-	16 800	-	16 800
Transaction costs		-	(1 951)	-	-	-	(1 951)	-	(1 951)
Equity 31 December 2014		**30 850**	**239 194**	**12 924**	**1 913**	**(254 005)**	**30 876**	**(75)**	**30 801**
Equity 1 January 2015		**30 850**	**239 194**	**12 924**	**1 913**	**(254 005)**	**30 876**	**(75)**	**30 801**
Total comprehensive income		-	-	-	(292)	(19 114)	(19 406)	(118)	(19 524)
Share issue	15	7 700	26 950	-	-	-	34 650	-	34 650
Transaction costs		-	(2 863)	-	-	-	(2 863)	-	(2 863)
Non-controlling investment		-	-	-	-	-	-	96	96
Equity 31 December 2015		**38 550**	**263 281**	**12 924**	**1 621**	**(273 119)**	**43 257**	**(97)**	**43 160**

CONSOLIDATED CASH FLOW STATEMENTS

(Amounts in NOK thousands)	Note	2015	2014
Cash flow from operating activities			
Loss before income tax		(19 232)	(23 446)
Impairment of investment in associate	12	-	817
Share of loss in associate	12	6 597	5 831
Share-based expenses	5	-	4 031
Changes in assets and liabilities			
Other receivables and prepayments	13	1 136	(1 007)
Trade payables		141	(815)
Other		(498)	(1 076)
Net cash used in operating activites		**(11 856)**	**(15 665)**
Cash flow from investing activities			
Acquisition of licenses	10	(428)	(319)
Investment in other exploration and evaluation assets	10	(2 650)	-
Purchases of property, plant and equipment	11	(84)	-
Investment in associate	12	(1 320)	-
Net cash used in investing activities		**(4 482)**	**(319)**
Cash flow from financing activities			
Share issuance net of transaction costs	15	31 787	14 849
Net cash from financing activities		**31 787**	**14 849**
Net change in cash and cash equivalents		15 449	(1 135)
Cash and cash equivalents at beginning of period	14	14 360	15 495
Cash and cash equivalents at end of period	**14**	**29 809**	**14 360**
Interest paid		-	-

NOTES TO THE CONSOLIDATED FINANCIAL STATEMENTS

NOTE 1 - GENERAL INFORMATION

Nordic Mining ASA ("the Company") and its subsidiaries (together "the Group") focus on exploration, extraction and production of high-end industrial minerals and metals. The address to Nordic Mining's office is Munkedamsveien 45, N-0250 Oslo, Norway.

These financial statements have been approved for issue by the Board of Directors on 19 April 2016.

NOTE 2 - SUMMARY OF SIGNIFICANT ACCOUNTING PRINCIPLES

Basis of preparation
The principal accounting policies applied in the preparation of these consolidated financial statements are set out below. These policies have been consistently applied unless otherwise stated.

The consolidated financial statements of Nordic Mining ASA have been prepared in accordance with International Financial Reporting Standards (IFRS) as adopted by the European Union. The consolidated financial statements have been prepared under the historical cost convention.

The annual accounts are based on the going concern assumption. The Board emphasises that there are elements of risk related to the long-term financing and consequently to the long-term ability to continue as a going concern. The Board expects that the positive clarification of regulatory matters for the Engebø project which was received in 2015 and the good progress for ongoing development activities will be positive for the Group's financial flexibility going forward. Please see the Board of Director's report and note 17 for further information.

Significant accounting judgments, estimates and assumptions
The preparation of the Group's financial statements requires management to make judgments, estimates and assumptions that affect the reported amounts of revenues, expenses, assets and liabilities, and the disclosure of contingent liabilities, at the reporting date. However, uncertainty about these assumptions and estimates could result in outcomes that could require a material adjustment to the carrying amount of the asset or liability affected in the future.

Key areas of estimation uncertainty:

- *Utilisation of tax loss carryforwards (note 8):*
  The Group has incurred significant tax loss carryforwards, but has not recognised a deferred tax asset related to these tax losses beyond offsetting deferred tax liabilities.
- *Impairment evaluation of exploration and evaluation assets (note 10):*
  Exploration and evaluation assets are evaluated for impairment under the indicators of IFRS 6 "Exploration for and evaluation of mineral resources."

  At 31 December 2015, management believes that facts and circumstances do not indicate that the exploration and evaluation assets are impaired. Estimations of resources and classifications based on the core drilling at Kvinnherad are ongoing, as is also the planning of a drilling program at Engebø. The preliminary drilling results at Reinfjord discovered mineral concentrations and there are ongoing activities to further evaluate whether there are sufficient mineral concentrations in the area to make the project commercially viable.

- *Investment in associate (note 12)*
  The Group has an investment in Keliber Oy in Finland. The business of Keliber Oy is currently in the exploration and development phase, and does not generate revenue. Uncertainty exists related to future values of this investment, and assessments have been made related to impairment of the investment. These assessments require substantial judgment. Please also see note 23 in the consolidated financial statements for further information.

Basis of Consolidation
The consolidated financial statements incorporate the financial statements of the Company and the subsidiaries controlled by the Company. Control is achieved where the Company has the power to govern the financial and operating policies of another entity so as to obtain benefits from its activities.

The subsidiaries include the 100% owned Nordic Rutile AS, located in Oslo, the 80% owned Nordic Ocean Resources AS, located in Oslo, and the 100% owned Nordic Quartz AS, located in Oslo. The accounting principles of the subsidiaries have been changed when necessary to ensure consistency with the policies adopted by the Group. All intra-group transactions, balances, income and expenses are eliminated on consolidation.

Non-controlling interest:
Non-controlling interest is presented as a separate line item in the Group's equity. The non-controlling interest's share of the net profit/loss is included in net loss in the income statement. Non-controlling interest includes part of the excess purchase price allocated to identifiable assets and liabilities at the acquisition date. The non-controlling interest's share of total comprehensive income/loss is allocated even if this results in a negative non-controlling interest.

Business combinations
The acquisition method of accounting is used to account for the acquisition of businesses and subsidiaries by the Group. The cost of an acquisition is measured as the fair value of the assets given, equity instruments issued and liabilities incurred or assumed at the

date of exchange. Identifiable assets acquired and liabilities and contingent liabilities assumed in a business combination are measured initially at their fair values at the acquisition date, irrespective of the extent of any non-controlling interest. The excess of the cost of acquisition over the fair value of the Group's share of the identifiable net assets acquired is recorded as goodwill.

Directly attributable transaction costs related to the business combination are expensed as incurred.

Investment in associates
The Group uses the equity method of accounting for investment in associates. Associated companies are investments in companies where the Group has significant influence, but not control. Significant influence normally exists when the Group controls between 20% and 50% of the voting rights.

Under the equity method, the investment in the associate is initially recognised at cost. The carrying amount of the investment is adjusted to recognise changes in the Group's share of net assets of the associate since the acquisition date. Goodwill relating to the associate is included in the carrying amount of the investment and is neither amortised nor individually tested for impairment. The income statement reflects the Group's share of the associate. Any transaction with the associate is eliminated to the extent of the interest in the associate.

Foreign currency translation
Functional and presentation currency
NOK is the functional currency of the parent and the presentation currency of the Group. Assets and liabilities in foreign entities, including goodwill and fair value adjustments related to business combinations are translated to NOK at the exchange rate at the balance sheet date. Revenues, expenses, gains and losses are translated using the average exchange rate during the period. Translation adjustments are recognised directly to Other Comprehensive Income.

Transactions and balances
Transactions in foreign currencies are initially recorded by the Group's entities at their respective functional currency spot rates at the date the transaction first qualifies for recognition. Monetary items denominated in foreign currencies are translated at the exchange rate at the balance sheet date. Foreign exchange gains and losses resulting from the settlement of such transactions and from the translation at year-end exchange rates of monetary assets and liabilities denominated in foreign currencies are recognised as finance income or finance expense in the income statement.

Acquisition of mining and mineral properties and exploration and development of such properties
IFRS 6 "Exploration for and evaluation of mineral resources" requires that exploration and evaluation assets are classified as tangible or intangible according to the nature of the assets acquired.

Some exploration and evaluation assets should be classified as intangibles, such as drilling rights and capitalised exploration costs. When technical feasibility and commercial viability of extracting a mineral resource is demonstrable, the assets should be reclassified as tangible assets. Evaluation and exploration assets that are classified as intangible assets are tested for impairment prior to reclassification.

Exploration and development for mineral properties
The Group employs the successful efforts method to account for exploration and development costs. All exploration costs, with the exception of acquisition costs of licenses and direct drilling costs of exploration holes are charged to expenses as incurred.

Drilling costs of exploration wells are temporarily capitalised pending the evaluation of the potential existence of mineral reserves. If reserves are not found, or if discoveries are assessed not to be technically and commercially recoverable, the drilling costs of exploration holes are expensed. Costs of acquiring licenses are capitalised and assessed for impairment at each reporting date.

Property, plant and equipment
The Group's property, plant and equipment, currently consisting of machinery and equipment, are recorded at cost less accumulated depreciation. Acquisition costs include costs directly attributable to the acquisition of the asset.

Subsequent costs are included in the asset's carrying amount or recognised as a separate asset, as appropriate, only when it is probable that future economic benefits associated with the item will flow to the Group and the cost of the item can be measured reliably. All other repairs and maintenance are charged to the income statement during the financial period in which they are incurred.

An item of property, plant and equipment is de-recognised upon disposal or when no future economic benefits are expected from its use or disposal. Any gain or loss arising on de-recognition of the asset is calculated as the difference between the net disposal proceeds and the carrying amount of the asset and is presented as a net gain or net loss in the income statement.

Depreciation is calculated on a straight-line basis over the useful life of the asset (land is not depreciated):

- Machinery and equipment: 4–10 years

The asset's useful life and residual amount are reviewed on an annual basis and are revised if necessary. The carrying amount of the asset is written down to recoverable amount when the carrying amount is higher that the estimated recoverable amount (further details are provided under "Impairment of non-financial assets" below).

Impairment of non-financial assets
Intangible assets that have an indefinite useful life or intangible assets not yet available for use are not subject to amortisation and are tested annually for impairment. Assets that are subject to amortisation are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less costs to sell and value in use. For the purposes of assessing impairment, assets are grouped at the lowest levels for which there are separately identifiable cash flows (cash-generating units). Non-financial assets other than goodwill that suffered impairment are reviewed for possible reversal of the impairment at each reporting date.

Government grants
Government grants are recognised in profit and loss on a systematic basis over the periods in which the Group recognises expenses of the related cost for which the grants are intended to compensate.

Government grants related to capitalised assets are presented in the balance by deducting the grant in the calculation of the carrying amount of the asset.

Leases
The Group has no agreements related to property, plant and equipment that are classified as finance leases.

Operating lease payments are recognised as an operating expense in the income statement on a straight-line basis over the lease term.

Receivables
Receivables are recognised initially at fair value and subsequently measured at amortised cost using the effective interest method, less provision for impairment. A provision for impairment of trade receivables is established when there is objective evidence that the Group may not be able to collect all amounts due according to the original terms of receivables.

Cash and cash equivalents
Cash and short-term deposits in the statements of financial position comprise cash at banks and other short-term highly liquid investments with original maturities of three months or less.

Share capital
Ordinary shares are classified as equity.

Share issuance costs that are incremental and directly attributable to the issue of new shares or options are shown in equity as a deduction, net of tax, from the proceeds.

Interest-bearing liabilities
All loans and borrowings are initially recognised at cost, being the fair value of the consideration received net of issue costs associated with the borrowing. After initial recognition, interest-bearing loans and borrowings are subsequently measured at amortised cost using the effective interest method. Any difference between proceeds (net of transaction costs) and the redemption value is recognised on the income statement over the period of the interest bearing liabilities.

De-recognition of financial liabilities
The Group de-recognises a financial liability (or a part of a financial liability) from its balance sheet when, and only when, it is extinguished. A financial liability is extinguished when the obligation specified in the contract is discharged or cancelled, or when it expires.

Trade payables
Trade payables are recognised initially at fair value and subsequently measured at amortised cost using the effective interest method.

Share-based compensation
The Group uses share-based, equity settled warrants as part of the compensation for senior management and qualified resource persons. The fair value of the services received is recognised as an expense in the financial statements over the period the options vest. The fair values of options that are fully vested on the grant date are fully recognised in the income statement when granted. Share-based compensation to employees and other qualified persons is measured by reference to the fair value of equity instruments issued. The Group uses the Black Scholes model to measure the fair value of options and warrants.

Income taxes
Income tax expense represents the sum of the taxes currently payable and deferred tax. Taxes payable are provided based on taxable profits at the current tax rate. Deferred taxes are recognised on differences between the carrying amounts of assets and liabilities in the financial statements and the corresponding tax bases used in the computation of taxable profit. Deferred tax liabilities are generally recognised for all temporary differences, and deferred tax assets are recognised to the extent that it is probable that taxable profits will be available against which deductible temporary differences can be utilised.

Deferred income tax is not recognised on temporary differences arising from initial recognition of an asset or liability in a transaction other than a business combination that at the time of the transaction affects neither accounting nor taxable profit nor loss.

The carrying amount of deferred tax assets is reviewed at each balance sheet date and reduced to the extent that it is no longer probable that sufficient taxable income will be available to allow all or part of the asset to be recovered.

Pensions
The Group has a defined benefit pension plan for its employees that meets the Norwegian statutory requirement. For the defined benefit plan, the cost of providing the benefits is determined using the unit credit method, with actual valuations being carried out at the end of each annual reporting period. Re-measurement, comprising actuarial gains and losses, the effect of asset ceiling (if applicable) and the return on plan assets (excluding interest), is reflected immediately in the statements of financial position with a charge or credit recognised in other comprehensive income in the period in which they occur. Past service costs are recognised in profit or loss in the period of a plan amendment. Net interest is calculated by applying the discount rate at the beginning of the period to the net defined benefit liability or asset.

Contingent liabilities
Contingent liabilities are defined as:

- possible obligations resulting from past events whose existence depends on future events
- obligations that are not recognised because it is not probable that they will lead to an outflow of resources
- obligations that cannot be measured with sufficient reliability

Contingent liabilities are not recognised on the balance sheet unless arising from assuming assets and liabilities in a business combination. Significant contingent liabilities are disclosed unless the possibility of an outflow of resources embodying economic benefits is remote. Please see note 10 in the consolidated financial statements regarding contingent liabilities related to the Engebø rutile deposit.

Cash flow statement
The Group reports the cash flow statement using the indirect method. That involves that the result for the period are adjusted for the effects of transactions without effect on cash and changes in assets and liabilities to show net cash flow from operations. Cash flow relating to investment activities and financing activities are shown separately.

Related party transactions
All transactions, agreements and business activities with related parties are conducted according to ordinary business terms and conditions. Parties are related if one party has the ability, directly or indirectly, to control the other party or exercise significant influence over the other party in making financial and operating decisions. Parties are also related if they are subject to common control or common significant influence. The Group provides note disclosure for related party transactions and balances, ref. note 20 in the consolidated financial statements.

Earnings per share
The calculation of basic earnings per share is based on the profit/loss attributable to ordinary shareholders using the weighted average number of shares outstanding during the year after deduction of the average number of treasury shares held over the period. The calculation of diluted earnings per share is consistent with the calculation of basic earnings per share while giving effect to all dilutive potential ordinary shares that were outstanding during the period, that is:

- The net profit for the period attributable to ordinary shares is increased by the after-tax amount of dividends and interest recognised in the period in respect of the dilutive potential ordinary shares and adjusted for any other changes in income or expense that would result from the conversion of the dilutive potential ordinary shares.
- Weighted average number of shares which includes the effect of all potential dilutive shares as if converted at the beginning of the period, or from the issue date if later.

New accounting standards
Only minor amendments issued by the IASB and endorsed by the EU were applied for the first time in 2015. These new pronouncements did not have a significant impact on the accounting policies and the consolidated financial statements of the Group.

New standards, amendments and interpretations issued, but not effective for the financial year beginning 1 January 2015, and not early adopted
The Group has not yet adopted certain new standards, amendments and interpretations to existing standards, which have been published, but are only effective for the accounting periods beginning on or after 1 January 2016 or later periods. The relevant new pronouncements are listed below:

IFRS 9 "Financial Instruments – Classification and Measurement", effective for 2018.
IFRS 15 "Revenue from Contracts with Customers", effective for 2018.
IFRS 16 "Leases", effective for 2019.
Amendments to IAS 16 and IAS 38 "Classification of Acceptable Methods of Depreciation and Amortisation", effective for 2016.
Amendment to IFRS 11 "Joint Arrangements", effective for 2016.
Annual improvements to IFRS 2012-2014 cycle, effective for 2016.

The impact on the Group's consolidated historical financial information of the future adoption of these and other new standards and interpretations is still under review.

NOTE 3 - SEGMENTS

The Group shows segments on the basis of products or products under development. The two reportable segments are:

- Titanium feedstock which can be produced by Nordic Rutile from the mineral deposit at Engebøfjellet. On 17 April 2015, the Ministry of Local Government and Modernisation approved the industrial area plan for the project. Also on 17 April 2015, the Ministry of Climate and Environment granted the discharge permit for the project.
- Quartz which can be produced from the quartz deposit in Kvinnherad. A scoping study outlines the potential for a profitable industrial quartz project.

The chief operating decision maker of the Group is the CEO on behalf of the management team of Nordic Mining ASA.

The reconciling column "Adjustments and eliminations" includes the Group's administration costs and other unallocated corporate business development costs as well as elimination entries related to preparing the consolidated financial statements. The Group uses the segments' profit/loss before tax from continuing operations as the basis for the segment results including some allocations of corporate expenses, but excluding purchase price allocations related to business combinations. All the numbers in the table below are in NOK thousands and represent the period 1 January – 31 December.

2015:

(Amounts in NOK thousands)	Quartz	Titanium	Adjustments and eliminations	Consolidated
Segment result	(453)	(9 758)	(9 021)	(19 232)
Impairment and share of loss from associate			(6 597)	(6 597)
Financial income			96	96
Financial costs			(4)	(4)
Allocated segment assets	2 156	6 366	38 391	46 913

2014:

(Amounts in NOK thousands)	Quartz	Titanium	Adjustments and eliminations	Consolidated
Segment result before tax	(526)	(9 604)	(13 316)	(23 446)
Impairment and share of loss from associate			(6 648)	(6 648)
Financial income			96	96
Financial costs			(14)	(14)
Allocated segment assets	-	5 444	28 915	34 359

The following table reconciles the results from the reporting segments to consolidated results before tax:

(Amounts in NOK thousands)	2015	2014
Profit/(loss) from segments	(10 211)	(10 130)
Not allocated consolidated costs	(2 516)	(6 750)
Not allocated share of loss in associate	(6 597)	(6 648)
Not allocated net finance	92	82
Profit/(loss) before tax from continuing operations	**(19 232)**	**(23 446)**

NOTE 4 – SALARIES

(Amounts in NOK thousands)	2015	2014
Wages and salaries	4 577	4 497
Social security costs	1 018	1 001
Pension costs	637	798
Board members, etc	1 060	1 062
Share-based payment	-	3 441
Capitalised payroll costs	(675)	-
Total	**6 617**	**10 799**
Average number of full time employees	3	3

Please see note 20 for further information about remuneration for senior management and guidelines for remuneration.

NOTE 5 – SHARE-BASED COMPENSATION

2015:
No options have been granted in 2015.

2014:
The annual shareholders meeting of Nordic Mining on 27 May 2014 decided to implement an incentive program for senior management and qualified resource persons. The board was given authority to allocate options that in full gives the right to sign up to 14 million new shares in Nordic Mining.

In June 2014, the Board granted options on 10.75 million Nordic Mining ASA shares to employees and associated resource persons, as well as selected stakeholders in Group projects. The exercise price for 8.25 million options is NOK 0.90, while the exercise price is NOK 1.80 for 2.5 million options. The options vested immediately and may be exercised until 18 May 2016.

	2015		2014	
	Number of options	Weighted average exercise price	Number of options	Weighted average exercise price
Outstanding 1 January	10 750 000	1.11	4 850 000	1.05
Granted during the year	-	-	10 750 000	1.11
Cancelled during the year	-	-	-	-
Exercised during the year	-	-	-	-
Expired during the year	-	-	(4 850 000)	1.05
Outstanding 31 December	**10 750 000**	**1.11**	**10 750 000**	**1.11**
Exercisable 31 December	**10 750 000**	**1.11**	**10 750 000**	**1.11**

Average fair value of the options granted in 2014 was NOK 0.37 per share while the average remaining contractual life at 31 December 2015 was 0.38 years. Weighted average assumptions used to calculate the real price of the granted options, using the Black Scholes model, were:

Issued in	2014
Volatility	91.19 %
Expected life	1
Risk free interest	1.28 %
Share price	1.04
Exercise price	1.11

NOTE 6 – OTHER OPERATING COSTS

(Amounts in NOK thousands)	2015	2014
Office costs and business service fee	485	480
Project costs – Engebø rutile project	1 913	4 232
Other business development	456	835
Other consulting fees	44	43
Share-based payment to consultants	-	591
Other costs	3 212	2 687
Refunded VAT	-	(951)
Research tax credit	-	(996)
Grant to developement expenses	-	(840)
Total	**6 110**	**6 081**

Auditor fees:

(Amounts in NOK thousands)	2015	2014
Statutory audit	507	410
Other attestation services	42	63
Tax services	-	-
Other financial audit	-	-
Total	**549**	**473**

The amounts are excluding VAT.

NOTE 7 – FINANCIAL INCOME AND FINANCIAL COSTS

(Amounts in NOK thousands)	**2015**	**2014**
Interest income on bank deposits	90	92
Foreign exchange gains	-	-
Other interest income	6	4
Finance income	**96**	**96**
Other finance costs	1	7
Foreign exchange losses	3	7
Finance costs	**4**	**14**

NOTE 8 - TAXES

The Group has incurred substantial tax losses carried forward and the related tax asset is shown in the table below. At this stage, the Group cannot substantiate that there will be sufficient future taxable income to be able to realise the Group's unused tax losses, and therefore the Group has not recognised deferred tax assets at 31 December 2015. Tax losses can be carried forward indefinitely in Norway.

(Amounts in NOK thousands)	2015	2014
Taxes payable	-	-
Deferred tax	-	-
Income tax expense/(income)	**-**	**-**

Tax effects of temporary differences and tax loss carryforwards at 31 December 2015:

(Amounts in thousands)	2015	2014
Mineral properties/PP&E	(988)	(358)
Pensions	475	383
Tax loss carryforwards	60 901	60 852
Total net deferred tax assets	**60 388**	**60 877**
Nominal tax rate (used for measurement)	25 %	27 %
Recognised in the statement of financial position:		
Deferred tax asset	-	-
Deferred tax liability	-	-

The Group recorded NOK 2.9 million gross in directly attributable transaction costs related to the 2015 share issue directly against equity (in 2014: NOK 2.0 million). The related tax effect of NOK 0.8 million is included in tax loss carryforwards.

The following table shows the reconciliation of expected tax using the nominal tax rate to the actual tax expense/(income):

(Amounts in thousands)	2015	2014
Loss before tax	(19 232)	(23 446)
Nominal tax rate	27 %	27 %
Expected income tax	**(5 193)**	**(6 330)**
Non-deductible costs	8	2
Non-taxable income	26	(271)
Non-deductible share compensation costs	-	1 071
Effect of non deductible expenses from associates	1 781	1 795
Effect of change in tax rate	4 831	-
Tax rate change on non-recognised tax assets	(4 831)	-
Non-recognised tax assets on current year result	3 378	3 733
Tax expense/(income)	**-**	**-**

NOTE 9 – EARNINGS PER SHARE

(Amounts in NOK thousands and number of shares in thousands)	2015	2014
Earnings		
Attributable to ordinary shareholders	(19 114)	(23 371)
Number of shares		
Weighted average number of ordinary shares outstanding	320 740	283 343
Earnings per share attributable to ordinary shareholders (amounts in NOK)		
Basic and diluted earnings per share	(0.06)	(0.08)

The effect of 10.75 million potentially dilutive shares arising from options (please see note 5 for further information) is not included in the calculation of diluted results per share for 2015 or 2014 since the effect is anti-dilutive.

NOTE 10 – EXPLORATION AND EVALUATION ASSETS

(Amounts in NOK thousands)	Licenses	Capitalised drilling costs	Total
Cost			
1 January 2014	5 125	1 326	6 451
Additions	319	-	319
31 December 2014	5 444	1 326	6 770
Additions	428	2 650	3 078
31 December 2015	**5 872**	**3 976**	**9 848**
Carrying amounts			
31 December 2014	5 444	1 326	6 770
31 December 2015	**5 872**	**3 976**	**9 848**

Mining concessions
The carrying amount for licenses relates to the Engebø area. Additionally, the Group has a conditional liability to the seller of NOK 40 million that will be paid if and when commercial operation commences at Engebø. No liability has been recognised per 31 December 2015.

In 2015, the Group has carried out a drilling program in Kvinnherad for the quartz deposit and planning of drilling program for the Engebø rutile deposit. The capitalised drilling costs includes directly attributable drilling costs for the titanium and quartz segments, as well as for the Reinfjord mineral deposit.

There were ongoing activities in 2015 related to evaluation of the Reinfjord mineral deposit in cooperation with NTNU (the Norwegian University of Science and Technology in Trondheim).

The exploration licenses are subject to annual renewal at the option of the Group. An annual fee is paid when the license period is extended.

NOTE 11 – PROPERTY, PLANT AND EQUIPMENT

(Amounts in NOK thousands)	Machinery and equipment	Total
Cost		
1 January 2015	-	-
Additions	84	84
31 December 2015	**84**	**84**
Depreciation		
1 January 2015	-	-
Depreciation for period	-	-
31 December 2015	**-**	**-**
Net book value		
31 December 2015	**84**	**84**
31 December 2014	-	-

The machinery and equipment acquired in 2015 will be depreciated over a period of 4-10 years.

NOTE 12 – INVESTMENT IN ASSOCIATES

The Group holds an investment of about 25% of the voting shares in Keliber Oy in Finland. The voting shares consist of A and B shares with unequal rights (A shares carry more of the losses).

The following table shows a summary of Keliber's financial information. The categories include the remaining amounts of excess fair values above the recognised amounts as allocated on initial recognition of the investment in associate in 2012.

(Amounts in NOK thousands)	2015	2014
Current assets	24 740	21 713
Non-current assets	45 007	51 278
Current liabilities	(2 953)	(2 233)
Non-current liabilities	(15 629)	(14 553)
Equity	**51 165**	**56 205**
Carrying amount of investment in associate:	6 182	11 102

The Group recognised its share of loss of the associate of NOK 6.6 million in 2015 and NOK 5.8 million in 2014. Additionally, the Group recognised an impairment loss of NOK 0.8 million in 2014.

In 2015, the Group estimated recoverable amount using fair value. The Group's ownership is approximately 25%. The estimated fair value has been based on the price of the share issuance in Keliber in 2015. Please also see note 23 in the consolidated financial statements for further information.

NOTE 13 – TRADE AND OTHER RECEIVABLES

(Amounts in NOK thousands)	2015	2014
Accounts receivable	10	449
Other receivables	5	6
Prepayments	454	110
Research tax credit	-	996
VAT receivable	521	565
Totalt	**990**	**2 126**

NOTE 14 – CASH AND CASH EQUIVALENTS

(Amounts in NOK thousands)	2015	2014
Bank deposits	29 809	14 360
Total cash and cash equivalents	**29 809**	**14 360**
Restriced cash in tax withholding account	295	374

NOTE 15 – SHARE CAPITAL

Number of shares outstanding	Ordinary Shares
2014:	
Opening balance	280 504 805
Share issuance	28 000 000
31 December 2014	**308 504 805**
2015:	
Opening balance	308 504 805
Share issuance	77 000 000
31 December 2015	**385 504 805**

All shares have equal rights. The nominal value is NOK 0.10 per share.

Share issue in 2015
In October 2015, Nordic Mining executed a rights issue of 77,000,000 shares with preferential right for shareholders. The subscription price was NOK 0.45 per share, resulting in gross proceeds of NOK 34.65 million. The net proceeds were approximately NOK 31.8 million after deducting directly attributable transaction costs of around NOK 2.9 million.

Share issue in 2014
In 2014, Nordic Mining executed a rights issue of 28,000,000 shares with preferential right for shareholders. The subscription price was NOK 0.60 per share, resulting in gross proceeds of NOK 16.8 million. The net proceeds were approximately NOK 14.8 million after deducting directly attributable transaction costs of around NOK 2.0 million.

The total net proceeds from these shares issues are disclosed in the cash flow statements.

Potential new shares
In 2014, the Company's annual general meeting approved an incentive program for senior management and qualified resource persons. The Board was given authority to grant options that in total give the right to issue up to 14 million new shares in Nordic Mining. A total of 10.75 million new options were granted in June 2014 as described in note 5, "Share-based remuneration". The authorisation from the annual general meeting was granted for two years and expires on 18 May 2016. As per the date of this report, no options have been exercised.

Please also see note 23 "Events after the balance sheet date" for authorisation of additional share issues.

NOTE 16 – OTHER CURRENT LIABILITIES

(Amounts in NOK thousands)	2015	2014
Tax withholding and social security accrual	490	581
Employee salary and holiday pay accrual	518	509
VAT payable	-	98
Accrued expenses	49	200
Total	**1 057**	**1 388**

NOTE 17 – FINANCIAL INSTRUMENTS AND RISK MANAGEMENT

Management of financial risk
Nordic Mining is exposed to certain types of financial risk related to the Group's financial instruments, primarily market risk related to floating interest rate risk on cash and cash equivalents, and liquidity risk.

The management of Nordic Mining manages the Group's financial risk. Risk management is primarily done by identifying and evaluating potential risk areas. Management focus is primarily on management of the liquidity risk to secure continuing operation and financing of the Group's capital intensive projects. The Group has until now not found it necessary to use derivatives or other financial instruments to manage financial risks.

Liquidity risk
The liquidity risk is the risk that the Group will not be able to pay financial obligations on their due date. The Group has to a large extent used equity financing in order to meet liquidity requirements related to financial obligations, covering of operational losses, and for investments.

All of the Group's financial liabilities as at 31 December 2015, NOK 1.4 million, mature within 6 months from the balance sheet date.

The Group has sufficient cash to be able to settle liabilities as at 31 December 2015 and estimated operating losses until the second half of 2016. Going forward, the Group will need to either raise more equity, issue debt instruments or divest assets depending on the development on ongoing projects.

Market risk
Market risk consists of the risk that real value or future cash flow related to financial instruments will vary as a consequence of market prices. Market risk includes, but is not limited to, currency risk, interest rate risk and price risk from sales. Currently, the Group has no exposure to price risk from sale of goods, and no financial instruments have been entered into related to future expected exposures. To a limited extent, the Group has market risk from financial instruments such as cash and cash equivalents and trade payables.

(i) Variable interest rate risk
The Group's cash and cash equivalents are exposed to changes in the market interest rate on bank deposits. The Group's exposure on the result is approximately +/-NOK 300,000 per percentage-point change in the variable market interest rate.

(ii) Currency exchange risk
The Group's operations are primarily in NOK, and there are limited transactions in foreign currency.

Credit risk
Credit risk is the risk of financial losses if a customer or counterpart of a financial instrument is unable to meet contractual obligations.

The Group's business is assessed to have only limited credit risk as at 31 December 2015. Cash and cash equivalents represent close to 100% of the Group's financial assets at 31 December 2015. There has been no loss recognised on trade receivables in 2015 or 2014.

Only to a limited degree routines for evaluation of credit risk have been introduced, however, discretionary evaluations are done on a case-by-case basis. Management will on an on-going basis evaluate the necessity of implementing stricter credit evaluations. Maximum exposure to credit risk is related to receivables which on the date of the accounts were NOK 0 million in 2015 and NOK 0.5 million in 2014.

Categories and fair value of financial instruments
The carrying amounts on the balance sheet of cash and cash equivalents, receivables, payables to suppliers, interest bearing bank loans and other short term financial items are close to fair value due to the short time period till maturity.

	2015		2014	
(Amounts in NOK thousands)	Carrying amount	Fair value	Carrying amount	Fair value
Loans and receivables	15	15	455	455
Cash and cash equivalents	29 809	29 809	14 360	14 360
Total financial assets	**29 824**	**29 824**	**14 815**	**14 815**
Financial liabilities measured at amortized cost:				
Accounts payable	798	798	753	753
Other current financial liabilities	567	567	709	709
Total financial liabilities	**1 365**	**1 365**	**1 462**	**1 462**

The management assessed that the fair values of cash and short-term deposits, trade receivables, trade payables, and other current liabilities approximate their carrying amounts largely due to the short-term maturities of these instruments.

Currency exchange rate sensitivity
There is immaterial currency exchange risk related to financial instruments as of 31 December 2015.

Capital management
The Group has used equity financing to a large degree to finance research, operations, purchase of licenses and other investments. The Group has previously also used long-term interest bearing loan and financial lease obligations. The goal of the Group's capital management is to secure liquidity for operations and for development of the Group's projects. The Group has no interest-bearing debt, and a cash balance well in exess of its liabilities. Thus, the net gearing ratio is negative; ratio of net debt (debt less cash) divided by total capital (net debt and equity) is -157% (as of 31 December 2014 -54%).

NOTE 18 – INVESTMENT IN SUBSIDIARIES

(Amounts in NOK thousands)	Location	Year incorp.	Share capital	Ownership	Equity 31.12.15	Net loss 2015
Nordic Rutile AS	Oslo, Norge	2006	15 098	100 %	15 102	(9 758)
Nordic Ocean Resources AS	Oslo, Norge	2011	117	80 %	(483)	(586)
Nordic Quartz AS	Oslo, Norge	2011	121	100 %	(322)	(453)

NOTE 19 – SHAREHOLDERS

The following 20 shareholders held most shares in the Company as per 31 December 2015:

Shareholders	Number of shares	% ownership
Nordnet Bank AB (nominee)	29 751 193	9.64 %
Skagen Vekst	18 416 432	5.97 %
Nordea Bank Plc. Finl. Clients (nominee)	14 510 733	4.70 %
Nordnet Livsforsikring	11 755 772	3.81 %
Dybvad Consulting AS	10 011 148	3.25 %
Danske Bank A/S (nominee)	7 070 466	2.29 %
Ove Klungland Holding NIL	7 023 696	2.28 %
Magil AS	6 500 000	2.11 %
Snati AS	6 000 000	1.94 %
Citibank, N.A. (nominee)	5 546 329	1.80 %
Infosave AS	5 144 863	1.67 %
Lithinon AS	4 167 898	1.35 %
Ole Kristian G. Stokken	3 736 721	1.21 %
Audstein Dybvad	3 356 000	1.09 %
Femcon AS	3 080 316	1.00 %
Adurna Invest AS	3 079 993	1.00 %
Reidar Jarl Hansen	2 878 124	0.93 %
Olav Birger Sletten	2 680 000	0.87 %
Jon Hovden	2 550 000	0.83 %
VPF Nordea Avkastning	2 524 134	0.82 %
Total 20 largest shareholders	149 783 818	38.85 %
Other shareholders	235 720 987	61.15 %
Total	**385 504 805**	**100 %**

NOTE 20 – RELATED PARTIES AND COMPENSATION OF MANAGEMENT

Transactions with related parties

Transactions with related parties adhere to the "arm's length principle". Nordic Mining has an agreement with Dag Dvergsten AS for office rental and services. The Company's board member Tore Viana-Rønningen is employed in Dag Dvergsten AS. The agreement can be cancelled by both parties on a six months' notice.

In 2015, the Company has expensed NOK 0.5 million related to the agreement with Dag Dvergsten AS (NOK 0.5 million in 2014).

Compensation of board members and key management in 2015

(Amounts in NOK thousands)	Salary	Board member fees	Other compensation	Pension costs	Share-based compensation[1]	Total
Ivar Sund Fossum, CEO	1 995	-	242	344	-	2 581
Lars K. Grøndahl, CFO	1 512	-	164	260	-	1 936
Mona Schanche, Exploration manager	1 061	-	142	183	-	1 387
Bent Erik Nordbø, Nomination Committee	-	15	-	-	-	15
Hans Olav Kvalvaag, Nomination Committee	-	15	-	-	-	15
Ole Klevan, Chairman Nomination Committee	-	30	-	-	-	30
Tarmo Tuominen, Board chairman	-	300	-	-	-	300
Tore Viana-Rønningen, Board member	-	175	-	-	-	175
Kjell Roland, Board member	-	175	-	-	-	175
Mari Thjømøe, Board member	-	175	-	-	-	175
Hilde Myrberg, Board member	-	175	-	-	-	175
Total	**4 569**	**1 060**	**548**	**787**	**-**	**6 963**

Compensation of board members and key management in 2014

(Amounts in NOK thousands)	Salary	Board member fees	Other compensation	Pension cost	Share-based compensation[1]	Total
Ivar Sund Fossum, CEO	1 972	-	241	292	1 562	4 067
Lars K. Grøndahl, CFO	1 485	-	160	283	940	2 867
Mona Schanche, Exploration manager	983	-	141	156	940	2 220
Tarmo Tuominen, Board chairman	-	300	-	-	-	300
Camilla Fiskevoll, retired Board member	-	79	-	-	-	79
Tore Viana-Rønningen, Board member	-	175	-	-	-	175
Thorild Widvey, retired Board member	-	79	-	-	-	79
Kjell Roland, Board member	-	175	-	-	-	175
Mari Thjømøe, Board member	-	96	-	-	-	96
Hilde Myrberg, Board member	-	96	-	-	-	96
Total	**4 439**	**1 000**	**542**	**732**	**3 442**	**10 154**

1) Fair value of granted options as measured under IFRS 2.

Management has no termination agreement and is subject to a normal statutory termination period of 3–6 months.

Guidelines for management remuneration

The main components of the guidelines for senior management salaries are as follows:

- The compensation package should reflect the responsibility and the tasks that the individual persons in senior management, and that the employee contributes towards the long-term creation of value in Nordic Mining.
- The Company will offer competitive conditions in order to attract relevant expertise for the development of the Company.
- The compensation package consists of fixed salary plus participation in an option program that has previously been approved by the annual meeting.
- Senior management participates in pension and insurance plans.
- Neither the Company's CEO nor other members of the senior management team has an agreement of a severance package in their employment contracts.

These guidelines have been used to hire senior management in Nordic Mining ASA and to establish salary levels.

Shares owned/controlled by members of the Board and senior management and those related to them as of 31 December 2015:

Name	Position	Number of shares	% ownership
Ivar Sund Fossum	CEO	2 123 092	0.69 %
Lars K. Grøndahl[1]	CFO	6 500 000	2.11 %
Mona Schanche	Exploration manager	184 317	0.06 %
Tarmo Tuominen	Board chairman	375 678	0.12 %
Kjell Roland	Board member	312 397	0.10 %
Tore Viana-Rønningen[2]	Board member	250 306	0.08 %
Mari Thjømøe[3]	Board member	232 779	0.08 %
Hilde Myrberg	Board member	71 027	0.02 %
Total		**10 049 596**	**3.26 %**

1) The shares are owned through the company Magil AS.

2) The shares are owned through the company ETVR Invest AS.

3) The shares are owned through the company ThjømøeKranen AS.

Options held by key management at 31 December 2015:

Name	Position	Total granted and outstanding	All granted in 2014
Ivar Sund Fossum	CEO	4 500 000	4 500 000
Lars K. Grøndahl	CFO	2 500 000	2 500 000
Mona Schanche	Exploration manager	2 500 000	2 500 000
Total		**9 500 000**	**9 500 000**

No options have been granted to members of the Board.

Please see note 23 in the consolidated financial statements for options granted after the balance sheet date.

NOTE 21 – PENSIONS

The Group has one benefit plan for Norwegian employees with a total of 3 active members.

Pension cost:

(Amounts in NOK thousands)	2015	2014
Pension cost - employee benefit	769	797
Pension cost - interest expense	18	1
Total pension related costs	**787**	**798**
Remeasurement gains/(losses) recorded to OCI	(647)	(1 763)

Movement in pension obligations during the year:

(Amounts in NOK thousands)	2015	2014
Pension obligations January 1	9 159	7 088
Current value of pension benefits for the year	769	797
Interest costs	183	225
Payments	(246)	(246)
Remeasurement loss/ (gain)	550	1 338
Other	66	(43)
Pension obligations as of 31 December	**10 480**	**9 159**

Movements in pension funds during the year:

(Amounts in NOK thousands)	2015	2014
Pension funds 1 January	7 742	7 042
Expected return on plan assets	165	224
Contributions	1 033	1 197
Payments	(246)	(246)
Other	(14)	(49)
Remeasurement (loss)/ gain	(98)	(425)
Pension funds as of 31 December	**8 582**	**7 742**

Pension liability is classified on the balance sheet as follows:

(Amounts in NOK thousands)	2015	2014
Pension funds	8 582	7 742
Pension obligations	(10 480)	(9 159)
Total	(1 898)	(1 417)
Other	-	-
Net pension asset	**(1 898)**	**(1 417)**
Pension asset/(liability) is shown in the balance sheet as:		
Other long-term asset	-	-
Other liabilities	(1 898)	(1 417)

Assumptions:

	2015	2014
Discount interest rate	1.90 %	2.30 %
Annual projected increase in salary	2.50 %	2.75 %
Annual projected G- regulation	2.25 %	2.50 %
Annual projected regulation of pension under payment	0.00 %	0.00 %

NOTE 22 – PAYMENTS TO AND FROM GOVERNMENTAL INSTITUTIONS

In accordance with the Accounting Act, section 3-3d, the Group has assessed its relations with and payments to and from governmental institutions. The Group's governmental relations are only with institutions in Norway. All relations and payments are in the ordinary course of business and related to i.a license payments, payment of prospectus/financial authority fees, R&D projects grants, tax refund, etc.

Estimated total payment from the Group to various Norwegian governmental institutions was around NOK 0.2 million in 2015 (2014: NOK 0.3 million). Estimated total payment to the Group from various Norwegian governmental institutions was around NOK 0 million in 2015 (2014: NOK 2 million).

NOTE 23 – EVENTS AFTER THE BALANCE SHEET DATE

Nordic Rutile AS

Managing director employed for Nordic Rutile AS

Thomas B. Addison, a mining engineer from the Norwegian University of Science and Technology (NTNU) with a broad background from the mining industry, took up the position as Managing Director for Nordic Rutile with effect from 1 February 2016. Addison will manage and coordinate the development of the Engebø rutile project, including activities related to the upcoming pre-feasibility study.

Appeal dismissed regarding the discharge permit for the Engebø project

On 19 February 2016, an appeal from various environmental organisations regarding the discharge permit for the Engebø project was resolved and dismissed by the Norwegian King in Council. Consequently, the discharge permit is final, and without further possibility for appeal. Two minor clarifications were included in the discharge permit, i.a. regarding monitoring of emigrating smolt.

Drilling program at the Engebø rutile deposit

A core drilling program was started at Engebø in February and completed in April 2016. Approximately 6,400 meters were drilled, mainly in the open pit part of the deposit. Analytical results from the first drill holes have been received. When all analytical tests are completed, the Qualified Person, Mr. Adam Wheeler will assess the information as a part of the update of the mineral resource estimates and classifications in accordance with the JORC Code. The revised resource model is expected to be finalised in Q3 2016. For more information, please see page 6–8 regarding Nordic Rutile AS.

Nordic Quartz AS

Resource estimates for the Kvinnherad quartz deposit

In February 2016, an independent assessment of the Kvinnherad hydrothermal quartz was completed based on i.a. information from the drilling program which was executed in the fall 2015. The Qualified Persons have estimated significant quartz-containing mineral resources in the inferred and indicated categories. The quartz content varies in the deposit with a substantial part in the massive zone category (>95% quartz content). For more information, please see page 10–11 regarding Nordic Quartz AS.

Nordic Ocean Resources AS

Comprehensive research program on seabed minerals

In January 2016, the research program "MarMine" started with participation from Nordic Ocean Resources AS and 13 other industrial companies and research institutions. MarMine is the first comprehensive research program in Norway with primary focus on the resource potential and technological aspects related to seabed minerals and mining. MarMine is coordinated by the Norwegian University of Science and Technology (NTNU) and has been granted approximately NOK 25 million from the Norwegian Research Council. For more information, please see page 16–17 regarding Nordic Ocean Resources AS.

Keliber Oy

Completion of pre-feasibility study

In March 2016, the pre-feasibility study for Keliber's lithium project was completed. The study indicates a significant economic potential from production of high-quality lithium carbonate. A preliminary net present value of EUR 97 million based on an 8% discount rate and with an internal rate of return of 21% has been estimated based on an annual lithium carbonate production of 9,000 tonnes. The estimated payback time from production start-up is approximately 4 years. For more information, please see page 12–14 regarding Keliber Oy.

Rights issue completed

Subsequent of the pre-feasibility study, Keliber has completed a rights issue with gross proceeds of approximately EUR 2.9 million. Nordic Mining participated pro rata with its 25% shareholding in Keliber and remains the largest shareholder in Keliber. The new financing will be used for further development work towards the bankable feasibility study which is scheduled for completion mid-2017.

Corporate matters

Authorisation to issue new shares

An extraordinary general meeting in Nordic Mining ASA was held 4 February 2016. The general meeting approved an authorisation to the Board of Directors to issue up to 170 million new shares in connection with possible equity issues to raise capital, or for consideration, in whole or in part, in connection with investment in other businesses. The authorisation which is valid till 30 June 2016, is not utilised as per the date of this annual report. Please also see note 15 to the consolidated financial statements.

Option agreement

An option agreement was awarded in February 2016 to Thomas B. Addison who took up the position as managing director of Nordic Rutile AS on 1 February 2016. Addison was awarded 2,000,000 options at a price of NOK 0.90 per share. One option can be converted into one share in Nordic Mining. All options are fully vested on award and valid till 18 May 2016. Addison does not own shares in Nordic Mining. Subsequent of the agreement, 12,750,000 options have been awarded to leading employees and resource persons under the option program which was approved in the General Meeting in May 2014.

Corporate accounts for Nordic Mining ASA

INCOME STATEMENTS

(Amounts in NOK thousands)	Note	2015	2014
Revenues from Group companies		6 821	6 384
Other income		-	-
Payroll and related costs	4	(6 617)	(10 799)
Other operating expenses	5	(3 867)	(3 968)
Impairment shares in subsidiaries and associates	13	-	(5 849)
Operating loss		**(3 663)**	**(14 232)**
Financial income	6	1 828	1 374
Financial costs	6	(3)	(84)
Profit/(loss) before tax		**(1 838)**	**(12 942)**
Income tax	7	-	-
Net profit/(loss)		**(1 838)**	**(12 942)**
Allocation of the loss			
Allocated to retained losses		(1 838)	(12 942)
Total allocation of the loss		**(1 838)**	**(12 942)**

BALANCE SHEETS

(Amounts in NOK thousands)	Note	2015	2014
ASSETS			
Non-current assets			
Exploration and evaluation assets	8	1 326	1 326
Investment in subsidiaries	3, 13	52 406	51 028
Investment in associate	13	12 423	11 103
Total non-current assets		**66 156**	**63 457**
Financial assets			
Long term receivables Group companies	9	43 263	31 865
Total financial assets		**43 263**	**31 865**
Total non-current assets		**109 418**	**95 322**
Current assets			
Other receivables and prepayments	9	462	116
Cash and cash equivalents	10	29 275	14 224
Total current assets		**29 737**	**14 340**
Total assets		**139 155**	**109 662**

BALANCE SHEETS

(Amounts in NOK thousands)	Note	2015	2014
SHAREHOLDERS' EQUITY AND LIABILITIES			
Shareholders' equity			
Share capital	11	38 550	30 850
Share premium	11	263 282	239 195
Other paid-in capital	11	12 924	12 924
Retained losses	11	(179 232)	(176 746)
Total equity	**11**	**135 525**	**106 223**
Non-current liabilities			
Pension liabilities	4	1 898	1 417
Total non-current liabilities		**1 898**	**1 417**
Current liabilities			
Trade payables		485	717
Provision and other current liabilities	12	1 247	1 305
Total current liabilities		**1 732**	**2 022**
Total liabilities		**3 630**	**3 439**
Total shareholders' equity and liabilities		**139 155**	**109 662**

Oslo, 19 April 2016
The Board of Directors of Nordic Mining ASA

Tarmo Tuominen *Chairman*	Kjell Roland	Tore Viana-Rønningen	Mari Thjømøe	Hilde Myrberg

Ivar S. Fossum
CEO

CASH FLOW STATEMENTS

(Amounts in NOK thousands)	Note	2015	2014
CASH FLOW FROM OPERATING ACTIVITIES			
Loss before income tax		(1 838)	(12 942)
Write down of investment in associate	13	-	5 849
Share-based expenses	4	-	3 651
Other changes in assets and liabilities			
Receivables, operating receivables from subsidiaries, prepayments	9	(13 121)	(10 621)
Trade payables		(233)	(487)
Accrued expenses and other current liabilities	12	(57)	(413)
Other		(167)	(328)
Net cash used in operating activites		**(15 416)**	**(15 291)**
CASH FLOW FROM INVESTING ACTIVITIES			
Investment in associate	13	(1 320)	-
Net cash used in investing activities		**(1 320)**	**-**
CASH FLOW FROM FINANCING ACTIVITIES			
Share issuance net of transaction costs	11	31 787	14 849
Net cash from financing activities		**31 787**	**14 849**
Net change in cash and cash equivalents		15 051	(442)
Cash and cash equivalents at beginning of period	10	14 224	14 666
Cash and cash equivalents at end of period	**10**	**29 275**	**14 224**
Non-cash transactions			
Conversion of debt to equity in subsidiaries		1 378	-

NOTES TO THE FINANCIAL STATEMENTS

NOTE 1 – GENERAL INFORMATION

Nordic Mining ASA ("the Company") and its subsidiaries (together "the Group) focus on exploration, extraction and production of high-end industrial minerals and metals. The address of Nordic Mining's office is Munkedamsveien 45, N-0250 Oslo, Norway.

The Board approved publication of the accounts on 19 April 2016.

NOTE 2 – SUMMARY OF THE MOST IMPORTANT ACCOUNTING PRINCIPLES

The most important accounting principles that have been used in developing the Company accounts are described below. These principles have been consistently applied unless otherwise stated.

Basic principles
The Company accounts have been presented in accordance with the Norwegian accounting act and generally accepted accounting principles in Norway. The related notes are an integral part of the financial statements of the Company.

The annual accounts are based on the going concern assumption. For further comments please see the Board of Directors' Report and note 17 of the consolidated financial statements.

Investment in subsidiaries and associated entities
Subsidiaries are companies controlled by the Company. Associated companies are investments in companies where the Company has significant influence, but not control. Significant influence normally exists when the Company controls between 20% and 50% of the voting rights.

Subsidiaries and associates are measured at cost in the statutory accounts. The investments are measured at acquisition cost, unless impairment has been necessary. Such assets are deemed to be impaired at fair value when a decrease in value cannot be considered to be of temporary nature, and in accordance with generally accepted accounting principles. Impairments are reversed when the basis for the impairment no longer applies.

Transactions in foreign currency
Transactions in foreign currencies are initially recorded in the functional currency rate at the date of the transaction. Monetary items denominated in foreign currencies are translated at the exchange rate at the balance sheet date. Foreign exchange gains and losses resulting from the settlement of such transactions and from the translation at year-end exchange rates of monetary assets and liabilities denominated in foreign currencies are recognised in the income statement.

Acquisition of mining and mineral properties and exploration and development of such properties
Exploration and evaluation assets are classified as tangible or intangible according to the nature of the assets acquired.

Some exploration and evaluation assets should be classified as intangibles, such as drilling rights and capitalised exploration costs. When technical feasibility and commercial viability of extracting a mineral resource is demonstrable, the assets should be reclassified as tangible assets. Evaluation and exploration assets that are classified as intangible assets are tested for impairment prior to reclassification.

Mining and mineral properties
Mining interests represent capitalised expenditures related to the acquisition, exploration and development of mining properties and related plant and equipment. Capitalised costs are depreciated and depleted using a unit of production method over the estimated economic life of the mine to which they relate.

Exploration and development for mineral properties
The Company employs the successful efforts method to account for exploration and development costs. All exploration costs, with the exception of acquisition costs of licenses and direct drilling costs of exploration wells are charged to expenses as incurred.

Drilling costs of exploration holes are temporarily capitalised pending the evaluation of the potential existence of mineral reserves. If reserves are not found, or if discoveries are assessed not to be technically and commercially recoverable, the drilling costs of exploration holes are expensed. Costs of acquiring licenses are capitalised and assessed for impairment at each reporting date.

Receivables
The Company's receivables are mainly receivables on Group companies. Receivables are recognised initially at cost, and subsequently measured at amortised cost using the effective interest method if the amortisation effect is material, less provision for impairment. A provision for impairment of trade receivables is established when there is objective evidence that the Company may not be able to collect all amounts due according to the original terms of receivables.

Cash and cash equivalents
Cash and cash equivalents consist of cash, bank deposits and other short term, easily convertible investments with maximum three months original maturity.

Share capital
Ordinary shares are classified as equity. Expenses that are directly linked to the issue of new shares or options are shown in equity as a deduction, net of tax, from the proceeds.

Loans
All loans and borrowings are initially recognised at cost, being the fair value of the consideration received net of issue costs associated with the borrowing. After initial recognition, interest-bearing loss and borrowings are subsequently measured at amortised cost using the effective interest method; any difference between proceeds (net of transaction costs) and the redemption value is recognised on the income statement over the period of the interest bearing liabilities.

Trade payables
Trade payables are recognised initially at fair value and subsequently measured at amortised cost using the effective interest method, if the amortisation effect is material.

Government grants
Government grants is recognised in profit and loss on a systematic basis over the periods in which the Company recognises expenses the related cost for which the grant are intended to compensate.

Government grants related to capitalised assets is presented in the balance by deducting the grant in arriving at the carrying amount of the asset.

Share-based compensation
The Company uses share-based, equity settled warrants as part of the compensation for senior management and qualified resource persons. The fair value of the services received is recognised as an expense in the financial statements over the period the options vest. The fair value of options that are fully vested on the grant date are fully recognised in the income statement when granted. Share-based compensation to employees and other qualified persons is measured by reference to the fair value of equity instruments issued. The Company uses the Black Scholes model to measure the fair value of options and warrants.

Deferred tax
Income tax expense represents the sum of the taxes currently payable and deferred tax. Taxes payable are provided based on taxable profits at the current tax rate. Deferred taxes are recognised on differences between the carrying amounts of assets and liabilities in the financial statements and the corresponding tax bases used in the computation of taxable profit. Deferred tax liabilities are generally recognised for all temporary differences and deferred tax assets are recognised to the extent that it is probable that taxable profits will be available against which deductible temporary differences can be utilised. Deferred income tax is not recognised on temporary differences arising from initial recognition of an asset or liability in a transaction other than a business combination that at the time of the transaction affects neither accounting nor taxable profit nor loss. The carrying amount of deferred tax assets is reviewed at each balance sheet date and reduced to the extent that it is no longer probable that sufficient taxable income will be available to allow all or part of the asset to be recovered.

Revenue recognition
The primary revenue comes from sale of services to Group companies. Revenues are recognised in the accounting period in which the services are provided.

Pensions
The Company has a defined benefit pension plan for its employees that meets the Norwegian statutory requirement. For the defined benefit plan, the cost of providing the benefits is determined using the unit credit method, with actual valuations being carried out at the end of each annual reporting period. Re-measurement, comprising actuarial gains and losses, the effect of asset ceiling (if applicable) and the return on plan assets (excluding interest), is reflected immediately in the statement of financial position with a charge or credit recognised in equity in the period in which they occur. Past service costs are recognised in profit or loss in the period of a plan amendment. Net interest is calculated by applying the discount rate at the beginning of the period to the net defined benefit liability or asset.

Cash flow statement
The Company reports the cash flow statement using the indirect method. That involves that the result for the period are adjusted for the effects of transactions without effect on cash and changes in assets and liabilities to show net cash flow from operations. Cash flow relating to investment activities and financing activities are shown separately.

Related parties
All transactions, agreements and business activities with related parties are processed on standard arm's length business terms. Parties are related if they have the possibility to directly or indirectly control the business or provide significant influence over the financial and operational decision of the business. The parties are also related if they are subject to "common control". The Company provides information in notes about transactions and balances with related parties, ref. note 20 in the consolidated financial statements.

Earnings per share
The calculations of earnings per share are based on the result assigned to ordinary shareholders using a weighted average of outstanding shares through the period after deduction for weighted number of shares in the period. The calculation of diluted earnings per share is consistent with the method for calculating basic earnings per share, considering potential diluted shares in the period:

- The net profit for the period that is assigned to ordinary shareholders is increased with an after-tax amount for dividends and interest recognised in the period related to potential diluted shares.
- Weighted average number of shares issued that include the effect of all potential diluted had been converted to ordinary shares in the beginning of the period or from the issuing date is this is later.

NOTE 3 – SIGNIFICANT TRANSACTIONS

In 2015, Nordic Mining participated pro rata to its 25% shareholding in a share issue in Keliber at €15 per share. The total investment amount was approximately NOK 1.3 million.

In 2014, Nordic Mining's shareholding in Keliber was reduced to approximately 25% as a result of share issues in which the Company did not participate. The shareholding in Keliber is classified as investment in an associate.

NOTE 4 – SALARIES, SHARE-BASED COMPENSATION, RELATED PARTY AND MANAGEMENT COMPENSATION, AND PENSIONS

Please see note 4, 5, 20, and 21 in the consolidated financial statements for information regarding salaries, share-based compensation, related party and key management, pensions, etc.

NOTE 5 – OTHER OPERATIONAL COSTS

(Amounts in NOK thousands)	2015	2014
Office costs etc.	485	480
Other business development	309	944
Other costs	3 073	2 334
Share-based payment	-	210
Total	**3 867**	**3 968**

Auditor fees:

(Amounts in NOK thousands)	2015	2014
Statutory audit	380	380
Other attestation services	32	18
Total	**412**	**398**

The amounts are excluding VAT.

NOTE 6 – FINANCIAL INCOME AND FINANCIAL COSTS

(Amounts in NOK thousands)	2015	2014
Interest income on bank deposits	90	90
Interest from Group companies	1 738	1 284
Foreign exchange gains	-	-
Finance income	**1 828**	**1 374**
Other finance costs	1	77
Foreign exchange losses	2	7
Finance costs	**3**	**84**

NOTE 7 – TAXES

The Company has incurred substantial losses to be carried forward, and the tax values are disclosed in the table below. At this stage, the Company cannot substantiate that there will be sufficient future income to be able to realise the Company's unused tax losses, and thus the Company has not recognised any deferred tax asset as at 31 December 2015.

There is no limit in years for tax loss carryforward in Norway.

Income taxes for the year:

(Amounts in thousands)	2015	2014
Taxes payable	-	-
Deferred tax	-	-
Income tax expense/(income)	**-**	**-**

Tax impact of temporary differences as of 31 December:

(Amounts in thousands)	2015	2014
Intangible assets	(332)	(358)
Pensions	475	383
Tax loss carryforwards	50 260	52 968
Net deferred tax assets	**50 403**	**52 993**
Nominal tax rate (used to measure deferred tax items)	25 %	27 %
Recognised on the balance sheet:		
Deferred tax asset	-	-
Deferred tax liability	-	-

Reconciliation of effective tax rate:

(Amounts in thousands)	2015	2014
Loss before tax	(1 838)	(12 942)
Nominal tax rate	27 %	27 %
Expected tax loss	(496)	(3 494)
Impairment of shares in subsidiaries and associates	-	1 579
Non-deductible costs	5	21
Non-taxable income	(3)	-
Non-deductible share compensation costs	-	986
Effect of rate change	4 032	-
Effect of rate change on non-recognised deferred tax asset	(4 032)	-
Non-recognised deferred tax asset allocable to profit and loss	494	908
Tax expense/(income)	**-**	**-**

Government grants/ R&D tax credits:
The Company received NOK 0.6 million in R&D tax credits in 2014 (NOK 0 in 2015).

NOTE 8 – EXPLORATION AND EVALUATION ASSETS

Carrying amount of concession related assets of NOK 1.3 million in 2015 and 2014 relates to successful exploration drilling in Reinfjord capitalised in accordance with the successful effort method. The assets will be amortised using the units of production method if the mineral reserves are deemed economically viable and production commences.

There has been ongoing activity in the project during 2015 in cooperation with the Norwegian University of Science and Technology (NTNU).

NOTE 9 – OTHER RECEIVABLES AND PREPAID EXPENSES

(Amounts in NOK thousands)	2015	2014
Accounts receivable	10	40
Other receivables	6	-
Prepayments	446	439
Intercompany receivables	-	6 128
Totalt	**462**	**6 607**

Specification of intercompany loans/receivables:

(Amounts in NOK thousands)	2015	2014
Nordic Rutile AS	40 002	30 579
Nordic Ocean Resources AS	362	692
Nordic Quartz AS	2 899	594
Total	**43 263**	**31 865**
Classified as current liabilities	-	-
Classified long-term receivables	43 263	31 865

The interest rate on the intercompany loans is 6% per year.

NOTE 10 – CASH AND CASH EQUIVALENTS

(Amounts in NOK thousands)	2015	2014
Bank deposits	29 275	14 244
Total cash and cash equivalents	**29 275**	**14 244**
Included in cash and cash equivalent – Employee witholding account	295	374

NOTE 11 – SHARE CAPITAL AND CHANGES IN EQUITY

	Ordinary Shares
2014:	
Opening balance	280 504 805
Share issuance	28 000 000
31 December 2014	**308 504 805**
2015:	
Opening balance	308 504 805
Share issuance	77 000 000
31 December 2015	**385 504 805**

Please see note 15 in the consolidated financial statements for information regarding share issues in 2014 and 2015, and note 19 for information regarding the largest shareholders in Nordic Mining ASA.

All shares have equal rights. Nominal value is NOK 0.10 per share.

Changes in equity:

(Amounts in NOK thousands)	Share capital	Share premium	Other-paid-in capital	Retained earnings	Total
Equity at 1 January 2014	**28 050**	**227 146**	**8 893**	**(162 041)**	**102 048**
Share-based payment	-	-	4 031	-	4 031
Share issue	2 800	14 000	-	-	16 800
Transaction costs on share issue	-	(1 951)	-	-	(1 951)
Actuarial gain losses on pensions	-	-	-	(1 763)	(1 763)
Loss for the period	-	-	-	(12 942)	(12 942)
Equity at 31 December 2014	**30 850**	**239 195**	**12 924**	**(176 746)**	**106 223**
Share-based payment	-	-	-	-	-
Share issue	7 700	26 950	-	-	34 650
Transaction costs on share issue	-	(2 863)	-	-	(2 863)
Actuarial gain losses on pensions	-	-	-	(647)	(647)
Loss for the period	-	-	-	(1 838)	(1 838)
Equity at 31 December 2015	**38 550**	**263 282**	**12 924**	**(179 231)**	**135 525**

NOTE 12 – PROVISION AND OTHER CURRENT LIABILITIES

(Amounts in NOK thousands)	2015	2014
Tax withholding and social security accrual	490	581
Employee salary and holiday pay accrual	518	509
VAT payable	239	113
Accrued expenses	-	101
Total	**1 247**	**1 305**

NOTE 13 – INVESTMENTS IN SUBSIDIARIES AND ASSOCIATE

Instruments in subsidiaries:

(Amounts in NOK thousands)	Location	Year incorp.	Share capital	Ownership	Equity 31.12.15	Net loss 2015	Carrying amount 31.12.15
Nordic Rutile AS	Oslo, Norge	2006	15 098	100 %	15 102	(9 758)	47 266
Nordic Ocean Resources AS	Oslo, Norge	2011	117	80 %	(483)	(586)	2 070
Nordic Quartz AS	Oslo, Norge	2011	121	100 %	(322)	(453)	3 070
Total							**52 406**

The projects carried out in the subsidiaries are in an early phase. Testing for impairment has been done, however, no impairment has been recognised.

Investments in associate

The Company holds an investment of approximately 25% in Keliber Oy in Finland, ref. note 12 in the consolidated financial statements for information about impairment recognised in 2014.

(Amounts in NOK thousands)	Carrying amount
Carrying amount 1.1.14	16 951
Impairment in 2014	(5 848)
Carrying amount 31.12.14	11 103
Additional investment 2015	1 320
Carrying amount 31.12.15	**12 423**

Nordic Mining made an additional investment of approximately NOK 1.3 million in Keliber in 2015. The Company subscribed new shares pro rata to its 25% ownership interest. Please also see note 23 in the consolidated financial statements for further information.

NOTE 14 – FINANCIAL INSTRUMENTS AND RISK MANAGEMENT

Management of financial risk
Nordic Mining is exposed to various types of financial risk related to the Company's financial instruments, primarily market risk related to floating interest rate on cash and cash equivalents, and liquidity risk. The Company manages financial risk primarily by identifying and evaluating potential risk areas. The Company has so far not found it necessary to use derivatives to several financial risks.

Liquidity risk
The liquidity risk is the risk that the Company is not able to pay its financial obligations upon maturity. The Company has used equity financing to a large degree in order to meet liquidity demands related to financial obligations, cover operational losses and for investments. Nordic Mining ASA does not have significant financial obligations. For a more complete description of Nordic Mining Group's liquidity risk please see note 17 in the consolidated financial statements and the Board of Directors' report.

Market risk
Variable interest risk
The Company is exposed to cash flow risk related to receivables from subsidiaries that has a floating interest rate. Furthermore, the Company has exposure to the floating interest risk related cash or cash equivalent deposits.

Currency exchange risk
The Company has limited exposure to currency exchange risk as at 31 December 2015. Currency transactions may arise, amongst others related to its associate. The Company evaluates unpaid balances and transactions in foreign currency, but has so far not decided to secure against currency exposure.

Credit risk
The Company does not have receivables from sales, and there are not many other payables (loans and payables are primarily from the companies within the Group; at 31 December 2015 the intercompany loans and payables amounted to NOK 43.2 million). The Company has a limited credit risk from external parties.

Sensitivity analysis
The Company's result and equity is exposed only to a limited degree to changes in interest rate (bank deposit and intercompany loans) and currency exchange rates.

NOTE 15 – EVENTS AFTER THE DATE OF THE ACCOUNTS

Please see note 23 in the consolidated financial statements.



Nordic Mining ASA

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RESPONSIBILITY STATEMENT

We confirm to the best of our knowledge that the consolidated financial statements for 2015 have been prepared in accordance with IFRS as adopted by the European Union, as well as additional information requirements in accordance with the Norwegian Accounting Act, that the financial statements for the parent company for 2015 have been prepared in accordance with the Norwegian Accounting Act and generally accepted accounting practice in Norway, and that the information presented in the financial statements gives a true and fair view of the assets, liabilities, financial position and result of Nordic Mining ASA and the Nordic Mining Group for the period.

We also confirm to the best of our knowledge that the Board of Directors' Report includes a true and fair review of the development, performance and financial position of Nordic Mining ASA and the Nordic Mining Group, together with a description of the principal risks and uncertainties that they face.

Oslo, 19 April 2016

The Board of Directors of Nordic Mining ASA

Tarmo Tuominen
Chairman

Kjell Roland
Deputy chairman

Hilde Myrberg
Board member

Mari Thjømøe
Board member

Tore Viana-Rønningen
Board member

Ivar S. Fossum
CEO

Building a better working world

Statsautoriserte revisorer
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To the Annual Shareholders' Meeting of
Nordic Mining ASA

AUDITOR'S REPORT

Report on the financial statements

We have audited the accompanying financial statements of Nordic Mining ASA, comprising the financial statements for the Parent Company and the Group. The financial statements of the Parent Company comprise the balance sheet as at 31 December 2015, the statements of income and cash flows for the year then ended and a summary of significant accounting policies and other explanatory information. The financial statements of the Group comprise the consolidated statement of financial position as at 31 December 2015, the statements of income, comprehensive income, cash flows and changes in equity for the year then ended as well as a summary of significant accounting policies and other explanatory information.

The Board of Directors' and CEO's responsibility for the financial statements

The Board of Directors and the CEO are responsible for the preparation and fair presentation of these financial statements in accordance with the Norwegian Accounting Act and accounting standards and practices generally accepted in Norway for the financial statements of the Parent Company and the International Financial Reporting Standards as adopted by the EU for the financial statements of the Group, and for such internal control as the Board of Directors and the CEO determine is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with laws, regulations, and auditing standards and practices generally accepted in Norway, including International Standards on Auditing. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

A member firm of Ernst & Young Global Limited

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the financial statements for the Parent Company and the Group.

Opinion on the financial statements of the Parent Company

In our opinion, the financial statements of Nordic Mining ASA have been prepared in accordance with laws and regulations and present fairly, in all material respects, the financial position of the Company as at 31 December 2015 and its financial performance and cash flows for the year then ended in accordance with the Norwegian Accounting Act and accounting standards and practices generally accepted in Norway.

Opinion on the financial statements of the Group

In our opinion, the financial statements of the Group have been prepared in accordance with laws and regulations and present fairly, in all material respects, the financial position of the Group as at 31 December 2015 and its financial performance and cash flows for the year then ended in accordance with the International Financial Reporting Standards as adopted by the EU.

Emphasis of matter

Without qualifying our opinion, we draw attention to the Board of Director's Report and note 17 in the Group's financial statements, which indicate that the Group will need to either raise more equity, sell assets or to issue debt instruments to finance future operations. Our opinion is not qualified in respect of this matter.

Report on other legal and regulatory requirements

Opinion on the Board of Directors' report and on the statements on corporate governance

Based on our audit of the financial statements as described above, it is our opinion that the information presented in the Directors' report and in the statements on corporate governance concerning the financial statements, the going concern assumption and the proposal for the allocation of the result is consistent with the financial statements and complies with the law and regulations.

Opinion on registration and documentation

Based on our audit of the financial statements as described above, and control procedures we have considered necessary in accordance with the International Standard on Assurance Engagements (ISAE) 3000, «Assurance Engagements Other than Audits or Reviews of Historical Financial Information», it is our opinion that the Board of Directors and Managing Director have fulfilled their duty to ensure that the Company's accounting information is properly recorded and documented as required by law and generally accepted bookkeeping practice in Norway.

Oslo, 19 April 2016
ERNST & YOUNG AS

Jon-Michael Grefsrød
State Authorised Public Accountant (Norway)

ARTICLES OF ASSOCIATION

for Nordic Mining ASA per 27 October 2015

1. The name of the company is Nordic Mining ASA. The company is a public limited liability company.

2. The registered office of the company is in Oslo.

3. The object of the company is to carry on exploration for coal, minerals and ores, mining activity, technology development, activities that may be associated herewith, and participation in other companies anywhere in the world.

4. The share capital of the company amounts to NOK 38,550,480.50 divided on 385,504,805 shares of a nominal value of NOK 0.10. The shares of the company shall be registered in the Norwegian Registry of Securities.

5. The board of directors of the company shall have from 3 to 8 members according to the decision of the shareholders' meeting. Two board members jointly can sign on behalf of the company.

6. The company shall have an election committee consisting of three members who shall be elected by the general meeting. The members of the election committee shall, when they are elected, be shareholders or representatives of shareholders of the company. The Election Committee shall make recommendations to the general meeting concerning the election of members and deputy members to the board of directors. The election committee shall also make recommendations concerning remuneration to such members. Members of the election committee are elected for a period of two years. The members of the board of directors which have been elected by the general meeting make recommendations for and adopt instructions for the election committee.

7. The shareholders' meeting shall deal with:
   i) Adoption of the annual accounts and annual report, including payment of dividends.
   ii) Other matters that pursuant to law are the business of the shareholders' meeting.

8. If a document that relates to an issue that the general meeting shall decide on is made available to the company›s shareholders on the company's website, then such a document does not have to be physically sent to the shareholders of the company. However, such a document shall be sent to the shareholder free of charge if shareholders request it.

9. Shareholders that plan to attend a general meeting have to give notice to the company within 5 days of the general meeting. Shareholders who have not given such notice within 5 days of the general meeting may be denied entrance to the general meeting.

10. The Board of Directors may determine that the shareholders may cast advance votes in writing in matters to be considered by the general meetings of the company. Such votes may also be casted through electronic means. Voting in writing requires an adequately secure method to authenticate the sender. The board of directors may determine further guidelines for written advance voting. The summons to the general meeting shall state whether advance voting is allowed prior to the general meeting, and, if so, the guidelines for such voting.

FINANCIAL CALENDAR 2016

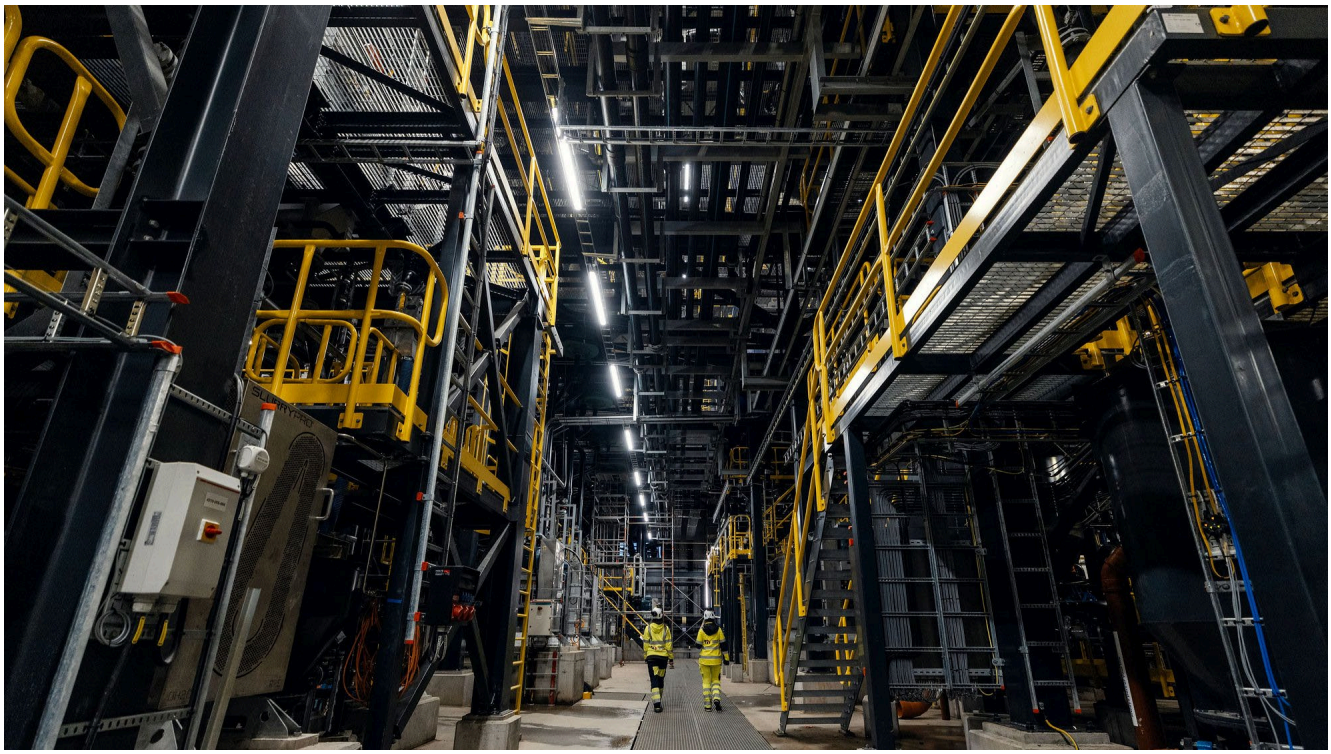
February	May	May	August	November
19	**13**	**18**	**19**	**11**
Fourth quarter results 2015	First quarter results 2016	Annual General Meeting	Second quarter results 2016	Third quarter results 2016

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INTERIM REPORT

Per 31 December 2024



MINERALS FOR A SUSTAINABLE FUTURE

SAFETY | ENVIRONMENT | INNOVATION

Nordic Mining ASA ("Nordic Mining" or the "Company") is a resource company with focus on high-end industrial minerals and metals. The Company is undertaking a large-scale industrial development at Engebø on the west coast of Norway through its wholly owned subsidiary, Engebø Rutile and Garnet AS, which has mining rights and permits to a substantial eclogite deposit with rutile and garnet.

In addition, Nordic Mining holds interests in other initiatives at various stages of development. This includes patented rights for a new technology for production of alumina and landowner agreement for exploration and development of a high purity quartz deposit in the Kvinnherad Municipality in Norway. Nordic Mining's project portfolio is of high international standards and holds significant economic potential.

Nordic Mining is listed on Oslo Stock Exchange.

Group interim report for the quarter ended 31 December 2024

Nordic Mining ASA ("Nordic Mining" or the "Company") is a Norwegian mining and minerals company incorporated in Oslo, Norway. The Company is currently ramping up production from one of the worlds' largest resources of natural rutile in the dual mineral Engebø deposit ("Engebø" or the "Engebø Project"), and the Company is committed to deliver critical minerals to Europe and international markets, producing the worlds' most climate friendly titanium feedstock.

The Engebø deposit has among the highest grades of rutile (TiO_2) compared to existing producers and other projects under development. The deposit also contains significant quantities of high-quality almandine garnet. Based on the current resource and reserve estimates, the mine-life is 39 years, comprising 15 years of open pit mining followed by 24 years of underground mining and stockpile reclamation. Favorable location, topography and local green hydropower enables efficient and climate friendly production of high-quality natural rutile and garnet. Engebø was fully financed by USD 277 million in March 2023. The construction is completed through four lump-sum EPC ("Engineering, Procurement and Construction") contracts with Sunnfjord Industripartner AS, Åsen & Øvrelid AS, Nordic Bulk AS and Normatic AS, and all parts of the mine and processing plant have been installed and commissioned at site. Offtake agreements have been secured for up to the full production of rutile and garnet for the first 5 years of production.

Highlights

- The construction project at Engebø has to date (31st December 2024) reported 995 working days by the four EPCs, including subcontractors, with zero LTIs. Total hours worked at site by the EPCs exceeded 400 000 hours in the quarter.
- First mineral concentrate was produced at Engebø on 23 December 2024.
- The Company reported NOK 139.4 million in capitalized costs related to the construction of the Engebø Project in the fourth quarter. The Company's consolidated carrying amount for *Mine under construction* and *Property, plant and equipment* was NOK 2.75 billion as of 31 December 2024.
- The company transferred from trading on Euronext Expand to Euronext Oslo Børs in November 2024.

Engebø project development and economy

- The main construction activities at Engebø were completed during the fourth quarter. Only minor balance of plant items remains to complete the scope of work for the EPC and sub-contractors. These activities have no impact to the production ramp-up as final testing of machinery is ongoing with EPCs and process equipment suppliers.
- The final documentation requirements according to the Planning and Building Act are being prepared by the various responsible companies in accordance with the different building applications.
- First ore to the milling and mineral separation circuits achieved in November 2024.
- First mineral concentrate achieved on 23 December 2024.
- The Company did not achieve all ramp-up goals set for January 2025 due to unforeseen challenges realised as capacity was increased during production ramp up. These issues have been identified and most have been rectified. Where rectification has not been possible, temporary short-term solutions have been implemented as we await remedied

equipment for the final solution. Temporary solutions reduce part of plant throughput but is not expected to have a significant impact on requirements in this current stage of ramp-up.

- The ramp-up is currently in a phase with uncertainty, where process equipment has increasing load and extended operating hours. Additional unforeseen challenges or debottlenecking requirements might occur as the ongoing tasks are of high complexity, and activities are running in parallel to achieve the production ramp-up plans.

- Revenue forecast shifted approximately one quarter by comparison to previous expectations based on the production ramp-up challenges.

- The Company target for first shipment of garnet in the end of first quarter and first shipment of rutile in second quarter.

- The Company is fully funded until positive cash flow, but due to deferred revenues the cash low-point will be lower than the previously reported project reserves of USD 25 million.

Market development

The pigment market declined in Q4 due to several reasons, with the main drivers being the conflicts in Ukraine and the Middle East, as well as usual seasonal effects in the Northern Hemisphere. Implementation of definitive tariffs for Chinese TiO_2 pigment into EU is expected to reduce the price competitiveness of Chinese imports and support operating rates for Western pigment producers. This may result in higher demand prospects for titanium feedstocks in the West going into 2025.

The demand for aircraft worldwide is strong and is growing resulting in steady demand for titanium sponge. Titanium sponge producers are reporting production levels at full capacity.

As from Q3 2023, rutile prices have been weakening due to the weakness in the pigment segment. Rutile prices seem to have stabilized and are expected to strengthen in 2025, driven by the improved market conditions in the pigment and metal sectors.

The Company has two rutile offtake agreements covering up to full production volume of rutile for the first five years. Price is based on market price mechanisms using global, independent consulting and publishing company TZ Minerals International Pty Ltd.

Industrial markets in both North America and Europe struggled in Q4. This was reflected in economic indicators and directly reflected slower demand for industrial abrasives including garnet. This trend continued into January, but there are early indications that demand will improve over the course of 2025.

Nordic Mining has offtake agreement for garnet with marketing partner BARTON group. Volume and prices are fixed for the first five years.

Financial performance in fourth quarter 2024[1]

The Engebø Project is currently in production ramp-up and the Group has, so far, no sales revenues from operations. Reported operating loss for the fourth quarter was NOK -26.9 million (NOK –9.6 million) and NOK -54.6 million for the full year (NOK -46.5 million).

Net financial items were NOK -67.6 million in the fourth quarter (NOK 28.9 million) and NOK -60.4 million for the full year (NOK 0.4 million). The main financial items in the fourth quarter

[1] *Unless other information is given, numbers in brackets for comparison relate to the corresponding period in 2023.*

consisted of net loss on foreign exchange related to the bond loan and royalty liability of NOK -134.9 million, other foreign exchange gain of NOK 15.1 million, interest on cash held of NOK 5.4 million, change in estimate of royalty liability of NOK 47.9 million and transaction costs from financing of NOK -1.0 million. Please see note 9 and 10 for further information. Borrowing costs on bond loan and royalty liability, net of interest on bond Escrow, has been capitalized under *Mine under construction*, in total NOK 71.4 million in the fourth quarter and NOK 242.6 million for the full year.

Reported net loss in the fourth quarter was NOK -94.5 million (NOK 19.3 million) and reported net loss of NOK -115.0 million for the full year (NOK -46.1 million).

In the fourth quarter, the Group has capitalized costs related to the construction work at Engebø of NOK 139.4 million on the balance sheet under *Mine under construction*, down from NOK 278.3 million in the third quarter of 2024 due to less capital-intensive work in the quarter. For the full year the Group capitalized costs related to the construction work at Engebø of NOK 1,346.0 million compared to NOK 1,088.7 million in 2023. Nordic Mining's consolidated combined carrying amount for *Mine under construction* and *Property, plant and equipment* was NOK 2.75 billion as of 31 December 2024 (Third quarter 2024: NOK 2.6 billion).

Net cash flow from operating activities for the full year was NOK -48.1 million (NOK -41.0 million). Net cash flow from the Group's investment activities related to *Investment in mine under construction* for the full year was NOK –1,072.8 million (NOK -885.1 million), and NOK -87.8 million (NOK -2.6 million) related to *Acquisition of property, plant and equipment*. The cash flow amount does not include capitalized net borrowing costs or outstanding payables, both of which are booked on the balance sheet under *Mine under construction* and *Property, plant and equipment*. Interest on the bond loan for the full year of 2024 of USD 12.0 million (corresponding to NOK 136.3 million) is included in interest and financing fees paid. Please see note 6 for further information related to the bond Escrow account. For the full year, the Group released USD 108 million (corresponding to NOK 1,152.4 million) from the bond Escrow account, resulting in net cash flow from financing activities of in total NOK 1,014.3 million (NOK 1,404.4 million).

The Group's cash and cash equivalents as of 31 December 2024 were NOK 454.8 million (Third quarter 2024: NOK 586.3 million). In addition, the Group had NOK 12.6 million on restricted account pledged toward Directorate of Mining ("DirMin") for clean-up measures in accordance with the operating license.

Nordic Mining's total assets as of 31 December 2024 were NOK 3.3 billion (31 December 2023: NOK 3.1 billion), and total equity was NOK 1.4 billion (31 December 2023: NOK 1.5 billion).

For further information relating to the Company's risk assessments, reference is made to the annual report for 2023 which is available on the Company's webpage www.nordicmining.com.

Oslo, 10 February 2025
The Board of Directors of Nordic Mining ASA

CONSOLIDATED INCOME STATEMENT

(Amounts in NOK thousands)	Note	**2024 01.10-31.12 Unaudited**	2023 01.10-31.12 Unaudited	**2024 01.01-31.12 Unaudited**	2023 01.01-30.09 Unaudited	2023 01.01-31.12 Audited
Payroll and related costs		**(3 915)**	(2 921)	**(11 126)**	(12 161)	(15 082)
Depreciation and amortization	4	**(1 499)**	(108)	**(2 726)**	(238)	(346)
Other operating expenses	8	**(21 531)**	(6 609)	**(40 753)**	(24 432)	(31 041)
Operating profit/(loss)		**(26 945)**	(9 638)	**(54 605)**	(36 831)	(46 469)
Fair value gains/losses on convertible loan		**-**	-	**-**	3 354	3 354
Net exchange rate gain/loss (-)	9, 10	**(119 824)**	24 190	**(127 106)**	1 721	25 911
Financial income	10	**53 300**	5 072	**69 806**	21 027	26 099
Financial costs	10	**(1 058)**	(372)	**(3 115)**	(54 630)	(55 002)
Profit/(loss) before tax		**(94 527)**	19 252	**(115 020)**	(65 359)	(46 107)
Income tax		**-**	-	**-**	-	-
Profit/(loss) for the period		**(94 527)**	19 252	**(115 020)**	(65 359)	(46 107)
Earnings per share						
(Amounts in NOK)						
Basic earnings per share		**(0,87)**	0,18	**(1,06)**	(0,78)	(0,51)
Diluted earnings per share		**(0,87)**	0,18	**(1,06)**	(0,78)	(0,51)

STATEMENT OF COMPREHENSIVE INCOME

(Amounts in NOK thousands)	**2024 01.10-31.12 Unaudited**	2023 01.10-31.12 Unaudited	**2024 01.01-31.12 Unaudited**	2023 01.01-30.09 Unaudited	2023 01.01-31.12 Audited
Net profit/(loss) for the period	**(94 527)**	19 252	**(115 020)**	(65 359)	(46 107)
Other comprehensive income:					
Items that will not be reclassified subsequently to profit or loss:					
Changes in pension estimates, net of tax	**317**	536	**317**	-	536
Other comprehensive income directly against equity	**317**	536	**317**	-	536
Total comprehensive income/(loss) for the period	**(94 210)**	19 788	**(114 703)**	(65 359)	(45 571)

CONSOLIDATED STATEMENT OF FINANCIAL POSITION

(Amounts in NOK thousands)	Note	**31.12.2024** **Unaudited**	31.12.2023 Audited
ASSETS			
Non-current assets			
Mine under construction	3	**2 654 418**	1 377 083
Property, plant and equipment	4	**97 171**	3 062
Right-of-use assets		**663**	1 025
Pension assets		**111**	-
Total non-current assets		**2 752 363**	1 381 170
Current assets			
Trade and other receivables		**27 704**	30 561
Spare parts inventory		**10 011**	-
Bond Escrow	6	-	1 075 042
Restricted cash		**12 645**	8 430
Cash and cash equivalents		**454 774**	634 984
Total current assets		**505 134**	1 749 017
Total assets		**3 257 497**	3 130 187
SHAREHOLDERS' EQUITY AND LIABILITIES			
Shareholders' equity			
Share capital	5	**1 300 938**	1 300 938
Share premium		**276 410**	277 928
Other paid-in capital		**16 038**	16 038
Retained earnings/(losses)		**(177 263)**	(62 243)
Other comprehensive income/(loss)		**(3 379)**	(3 696)
Total equity		**1 412 744**	1 528 965
Non-current liabilities			
Lease liabilities		**194**	466
Bond loan	6	**1 043 609**	902 182
Royalty liability	7	**599 798**	517 574
Pension liabilities		-	219
Total non-current liabilities		**1 643 601**	1 420 441
Current liabilities			
Trade payables		**44 394**	94 312
Other current liabilities		**156 757**	86 468
Total current liabilities		**201 151**	180 780
Total liabilities		**1 844 752**	1 601 221
Total shareholders' equity and liabilities		**3 257 497**	3 130 187

CONSOLIDATED STATEMENT OF CHANGES IN EQUITY

Unaudited

(Amounts in NOK thousands)	Note	Share capital	Share premium	Other-paid-in capital	Other compre hensive income/(loss)	Accumulated losses	Total equity
Equity 1 January 2023		**139 390**	**319 430**	**16 038**	**(4 232)**	**(16 135)**	**454 491**
Profit/(loss) for the period		-	-	-	-	(46 107)	(46 107)
Other comprehensive income		-	-	-	536	-	536
Total comprehensive income		**-**	**-**	**-**	**536**	**(46 107)**	**(45 571)**
Share issue		1 161 548	-	-	-	-	1 161 548
Transaction costs		-	(41 501)	-	-	-	(41 501)
Equity 31 December 2023		**1 300 938**	**277 928**	**16 038**	**(3 696)**	**(62 243)**	**1 528 965**
Equity 1 January 2024		**1 300 938**	**277 928**	**16 038**	**(3 696)**	**(62 243)**	**1 528 965**
Profit/(loss) for the period		-	-	-	-	(115 020)	(115 020)
Other comprehensive income		-	-	-	317	-	317
Total comprehensive income		**-**	**-**	**-**	**317**	**(115 020)**	**(114 703)**
Share issue	5	0	-	-	-	-	0
Transaction costs	5	-	(1 518)	-	-	-	(1 518)
Equity 31 December 2024		**1 300 938**	**276 410**	**16 038**	**(3 379)**	**(177 263)**	**1 412 744**

CONDENSED CONSOLIDATED CASH FLOW STATEMENT

(Amounts in NOK thousands)	Note	**2024 01.01-31.12 Unaudited**	2023 01.01-31.12 Audited
Operating activities:			
Net cash from/used (-) in operating activites		**(48 085)**	(40 990)
Investing activities:			
Investment in mine under construction		**(1 072 832)**	(885 096)
Acquisition of property, plant and equipment		**(87 803)**	(2 628)
Sale of property, plant and equipment		-	359
Net cash used in investing activities		**(1 160 635)**	(887 365)
Financing activities:			
Share issuance		**0**	1 021 926
Transaction costs, share issue		**(1 518)**	(41 501)
Transfer from Bond Escrow	6	**1 152 427**	-
Net proceeds from royalty financing		-	536 820
Interest paid		**(136 317)**	(88 694)
Other financing fees paid		-	(23 686)
Payment of lease liabilities		**(305)**	(439)
Net cash from financing activities		**1 014 287**	1 404 426
Net change in cash and cash equivalents		**(194 433)**	476 072
Cash and cash equivalents at beginning of period		**634 984**	164 703
Effect of exchange rate fluctuation on cash held		**14 224**	(5 791)
Cash and cash equivalents at end of period		**454 774**	634 984
Net change in restricted cash		4 215	4 215
Restricted cash at beginning of period		8 430	4 215
Restricted cash at end of period		**12 645**	8 430
Restricted and unrestricted cash at end of period		**467 419**	643 414

NOTES TO THE INTERIM FINANCIAL STATEMENTS FOR THE PERIOD ENDED 31 December 2024

Note 1 – ACCOUNTING PRINCIPLES

These interim financial statements have been prepared in accordance with International Accounting Standard (IAS) 34, "Interim Financial Reporting". They do not include all the information required for full annual financial reporting and should be read in conjunction with the consolidated financial statements of Nordic Mining ASA and the Group for the year ended 31 December 2023.

This report was authorized for issue by the Board of Directors on 10 February 2025.

The accounting policies adopted are consistent with those followed in the preparation of the Company's and the Group's annual financial statements for the year ended 31 December 2023. In 2024 the Group has entered into derivative foreign exchange contracts. See note 9. Derivative instruments are classified as financial assets or liabilities at Fair Value Through Profit or Loss (FVTPL). The carrying value of derivative instruments at FVTPL represents the instrument's fair market value. Any gains or losses arising on re-measurement are recognized in the income statement as incurred.

New standards, amendments and interpretations to existing standards effective from 1 January 2024 did not have any significant impact on the financial statements.

Note 2 – SEGMENTS

The Group presents segments based on of the Group's mineral projects. The only reportable segment of the Group is the Rutile and Garnet segment. These are the minerals which can be produced from the mineral deposit at Engebø. The Chief Operating Decision Maker ("CODM") for the segment is the board of Nordic Mining ASA.

Note 3 - MINE UNDER CONSTRUCTION

The Engebø project is in a test phase and ramp-up phase, which means that the construction phase has been completed and all significant parts of the mine and processing plant have been installed and commissioned at site. At the end of the period, the company does not consider the plant to be operating in the manner intended by the management and the direct costs related to the work described above have been capitalized in the balance sheet as Mine under construction.

Note 4 - PROPERTY, PLANT AND EQUIPMENT

Additions to Property, plant and equipment in 2024 relate mainly to the administration building and the process area workshop. The administration building and the process area workshop are depreciated on a straight-line basis over an estimated useful life of 39 years.

Note 5 - SHARE CAPITAL

Following the issuance of 5 shares in Q1 2024 to facilitate the 20:1 reverse split completed in the first quarter, Nordic Mining's share capital increased by NOK 3 to NOK 1,300,938,396 divided into 108,411,533 shares, each with a par value of NOK 12.

Note 6 - BOND LOAN AND BOND ESCROW

Nordic Mining ASA's wholly owned subsidiary Engebø Rutile and Garnet AS has a USD 100 million 5-year senior secured bond listed on Nordic ABM with ticker: ERUGA01 PRO. The bond is administered by Nordic Trustee, has fixed coupon of 12.5% per annum, with interest payable quarterly in arrears, and an issue price of 90%.

The net proceeds of the bond of USD 90 million were on issue deposited into a Bond Escrow account, together with issue discount of USD 10 million, four months bond interest of USD 4.2 million, and transaction costs of USD 3.3 million, transferred by Engebø Rutile and Garnet AS in line with the bond terms. Following conditions of the Engebø Project being fully funded, which were satisfied on 8 March 2023, the bonds were reclassified to non-current liability in the statement of financial position. The proceeds from the bond were released in three tranches from the Bond Escrow account after satisfaction of certain predisbursement conditions precedent, to be used for costs and expenditures to bring the Engebø Project into commercial production.

In Q1 2024 the first release of USD 30 million from the bond escrow was completed, in Q2 2024 the second release of USD 30 million was completed, and in Q3 2024 the Company completed the third and final release of USD 48 million.

The bond agreement has a financial covenant stipulating that Engebø Rutile and Garnet AS shall at all times maintain cash on its account of no less than USD 15 million. A breach of the covenant could result in a default under the agreement.

Note 7 - ROYALTY LIABILITY

In November 2023 Nordic Mining ASA's wholly owned subsidiary Engebø Rutile and Garnet AS completed drawdown of the USD 50 million non-dilutive royalty instrument from OMRF (Zr) LLC which is managed by the Orion Resource Partners Group ("Orion"). The future royalty payments under the royalty agreement equal to 11% of gross revenue from the Engebø Project.

The royalty liability was initially recognized at the USD 50 million drawdown received net of directly attributable transaction costs at drawdown. After initial recognition the liability under the royalty agreement is subsequently measured at amortized cost using the effective interest method.

Amortized cost is recognized as borrowing cost and capitalized under Mine under construction until construction is completed, in total NOK 111.1 million YTD 2024.

In fourth quarter 2024 the Company has, based on updated Rutile price forecasts from TZMI, revised its estimates of future cash flows related to the royalty agreement. The net effect of the change in estimate, NOK 47.9 million, has been recognized as financial income.

Next year's estimated royalty payments have been reclassified to other current liabilities.

Note 8 - OTHER OPERATING EXPENSES

The Norwegian Supreme Court ruled in March 2024 in favor of Nordic Mining on all counts in the case against Arctic Mineral Resources ("AMR"). The court also ruled that AMR shall pay all legal expenses. Total refund of legal expenses amounted to NOK 12.4 million and has been recorded as a reduction of other operating expenses in Q1 2024. The amount was received in April 2024.

Note 9 - FOREIGN EXCHANGE (FX) DERIVATIVE CONTRACTS

The Group has entered into foreign exchange (FX) derivative contracts for forward sale of USD and purchase of NOK in Q2 2024 and Q3 2024. The purpose of the trades was to hedge the USD/NOK foreign exchange rate for the release of USD amounts from bond escrow. The value dates aligned with the expected bond Escrow account release dates for the second and third releases.

Description	Sell currency	Sell amount	Buy currency	Buy amount	Exchange	Value Date
Forward FX contract	USD	25 million	NOK	262.5 million	10,5000	23 May 2024
Forward FX contract	USD	20 million	NOK	211.6 million	10,5818	20 Aug 2024

The contracts listed above expired in Q2 and in Q3 2024, with a net YTD loss of NOK 5.9 million. See note 10.

Note 10 - NET EXCHANGE RATE GAIN/LOSS (-), FINANCIAL INCOME AND FINANCIAL COSTS

2024:
Net exchange rate gain/loss (-) in the fourth quarter and YTD 2024 consists mainly of:

- foreign exchange gain of NOK 0.0 million on bond Escrow in USD (YTD 2024: gain NOK 51.9 million),
- foreign exchange loss of NOK 84.6 million on the USD bond loan (YTD 2024: loss NOK 118.1 million),
- foreign exchange loss of NOK 50.3 million on the USD royalty liability (YTD 2024: loss NOK 66.3 million),
- foreign exchange gain of NOK 0.0 million on foreign exchange derivatives (YTD 2024: loss NOK 5.9 million), and
- other foreign exchange gain of NOK 15.1 million (YTD 2024: gain NOK 11.3 million).

Financial income in the fourth quarter and YTD 2024 consists mainly of:

- interest on cash held of NOK 5.4 million (YTD 2024: NOK 21.9 million).
- change in estimate royalty liability of NOK 47.9 million (YTD 2024: NOK 47.9 million).

Financial costs in the fourth quarter and YTD 2024 consist mainly of:
- transaction costs, fees from financing and other items of NOK 1.0 million (YTD 2024: NOK 3.1 million).

2023:
Net exchange rate gain/loss (-) in the fourth quarter and YTD 2023 consists mainly of:
- foreign exchange loss of NOK 46.9 million on bond Escrow in USD (YTD 2023: gain NOK 30.9 million),
- foreign exchange gain of NOK 45.0 million on the USD bond loan (YTD 2023: loss NOK 31.5 million),
- foreign exchange gain of NOK 31.6 million on the USD royalty liability (YTD 2023: gain NOK 31.6 million), and
- other foreign exchange loss of NOK 5.4 million (YTD 2023: loss NOK 5.0 million).

Financial income in the fourth quarter and YTD 2023 consists mainly of:
- interest on cash held and bond Escrow of NOK 5.1 million (YTD 2023: NOK 26.1 million).

Financial costs in the fourth quarter and YTD 2023 consists mainly of:
- interest costs on bond loan of NOK 0.0 million as borrowing costs have been capitalized to Mine under construction (YTD 2023: NOK 30.1 million), and
- transaction costs from financing of NOK 0.3 million (YTD 2023: NOK 24.8 million).

Note 11 - FIXED PRICE ELECTRICITY CONTRACT
The Company has entered into a fixed price contract for the purchase of electricity to the mining facilities in Engebø. The fixed price contract covers a portion of the estimated use by the production facilities over the next three years (2025-2027). The contract qualifies for the own use exemption under IFRS 9 and is not defined as a financial instrument.

Note 12 – EVENTS AFTER BALANCE SHEET DATE
In January there was a minor fire discovered in one of the drying machines at the Engebø facility. No one was injured due to the incident, and the incident was handled according to procedures. The fire has not caused any significant delays in the production ramp-up phase.

Minerals for a sustainable future



NORDIC MINING

ANNUAL REPORT **2024**



A forward-looking resource company with integrated operations in exploration, extraction and production of high-end minerals and metals

SAFETY | ENVIRONMENT | INNOVATION

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CEO'S REPORT

Safety – Environment – Innovation

Dear shareholder,

Global uncertainty leads to more focus on the secure supply of critical minerals

2024 continued a trend toward increasing global uncertainty. Well established partnerships and alliances are being challenged. Increased protectionism and tariffs mark a shift away from free trade which will impact the trade patterns across most commodities, and not least critical minerals. This has led to a call across Europe for regional production and ample supply of critical minerals.

Engebø plant construction completed, moving into commissioning and production ramp-up

The Engebø project team and contractors continued their progress in the construction of Engebø Rutile and Garnet during 2024. Despite various challenges within construction, logistics as well as currency fluctuations, the progress of the installation of the process plant has been impressive.

The construction was completed in November, and we started the stepwise commissioning of the various elements of the plant. More than 400 000 working hours were recorded by the EPC contractors without any Lost Time Injuries. This is an impressive accomplishment!

On 23 December, we reported that the first few kilograms of mineral concentrate had been produced from the Engebø plant. The complexity of the production ramp-up of a new mine and processing plant cannot be understated. At Engebø we are lucky to have a unique family of entrepreneurial employees with a broad range of skillsets, all needed to tackle the various hurdles in our way as we increase towards design scale production rates.

Our Engebø plant will become a prominent global player within two strategic industrial minerals. We will be the only garnet producer in Europe and the second producer of natural rutile after Ukraine. The strategic position of Engebø as a long-term producer in Europe with excellent access to overseas markets has strengthened beyond what we expected just a few years ago.





Attention to the environment

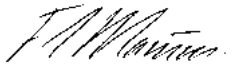
In our drive towards becoming a mineral producer with a record low carbon footprint, we need to carefully consider the impact our operations will have on nature and biodiversity. In 2024, we completed a comprehensive environmental monitoring program on land and in the marine environment to establish a complete baseline for the status of environment and biodiversity in the Engebø area prior to commencing production.

Nordic Mining has been an active promoter of the Canadian ESG scorecard system Towards Sustainable Mining (TSM) that was developed by the Mining Association of Canada. We intend to report according to TSM from the day we start operating at Engebø and will seek to adapt the TSM to comply with and include other internationally recognized standards for ESG.

A long-term sustainable mineral producer

In 2024, we progressed our development of the high-purity quartz deposit in the Kvinnherad Municipality and in November we started a bulk test program to fully understand the commercial potential of the hydrothermal quartz vein. The preliminary analysis was positive, indicating that the resource has the potential to be amongst the purest quartz products globally.

During the many years of developing a greenfield mine in Norway, the first in nearly four decades, we have gained significant experience and competence that we intend to further leverage. As we enter 2025, we review our strategy to position Nordic Mining for building a new mineral industry for a sustainable future.



Finn Ivar Marum
CEO

Sustainability report



Minerals for a sustainable future

Minerals and metals are vital to modern society, driving technological advancements and supporting the transition to a sustainable future. As demand for critical minerals continues to rise alongside technological innovations and the need for sustainable solutions, we recognize our responsibility to operate in a way that minimizes our environmental footprint while creating positive ripple effects for local communities and stakeholders.

With this growing demand, the shift towards a more sustainable mining industry is important. The industry must actively work to reduce its environmental and social footprint while taking climate action. Nordic Mining's strategy for Environmental, Social and Governance ("ESG") matters is tied to our projects and is built on four key pillars:

- Business ethics and anti-corruption
- Environmental and climate responsibility
- Social responsibility
- A safe and healthy work environment

A key part of our commitment to sustainability is the adoption of the Towards Sustainable Mining (TSM) initiative. TSM is a globally recognized program that helps mining companies manage environmental and social risks. The Norwegian Mineral Industry Association is leading the implementation of this system in the Norwegian mining industry. Under TSM, we will report on

eight key protocols related to community engagement, environmental stewardship, and energy efficiency. Our reporting will begin in 2025 once operations are fully established, with the first scores published in 2026. The work with TSM is ongoing and already partially integrated into our processes and we believe it will drive sustainable change in the mining sector.

We are committed to aligning our operations with The United Nations Sustainable Development Goals ("SDGs"), which define universal targets to address global challenges. Nordic Mining's sustainability goals focus on economic, environmental and social performance, guiding all stages of our project, from exploration and development to production and closure.

Sustainability is already a key focus in the company and the ESG team has been working at full capacity throughout 2024 and will use the next years to further develop the systems, processes, data and structures needed to comply with upcoming reporting standards. This period allows us to strengthen our foundation and ensure transparency. By investing in sustainable solutions, we are preparing to meet future reporting requirements and contribute to a responsible mineral industry.

E – ENVIRONMENTAL MATTERS

Climate change

Climate change is one of the greatest challenges of our time, and as a mining and minerals company, we recognize our responsibility to minimize our environmental impact and contribute to a low-carbon future. The Paris Agreement sets ambitious goals to limit global warming to 1.5°C and the European Union aims to be a climate neutral economy by 2050. Reaching a low-carbon future requires a reduction of greenhouse gas (GHG) emissions across industries and a large-scale shift to clean energy sources like solar, wind, hydro, and geothermal power. Mining companies play a crucial role in the transition by supplying the essential minerals needed for green energy technologies.

Nordic Mining's impact

Nordic Mining operates in a landscape where climate change represents both risks and opportunities. Physical risks such as extreme weather events, rising temperatures, and natural disasters can disrupt our operations and damage the infrastructure. Increased floods, droughts, and storms can pose challenges to site stability, water management, and worker safety. In addition to physical risks, there are transition risks related to climate policies, technological innovations, and market expectations which are shaping the industry. Stricter environmental regulations and carbon pricing mechanisms could lead to increased operating costs, while rapid technological innovation may require adaptation to new processing methods.

Climate change can also create opportunities for Nordic Mining and companies in the mining and minerals segment. The growing demand for critical minerals is essential to technological developments and the green transition. Investments in energy efficiency, electrification of operations, and renewable energy sourcing can not only reduce emissions but also lower long-term energy costs. By having a sustainable mining practice, we can strengthen stakeholder relationships, access funding for green initiatives, and stay competitive in a market that values responsible sourcing. By tackling climate challenges, we aim to future-proof our operations while contributing to a more sustainable development.

Reducing GHG emissions is a central aspect of our work connected to climate change. To evaluate the GHG emissions from Nordic Mining's rutile production, Minviro UK carried out an independent Life Cycle Assessment (LCA), covering all stages from extraction to final product. The LCA was conducted in 2022



ENVIRONMENT AND BIODIVERSITY

We prioritize the protection of ecosystems and biodiversity supporting SDG 14 (Life Below Water) and SDG 15 (Life on Land) through responsible land and water management. By reducing our footprint and restoring affected areas, we ensure our operations contribute to the environment.



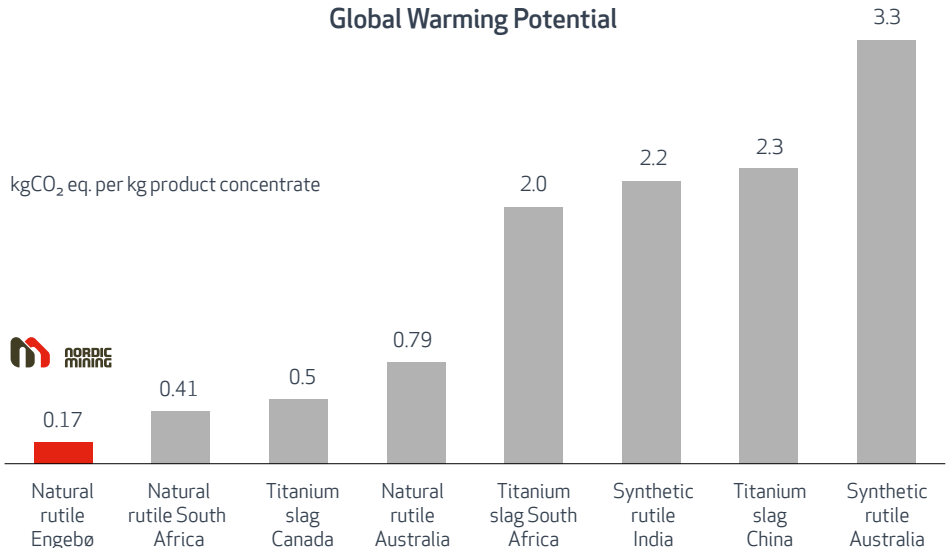
ENERGY EFFICIENCY AND CLIMATE ACTION

We are committed to reducing emissions and improving energy efficiency, supporting SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Change). Our projects are designed with a focus on energy efficiency and emission reduction, and we will continue finding solutions and modern innovations to improve energy efficiency further.



SOCIAL RESPONSIBILITY

Our people and local communities are the core of our sustainability efforts. We actively contribute to SDG 3 (Good Health and Wellbeing) and SDG 11 (Sustainable Cities and Communities) by fostering safe, inclusive and diverse workplaces while engaging with local communities to promote long-term social improvement.



Minviro (2022) Prospective Life Cycle Assessment Study of Nordic Mining's Natural Rutile Project at Engebø.

and calculated the Global Warming Potential (GWP) and included scope 1, 2 and 3 emissions. The GWP impact of the rutile from our operations was determined to be 0.17 kg of CO_2 equivalents, and the main contributors to our carbon footprint are diesel consumption in mining operations and explosives used for ore extraction. Annual GHG emissions are estimated to be 3085 tonnes of CO_2 equivalents, with an energy consumption of 0.08TWh.

Minviro also performed a benchmarking study as part of the LCA that compared rutile from our operations with alternative titanium-bearing feedstocks, including natural and synthetic rutile, as well as titanium slag. The results from the study showed that rutile from our operations has a significantly lower GWP impact, positioning it as a more sustainable alternative in the market. Results from the GWP benchmarking are summarized in the chart below.

Nordic Mining's ambitions

Nordic Mining's goal is net zero emissions from our operations. We are committed to being transparent about our carbon footprint, by publicly disclosing carbon emissions from our operations and providing benchmarking data for our products when available. By collaborating with suppliers and customers, we aim to reduce emissions throughout the value chain.

In terms of location, Nordic Mining's Engebø project has a great advantage by having the open-pit mine located just a few hundred meters from the process plant and port, meaning a tight infrastructure with minimal transportation. We have investigated options for electrification of the fleet and will, when feasible, transition to a fully electrified mining operation.

Waste management

One of the biggest challenges in the mining industry is finding sustainable ways to manage extractive waste. Mining and mineral extraction generates large volumes of waste, including waste rock and tailings.

Nordic Mining's impact

Our operations produce waste in the form of waste rock and tailings, and to ensure proper waste management we have a Construction Environmental Management Plan (CEMP) in place for the construction phase of the Engebø project and a Waste Management Plan in place for the operational phase. The CEMP identifies potential environmental risks and outlines measures to prevent environmental incidents and enhance performance. The Waste Management Plan follows EU's best available techniques[1] for extractive waste management and ensures that the right measures are in place to minimize environmental impact and protect human health. It also includes strategies for reducing waste and exploring opportunities for re-use of waste materials for both internal and external use. Refer to section *Water, marine resources, biodiversity and ecosystems* for more information on waste management related to marine biodiversity.

In Nordic Mining's CEMP, our goal is that 90% of the non-hazardous waste from the construction site will be sorted (source sorting). In 2024, we managed to source sort 92% of all non-hazardous waste from the construction. Data is based on monthly reports received from the EPCs.

As part of the demands in Nordic Mining's Environmental Discharge Permit issued by the Norwegian Environment Agency (Miljødirektoratet), we are required to report production volumes, waste volumes, energy consumption and waste control results on an annual basis. In addition, we are required to work on finding alternative ways to minimize the need for disposal, which is also reported annually.

We are committed to complying with the requirements in our operating license given by the Directorate of Mining (DirMin). In recent years, the Ministry of Trade, Industry and Fisheries has introduced additional and more stringent requirements to our operating license. These requirements are closely followed and we actively work to ensure compliance and documentation of our adherence to these regulatory requirements.

Nordic Mining's ambitions

Our goal is to reduce waste and to improve resource efficiency by integrating sustainable practices in our operations. We continuously monitor and assess our waste streams, seeking to reduce waste volumes, improve tailings management and to explore circular economy solutions to reuse waste rock.

Water, marine resources, biodiversity and ecosystems

Water, marine resources and biodiversity are essential for the health of ecosystems. As a mining and minerals company, we know that our

1. European Commission Reference Document on Best Available Techniques for Management of Waste from the Extractive Industries, in accordance with Directive 2006/21/EC 2018.

operations can have direct and indirect impacts on these resources. Excess materials from our production consist of waste rock from the mine and tailings from the processing plant. In line with our operating license given by the Directorate of Mining (DirMin), waste rock is deposited on a land-based disposal site, and deep-sea tailings in the fjord.

Nordic Mining's impact

Our activities will affect water resources in multiple ways, from water consumption to discharges that can impact local water bodies and marine environments, leading to disturbances in aquatic habitats and biodiversity. Understanding and managing our environmental impact is a key priority. As a result, we have developed a Water Stewardship Program in collaboration with SRK Consulting, built on a Water Balance Model, a Water Impact Assessment and a Water Management Plan.

To track and assess how our operations affect marine ecosystems, biodiversity, water and surrounding habitats, we have developed an in-depth environmental monitoring program using state of the art technology to track and assess how our operations affect marine ecosystems, biodiversity, water and surrounding habitats. Ongoing monitoring and evaluations, both monthly and quarterly, cover airborne dust, vibrations and noise, as well as risk of emissions into the fjord surface water and fresh-water bodies. Water samples are collected, analyzed and registered monthly and reported annually to the Norwegian Environment Agency (Miljødirektoratet) through their portal "Vannmiljø".

In line with our environmental monitoring program, extensive baseline monitoring of the fjord has been finalized during 2024 ensuring updates of the baseline prior to production start-up. The monitoring covers soft and hardbottom habitats, beach zone, water quality and sedimentation rates. This data is collected through regular measurement rounds, ensuring a complete baseline, and reporting is done in collaboration with DNV. The data provides valuable information for understanding the natural state prior to production start-up and enables us to take proactive steps to monitor and reduce our impact and safeguard the surrounding environment. Refer to the table above to see a selection of some of the actions that have been performed as part of the baseline monitoring.

Description of action	Purpose of action	Number of measurements/ units tested
Mapping the distribution of fish eggs and zooplankton.	To increase our knowledge about important spawning areas for cod and other fish species, as well as the species composition of fish and zooplankton in the Førdefjord.	50 measurements from fish and larvae resulted in 1148 eggs from different fish species registered and analyzed.
Visual surveys with Remotely Operated Vehicle (ROV) drones.	To uncover any occurrences of red-listed or vulnerable benthic habitats in deep water in the fjord.	A total of 6.6 km of transects were registered and examined.
Mapping of shallow water and kelp forest communities in the vicinity of the fjord deposit.	To document the condition of the shallow water communities (macroalgae) around the fjord deposit.	7 kelp forest occurrences mapped, and 2 locations mapped for shallow water communities and eutrophication status.
Analysis of the water quality in the area surrounding Engebø.	To understand and document the current water quality of the Førdefjord prior to production start-up and to get a baseline for the effect the deposit of tailings may have on the environment.	35,000 measurements conducted from August 2023 to August 2024.
Mapping of sedimentation of particles on the seabed.	To quantify the sedimentation rate and analyse the material that sediments.	3 different locations measured through 2024.

We have an ambitious goal for the Engebø Project, with a goal of biodiversity net gain for life of mine. We are currently monitoring and tracking biodiversity actions, and there is also a Biodiversity Action Plan in place. The plan is developed in collaboration with DNV and Asplan Viak to support our work to reduce, restore and compensate biodiversity loss for the project's footprint and to ensure that we reach our biodiversity targets.

Our biodiversity plan includes a system for tracking "nature points", which measures biodiversity, both terrestrial and marine.

Calculation of terrestrial biodiversity net loss and gain is based on a methodology which accounts for biodiversity loss due to negative impact of the Engebø project, and biodiversity gain due to restoration measures and offsets. In the first years of the project, we will have a negative nature point score due to terrain interventions and waste rock deposits that impact the natural environment. However, through restoration efforts and by implementing other mitigating measures, we aim to gradually improve the score and eventually achieve a positive balance. It is also possible to achieve a positive score from the outset, as the terrain interventions are being carried out in areas of low natural value, such as regions dominated by spruce and pine. When we restore these areas, we plan to establish deciduous forests with tree species that promote high biodiversity, significantly improving the natural value of the land.

Every year, we will review the budget for nature points and will implement specific actions each year to increase our score. In 2024 we replanted trees, prepared a habitat for frogs which involved relocating all frog eggs from the sedimentation basin area before starting the groundwork and established meadows. In 2025 we plan to establish a pond for amphibians, continue to form meadows and start planning on restoring peatbogs.

Currently, there is no specific methodology for calculating the net loss or net gain of marine biodiversity. The marine environment is dynamic, which means that biodiversity loss does not always occur within a given area. To calculate marine biodiversity, we use a methodology based on terrestrial biodiversity, with some modifications. We have set goals regarding biodiversity in the fjord, where the main goal is to minimize biodiversity impact during operations. We have also set a goal to restore biodiversity.

In 2024, thorough baseline monitoring of several indicators of the biodiversity and the general state of the fjord has been conducted. This gives us valuable information about the current state of the fjord and which mitigations we can take to minimize our impact.



Nordic Mining's ambitions

We have a long-term planning perspective for the mining project at Engebø. In 2022, a conceptual closure and reclamation plan was completed which outline a management system to ensure that we can successfully rehabilitate the mine site at closure. In line with our biodiversity goal, we aim for a high degree of restoration to return the area to nature and enable meaningful use for the local populations post-closure.

S – SOCIAL MATTERS

Own workforce

Our employees are our most valuable resource, and we prioritize their health, safety, and well-being. We have a proactive approach by ensuring that these values are integrated in all stages of our operations. By fostering a strong culture of health, safety, and mutual respect, we ensure that every individual can succeed and contribute to Nordic Mining's goals.

Nordic Mining's impact

Our operations are dependent on a foundation of safety. We continuously assess and manage potential risks to prevent injuries and health issues. During our construction phase, we reported zero Lost Time Injuries (LTI). We are committed to creating a safety-driven culture. Mental health and inclusivity are key priorities, and we promote a respectful environment for all employees, regardless of ancestry, race, gender, religious beliefs, or sexual orientation, with zero tolerance for harassment or discrimination.

Nordic Mining's ambitions

Going forward with the start of our production, we aim to strengthen our commitment to safety and inclusivity by further enhancing our health and safety protocols and fostering an environment where diversity and respect are core values. Our goal is to ensure that every employee feels valued, respected, and empowered to reach their full potential in a safe and inclusive workplace.

Workers in the value chain

Nordic Mining recognizes that our responsibility extends beyond our own workforce to the workers within our broader value chain. We believe that maintaining high ethical standards is essential for creating value for all parties involved.

Nordic Mining's impact

We are committed to ensuring that all workers in our value chain are treated with respect and fairness. This includes promoting ethical conduct on all levels, from our employees to third-party contractors and suppliers. We ensure compliance with applicable laws and regulations, promote transparency, and enforce zero tolerance for bribery, corruption, or unethical business practices.

In July 2022, the Norwegian Transparency Act came into effect, requiring companies to carry out human rights due diligence across their operations, supply chains, and business relationships. As part of our commitment to transparency, we provide detailed reporting on our compliance with the Norwegian Transparency Act. Nordic Mining's reporting on the Norwegian Transparency Act will be made available on the company's website by 30 June 2025.

Nordic Mining's ambitions

Looking ahead, we will continue to strengthen our commitment to ethical conduct and responsible business practices by encouraging greater accountability and transparency throughout the supply chain.

Affected communities

Our social responsibility is closely tied to the communities where we operate. Mineral production can bring new opportunities for local development and economic growth. Our goal is to contribute to the well-being of local communities and residents by providing job opportunities and supporting local services. We are committed to actively engaging with communities and stakeholders to build strong, sustainable relationships throughout the life of the mine.

Nordic Mining's impact

Our operations aim to bring about meaningful contributions to the affected communities, both in terms of economic development and social welfare. We have worked to establish transparent and respectful relationships with local communities and stakeholders, ensuring they are well informed and that their concerns are heard and addressed. This is done through bi-annual meetings with a Resource Group, and quarterly neighborhood meetings in both Vevring and Kvammen to create an arena for communication and the possibility to raise potential concerns. We continue to assess and mitigate any potential impacts on the health and well-being of those living in the areas we affect.

Nordic Mining's ambitions

We are committed to enhancing our community engagement efforts. We aim to strengthen our relationship with local communities further and will respect the cultural, political and social diversity of the area in which we operate.



G – GOVERNANCE MATTERS

Business conduct

Our commitment to high ethical standards and transparency is central to how we operate. We prioritize integrity, fairness, and respect in all our interactions with employees, partners, customers, and the wider community.

Nordic Mining's impact

We maintain strong corporate governance, ensuring compliance with laws, regulations, and international industry practices. Our operations uphold human rights, labor rights, anti-corruption measures, and environmental responsibility. We have not identified any issues deviating from these standards, reflecting our commitment to responsible business practices. As previously mentioned, we provide reporting on our compliance with the Norwegian Transparency Act which is available to the public on our website.

As part of our commitment to strong governance and regulatory compliance, we have recently conducted a review and update of all company policies as the Group's new CEO assumed his position 1 March 2025. This process has ensured that our policies remain current and approved by the correct authorities within the Group. The policies have been formally reviewed, approved and signed by new CEO, Finn Ivar Marum, in March and April 2025.

Nordic Mining's ambitions

We aim to further integrate sustainability and ethical practices into our culture, strengthening compliance and transparency. Our goal is to lead in responsible business conduct within the mining sector and continue upholding values of integrity and respect for people and the environment.



OPERATIONS

ENGEBØ – rutile and garnet

The Company announced on 23 December 2024 that the first mineral concentrates were produced at the Engebø Rutile and Garnet Project as commissioning advances and production ramp-up commences. The operations at Engebø will focus on maintaining the quality of the mineral concentrates as the production is ramping up to designed operating rates over the next quarters and reach stable operations during 2025.

The Engebø deposit has among the highest grades of rutile (TiO_2) compared to existing producers and other projects under development. The deposit also contains significant quantities of high-quality almandine garnet. Based on the current resource and reserve estimates, the mine-life is 39 years, comprising 15 years of open pit mining followed by 24 years of underground mining and stockpile reclamation. Favorable location, topography and local, green hydropower enables efficient and climate friendly production of high-quality natural rutile and garnet. Offtake agreements have been secured for up to the full production of rutile and garnet for the first five years of production.

The Company successfully completed the staged release of funds from the USD 100 million senior secured bond escrow account for the Engebø Project. The first release of USD 30 million occurred in March, followed by a second USD 30 million release in May, and the final USD 48 million release in August. Each release was contingent upon an independent engineer confirming that the cost-to-complete test was satisfied. These third-party assessments affirmed that the project remains on schedule and within budget, ensuring sufficient funding for its completion.

The construction of the Engebø Project has been completed through four lump-sum EPC ("Engineering, Procurement and Construction") contracts with Sunnfjord Industripartner AS, Åsen & Øvrelid AS, Nordic Bulk AS and Normatic AS, and all parts of the mine and processing plant have been installed and commissioned at site.

The main construction activities at Engebø were completed during the fourth quarter. Only a minor balance of plant items remains to complete the scope of work for the EPC and subcontractors. These activities have no impact on the production ramp-up as final testing of machinery is ongoing with EPCs and mechanical process equipment suppliers.

The construction project reported 995 working days by the four EPCs, including subcontractors, with zero LTIs. Total hours worked at site for the project, by the EPCs, exceeded 400 000 hours by end of 2024.

Despite challenges in worldwide logistics with congested ports around the world, the project was able to mitigate all significant fabrication and logistics risks related to mechanical process equipment packages without impacting the planned construction schedule.

The administration and workshop buildings were completed in the first quarter and the operations team started using the facilities for operation readiness in May. The operations team started a significant onboarding process growing to around 75 employees by the end of the third quarter, which is sufficient for full commissioning of ore and early stage of production ramp-up. In steady state operations, the total expected number of employees is 110–120, including the mining services provider.

Significant milestones achieved in relation to commissioning of the process plant:

- First ore to primary crushing, including ore pass design verification in September
- First ore to the milling and mineral separation circuits achieved in November
- First mineral concentrate was produced at Engebø on 23 December



In the second quarter, the company entered into a 5-year mining alliance agreement with Sunnfjord Industripartner AS to provide mining services for the open-pit operations. The contract commenced in September with machinery and resources ramping up activities in parallel with preparing for production ramp-up. The construction phase has facilitated the ore required for the first 3 months of production ramp-up and the initial focus for mining activities is to provide access to high grade ore for continued production and prepare all required infrastructure for efficient mining operations.

Long-term offtake agreements secured for all production from Engebø

In 2023, Nordic Mining, through its wholly owned subsidiary Engebø Rutile and Garnet AS (ERG), entered into a global exclusive offtake agreement for the full planned garnet production from Engebø for the first five years of production. The offtake agreement is for the supply and delivery of a minimum total of 762,500 metric tonnes of garnet concentrate in the five-year contract period, with a target of 825,000 metric tonnes, which is the full planned garnet production in the first five years of production. Further to the initial garnet offtake, the parties shall discuss extension of the cooperation, comprising for example joint marketing, sales, and distribution of garnet from the Engebø Rutile and Garnet Project. The consideration under the garnet offtake agreement will be based on a pre-agreed price schedule.

In 2022, Nordic Mining, through its wholly owned subsidiary ERG, entered into two rutile offtake agreements.


READING
CAUTION
CAUTION

In June 2022, it entered into a five-year rutile offtake agreement with Iwatani, a reputable Japanese trading house. As part of the agreement, Iwatani made an equity investment of NOK 191.7 million in Nordic Mining for the Engebø Project at the time of signing. The offtake agreement is for the sale of 20,000 tonnes per annum of natural rutile from the Engebø Project over five years based on the market price, with commercial terms, for 95% natural rutile concentrate and adjusted for actual TiO_2 content.

In October 2022, ERG signed the final rutile offtake agreement. The consideration under the rutile offtake agreement will be based on the market price for 95% natural rutile concentrate, adjusted for actual TiO_2 content, as determined from TZMI index or annual price discussions between the parties.

These three offtake agreements are expected to cover substantially all the planned production for the first five years of both rutile and garnet.

Long-term fundamentals for rutile and garnet supply continue to be strong

The titanium market experienced a dynamic 2024, marked by periods of growth and challenges across different sectors. The year began with a recovery in the titanium dioxide (TiO_2) pigment market as demand increased and inventories were replenished, allowing producers to operate at higher utilization rates. Titanium feedstock suppliers also saw improved conditions, with sales volumes surpassing production levels. The titanium metal sector remained robust throughout the year, driven by a strong backlog in the aviation industry and increasing military expenditures.

Despite a promising first half, the pigment market softened in the latter part of the year due to seasonal slowdowns, a weak housing market, and broader economic uncertainties. However, the introduction of anti-dumping duties by the European Commission on Chinese TiO_2 imports between 35 to 40 percent created a more favorable environment for western producers. This regulatory shift, combined with expected economic stimulus measures and lower interest rates, is likely to support long-term demand.

The titanium metal sector remained a key area of strength, with global aircraft demand driving steady consumption of titanium sponge. Producers reported full capacity production levels, while the semiconductor industry showed signs of recovery, further supporting demand.



Although rutile prices weakened since late 2023 due to the pigment sector's struggles, they stabilized by year-end and are expected to strengthen in 2025 as market conditions improve.

Several major rutile deposits are expected to be depleted in the coming years, while an increase in titanium sponge and metal produced by western producers is expected. Nordic Mining is well positioned to supply rutile, a critical mineral, to this segment.

The industrial abrasives market faced challenges, particularly in North America and Europe, where high interest rates and slowing industrial activity weighed on demand. Supply chain disruptions from South Africa and elevated freight costs from Australasia added pressure.

However, early signs of recovery emerged towards the end of the year, suggesting a more positive outlook for 2025.

There is currently no production of garnet in Europe and the global supply of high-quality garnet for high-end applications has over the last years been short of the demand. The existing main producers are in Australia, China, India, and South-Africa. Regulatory measures introduced by the Indian government in 2016 continue to affect a substantial part of the Indian garnet production. It is uncertain when and to what extent Indian production will re-enter the market. In the USA, domestic production is significantly short of the demand.

Nordic Mining successfully maintained its strategic position throughout the year with long-term offtake agreements for rutile and garnet, ensuring stable sales volumes and predictable revenue streams from 2025. The company's agreements, covering up to full production for the first five years, provide resilience against short-term market fluctuations and position it well for future growth. With improving macroeconomic conditions, regulatory support, and strong demand in key sectors, the outlook for 2025 remains positive, offering promising opportunities for value creation for investors.

The global market for minerals is influenced by a range of economic, geopolitical, and regulatory factors, and in 2025 the market faces significant uncertainty, particularly regarding future trade policies and tariffs. The Group is paying close attention to the development and is keeping a close dialogue with our suppliers and customers.



OPERATIONS

STRATEGIC ASSETS AND INITIATIVES

In addition to Nordic Mining's production of rutile and garnet from Engebø, the Group continues its engagement in other strategic initiatives within high-end industrial minerals and metals. This includes exclusive exploration rights to a quartz deposit in Norway and patented rights for a new technology for production of alumina which are jointly owned with the Institute for Energy Technology.

HIGH PURITY QUARTZ – Positioning for future growth in IT and sustainable energy

The Kvinnherad Quartz deposit is a hydrothermal quartz vein in Western Norway, located close to infrastructure approximately 700 meters from the county road and the ocean. Nordic Mining has actively been engaged with local stakeholders over many years to establish good communication and long-term relations.

During the second quarter of 2024, Nordic Mining's MoU partner at the Kvinnherad Quartz deposit decided to finalize its cooperation with regards to the development of the project, and Nordic Mining decided to continue its engagement as sole owner of the exploration rights through its wholly owned subsidiary Nordic Quartz. No consideration was paid in relation to the takeover of the MoU partners exploration rights, and Nordic Quartz will use its rights in the MoU to enter into the landowner agreement as the sole party.

The total Mineral Resource Estimate currently stands at 4.3 Mt, with 2.9 Mt of Indicated resources @65% hydrothermal quartz, and 1.3 Mt of Inferred resources @66% hydrothermal quartz. Geochemical analysis and processing test work has shown that quartz from this deposit can be used to produce a High Purity Quartz (HPQ) product, which makes it unique since there are few deposits globally suited for that purpose. HPQ is vital in the production of photovoltaic components, semiconductors, specialized glassware, and fiber optics.

Processing activities have been the focus in 2024. This includes analysis of quality variations in the deposit, flow sheet verification, and bulk sample processing. A field work campaign was successfully completed in November, extracting 10 tonnes of ore for processing test work at large scale. The processing test work continues into 2025, and the primary objective is to produce product samples for industrial testing. We see this as a crucial next step to validate the quality of the product, which will mitigate risks moving forward. Based on positive conclusions from this activity, we may start the work with a drilling campaign during the 2nd half of 2025, followed by a prefeasibility study (PFS).

Other activities this year involve desktop studies on social and environmental impact, implementation of the area into the municipality master plan, and basic evaluations of mining methods. Some of these activities will also proceed in 2025.

TITANIUM – Advanced materials

Nordic Mining's subsidiary ERG will produce high grade natural rutile with substantially lower carbon footprint compared with peering producers of titanium feedstock. In addition, the rutile from Engebø has low levels of radioactive elements like Uranium and Thorium, making it ideal for production of high-quality titanium metal.

Following the CRMA initiative from the EU, titanium metal has been listed as a critical and strategic material in the EU. Nordic Mining has completed a preliminary conceptual study of future production of titanium sponge from the Engebø rutile deposit. A possible future engagement to establish new production of titanium sponge will likely be organized as a separate unit in the Group.



Kvinnherad quartz deposit.

ALUMINA – Sustainable Technology Development

Nordic Mining has since 2009 been engaged in development of a new technology for alumina production as a sustainable alternative to the current production. The technology has successfully been developed together with the Institute for Energy Technology («IFE») and has been patented in several countries including Norway, USA, Canada and with the European Patent Office. In June 2019, the Company was granted a EUR 5.9 million project from EU's Horizon 2020, the AlSiCal project, together with 15 partners in 9 countries. The AlSiCal was finalized in Q2 2024, proving the technical viability of the technology[2]. The group will evaluate possible opportunities that may be of interest for utilizing the AlSiCal technology.

SEABED MINERALS – Research and Knowledge Building

Nordic Mining has taken pioneering initiatives related to seabed mineral exploration and knowledge building in Norway. Nordic Mining participated in the MarMine project on marine mineral resources which was concluded in 2020. The project was coordinated by the Norwegian University of Science and Technology. The Norwegian Research Council granted NOK 25 million to the project which had a strong industrial basis and participation. After a strategic review, the Company has decided to pause its engagement in seabed mineral exploration, focusing on strategic growth initiatives onshore.

2. https://www.alsical.eu/

BOARD OF DIRECTORS' REPORT

Minerals for a sustainable future

Nordic Mining (the "Company") is a Norwegian mining and minerals company incorporated in Oslo, Norway. The Company's assets comprise the following subsidiaries (jointly, the "Group"):

- Engebø Rutile and Garnet AS (100%): Production of rutile and garnet
- Nordic Quartz AS (100%): High-purity quartz
- Nordic Titanium AS (100%): Titanium sponge

INTRODUCTION AND OVERVIEW

Nordic Mining is a resource company with focus on high-end industrial minerals and metals.

The Group is currently ramping up production from one of the world's largest resources of natural rutile in the dual mineral Engebø deposit ("Engebø" or "Engebø Project") on the west coast of Norway, where it has mining rights and permits to a substantial eclogite deposit with rutile and garnet. The Company is committed to delivering critical minerals to Europe and international markets, producing the world's most climate friendly titanium feedstock.

In addition, the Group holds a landowner agreement for exploration and development of a high purity quartz deposit in the Kvinnherad Municipality in Norway and is currently conducting a test work program where bulk samples from the deposit will be used for pilot scale processing of high purity quartz product through a full cycle process.

Nordic Mining's project portfolio is of high international standards and holds significant economic potential. The assets, and in particular the wholly owned Engebø Project, provide a solid value basis for Nordic Mining's shareholders. For more information about the Group's Projects, see pages 11 - 16 of this annual report.

GROUP PROJECTS

Engebø Rutile and Garnet

The Engebø deposit has among the highest grades of rutile (TiO_2) compared to existing producers and other projects under development. The deposit also contains significant quantities of high-quality garnet. The Engebø expected life of mine is 39 years, consisting of 15 years of open pit mining followed by 24 years of underground mining. Favorable location, topography and local hydropower enables efficient and climate friendly production of high-quality natural rutile and garnet.

Engebø Rutile and Garnet AS (ERG) has entered into offtake agreements that cover substantially all the planned production for the first five years. In 2022 ERG entered into offtake agreements for rutile, and in January 2023 ERG entered into an exclusive offtake agreement for up to the full planned garnet production from Engebø for the first 5 years of production. Further to the initial garnet offtake, the parties shall discuss extension of the cooperation, comprising for example joint marketing, sales, and distribution of garnet from the Engebø Project. The consideration under the garnet offtake agreement will be based on a pre-agreed price schedule.

In March 2023, Nordic Mining secured the final part of the project financing package for the Engebø Project, comprising equity, senior secured bond, and non-dilutive royalty financing. In March 2025, Engebø increased the existing bonds with USD 33 million. Reference is made to note 26 in the consolidated financial statements for information regarding the bond increase.



The main construction activities at Engebø were completed during the fourth quarter 2024, and only a minor balance of plant items remains to complete the scope of work from the EPC's and sub-contractors by year end 2024. On 23 December 2024, the Company achieved production of first mineral concentrate, which marks an important milestone for the company and transition to the ramp-up phase that started in January 2025. The ramp-up phase will be carried out in 2025, and the Company is targeting design operating rates and stable operations in 2025.

FINANCIAL PERFORMANCE

For comparison, numbers in brackets relate to the comparable period in 2023.

The Engebø Project is currently in production ramp-up and the Group has, so far, no sales revenues from operations. Reported operating loss for 2024 was NOK -54.6 million (NOK –46.5 million), with around NOK –34.7 million (NOK 27.2) resulting from non-capitalizable operating costs related to the development and construction of the Engebø Project.

Net financial items were NOK -60.4 million for 2024 (NOK 0.4 million), with the main financial items being net loss on foreign exchange related to the bond loan, Bond Escrow and royalty liability of NOK -132.5 million, loss on foreign exchange derivates of NOK -5.9 million, other foreign exchange gain of NOK 11.2 million, interest on Bond Escrow and bank deposits of NOK 21.9 million, change in estimate of royalty liability of NOK 47.9 million and, costs from financing of NOK –225.2 million. Please see note 6 for further information. Borrowing costs on bond loan, net of interest on Bond Escrow, following satisfaction of financing conditions in



March 2023, and borrowing costs on the royalty liability have been capitalized under Mine under construction, in total NOK 21.5 million for 2024.

Reported net loss was NOK –115.0 million for 2024, compared to a net loss of NOK -46.1 million for 2023.

In 2024, the Group capitalized NOK 1,346.0 million on the balance sheet under Mine under construction for direct costs related to the construction work at Engebø, up from NOK 1,088.7 million in 2023. Nordic Mining's consolidated carrying amount for Mine under construction was NOK 2.75 billion as of 31 December 2024 (31 December 2023: NOK 1.4 billion).

Net cash outflow from operating activities for 2024 was NOK –48.1 million as compared to NOK –41.0 million in 2023. Net cash flow from the Group's investment activities related to Investment in Mine under construction for 2024 year was NOK -1,072.8 million (NOK –885.1 million), and NOK -87.8 million (NOK -2.6 million) related to Acquisition of property, plant and equipment. The cash flow amount does not include capitalized net borrowing costs or outstanding payables, both of which are booked on the balance sheet under Mine under construction and Property, plant and equipment. Interest on the bond loan for 2024 of USD 12.0 million (corresponding to NOK 136.3 million) is included in interest and financing fees paid. Please see note 12 for further information related to the bond Escrow account. For 2024, the Group released USD 108 million (corresponding to NOK 1,152.4 million) from the bond Escrow account, resulting in net cash flow from financing activities of in total NOK 1,014.3 million (NOK 1,404.4 million).

The Group's cash and cash equivalents as of 31 December 2024 were NOK 454.8 million (31 December 2023: NOK 635.0 million). In addition, the Group had NOK 12.6 million on restricted account pledged toward Directorate of Mining ("DirMin") for clean-up measures in accordance with the operating license. Please see note 13 for further information.

Nordic Mining's total assets as of 31 December 2024 were NOK 3.3 billion (31 December 2023: NOK 3.1 billion), and total equity was NOK 1.4 billion (31 December 2023: NOK 1.5 billion).

Based on current forecasts and plans, the Board considers that the Group's financing and working capital are satisfactory to secure payment of financial obligations for at least 12 months from the time of this report. The Board confirms that the financial statements have been prepared based on a going concern assumption and in accordance with section 3-3a of the Accounting Act. The financial statements for Nordic Mining are prepared in accordance with the IFRS® Accounting Standards as endorsed by the EU.

RISK MANAGEMENT

The Group is exposed to a number of risks that may affect its business, including political and regulatory, market, operational, and financial risks. In the opinion of the Board, the Company has implemented management systems that are satisfactory to address risk management and internal controls for the current stage of the Group.


KASK
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Political and regulatory risk
As a resource company in the mining industry, Nordic Mining depends on permits and licenses from relevant authorities.

In May 2022, the Ministry of Trade, Industry and Fisheries («MTIF») resolved that Nordic Mining's operating license is maintained as granted with full rights to the Engebø deposit, confirming the resolution from the Directorate of Mining. The decision from MTIF is final and cannot be appealed. The operating license is granted for the life of mine of the project which includes an open pit and underground phase, however, with a possibility for revision after 10 years. The license regulates operational scope, methodology and procedures to secure safe and efficient production of the mineral resources and follows the strict regulation practice for Norwegian mining operations which implies high standards for environment, health, and safety. In January 2021, the Agency granted the revised environmental permit, commenting that the significant reduction in chemical consumption will have lower impact on the environment than the previous planned consumption. The decision was confirmed by the Ministry of Climate and Environment in November 2021 concluding that the complaints received in relation to the revised discharge permit do not provide any basis to revoke or change the permit. The decision from the Ministry of Climate and Environment is final and cannot be appealed. This completed the main regulatory framework required for the project, including extraction permits, approved zoning plan for the mining and processing areas, and the environmental permit. The zoning plan for the mining and processing areas, including detailed regulations, and the environmental permit for the project are finally granted with no possibilities for appeal. Per December 31, 2024, there is an ongoing case between two Norwegian environmental organizations and the Norwegian state concerning the Norwegian state's waste permit to ERG. EFTA made an advisory opinion in March 2025 and the case is to be heard by the Borgarting Court of Appeal (Borgarting lagmannsrett) in June 2025. Reference is made to note 26 in the consolidated financial statements for more information.

In general, whether and when permits will be granted, amended or revoked, and the terms and conditions stipulated related to regulatory matters, are not fully within the Group's control.

The uncertainty created by unpredictable government policies, such as trade tariffs, sanctions, and regulatory changes, can disrupt supply chains and market prices. Mitigating these risks are done by staying informed about the political development, keeping a close dialogue with our suppliers and customers, and engaging in any risk mitigating strategies.

Financial risk
Financial risk includes liquidity risk, currency risk and interest rate risk. The Group's liquidity management is coordinated by the Group's Chief Financial Officer with the assistance of Sumit Up AS, which has been engaged to provide accounting services. The Board has established rules governing the authorizations of the CEO, and the CEO has established rules governing the authorizations of the CFO.

Nordic Mining's cash balances are deposited in bank accounts in Norwegian Kroner (NOK), United States Dollars (USD), Euro (EUR) and Australian Dollars (AUD). The Group's main foreign currency exposure relates to its bond loan and royalty liability which are denominated in USD. The Group's future revenue is expected to be denominated primarily in USD, with a significant percentage of income taxes, operating expenses, capital expenditures and future dividends in NOK. Therefore, the Group has a large part of the financial indebtedness in USD to reduce the overall economic currency risk related to the Engebø Project. The group had no outstanding foreign exchange hedges or instruments at year-end 2024.

The Group has significant debt through its USD 100 million bond and its USD 50 million royalty instrument, but neither is impacted by interest rate fluctuations. The bond has a fixed interest rate of 12.5% and the royalty instrument payments are not tied to interest rates. The Group had no outstanding interest rate hedges at year-end 2024.

Liquidity risk
Liquidity risk is the risk that the Group will not be able to pay its financial obligations as they fall due. The Group has so far used a mix of equity financing, bond loan and royalty financing to meet liquidity requirements related to financial obligations, to cover operational losses, and for investments.

The Group had as of 31 December 2024 NOK 1,043.6 million in interest-bearing debt, comprising a USD 100 million senior secured bond measured at amortized cost using the effective interest method.

Nordic Mining's financing package for the Engebø Project consist of equity, senior secured bond, and non-dilutive royalty financing.

The bond agreement has a financial covenant stipulating that ERG shall at all times maintain cash on its accounts of no less than USD 15 million and a minimum equity ratio of no less than 25 % at Group level at each quarter end. A breach of the covenant could result in a default under the agreement.

In March 2025, the Company completed an increase of USD 33 million on existing bonds. In connection with the publication of the fourth quarter results, the Company reported that the expected minimum liquidity of USD 25 million was set to be lower than previously reported. Following this, the Company received an inquiry from bond investors with an offer to increase the existing bond, whereupon the Company used the opportunity to strengthen the liquidity of ERG with USD 33 million so they can continue their production ramp-up in an optimal way and at the same time obtain a liquidity buffer in case of any unforeseen events.

Market risk
Mineral prices can be affected by factors such as changes in supply and demand, global economic developments, competition etc. which are beyond the Group's control. Further, there is a risk that not all the Group's products can be sold at favorable terms and conditions. Mitigating these market risks is done by measures which include e.g. business strategies and selling in different geographies and industries, pricing structures, and fixed volumes in long-term offtake agreements.

Operational risk
Mineral extraction is a high-risk activity. Generally, few investigated areas develop into producing mining operations. Long-term returns



in Nordic Mining will depend on the success of the Group's exploration, development, and operating activities.

Nordic Mining is exposed to normal business risk associated with contracts with various suppliers.

CORPORATE GOVERNANCE

The Group's principles for corporate governance, ethical guidelines, and a general management structure are based on the principles of "The Norwegian Code of Practice for Corporate Governance". Reference is made to page 25 for the Board's report on corporate governance.

Nordic Mining's corporate governance policy is founded on prevailing statutory and regulatory requirements and corporate governance is implemented through processes and control measures established to protect the interests of the Company's shareholders and other stakeholders.

Nordic Mining has established policies to insure both people and property for certain risks as well as established a liability insurance for Directors. Nordic Mining has developed guidelines concerning corporate, social, and ethical conduct which are available at the corporate website.

The Company has assessed its relations with, and payments to and from, governmental institutions in accordance with section 3-3d of the Accounting Act. For more information, see Note 24 in the consolidated financial statements.

ORGANIZATIONAL MATTERS

At the end of 2024 Nordic Mining had 80 employees (24), of which 76 (21) are employed in the subsidiary ERG, and four (three) are employed in the Company. The employee base of the Group consisted of 19 women and 61 men. In ERG the management team consisted of five women and four men.

The Board of Nordic Mining consists of three men and two women. Kjell Roland has been Chair of the Board since 2019 and a board member since 2012. The composition of the Board will be evaluated in connection with the annual general meeting in line with customary procedures.

The Company facilitates equal opportunities for professional and personal development regardless of gender. The Company has a reasonable gender balance and strives to maintain a good working environment. The Management team at the end of 2024 comprised four (four) men and no (no) women. Sick leave in 2024 was less than 2.6%, and no safety issues were recorded.

SHAREHOLDERS AND CAPITAL SITUATION

Nordic Mining has one class of shares, each with a nominal value of NOK 12 as at year-end 2024. In November 2024, the Company's shares were listed on Euronext Oslo Børs, after having been listed on Euronext Expand Oslo since 2007. The shares may be traded without restrictions. The Company had 16,000 registered shareholders at year-end with around 40% of the shares held by shareholders domiciled outside of Norway.

In March 2024, Nordic Mining completed a reverse split with a ratio of 20:1. Following registration of the new share capital and reverse split the Company's share capital is NOK 1,300,938,396 divided by 108,411,533 shares, each with a par value of NOK 12.

PARENT COMPANY FINANCIAL RESULTS

The net profit for the parent company Nordic Mining ASA for 2024 was NOK 6.9 million (NOK 50.8 million). As of 31 December 2024, the total equity for the parent company amounted to NOK 2.05 billion (NOK 2.0 billion).

The Board proposes that the year's profit of NOK 6,909,643.58 in Nordic Mining ASA shall be transferred to retained earnings.

OUTLOOK

For Nordic Mining, the top priority for 2025 is reaching steady production at design capacity for both rutile and garnet at Engebø. Entering steady production will open new opportunities and means that we have a solid platform on which to further develop the company. Developing a new strategy to guide our next phase will be a key task for the board in 2025. We will evaluate possible avenues including developing new mineral deposits, of which the quartz project is an example, or going further into our value chain with the processing of titanium sponge project as an example. Engebø Rutile and Garnet is the first new mineral deposit to be developed in Norway in almost 40 years and capitalizing on that position and competence presents a unique opportunity.

Oslo, 24 April 2025
The Board of Directors of Nordic Mining ASA

Kjell Roland	Kjell Sletsjøe	Eva Kaijser	Benedicte Nordang	Tom Lileng	Finn Ivar Marum
Chair	*Deputy chair*	*Board member*	*Board member*	*Board member*	*CEO*

THE BOARD OF DIRECTORS



Kjell Roland
Chair

Kjell Roland holds a Master of Science degree from the department of Economics at the University of Oslo, a lower degree in Philosophy from the University of Tromsø and has been a visiting scholar at the Department of Economics and Department Operations Research at Stanford University. Roland was CEO of Norfund (the Norwegian government's investment fund for developing countries) from 2006–2018. Roland co-founded ECON in 1986 and was partner and CEO in ECON Management AS and ECON Analysis for more than two decades. As a consultant, he has worked on macroeconomics, energy and environmental issues for private companies, governments, and international organizations such as the World Bank and the Asian Development Bank. Roland is a Norwegian citizen and resides in Oslo, Norway.



Kjell Sletsjøe
Deputy Chair

Kjell Sletsjøe holds a Master of Science in Civil Engineering from the University of Science and Technology in Trondheim, Norway and an MBA from Columbia University in New York, USA. Sletsjøe has comprehensive international management experience from mining, coatings, and construction industries as well as from consulting. He has been CEO of Rana Gruber AS (iron ore), Lundhs AS (natural stone) and held various top management positions in Jotun Group (coatings) in Norway, UK and Malaysia. Sletsjøe has also worked as a business consultant in McKinsey & Co and Hartmark Consulting and served on several boards in Europe and Asia. He now serves as board member of several companies. Sletsjøe is a Norwegian citizen and resides in Sandefjord, Norway.



Eva Kaijser
Board Member

Eva Kaijser holds a Bachelor of Science in Business Administration and Economics with advanced studies in Finance from the University of Stockholm, Sweden. Kaijser has 25 years of experience from the mining industry, whereof 11 years in the Boliden group in various positions including top management. Kaijser has been CFO in Northland Resources, CEO in Nordic Mines and CFO in Nynas. Eva Kaijser runs an investment and consulting business, alongside with being a board member in listed and private companies. Kaijser is a Swedish citizen and resides in Stockholm, Sweden.



Benedicte Nordang
Board Member

Benedicte Nordang is a Naval Architect with a Master of Science from the Norwegian Institute of Technology. She has more than 30 years' experience from the offshore industry, including various management positions from Equinor ASA and Aker Marine Contractors. Nordang has held board positions in the mining industry for more than 10 years, including Nussir ASA and Wega Mining ASA. She currently works as Chief Engineer Project Management & Control at Equinor ASA. Nordang is a Norwegian citizen and resides in Oslo, Norway.



Tom Lileng
Board Member

Tom Lileng holds a Bachelor of Science in Finance and MBA from Florida Atlantic University. He was most recently Managing Director of General Oriental Advisory where he was responsible for inter alia portfolio management and investment strategy. He has broad financial background from the global financial services industry including from UBS, SPI Funds, and Santander Asset Management, and he has experience from mining investment projects. Lileng resides in Switzerland.

THE MANAGEMENT TEAM



Ivar S. Fossum
CEO until 1 March 2025

Fossum holds a Master of Science in Mechanical Engineering from the University of Science and Technology ("NTNU") in Trondheim, Norway. He has previously held various managerial and commercial positions within the petroleum and fertilizer industries in the Norsk Hydro Group and in FMC Technologies, including as General Manager of Norsk Hydro East Africa Ltd. and as Chief Executive Officer of Loke AS. Fossum is a Norwegian citizen and resides in Asker, Norway.



Finn Ivar Marum
CEO from 1 March 2025

Marum holds a Master of International Affairs from Columbia University and a Bachelor of Arts from Concordia College. He brings experience in industrial scale up and capital markets to his role as CEO of Nordic Mining, with prior experience as CEO of the Nortek Group, Senior Partner at HitecVision, and Executive Vice President at Norfund, the Norwegian Investment Fund for Developing Countries. Marum has held significant board roles and is serving as Chairman of Moelven Industrier ASA and board member of GK Gruppen AS. Marum is a Norwegian citizen and resides in Oslo, Norway.



Tord Meling
CFO

Meling holds a Master of Science in economics from the Norwegian School of Economics (NHH). Meling joined Nordic Mining in August 2024 as Chief Financial Officer (CFO). He has broad financial and managerial experience, with nine years as Investment Director at Ojada AS/ Sayonara AS and more than ten years of experience from Norwegian Air. In Norwegian Air, Meling was part of the financial management team with responsibilities within business development, project management and corporate finance. The last five years in Norwegian Air he was Head of Aircraft Finance. Meling is a Norwegian citizen and resides in Oslo, Norway.



Maurice Kok
Commercial Director

Kok holds a Master of Science in Business Administration from Erasmus University in Rotterdam, the Netherlands. He has more than 15 years' experience in sales, marketing, and business development positions in Elkem, TiZir/Eramet and Kalbar Operations. He has been involved with mining projects in Senegal and Australia, at an early stage ahead of operations commencing. Kok is a Dutch citizen and resides in Tromsø, Norway.



Kenneth Nakken Angedal
Managing Director Engebø Rutile and Garnet

Angedal holds a Bachelor of Automation Technology, Control Engineering from the Western Norway University of Applied Science. Angedal has had the position as Project Manager for the Engebø Project from August 2018 to January 2022. He has broad management and project experience from various technical and management positions in the ABB Group including as Vice President, Digital Services in ABB's Marine Business Unit. Angedal is a Norwegian citizen and resides in Førde, Norway.



Trond Langeng
Manager Resource and Development

Langeng holds a Master of Resource and Bedrock Geology from the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. He has experience as an exploration geologist in Capella Minerals Norway AS. Besides planning and conducting geological projects, he also has experience with community relations and permitting. Langeng is a Norwegian citizen and resides in Oslo, Norway.



CORPORATE GOVERNANCE

Proactive and transparent corporate governance is essential for aligning the interests of our various stakeholders. The Board of Directors (the "Board") of Nordic Mining ASA ("Nordic Mining" or the "Company") believes that good corporate governance drives sustainable business conduct and long-term value creation. Nordic Mining's framework for corporate governance has been implemented to decrease business risk, maximize shareholder value, and utilize the Company's resources in an efficient and sustainable manner for the benefit of shareholders, employees, and society at large.

Implementation and reporting on corporate governance

Nordic Mining targets to comply with the principles in the Norwegian Code of Practice for Corporate Governance (the "Corporate Governance Code") where applicable and will explain possible deviations. The Company's corporate governance framework is subject to annual reviews and discussions by the Board.

The Corporate Governance Code, last revised on 14 October 2021, is available on the Norwegian Corporate Governance Committee's website (www.nues.no). The objective of the Corporate Governance Code is that companies listed on regulated markets in Norway will practice corporate governance that regulates the division of roles between shareholders, the Board, and executive management ("Management") more comprehensively than is required by legislation.

As an issuer of shares on Oslo Stock Exchange, Nordic Mining complies with and operates in accordance with rules governing the Norwegian stock exchange, including the at any time applicable rules of Continuing Obligations of Oslo Rule Book II Section 4.4, as well as the corporate governance principles and practices as required by the Norwegian Accounting Act section 3-3b. The Company has fulfilled its corporate governance reporting requirements.

Business

Nordic Mining's objectives are defined in the Company's Articles of Association which are published on page 71 of this annual report as well as at the corporate website (www.nordicmining.com): *"The object of the Company is to carry out exploration for minerals and ores, mining activity, technology development, activities that may be associated herewith, and participation in other companies anywhere in the world."*

It is the responsibility of the Board to define clear objectives, strategies, and risk profiles for the Company's business activities and to ensure that these support value creation for shareholders. The Board evaluates these objectives, strategies, and risk profiles at least annually. More details on Nordic Mining's activities and strategies are presented in the Board of Directors' Report on pages 17-22 of this annual report.

Nordic Mining owns 100% of the shares in the subsidiaries Engebø Rutile and Garnet AS, Nordic Quartz AS and Nordic Titanium AS (jointly "the Group").

Equity and dividends

As of 31 December 2024, the Group's equity amounted to NOK 1.4 billion, which is equivalent to 43% of the total assets. The Board assesses the Company's capital structure on a regular basis to ensure adequate liquidity for prioritized activities and funding for the Group's planned construction projects.

Nordic Mining plans to implement a competitive dividend policy with the objective of providing its shareholders with a return on investment at minimum comparable with investments with similar risk profiles. The return should come in the form of cash dividends and/or share buyback, if applicable, and increased share value. The amount of any dividends to be distributed will depend on the Group's investment needs and general development and financing of the Company.

For information on equity issues in 2024 and up to the date of this report, as well as the status of authorizations from the general meeting to the Board to increase the share capital of the Company, reference is made to the Board of Directors' Report.

Equal treatment of shareholders and transactions with related parties

There were no significant transactions between the Company and related parties in 2024, except for ordinary commercial transactions with subsidiaries. All transactions between the Company and related parties are on an arm's length basis.

Any recommendation made by the Board to waive the pre-emption rights of existing shareholders to subscribe for shares in the event of an increase in share capital will be justified. In the opinion of the Board, satisfactory arguments and information have been provided regarding such deviations from existing shareholders' priority rights related to equity issues by the Company.

Shares and negotiability

Nordic Mining has one class of shares, and all shares carry equal rights. The Articles of Association do not contain any provisions restricting the exercise of voting rights.

Further, the Articles of Association place no restrictions on the transferability of Nordic Mining shares, and the shares are freely negotiable.

General meetings

The shareholders exercise supreme authority in Nordic Mining through the general meeting. The Company's Articles of Association and the provisions of the Norwegian Public Limited Companies Act assign the following functions to the general meeting:

- Election of members of the Nomination Committee.
- Election of members of the Board.
- Election of the external auditor and approval of the auditor's remuneration.
- Adoption of the annual accounts and the Board of Directors' Report.
- Resolve any distribution of dividend recommended by the Board.
- Consideration of any other items on the agenda in the notice of the general meeting.

Nordic Mining's annual general meeting in 2024 was held on 23 May 2024. The date of the forthcoming annual general meeting is 27 May 2025.

Notices of general meetings are published as stock exchange releases and made available on the corporate website at least 21 days in advance of a general meeting. The Company's annual report is published on the corporate website at least 21 days prior to the annual general meeting. General meeting notices outline the agenda matters and are distributed in Norwegian with an English translation to foreign shareholders.

The general meeting votes on each matter separately and all shareholders are entitled to submit items to the general meeting agenda, to meet, speak, and vote, either in person or by proxy. The deadline for notifying attendance is normally two days prior to the general meeting.

The Nomination Committee's recommendation concerning the election of Directors and members of the Nomination Committee is published together with the notice of the general meeting. In line with the Corporate Governance Code's recommendation, it is the Company's policy that the general meeting votes on each candidate separately.

Nordic Mining has around 16,000 shareholders who are widely distributed geographically. The Company provides shareholders that are unable to attend in person the opportunity to vote on every item on the agenda by proxy. To ensure that general meetings are conducted professionally and impartially, the Company's share registrar, DNB Verdipapirservice, assists on practical matters in relation to the general meeting.

Representatives of the Board and Management are represented at the general meetings. Normally, the Company's auditor and legal advisor are also present. The general meeting is normally chaired by the Chair or the Deputy Chair of the Board. In the event of disagreement about specific agenda items where the Chair of the meeting either supports one of the factions or for other reasons cannot be considered impartial, Nordic Mining has procedures to ensure that the meeting is chaired impartially. In such cases, the general meeting will have an opportunity to appoint an alternative Chair of the meeting to ensure impartiality in relation to the item(s) on the agenda.

Nomination Committee

The Articles of Association stipulates that the Company shall have a Nomination Committee consisting of three members who shall be elected by the general meeting for terms of two years. As of 31 December 2024, the Nomination Committee consisted of the following members who all are independent of the Board and Management:

- **Ole G. Klevan, Chair**
  Lawyer/Partner and Head of Industry & Energy at the law firm Schjødt
- **Torger Lien, Member**
  CEO of TSO Holding AS and board member of Nord Pool Holding AS and Energy GmbH
- **Brita Eilertsen, Member**
  Non-executive Director for listed and unlisted companies

The Nomination Committee's duties are to:

- Prepare recommendations to the general meeting concerning the election and remuneration of Directors.
- Prepare recommendations to the general meeting regarding the election of members to the Nomination Committee.

The Nomination Committee's recommendations contain separate justifications for each candidate proposed. Contact details and guidelines for the Nomination Committee are available on the corporate website.

Board of Directors; composition and independence

As of 31 December 2024, the Board of Directors consisted of five members who all are independent of the Company's major shareholders and Management. The Chair of the Board and the other Directors are elected by the general meeting for terms not exceeding two years.

Further information on each Director is available on page 23 of this annual report and on the corporate website. Information about Directors' remuneration and number of shares held in Nordic Mining is provided in Note 21 to the consolidated financial statements.

As of 31 December 2024, and at the date of this report, the Board consists of:

- **Kjell Roland, Chair**
  Participated in 23 of 23 meetings in 2024
- **Kjell Sletsjøe, Deputy Chair**
  Participated in 23 of 23 meetings in 2024
- **Eva Kaijser, Board Member**
  Participated in 22 of 23 meetings in 2024
- **Benedicte Nordang, Board Member**
  Participated in 21 of 23 meetings in 2024
- **Tom Lileng, Board Member**
  Participated in 23 of 23 meetings in 2024

The work of the Board

The Board's work follows an annual plan which is evaluated and approved at or before the start of the calendar year. The agenda items reflect the Board's main duties for the overall governance of the Group and for the general monitoring of the Group's activities. The Board evaluates its performance and expertise at least annually and makes the evaluation available to the Nomination Committee.

The Board has established written instructions for its own work and the work of the CEO, and the CEO has established instructions for other Management. These instructions cover issues concerning the Board's duties and responsibilities, the CEO's duty to inform the Board, and procedural rules for the Board's and Management's work.

The Company's ethical guidelines include rules intended to avoid conflicts of interest and require that any person acting on behalf of Nordic Mining act honestly and in line with principles for good business ethics. The ethical guidelines require Directors and Management to notify the Board in case they, directly or indirectly, hold a material interest in a transaction or key matter of the Company or the Group. The Board's consideration of material matters in which the Chair is personally involved, or in other way is restrained from participating in, shall be chaired by the Deputy Chair or another Director.

At present, the Company is not required to establish an Audit Committee, as governed by the Norwegian Public Limited Liability Companies Act. Considering the Company's current phase of development, it is the opinion of the Board that assessments linked to financial statements and remuneration of Management are most appropriately undertaken by the Board acting as a whole. The Board will continue to assess potential benefits of establishing Board committees (e.g., Audit Committee, Compensation Committee or other) going forward.

Risk management and internal control

The Board is responsible for ensuring that the Company has good internal control and a well-functioning system for risk management and social responsibility. The Board's annual plan includes a review of the Company's risk areas and internal control system. In the Board's opinion, the current governance systems satisfactorily address risk management and internal control.

Management is responsible for establishing and maintaining an adequate level of internal control regarding the Group's financial reporting. Internal control related to financial reporting is a process that is designed to provide reasonable certainty that financial reporting is reliable and

that financial statements are prepared in accordance with the International Financial Reporting Standards ("IFRS"), as adopted by the EU. The accounting principles applied by the Group conform to the IFRS as published by the International Accounting Standards Boards ("IASB"). A summary of significant accounting principles as well as discussion of risk factors are included in Note 2 and 18, respectively, in the consolidated financial statements.

The Company has engaged Sumit Up AS as the Group's accountant and has established routines for accounting work and reporting.

Remuneration of the Board

The remuneration of the Board is proposed by the Nomination Committee and resolved by the general meeting. The remuneration of the Board is not linked to the Company's performance and Directors are not granted share options.

The remuneration of the Board reflects the Board's responsibility, expertise, time commitment and the complexity of the Company's activities. Information on the remuneration to the Board in 2024 is included in Note 21 in the consolidated financial statements.

Remuneration of Management

Pursuant to section 6-16a of the Public Limited Liability Companies Act, the Board prepares an annual statement on the setting of salaries and other remuneration for Management. The statement is presented to and considered by the general meeting. Any equity-based remuneration is resolved by the general meeting.

The key principles underlying the remuneration of Management for 2024 have been that total remuneration should reflect the responsibilities and duties undertaken by each individual in Management, as well as contribution to the long-term value creation in the Group. In the opinion of the Board, it is crucial for Nordic Mining to offer competitive salaries and conditions to attract the qualities and expertise necessary to promote the strategic development of the Group, nationally as well as internationally.



From the left: Kjell Roland, Eva Kaijser and Kjell Sletsjøe.

Share options have been granted to employees in the past. There were no outstanding options at year-end 2022, 2023 or 2024.

Information regarding remuneration of Management in 2024 is presented in Note 21 in the consolidated financial statements.

Pursuant to the requirements under section 6–16b in the Public Limited Liability Companies Act a more detailed remuneration report will be prepared for advisory vote by the annual general meeting in May 2025.

Information and communications

Nordic Mining has adopted guidelines designed to ensure that its information policy is based on the principles of openness and equal treatment of all shareholders and participants in the securities market. The objective is to maintain accounting and reporting systems in which the investors will have confidence.

Management is responsible for communication with the capital markets and for relations with current and potential new investors. Nordic Mining's financial reports provide comprehensive information about the Group's operations, including its major value drivers and risk factors.

The financial reports and other information are published electronically. All shareholders are treated equally in relation to access to financial information. Reports, stock exchange releases and other presentation material are made available at the corporate website.

Take-overs

Nordic Mining's Articles of Association do not set any measures to limit the opportunity to acquire shares in the Company. In the event of a take-over bid for Nordic Mining, the Board will handle the bid in accordance with Norwegian law and the Norwegian Code of Practice for Corporate Governance and follow the overriding principle of equal treatment of all shareholders. Further, the Board will strive to ensure that the shareholders are given sufficient information and time to assess the offer as well as ensure that the Company's business activities are not unnecessarily disrupted.

The Board will not seek to prevent any take-over unless it believes that the best interests of the Company and the shareholders justify such a take-over. The Board will not exercise mandates or pass resolutions with the intention of obstructing any take-over bid unless it is approved by the general meeting following the announcement of the bid.

The Board will issue a statement in accordance with statutory requirements and the recommendations in the Corporate Governance Code, including considerations regarding a possible valuation from an independent expert.

Transactions that in effect imply a sale of Nordic Mining's entire business will be subject to approval by the general meeting.

The Company has not established other principles for potential take-over situations.

Auditor

Nordic Mining's auditor is elected by the general meeting and is independent of the Company. The general meeting also approves the auditor's remuneration.

The auditor's work is based on a plan that is presented to the Board on an annual basis. The auditor attends Board meetings that discuss and approve the Group's and Company's annual reports. At such meetings, the auditor gives a statement of any material changes to Nordic Mining's accounting principles and provides an assessment of material accounting estimates, as well as a complete account of any situation where there has been disagreement between the auditor and Management.

The auditor presents to the Board a review of the Company's control routines and potential areas of improvement in relation to accounting. When required and at least once a year, the auditor meets with the Board without Management present.

Nordic Mining places importance on independence and has clear guidelines regarding the use of other services from external auditors. All services from the external auditor, including non-audit services, are subject to pre-approval as defined by the Board of Directors in line with the Public Audit Act that entered into force on 1 January 2021.

Information on the remuneration to the auditor in 2024, including breakdown between statutory auditing and non-audit services, is presented in Note 5 to the consolidated financial statements.

Oslo, 24 April 2025
The Board of Directors of Nordic Mining ASA

Kjell Roland	Kjell Sletsjøe	Eva Kaijser	Benedicte Nordang	Tom Lileng	Finn Ivar Marum
Chair	*Deputy chair*	*Board member*	*Board member*	*Board member*	*CEO*



Consolidated accounts for Nordic Mining

CONSOLIDATED STATEMENT OF PROFIT OR LOSS

(Amounts in NOK thousands)	Note	2024	2023
Payroll and related costs	4,20	(11 126)	(15 082)
Depreciation and amortization	10	(2 726)	(346)
Other operating expenses	5	(40 753)	(31 041)
Operating profit/(loss)		**(54 605)**	**(46 469)**
Fair value gains/losses on convertible loan	17	-	3 354
Net exchange rate gain/loss (-)	6	(127 106)	25 911
Financial income	6	69 806	26 099
Financial costs	6	(3 115)	(55 002)
Profit/(loss) before tax		**(115 020)**	**(46 107)**
Income tax	7	-	-
Profit/(loss) for the period		**(115 020)**	**(46 107)**
(Amounts in NOK)			
Earnings per share			
Basic earnings per share	8	(1.06)	(0.51)
Diluted earnings per share	8	(1.06)	(0.51)

CONSOLIDATED STATEMENT OF COMPREHENSIVE INCOME

(Amounts in NOK thousands)	Note	2024	2023
Net profit/(loss) for the period		**(115 020)**	**(46 107)**
OTHER COMPREHENSIVE INCOME			
Items that will not be reclassified subsequently to profit or loss:			
Changes in pension estimates, net of tax	14,22	317	536
Other comprehensive income directly against equity		**317**	**536**
Total comprehensive income/(loss) for the period		**(114 703)**	**(45 571)**

CONSOLIDATED STATEMENT OF FINANCIAL POSITION

(Amounts in NOK thousands)	Note	31.12.2024	31.12.2023
ASSETS			
Non-current assets			
Mine under construction	9	2 654 418	1 377 083
Property, plant and equipment	10	97 171	3 062
Right-of-use assets	10	663	1 025
Pension assets	22	111	-
Total non-current assets		**2 752 363**	**1 381 170**
Current assets			
Trade and other receivables	11,18	27 704	30 561
Spare parts inventory		10 011	-
Bond Escrow	12	-	1 075 042
Restricted cash	13	12 645	8 430
Cash and cash equivalents	13	454 774	634 984
Total current assets		**505 134**	**1 749 017**
Total assets		**3 257 497**	**3 130 187**

(Amounts in NOK thousands)	Note	31.12.2024	31.12.2023
SHAREHOLDERS' EQUITY AND LIABILITIES			
Shareholders' equity			
Share capital	14	1 300 938	1 300 938
Share premium	14	276 410	277 928
Other paid-in capital		16 038	16 038
Retained earnings/(losses)		(177 263)	(62 243)
Other comprehensive income/(loss)	14	(3 379)	(3 696)
Total equity		**1 412 744**	**1 528 965**
Non-current liabilities			
Lease liabilities	23	194	466
Bond loan	12,18	1 043 609	902 182
Royalty liability	15	599 798	517 574
Pension liabilities	22	-	219
Total non-current liabilities		**1 643 601**	**1 420 441**
Current liabilities			
Trade payables	18	44 394	94 312
Other current liabilities	16	156 757	86 468
Total current liabilities		**201 151**	**180 780**
Total liabilities		**1 844 752**	**1 601 221**
Total shareholders' equity and liabilities		**3 257 497**	**3 130 187**

Oslo, 24 April 2025
The Board of Directors of Nordic Mining ASA

Kjell Roland
Chair

Kjell Sletsjøe
Deputy chair

Eva Kaijser
Board member

Benedicte Nordang
Board member

Tom Lileng
Board member

Finn Ivar Marum
CEO

CONSOLIDATED STATEMENT OF CHANGES IN EQUITY

(Amounts in NOK thousands)	Note	Share capital	Share premium	Other-paid-in capital	Other comprehensive income/(loss)	Accumulated losses	Total equity
Equity 1 January 2023		**139 390**	**319 430**	**16 038**	**(4 232)**	**(16 135)**	**454 491**
Profit/(loss) for the period		-	-	-	-	(46 107)	(46 107)
Other comprehensive income		-	-	-	536	-	536
Total comprehensive income		**-**	**-**	**-**	**536**	**(46 107)**	**(45 571)**
Share issue	14	1 161 548	-	-	-	-	1 161 548
Transaction costs		-	(41 501)	-	-	-	(41 501)
Equity 31 December 2023		**1 300 938**	**277 928**	**16 038**	**(3 696)**	**(62 243)**	**1 528 965**
Equity 1 January 2024		**1 300 938**	**277 928**	**16 038**	**(3 696)**	**(62 243)**	**1 528 965**
Profit/(loss) for the period		-	-	-	-	(115 020)	(115 020)
Other comprehensive income		-	-	-	317	-	317
Total comprehensive income		**-**	**-**	**-**	**317**	**(115 020)**	**(114 703)**
Share issue	14	0	-	-	-	-	0
Transaction costs	14	-	(1 518)	-	-	-	(1 518)
Equity 31 December 2024		**1 300 938**	**276 410**	**16 038**	**(3 379)**	**(177 263)**	**1 412 744**

CONSOLIDATED STATEMENT OF CASH FLOWS

(Amounts in NOK thousands)	Note	2024	2023
Operating activities			
Income/loss (-) before income tax		(115 020)	(46 107)
Depreciation	10	2 726	346
Gain/loss on sale of fixed assets		-	117
Gains/losses on on convertible loan	17	-	(3 354)
Interest and fees, loans and borrowings		(21 216)	94 458
Interest Bond Escrow	12	(25 497)	(53 517)
Interest income bank deposits		(21 945)	(14 335)
Interest income bank deposits received		21 945	14 335
Foreign exchange, net		118 267	(25 167)
Change in working capital		(3 118)	(2 495)
Transfer to restricted account	13	(4 215)	(4 215)
Difference between pension expense and payment		(13)	(1 057)
Net cash from/used (-) in operating activites		**(48 086)**	**(40 990)**
Investing activities			
Investment in mine under construction	9	(1 072 831)	(885 096)
Acquisition of property, plant and equipment	10	(87 803)	(2 628)
Sale of property, plant and equipment		-	359
Net cash used in investing activities		(1 160 635)	(887 365)

(Amounts in NOK thousands)	Note	2024	2023
Financing activities			
Share issuance	14	0	1 021 926
Transaction costs, share issue	14	(1 518)	(41 501)
Transfer from Bond Escrow	12	1 152 427	-
Net proceeds from royalty financing	15	-	536 820
Interest paid		(136 317)	(88 694)
Other financing fees paid		-	(23 686)
Payment of lease liabilities	23	(305)	(439)
Net cash from financing activities		**1 014 287**	**1 404 426**
Net change in cash and cash equivalents		**(194 434)**	**476 072**
Cash and cash equivalents at beginning of period		634 984	164 703
Effect of exchange rate fluctuation on cash held		14 224	(5 791)
Cash and cash equivalents at end of period		**454 774**	**634 984**
Net change in restricted cash		4 215	4 215
Restricted cash at beginning of period		8 430	4 215
Restricted cash at end of period		12 645	8 430
Restricted and unrestricted cash at end of period		**467 419**	**643 414**

NOTES TO THE CONSOLIDATED FINANCIAL STATEMENTS

NOTE 1 - GENERAL INFORMATION

Nordic Mining ASA ("the Company") and its subsidiaries (together "the Group") is a resource Company with focus on high-end industrial minerals and metals. The Group is undertaking a large-scale industrial development at Engebø on the west coast of Norway where the Group has mining rights and permits to a substantial eclogite deposit with rutile and garnet.
The address to Nordic Mining's office is Munkedamsveien 45, N-0250 Oslo, Norway.

These financial statements were approved for issue by the Board of Directors on 24 April 2025.

NOTE 2 - SUMMARY OF MATERIAL ACCOUNTING POLICIES

Basis of preparation
Material accounting policies applied in the preparation of these consolidated financial statements are set out below. These policies have been consistently applied unless otherwise stated. The consolidated financial statements of Nordic Mining ASA have been prepared in accordance with IFRS® Accounting Standards as adopted by the EU.

The consolidated financial statements have been prepared on a historical cost basis with some exceptions outlined below; the main exceptions being plan assets under defined benefit pension plans and derivative instruments measured at fair value.

Significant accounting judgments, estimates and assumptions
The preparation of the Group's financial statements requires Management to make judgments, estimates and assumptions that affect the reported amounts of revenues, expenses, assets and liabilities, and the disclosure of contingent liabilities, at the reporting date. Uncertainty about these assumptions and estimates could result in significant risk of a material adjustment to the carrying amounts of assets and liabilities within the next financial year.

Key areas of judgement and estimation uncertainty:

- *Royalty liability (Note 15):*
  The future royalty payments under the royalty agreement equal to 11% of gross revenue from the Engebø Project. The royalty liability is therefore subject to a high degree of judgment and estimation involved in establishing assumptions for the estimation of the expected future royalty payments. It requires long-term assumptions to be made concerning a number of economic factors such as future production levels, price expectations and market conditions. At each reporting period, modifications to production plans and price expectations are evaluated, and when required, a modification gain/loss is recognized.

  The royalty liability lasts for the entire operational life of the mine, with an upper limit of 90 years. The current expected life of the mine is 39 years, but the life of the mine could end up being shorter or longer and changes to the expected life of the mine may impact the assessment of the royalty liability

  The Group has the option to reduce the royalty rate from 11% to 5.5% on certain conditions in 2028 or 2029. The buyback fee for such a reduction event is based on a calculation securing the royalty holder a certain return on the reduced portion of the royalty instrument for the duration it was held. If the Group assesses that a future reduction event is the most economic and likely scenario it may impact the assessment of the royalty liability. At this stage this option to reduce the royalty rate has not been included in the calculations.

- *Impairment of Mine under construction (note 9):*
  The Group reviews whether its Mine under construction has suffered any impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An asset is written down to its recoverable amount when the recoverable amount is lower than the carrying value of the asset. The recoverable amount is the higher of fair value less expected cost to sell and value in use (present value based on the future use of the asset).

  The Group has performed an impairment test due to indicators of impairment being present at year end 2024 for the value of the mine in Engebø. Indicators considered are delays in production and shipment volumes compared to original plans, resulting in a reduction of expected revenue generated from ERG in 2025. In addition, there has been an overall reduction in rutile prices from 2025 and onwards compared to previous price estimates, which affects the market outlook.

  All impairment assessments require a high degree of estimation, including assessments of expected future cash flows from the mine and the estimation of applicable discount rates. Impairment testing requires long-term assumptions to be made concerning economic factors such as future production levels, market conditions, production expense, discount rates and political risk among others, in order to establish relevant future cash flow estimates. There is a high degree of reasoned judgment involved in establishing these assumptions. In our assessment of future cash flows, we have made assumptions on future production levels, marked conditions and prices, and production expenses. Future production levels are based on our internal financial model for the first five years and the UDFS for the remaining years of the mine. Market conditions and prices are based on offtake agreements for the first five years, and estimated market prices are based on an external marked expert, TZMI, for the remaining years of the mine. Production

expenses are based on our internal financial model for the first five years and the UDFS for the remaining years of the mine.

The required return on equity is estimated using the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) to determine the required rate of return. The WACC calculation is sensitive to its input factors. The 10-year US government bond loan rate per 31 December 2024 is used as the risk free rate. The beta estimate is based upon industry levered beta and the market risk premium is the country risk. The debt interest is the weighted average of the IRR on the bond loan and the royalty loan. The WACC used is 16.5%.

Results of the impairment test showed that the net present value of the future cash flows of ERG is above the net carrying amount of the mine. As a result, no impairment was recognized.

- *Functional currency:*
  The functional currency of all entities in the Group is the Norwegian Kroner (NOK). The determination of functional currency involves judgement to identify the primary economic environment in which the entity operates, and the management needs to reconsider the functional currency of the entity if there is a change in events and conditions which can determine the primary economic environment assessment.

  In the case of the subsidiary Engebø Rutile and Garnet AS, it is considered appropriate using NOK as the functional currency as NOK most faithfully represent the currency of the primary economic environment in which the entity operates.

- *Capitalization of deferred tax assets (Note 7):*
  The Group has incurred substantial tax losses carried forward. At year-end 2024, the Group cannot substantiate that there will be sufficient future taxable income to be able to realize the Group's unused tax losses, and therefore the Group has not recognized deferred tax assets at 31 December 2024. At year-end 2024, the Group has NOK 201.6 million in unrecognized net deferred tax assets.

Inventories
Rutile and garnet ore stockpiles are valued at the lower of cost or net realizable value. Net realizable value is the estimated future sales price of the product the company expects to realize when the product is processed and sold, less estimated costs to complete production and bring the product to sale. The sales price of the products is determined based on relevant market prices and offtake agreements.

Cost of finished goods is determined using the weighted-average method and comprises direct purchase costs and an appropriate portion of fixed and variable overhead costs, including depreciation and amortization, incurred in converting materials into finished goods, based on the normal production capacity. The cost of production is allocated to rutile and garnet products with an equal value.

Costs of ore stockpiles which is stored at desired locations around the pit is valued to costs from ore extraction operations which includes blasting and transportation. Ore in circuit includes crushed ore stored in silos which represent material that is currently in process of being converted to saleable product. In-process material is measured based on assays of the material fed to process and the projected recoveries at the respective plants. In-process inventories are valued at the average cost of the material fed to process attributable to the source material coming from the mine or stockpile plus the in-process conversion costs, including the applicable depreciation relating to the process facility, incurred to that point in process. Materials, production supplies and spare parts are measured using the first-in, first-out (FIFO) method.

Basis for consolidation
The consolidated financial statements comprise the financial statements of the Company and its subsidiaries. The subsidiaries include Engebø Rutile and Garnet AS, Nordic Titanium AS and Nordic Quartz AS, all 100% owned and located in Norway. The accounting principles of the subsidiaries have been changed when necessary to ensure consistency with the policies adopted by the Group. All intra-group transactions, balances, income and expenses are eliminated.

Foreign currency translation
Functional and presentation currency
Items included in the financial statements of each of the Group's entities are measured using the currency of the primary economic environment in which the entity operates (the functional currency). NOK is the functional currency of all entities in the Group. NOK is also the presentation currency of the Group.

Transactions and balances
Foreign currency transactions are translated into the functional currency using the exchange rates at the dates of the transactions. Foreign exchange gains and losses resulting from the settlement of such transactions, and from the translation of monetary assets and liabilities denominated in foreign currencies at year-end exchange rates, are recognized in the income statement.

Mine under construction
All expenditure of the construction, installation or completion of infrastructure facilities is capitalized as Mine under construction. There is a high degree of judgment applied in determining capitalization versus expensing of cost incurred. After production starts, all costs included in Mine under construction are transferred to the category 'Producing mine' and other relevant categories. Mine under construction is not depreciated until construction is completed and the assets are available for their intended use. Mine under construction is stated at historical cost less accumulated depreciation and any impairment.

Property, plant and equipment
Property, plant and equipment is stated at historical cost less accumulated depreciation and any impairment.

Depreciation is calculated on a straight-line basis over the useful life of the asset.

The carrying amount of the asset is written down to recoverable amount when the carrying amount is higher than the estimated recoverable amount.

Borrowing costs
Borrowing costs that are directly attributable to the acquisition or construction of the mine are capitalized during the period of time that is required to complete and prepare the mine for its intended use. Interest income from the Bond Escrow is

deducted from the borrowing costs eligible for capitalization. Other borrowing costs are expensed in the period in which they are incurred.

Borrowing costs related to the bond loan up to the satisfaction of the condition of the Engebø Project being fully financed are recognized as expense in the income statement. Following the satisfaction of the financing conditions on 8 March 2023, net borrowing costs are capitalized as part of Mine under construction. Borrowing costs are presented in the cash flow statement as Interest and fees, loans and borrowings.

Bond loan
The bond loan is initially recognized at cost, being the fair value of the consideration received net of issue costs associated with the borrowing (including any discounts and premium). After initial recognition, the bond loan is subsequently measured at amortized cost using the effective interest method; any difference between proceeds (net of transaction cost including any discounts and premium) and the redemption value is recognized on the income statement over the period of the loan.

Bond Escrow
The restricted cash balances from the bonds were previously classified as "Bond Escrow" in the consolidated statement of financial position, and have been recognized as cash in the consolidated statement of financial position when the funds were released from the escrow account.

Royalty liability
The Group completed in 2023 the drawdown of a USD 50 million non-dilutive royalty instrument, with future royalty payments under the Royalty Agreement equal to 11% of gross revenue from the Engebø Project.

The royalty liability is initially recognized at the USD 50 million drawdown received net of directly attributable transaction costs at drawdown. After initial recognition the royalty liability under the Royalty Agreement is subsequently amortized at the effective interest rate, and the difference between the drawdown received net of transaction costs and the royalty payments is recognized as financial cost in the income statement, over the period for the expected royalty payments. At each reporting period, modifications to production plans and price expectations are evaluated, and when required, a modification gain/loss is recognized. Estimated royalty payments due within 12 months are classified as current liabilities.

Until construction of the Engebø project is completed, amortized cost is recognized as borrowing cost and capitalized under Mine under construction.

Derivative instruments
Derivative instruments are classified as financial assets or liabilities at Fair Value Through Profit or Loss (FVTPL). The carrying value of derivative instruments at FVTPL represents the instrument's fair market value. Any gains or losses arising on remeasurement are recognized in the income statement as incurred.

The Group has entered into a fixed price contract for the purchase of electricity to the mining facilities in Engebø. The fixed price contract covers a portion of the estimated use by the production facilities over the next three years (2025-2027). The contract qualifies for the own use exemption under IFRS 9 and is not defined as a financial instrument.

Cost of equity transactions
Share issuance cost that is incremental and directly attributable to the issue of new shares are shown in equity as a deduction from the proceeds. When deferred tax assets are not recognized, items recorded directly to equity are accounted as gross, without any deduction of deferred taxes.

Contingent liabilities
Contingent liabilities are defined as:

- Possible obligations resulting from past events whose existence depends on future events.
- Obligations that are not recognized because it is not probable that they will lead to an outflow of resources.
- Obligations that cannot be measured with sufficient reliability.

Contingent liabilities are not recognized on the balance sheet unless arising from assuming assets and liabilities in a business combination. Significant contingent liabilities are disclosed unless the possibility of an outflow of resources embodying economic benefits is remote. Reference is made to Note 9 and 25 in the consolidated financial statements regarding contingent liabilities.

New standards, amendments and interpretations adopted by the Group
New standards and amendments to standards and interpretations effective from 1 January 2024, including the amendments to IAS 1 – Non-current Liabilities with Covenants, did not have any significant impact on the financial statements.

New standards, amendments and interpretations issued and effective as of 1 January 2025 not adopted by the Group
A number of new standards and amendments to standards and interpretations are effective for annual periods beginning on or after 1 January 2025 and have not been applied in preparing these financial statements. None of these new standards and amendments to standards and interpretations are expected to have any significant impact on the Group's financial statements, except for IFRS 18 Presentation and Disclosure in Financial Statements effective from 1 January 2027. The Group is currently assessing the potential impact of this new standard.

NOTE 3 - SEGMENTS

The Group presents segments based on of the Group's mineral projects. The only reportable segment of the Group is the Rutile and Garnet segment. These are the minerals which can be produced from the mineral deposit at Engebø. The Chief Operating Decision Maker ("CODM") for the segment is the board of Nordic Mining ASA.

NOTE 4 - SALARIES

(Amounts in NOK thousands)	**2024**	**2023**
Wages and salaries	44 579	25 970
Social security costs	7 213	4 732
Pension costs defined benefit plan	391	512
Pension costs defined contribution plan	1 976	984
Board members, etc	1 840	1 840
Other personnel costs	1 389	1 139
Capitalized payroll costs	(46 262)	(20 095)
Total	**11 126**	**15 082**
Average number of full time employees	47	18

Reference is made to Note 22 for further information about remuneration of Senior Management and guidelines for remuneration.

NOTE 5 - OTHER OPERATING COSTS

(Amounts in NOK thousands)	**2024**	**2023**
Lease expenses	6 068	3 716
Consulting and legal fees	10 684	14 236
Other costs	24 001	13 089
Total	**40 753**	**31 041**

The Norwegian Supreme Court ruled in March 2024 in favor of Nordic Mining on all counts in the case against Arctic Mineral Resources ("AMR"). The court also ruled that AMR shall pay all legal expenses. Total refund of legal expenses amounted to NOK 12.4 million and has been recorded as a reduction of other operating costs in 2024. The amount was received in April 2024.

Auditor fees

(Amounts in NOK thousands)	**2024**	**2023**
Statutory audit	2 122	1 783
Other attestation services	88	492
Total	**2 209**	**2 275**

The amounts exclude VAT.

See note 18 for information about fixed price electricity contract.

NOTE 6 - NET EXCHANGE RATE GAIN/LOSS (-), FINANCE INCOME AND FINANCE COSTS

The following table shows the components of net exchange rate gain/loss (-), financial income and financial expense:

(Amounts in NOK thousands)	**2024**	**2023**
Foreign exchange gain/loss (-) on bond Escrow in USD	51 888	30 917
Foreign exchange gain/loss (-) on the USD bond loan	(118 100)	(31 510)
Foreign exchange gain/loss (-) on the the USD royalty liability	(66 279)	31 551
Foreign exchange gain/loss (-) on foreign exchange derivatives*	(5 854)	-
Other net foreign exchange gain/loss (-)	11 239	(5 047)
Net exchange rate gain/loss (-)	**(127 106)**	**25 911**
Interest income on bank deposits	21 945	14 335
Interest income, Bond Escrow**	25 497	53 517
Interest income, Bond Escrow, capitalized**	(25 497)	(41 752)
Change in estimate royalty liability (see note 16)	47 860	-
Finance income	**69 806**	**26 099**
Interest cost and transaction cost bond loan**	(158 091)	(152 264)
Interest cost and transaction cost bond loan, capitalized**	158 091	122 069
Amortized cost royalty liability (see note 16)	(111 053)	(12 305)
Amortized cost royalty liability, capitalized (see note 16)	111 053	12 305
Other finance costs***	(3 114)	(24 805)
Finance costs	**(3 115)**	**(55 002)**

* The Group has entered into foreign exchange (FX) derivative contracts for forward sale of USD and purchase of NOK in Q2 2024 and Q3 2024. The purpose of the trades was to hedge the USD/NOK foreign exchange rate for the release of USD amounts from bond escrow. The value dates aligned with the expected bond Escrow account release dates for the second and third releases (see note 12). The contracts expired in Q2 2024 and in Q3 2024, with a net loss of NOK 5.9 million.

** Interest and transaction costs on bond loan, net of interest income on bond escrow, has been capitalized to Mine under construction from March 2023.

*** Other finance costs in 2023 relates to transaction costs related to the USD 50 milllion non-dilutive royalty financing agreement for the period up to draw down in November 2023 (see Note 15 for details on royalty liability), and other finance costs.

NOTE 7 - INCOME TAXES

The Group has incurred substantial tax losses carried forward and the related tax asset is shown in the table below. At year-end 2024, the Group cannot substantiate that there will be sufficient future taxable income to be able to realize the Group's unused tax losses, and therefore the Group has not recognized deferred tax assets at 31 December 2024. Tax losses can be carried forward indefinitely in Norway.

Amounts in NOK thousands	**2024**	**2023**
Taxes payable	-	-
Deferred tax	-	-
Income tax expense/(income)	**-**	**-**

Tax effects of temporary differences and tax loss carryforwards at 31 December:

Amounts in thousands	**2024**	**2023**
Mine under construction/PP&E	(115 040)	(10 785)
Pensions	(25)	48
Bond loan	(7 291)	(9 667)
Royalty liability	142 350	113 866
Tax loss carryforwards	181 620	82 629
Total net deferred tax assets	**201 614**	**176 091**
Nominal tax rate (used for measurement)	22 %	22 %
Recognized in the statement of financial position:		
Deferred tax asset	-	-
Deferred tax liability	-	-

The Group recognized NOK 1.5 million in gross transaction cost of the 2024 share issues directly in equity (2023: NOK 41.5 million) which is included in tax loss carry forwards.

The following table shows the reconciliation of expected tax using the nominal tax rate to the actual tax expense/(income):

Amounts in thousands	**2024**	**2023**
Income/loss (-) before tax	(115 020)	(46 107)
Nominal tax rate	22 %	22 %
Expected income tax	**(25 304)**	**(10 144)**
Non-deductible costs	46	(16)
Non-taxable income	-	-
Effect of non-taxable gains/losses on convertible loan	-	(989)
Effect of non taxable gains/losses on investments	-	-
Non-recognized tax assets on current year result	25 258	11 149
Tax expense/(income)	**-**	**-**

NOTE 8 - EARNINGS PER SHARE

(Amounts in NOK thousands and number of shares in thousands)	**2024**	**2023**
Earnings		
Attributable to ordinary shareholders	(115 020)	(46 107)
Number of shares		
Weighted average number of ordinary shares outstanding – basic*	108 412	90 183
Weighted average number of ordinary shares outstanding – diluted*	108 412	90 550
(Amounts in NOK)		
Earnings per share attributable to ordinary shareholders		
Basic earnings per share	(1.06)	(0.51)
Diluted earnings per share	(1.06)	(0.51)

* In March 2024 the Company completed a 20:1 reverse split, reducing the number of shares from 2,168,230,655 shares per 31 December 2023 to 108,411,533 shares. In accordance with IAS 33 the share count is adjusted retrospective for the reverse split.

The effect of potentially dilutive shares arising from the previous convertible loan (ref. Note 17) is not included in the calculation of diluted earnings per share for 2023 as these would be anti-dilutive.

NOTE 9 - MINE UNDER CONSTRUCTION

(Amounts in NOK thousands)	**Mine under construction**
Cost at 1 January 2023	288 410
Transfer from evaluation and exploration assets	-
Additions	1 088 673
Cost at 31 December 2023	**1 377 083**
Additions	1 277 335
Cost at 31 December 2024	**2 654 418**
Provision for impairment at 1 January 2023	-
Impairment	-
Provision for impairment 31 December 2023	**-**
Impairment	-
Provision for impairment 31 December 2024	**-**
Net book value 31 December 2024	**2 654 418**
Net book value 31 December 2023	1 377 083
Net book value 1 January 2023	288 410

2024:
The Engebø project is in a test phase and ramp-up phase, which means that the construction phase has been completed and all significant parts of the mine and processing plant have been installed and commissioned at site. At the end of the period, the company does not consider the plant to be operating in the manner intended by the management and the direct costs related to the work described above have been capitalized in the balance sheet as Mine under construction.

2023:
The Engebø Project is under construction, which includes continuation of Detail Engineering of the process plant, procurement and fabrication of critical process equipment, groundwork on the mine access road and ground – and building works on the process plant area, tunnel work and raise drilling of the vertical ore pass. The direct costs related to the work described above have been capitalized in the balance sheet as Mine under construction.

Mining concessions Engebø
The carrying amount for licenses related to the Engebø area was included in the transfer from Evaluation and exploration assets to Mine under construction in 2022. Additionally, the Group has a conditional liability to the seller of NOK 40 million that will be paid when commercial operation commences at Engebø. No liability has been recognized as per 31 December 2024 or 31 december 2023 as the Group's accounting policy is to account for conditional liabilities upon the relevant condition being met, and the condition of commercial operation was not met.

Pledged as security
The USD 100 million bond loan has mortgages over all real properties owned by Engebø Rutile and Garnet AS and property accession rights agreements (Nw. utvinningsavtaler), first priority floating charge over all machinery and plant, vehicles, inventory and trade receivables of ERG, and first priority pledge over any government granted mining or extraction right. For further details on pledges please see ticker ERUGA01 PRO at https://live.euronext.com/nb to read the loan agreement.

Impairment
Management have performed an impairment test of the mine. The recoverable amount was determined to be the value in use, which was determined to be higher than the carrying amount of the mine. The Company has therefore not recognized an impairment charge. The value in use calculation is highly sensitive to the revenue assumptions as a significant reduction in estimated revenue could result in an impairment. The test used assumptions as mentioned in note 2.

In connection with the impairment test of the mine, sensitivity analyses are carried out for the cash generating unit. A reduction of revenue of 6,5% overall can result in fair value being below carrying value, resulting in an impairment of the mine. An increase in WACC to 19% (from the base of 16,5%) can result in fair value being below carrying value, resulting in impairment. If the ramp up is further delayed by another 6 months, it can result in fair value being below carrying value, resulting in an impairment of the mine.

NOTE 10 - PROPERTY, PLANT, EQUIPMENT AND RIGHT-OF-USE ASSETS

(Amounts in NOK thousands)	**Property, machinery and equipment**	**Buildings***	**Right-of-use assets**	**Total**
Cost				
1 January 2023	1 577	-	664	2 241
Additions	2 628	-	1 085	3 713
Disposals	(1 051)	-	-	(1 051)
31 December 2023	**3 154**	**-**	**1 749**	**4 903**
Additions	14 388	82 085	-	96 473
Disposals	-	-	-	-
31 December 2024	**17 542**	**82 085**	**1 749**	**101 376**
Depreciation				
1 January 2023	(487)	-	(558)	(1 045)
Depreciation expense	(180)	-	(166)	(346)
Disposals	575	-	-	575
31 December 2023	**(92)**	**-**	**(724)**	**(816)**
Depreciation expense	(1 271)	(1 093)	(362)	(2 726)
Disposals	-	-	-	-
31 December 2024	**(1 363)**	**(1 093)**	**(1 086)**	**(3 542)**
Net book value:				
31 December 2024	**16 179**	**80 992**	**663**	**97 834**
31 December 2023	3 062	-	1 025	4 087
1 January 2023	1 090	-	106	1 196

* Additions to buildings in 2024 relate to the administration building and the process area workshop that has been completed in 2024. These buildings are classified within Property, plant and equipment in the balance sheet.

Machinery and equipment are depreciated on a straight-line basis over an estimated useful life of 4-10 years. Property is not depreciated. Buildings are depreciated on a straight-line basis over an estimated useful life of 39 years (life of the Mine).

NOTE 11 - TRADE AND OTHER RECEIVABLES

(Amounts in NOK thousands)	**2024**	**2023**
Other financial receivables	959	904
Prepayments	3 023	1 848
VAT receivable	23 722	27 809
Total	**27 704**	**30 561**

NOTE 12 - BOND LOAN AND BOND ESCROW

Nordic Mining ASA's wholly owned subsidiary Engebø Rutile and Garnet AS has a USD 100 million 5-year senior secured bond listed on Nordic ABM with ticker: ERUGA01 PRO. The bond is administered by Nordic Trustee, has fixed coupon of 12.5% per annum, with interest payable quarterly in arrears, maturity in November 2027, and an issue price of 90%.

The net proceeds of the bond of USD 90 million were on issue deposited into a Bond Escrow account, together with issue discount of USD 10 million, four months bond interest of USD 4.2 million, and transaction costs of USD 3.3 million, transferred by Engebø Rutile and Garnet AS in line with the bond terms. Following conditions of the Engebø Project being fully funded, which were satisfied on 8 March 2023, the bonds were reclassified to non-current liability in the statement of financial position. The proceeds from the bond were released in three tranches from the Bond Escrow account after satisfaction of certain predisbursement conditions precedent, to be used for costs and expenditures to bring the Engebø Project into commercial production.

In Q1 2024 the first release of USD 30 million from the bond escrow was completed, in Q2 2024 the second release of USD 30 million was completed, and in Q3 2024 the Company completed the third and final release of USD 48 million.

The bond loan was initially recognized at cost, being the fair value of the consideration received net of issue costs associated with the borrowing (inclusive the 10% discount). After initial recognition, the bond loan is subsequently measured at amortized cost using the effective interest method; any difference between proceeds (net of transaction cost including the 10% discount) and the redemption value is recognized on the income statement over the period of the loan.

2024

(Amounts in thousands)	**Carrying amount Bond Loan**	**Carrying amount Bond Escrow**	**Cash transferred to Bond Escrow**
At 1 January	902 182	1 075 042	
Amortization of fees	23 328		
Interest payment from Bond Escrow		-	
Interest income on bond escrow		25 497	
Foreign exchange	118 100	51 888	
Release from Bond Escrow		(1 152 427)	1 152 427
Total at year end	**1 043 609**	**0**	**1 152 427**

2023

(Amounts in thousands)	**Carrying amount Bond Loan**	**Carrying amount Bond Escrow**	**Cash transferred to Bond Escrow**
At 1 January	850 825	1 032 597	
Amortization of fees	19 847		
Interest payment from Bond Escrow		(41 989)	
Interest income on bond escrow		53 517	
Foreign exchange	31 510	30 917	
Total at year end	**902 182**	**1 075 042**	**-**

The bond loan is secured by first priority pledge over the shares of Engebø Rutile and Garnet AS ("ERG"), mortgages over all real properties owned by ERG and property accession rights agreements (Nw. utvinningsavtaler), first priority floating charge over all machinery and plant, vehicles, inventory and trade receivables of ERG, first priority pledge over any government granted mining or extraction rights and other security usual and customary for a transaction of this type. The bond loan contains certain financial covenants including minimum liquidity of USD 15 million at all time in ERG and a minimum equity ratio of no less than 25% at Group level at each quarter date. For further details please see ticker ERUGA01 PRO at https://live.euronext.com/nb to read the loan agreement.

The table below provides an overview of the maturity profile and estimated interest payments for the Company's bond loan. Please note that the annual interest payment is USD 12.5 million, so the estimated interest payments in NOK are dependent on the USD/NOK exchange rate. The figures in the table below are based on the exchange rate at year end 2024.

(Amounts in thousands)	1 year	2-5 years	Estimated payments
Repayment		(1 135 340)	(1 135 340)
Estimated interest	(141 918)	(283 835)	(425 753)
Total payments on bond loan	**(141 918)**	**(1 419 175)**	**(1 561 093)**

See note 26 for information about increase of the existing bond loan in March 2025 through a tap issue with USD 33 million, priced at 101.00% of par.

NOTE 13 - CASH AND CASH EQUIVALENTS

(Amounts in NOK thousands)	2024	2023
Bank deposits	454 774	634 984
Total cash and cash equivalents	**454 774**	**634 984**
Restriced cash in tax withholding account	2 825	1 372

In addition to the amounts referred to above, the Group has a deposit of NOK 12.6 million (2023: NOK 8.4 million) on a restricted account at year-end presented as current assets pledged toward the Directorate of Mining. According to the standard procedure in Norway, the Group is obligated to provide financial security in favor of the Directorate of Mining. The size of the security is according to the requirement in the operational license to cover safety and clean-up measures in case of mine closure.

NOTE 14 - SHARE CAPITAL

Number of shares outstanding	Ordinary Shares
2023	
Opening balance	232 316 772
Share issuance	1 935 913 883
31 December 2023	**2 168 230 655**
2024	
Opening balance	2 168 230 655
Reverse split 20:1	(2 059 819 122)
Number of shares after reverse split 20:1	108 411 533
Share issuance	-
31 December 2024	**108 411 533**

All shares carry equal rights and had a par value of NOK 12 per share as of 31 December 2024.

2024
In March 2024, Nordic Mining completed a reverse split of 20:1 reducing the number of shares to 108,411,533 shares and increasing the par value to NOK 12 per share.

2023
In March 2023, Nordig Mining completed a private placement of 1,566,666,667 new shares at a subscription price per new share of NOK 0.60 with gross proceeds of NOK 940 million. The convertible loan was converted as a consequence of the private placement. The convertible loan with accrued interest, in total NOK 139,621,875, was converted at the same subscription price as in the private placement, i.e. NOK 0.60 per share. Fjordavegen Holding received 232,703,125 new shares in the company at a subscription price per share of NOK 0.60.
In April 2023, Nordic Mining completed a subsequent offering with 136,544,091 new shares at a subscription price per new share of NOK 0.60 with gross proceeds of NOK 81.9 million.

Following registration of the new shares from the private placement in March 2023, the conversion of the convertible loan in March 2023, and the new shares from the subsequent offering in April 2023, Nordic Mining's share capital has increased by NOK 1,161,548,330 to NOK 1,300,938,393.40 divided into 2,168,230,655 shares, each with a par value of NOK 0.60.

Components of other comprehensive income
The following table shows a reconciliation of the components of other comprehensive income ("OCI"):

(Amounts in NOK thousands)	Actuarial gain/loss	Total OCI
Balance on 1 January 2023	(4 232)	(4 232)
Actuarial gain/(loss)	536	536
Balance on 31 December 2023	**(3 696)**	**(3 696)**
Actuarial gain/(loss)	317	317
Balance on 31 December 2024	**(3 379)**	**(3 379)**

NOTE 15 - ROYALTY LIABILITY

In November 2023 Nordic Mining ASA's wholly owned subsidiary Engebø Rutile and Garnet AS completed drawdown of the USD 50 million non-dilutive royalty instrument from OMRF (Zr) LLC which is managed by the Orion Resource Partners Group ("Orion"). The future royalty payments under the royalty agreement equal to 11% of gross revenue from the Engebø Project.

The royalty liability lasts for the entire operational life of the mine, with an upper limit of 90 years. The Group have the option to reduce the royalty rate from 11% to 5.5% on certain conditions in 2028 or 2029. The buyback fee for such a reduction event is based on a calculation securing the royalty holder a certain return on the reduced portion of the royalty instrument for the duration it was held.

The royalty liability was initially recognized at the USD 50 million drawdown received net of directly attributable transaction costs at drawdown. After initial recognition the royalty liability under the Royalty Agreement is subsequently amortized at the effective interest rate, and the difference between the drawdown received net of transaction costs and the royalty payments is recognized as financial cost in the income statement, over the period for the expected royalty payments. The option to reduce the Royalty rate described above has not been included in these calculations. At each reporting period, modifications to production plans and price expectations are evaluated, and when required, a modification gain/loss is recognized. Estimated royalty payments due within 12 months are classified within other current liabilities.

Until construction of the Engebø project is completed, amortized cost is recognized as borrowing cost and capitalized under Mine under construction, in total NOK 111.1 million in 2024 (2023: NOK 12.3 million).

In December 2024 the Company has, based on updated Rutile price forecasts from TZMI, revised its estimates of future cash flows related to the royalty agreement. The net effect of the change in estimate, NOK 47.9 million, has been recognized as financial income.

Next year's estimated royalty payments have been reclassified to other current liabilities at 31 December 2024.

An annual royalty fee is also calculated and paid to land owners for the extraction of minerals. The royalty fee is equal to 0.5% of the annual income from rutile products sold and 1.25% of the annual income of garnet and other sub products sold. For other minerals not being sub products of rutile, the royalty fee is set to 2% of the corresponding annual income. The royalty fee to land owners will be recognized as an expense when incurred.

2024

(Amounts in NOK thousands)	Carrying amount	Cash flow
At 1 January	517 574	
Foreign exchange	66 279	
Amortization, change in estimate and other	15 946	
Total non-current portion of royalty liability	**599 798**	**-**

2023

(Amounts in NOK thousands)	Carrying amount	Cash flow
At 1 January	-	
Draw down	540 394	540 394
Fees paid at inception	-3 574	(3 574)
Foreign exchange	-31 551	
Amortization	12 305	
Total non-current portion of royalty liability	**517 574**	**536 820**

NOTE 16 - OTHER CURRENT LIABILITIES

(Amounts in NOK thousands)	**2024**	**2023**
Tax withholding and social security accrual	5 192	2 537
Employee salary and holiday pay accrual	4 354	2 532
VAT payable	-	241
Lease liability	305	305
Accrued interest bond loan	20 105	18 015
Accrued expenses and other	126 801	62 838
Total	**156 757**	**86 468**

Other current liabilities primarily relates to the short term portion of the royalty liability and amounts held back from EPC's pending the completion of the construction project in accordance with contract.

NOTE 17 - CONVERTIBLE LOAN

In January 2022, Nordic Mining entered into a NOK 132.5 million 5% interest bearing convertible loan in favor of Fjordavegen Holding AS, a local investor group led by two of the EPC partners for the Engebø project. This transaction was the first step in the project financing of the Engebø Project.

The convertible loan with accrued interests, in total NOK 139.6 million, was converted into 232,703,125 new shares in Nordic Mining ASA on 4 March 2023, in relation to the private placement to fully fund the Engebø Project.

2023

(Amounts in NOK thousands)	**Carrying amount**	**Cash flow**
At 1 January	142 976	
Change in fair value	-3 354	
Conversion	-139 622	
Total	**-**	**-**

NOTE 18 - FINANCIAL INSTRUMENTS AND RISK MANAGEMENT

Management of financial risk

Nordic Mining is exposed to certain types of financial risk related to the Group's financial instruments, primarily market risk related to floating interest rate risk on cash and cash equivalents, liquidity risk and currency risk.

Management of Nordic Mining manages the Group's financial risk primarily by identifying and evaluating potential risk areas. Management's focus is primarily on managing liquidity risk to secure continuing operations and financing of the Group's capital-intensive projects. Nordic Mining's cash holdings are placed in bank accounts in Norwegian Kroner (NOK), United States Dollars (USD), Euro (EUR) and Australian Dollars (AUD). At year-end 2024, the Group's main currency exposure is related to its bond loan and royalty liability, which are denominated in USD.

The Group has at year-end 2024 interest-bearing debt in the form of a bond loan. The Group's financial instruments at year-end 2024 mainly consist of the bond loan, royalty liability, bank deposits, customary short-term receivables, trade and other payables.

Liquidity risk

Liquidity risk is the risk that the Group will not be able to settle its financial obligations as they fall due. The Group has historically used equity financing in order to meet liquidity requirements related to financial obligations, covering operational losses, exploration activities and investments. In order to secure financing of the Engebø project, the Group issued a bond loan and a convertible loan in addition to divesting its investment in Keliber in 2022. In 2023 the Group has issued equity and completed the draw down of the non-dilutive royalty financing, and the Engebø Rutile and Garnet Project is fully financed. The project financing comprises equity, debt and royalty financing. In order to strengthen the liquidity in ERG, the Group has carried out a tap issue on its existing bond loan subsequent to year end. Due to unforeseen challenges in Q1 2025, there has been a delay in the production and shipment plans affecting the estimated revenues for 2025. We remain confident in the Group's liquidity position, supported by the positive contribution from the tap issue in March 2025. For more information see note 26.

The Group estimates the remaining CAPEX in the Engebø project to be NOK 100 million at year end 2024. The Groups cash position at year end 2024 was NOK 467 million including NOK 13 in restricted cash.

The bond loan contains certain financial covenants including minimum liquidity of USD 15 million at all time in ERG and a minimum equity ratio of no less than 25% at Group level at each quarter date. The Group was in compliance with the covenants at year end.

Payments to the royalty holder are tied to the level of gross revenue; the outstanding royalty liability will decrease if gross revenue decreases and conversely the outstanding royalty liability will increase if gross revenue increases. Hence, reduced liquidity due to reduced revenue also reduces the financial obligations due under the royalty financing.

Of the Group's financial liabilities as at 31 December 2024 NOK 175.5 million mature within 6 months from balance sheet date (2023: NOK 159.7 million).

Market risk
Market risk consists of the risk that real value or future cash flow related to financial instruments will vary as a consequence of fluctuation in market prices. Market risk includes, but is not limited to, currency risk, interest rate risk and price risk from sales.

Fixed price electricity contract
The Group has entered into a fixed price contract for the purchase of electricity to the mining facilities in Engebø. The fixed price contract covers a portion of the estimated use by the production facilities over the next three years (2025-2027). The contract includes the delivery of 4MW per hour at a fixed price of NOK 0.404/KWh. The contract qualifies for the own use exemption under IFRS 9 and is not defined as a financial instrument.

(i) Interest rate risk
The Group's interest bearing debt at year-end is at fixed interest rates and the Royalty liability is not exposed to changes in the market interest rate. The Group's bank deposits are exposed to changes in the market interest rate.

The Group's exposure on the result at year end 2024 is approximately +/-NOK 4.7 million per percentage-point change in the variable market interest rate (2023: NOK 17.2 million).

(ii) Currency exchange risk
At year-end 2024, the Group's main currency exposure is related to its bond loan and royalty liability, wich are denominated in USD. A 10% increase or decrease in the USD currency rates would decrease/increase the net income and equity by approximately NOK 173.5 million at year-end.

At year-end 2023, the Group's main currency exposure is related to its bond loan, Bond Escrow and royalty liability, wich are denominated in USD. A 10% increase or decrease in the USD currency rates would decrease/increase the net income and equity by approximately NOK 46.0 million at year-end.

The Group had no foreign exchange hedges or instruments as per year-end 2024. Se note 6 for information about foreign exchange derivative contracts entered into in 2024 for forward sale of USD and purchase of NOK to hedge the USD/NOK foreign exchange rate for the release of USD amounts from bond escrow during 2024. These contracts expired in Q2 2024 and in Q3 2024.

Credit risk
Credit risk is the risk of financial losses if a customer or counterpart of a financial instrument is unable to meet contractual obligations.

The Group's current business has only limited credit risk. Cash and cash equivalents and security deposits in banks represent a large portion of the Group's financial assets at 31 December 2024. There has been no recognized loss on trade receivables in 2024 or 2023.

Procedures for evaluation of credit risk have been introduced and discretionary evaluations are done on a case-by-case basis.

Political risk
In addition to financial risk, the Group is exposed to political risk related to its mining projects. The political risk includes the risk of not obtaining or extending the relevant governmental permits necessary to extract and produce minerals from these mining projects.

The Group operates in an industry which is subject to extensive laws and regulations relevant for mining operations, in particular in relation to environmental and operational issues, which have become more stringent over time, and this development is expected to continue. Compliance with respect to environmental regulations, closure and other matters may involve significant costs and/ or other liabilities.

Failure to comply with applicable environmental laws, regulations and permitting requirements may result in enforcement actions including orders issued by regulatory or judicial authorities causing operations to cease or be curtailed and may include obligations to take corrective measures requiring capital expenditures, installation of additional equipment or remedial actions. There is a risk that the Group due to its engagement in mining and mineral processing activities will be required to compensate those suffering loss or damage by reason of such activities and may incur civil or criminal fines or penalties for violation of applicable laws or regulations.

Current environmental laws, regulations and permits governing operations and activities of mining companies may be changed. Regulatory requirements surrounding site reclamation and remediation activities, or more stringent implementation thereof, could have a material adverse impact on the Group and cause increases in capital expenditures or production costs or reduction in levels of operational production, or require abandonment or delays in the development of new sites. There are no current amendments that the Group is aware of that may impact the assets of the Group.

Nordic Mining's climate-related financial risk is considered to be low. The mining operations at the Group's main asset, the Engebø Project, is expected to have the lowest greenhouse gas footprint of all titanium feedstock producers due to available hydroelectric power in the area and a tight infra-structure with minimal transportation. Nordic Mining has a target of zero greenhouse gas emissions at Engebø and has initiated the development of a Climate Strategy Plan. The Group considers that there is minimal risk for stranded assets.

All goods produced by Nordic Mining is planned to be exported abroad, and our products are thus exposed to changes in international tariffs and introduction of new tariffs. According to our offtake agreements, our products are sold FoB (Free on Board) which means that it is our customers who will clear the goods through customs for the first five years of production.

Fair value of financial instruments

2024:

The carrying amounts on the balance sheet of cash and cash equivalents, receivables, payables to suppliers, and other short-term financial items are close to fair value due to the short time period until maturity.

For the bond loan issued in November 2022 it is assessed that the fair value at year-end was around 101% of the nominal value of USD 100 million, based on latest quoted market price (level 2 in the fair value hierarchy according to IFRS 13).

For the royalty liability drawn in November 2023, the Group has assessed that the fair value at year-end is above the nominal value of USD 50 million. This is based on reduced risk and uncertainty of both the production outlook for Engebø, as well as the overall marked outlook per 31 December 2024 compared to at the timing of the liability draw in November 2023. The reduced uncertainty and risk has led to a reduced discount rate, resulting in an incease of fair value. The fair value of the royalty liablity is estimated to be approximately USD 65.8 million (level 3 in the fair value hierarchy according to IFRS 13).

2023:

The carrying amounts on the balance sheet of cash and cash equivalents, Bond Escrow, receivables, payables to suppliers, and other short-term financial items are close to fair value due to the short time period until maturity.

For the bond loan issued in November 2022 it is assessed that the fair value at year-end was around 95% of the nominal value of USD 100 million, based on latest quoted market price (level 2 in the fair value hierarchy according to IFRS 13).

For the royalty liability drawn in November 2023 it is assessed that the fair value at year-end was the same as the nominal value of USD 50 million (level 3 in the fair value hierarchy according to IFRS 13).

Categories of financial instruments

Year ended 31 December 2024

(Amounts in NOK thousands)	**Amortized cost**	**Fair value through profit or loss**	**Carrying amount**
Financial assets by category			
Trade and financial receivables	959		959
Bond escrow	-		-
Restricted cash	12 645		12 645
Cash and cash equivalents	454 774		454 774
Total financial assets	**468 378**	**-**	**468 378**
Financial liabilities by category			
Accounts payable	44 394		44 394
Bond loan	1 043 609		1 043 609
Convertible loan	-	-	-
Royalty liability	599 798		599 798
Other current financial liabilities	131 155		131 155
Total financial liabilities	**1 818 956**	**-**	**1 818 956**

Year ended 31 December 2023

(Amounts in NOK thousands)	Amortized cost	Fair value through profit or loss	Carrying amount
Financial assets by category			
Trade and financial receivables	904		904
Bond escrow	1 075 042		1 075 042
Restricted cash	8 430		8 430
Cash and cash equivalents	634 984		634 984
Total financial assets	**1 719 360**	**-**	**1 719 360**
Financial liabilities by category			
Accounts payable	94 312		94 312
Bond loan	902 182		902 182
Convertible loan	-	-	-
Royalty liability	517 574		517 574
Other current financial liabilities	65 370		65 370
Total financial liabilities	**1 579 438**	**-**	**1 579 438**

Capital management

The Group has historically used equity financing to finance research, operations, purchase of licenses and other investments. In order to secure financing of the Engebø project, the Group issued a bond loan and a convertible loan in addition to divesting its investment in Keliber in 2022. In 2023 the Group issued equity and completed the draw down of the non-dilutive royalty financing. In March 2025 Engebø Rutile and Garnet AS completed a tap issue of USD 33 million under the existing USD bond. Nordic Mining's financing comprise of equity and Engebø Rutile and Garnet AS' financing comprises of equity, debt and royalty financing. When Engebø transition to normal operation and positive cash flow, the Company will consider how to manage capital and distribution of dividends. For more information on liquidity risk see Board of Directors' report, and for more information on the maturity of the bond loan debt see Note 12. The ratio of net debt (debt less cash) divided by total capital (net debt and equity) as of 31 December 2024 is 43% (2023: 31%).

NOTE 19 - INVESTMENTS IN SUBSIDIARIES

The table below provides an overview of Nordic Mining ASA's subsidiaries as at 31 December 2024:

(Amounts in NOK thousands)	Location	Year incorp.	Ownership
Engebø Rutile and Garnet AS	Oslo, Norway	2006	100 %
Nordic Titanium AS	Oslo, Norway	2011	100 %
Nordic Quartz AS	Oslo, Norway	2011	100 %

NOTE 20 - SHAREHOLDERS

The table below shows the Company's 20 largest shareholders as at 31 December 2024:

Shareholder	Number of shares	% ownership
Fjordavegen Holding AS	16 218 489	14.96 %
Iwatani Corporation	15 979 133	14.74 %
Morgan Stanley & Co. Int. Plc.	11 419 311	10.53 %
Nordnet Bank AB	2 788 128	2.57 %
Skandinaviska Enskilda Banken AB	2 267 503	2.09 %
Nordnet Livsforsikring AS	2 011 394	1.86 %
Clearstream Banking S.A.	1 900 562	1.75 %
The Bank of New York Mellon SA/NV	1 007 560	0.93 %
Pro AS	937 204	0.86 %
UBS AG	925 980	0.85 %
Stavanger Forvaltning AS	840 000	0.77 %
J.P. Morgan Securities LLC	674 330	0.62 %
Goldman Sachs International	674 323	0.62 %
Nordea Bank Abp	648 712	0.60 %
Citibank, N.A.	600 000	0.55 %
Danske Bank A/S	499 816	0.46 %
Joma Invest AS	400 000	0.37 %
Melum Mølle AS	350 000	0.32 %
O Drage AS	335 899	0.31 %
Fredrik Rosenberg	325 785	0.30 %
Total 20 largest shareholders	**60 804 129**	**56.09 %**
Other shareholders	47 607 404	43.91 %
Total	**108 411 533**	**100.00 %**

NOTE 21 - RELATED PARTIES AND COMPENSATION OF MANAGEMENT

Compensation to Board members and Senior Management in 2024

(Amounts in NOK thousands)	Salary incl. bonus	Board member fees	Other compensation	Pension costs	Total
Ivar S. Fossum, CEO	3 279	-	170	307	3 756
Jens Gisle Schnelle, former Interim CFO[1]	232	-	1	51	284
Tord Meling, CFO[2]	839	-	4	48	891
Kenneth N. Angedal, Managing Director Engebø Rutile and Garnet	2 009	-	9	97	2 115
Trond Langeng, Manager Resource and Development[3]	823	-	9	61	893
Maurice Kok, Commercial Director	1 362	-	11	106	1 479
Ole Klevan, Nomination Committee (Chair)	-	60	-	-	60
Brita Eilersen, Nomination committee	-	40	-	-	40
Torger Lien, Nomination committee	-	40	-	-	40
Kjell Roland, Chair of the Board	-	500	-	-	500
Kjell Sletsjøe, Deputy Chair of the Board	-	300	-	-	300
Eva Kaijser, Board member	-	300	-	-	300
Benedicte Nordang, Board member	-	300	-	-	300
Tom Lileng, Board member	-	300	-	-	300
Total	**8 544**	**1 840**	**205**	**669**	**11 259**

1. Jens Gisle Schnelle left the Company on 31 January 2024, and compensation shown in the table above is for the period up to this date.
Consultancy fee for the period after 31 January 2024 paid to Exman AS, a company owned by Jens Gisle Schnelle, is NOK 2.4 million.
2. Tord Meling joined the Company 12 August 2024.
3. Trond Langeng joined the Company 11 March 2024.

Compensation to Board members and Senior Management in 2023

(Amounts in NOK thousands)	Salary	Board member fees	Other compensation	Pension costs	Total
Ivar S. Fossum, CEO	4 151	-	210	530	4 891
Jens Gisle Schnelle, Interim CFO[1]	414	-	3	-	417
Christian Gjerde, former CFO[2]	2 064	-	9	83	2 156
Kenneth N. Angedal, Managing Director Engebø Rutile and Garnet	2 168	-	16	91	2 275
Mona Schanche, former VP Resource and Sustainability[3]	1 397	-	7	178	1 583
Maurice Kok, Commercial Director	1 225	-	13	99	1 337
Terje Gundersen, former Project Director[4]	690	-	7	43	740
Ole Klevan, Nomination Committee (Chair)	-	60	-	-	60
Brita Eilersen, Nomination committee	-	40	-	-	40
Torger Lien, Nomination committee	-	40	-	-	40
Kjell Roland, Chair of the Board	-	500	-	-	500
Kjell Sletsjøe, Deputy Chair of the Board	-	300	-	-	300
Eva Kaijser, Board member	-	300	-	-	300
Benedicte Nordang, Board member	-	300	-	-	300
Antony Beckmand, former Board member	-	300	-	-	300
Total	**12 109**	**1 840**	**266**	**1 025**	**15 239**

1. Jens Gisle Schnelle joined the Company 15 October 2023.
2. Christian Gjerde left the Company 30 September 2023.
3. Mona Schanche left the Company on 30 June 2023.
4. Terje Gundersen left the management group on 2 June 2023, and compensation shown in the table above is for the period up to this date.

Senior Management is subject to termination periods of 3-6 months.

Guidelines for management remuneration

The main components of the guidelines for Senior Management salaries are as follows:

- The compensation package should reflect the responsibility and the tasks of the individual persons in Senior Management, and what the employee contributes towards the long-term creation of value in Nordic Mining.
- The Company will offer competitive conditions to attract relevant expertise for the development of the Company.
- The compensation package consists of fixed salary plus participation in an option program that has been approved by the annual meeting.
- Senior Management participates in pension and insurance plans.

These guidelines have been used to recruit Senior Management in Nordic Mining ASA and to establish salary levels.

Shares owned/controlled by members of the Board and senior management and those related to them as of 31 December 2024

Name	No of shares	% owned
Kjell Roland, Chair of the Board	29 523	0.03 %
Kjell Sletsjøe, Deputy Chair of the Board	17 750	0.02 %
Ivar S. Fossum, CEO	122 961	0.11 %
Kenneth N. Angedal, Managing Director Engebø Rutile and Garnet	22 291	0.02 %
Total	**192 525**	**0.18 %**

Shares owned/controlled by members of the Board and senior management and those related to them as of 31 December 2023

Name	No of shares	% owned
Kjell Roland, Chair of the Board	590 475	0.03 %
Kjell Sletsjøe, Deputy Chair of the Board	355 009	0.02 %
Ivar S. Fossum, CEO	2 459 230	0.11 %
Kenneth N. Angedal, Managing Director Engebø Rutile and Garnet	445 822	0.02 %
Total	**3 850 536**	**0.18 %**

NOTE 22 - PENSIONS

The Group has a defined benefit plan or a defined contribution plan (for new employees) for its employees in the parent company, Nordic Mining ASA and a defined contribution plan for its employees in Engebø Rutile and Garnet AS. The plans meet the Norwegian statutory requirements for pension plans for employees.

Defined Benefit Plan

The Group has one benefit plan for Norwegian employees with a total of 1 active member at year end 2024. The Group's defined benefit pension plan is a final salary plan and contributions are made to a separately administered fund. The level of benefits provided depends on the member's length of service and salary at retirement age.

Pension cost

(Amounts in NOK thousands)	2024	2023
Pension cost - employee benefit	425	665
Pension cost - interest expense	12	43
Total pension related costs	**437**	**709**
Remeasurement gains/(losses) recorded to OCI	317	536

Movement in pension obligation during the year

(Amounts in NOK thousands)	2024	2023
Pension obligations January 1	14 009	17 404
Current value of pension benefits for the year	437	709
Interest costs	380	455
Payments	(372)	(371)
Remeasurement loss/ (gain)	(302)	(3 553)
Other	(37)	(635)
Pension obligations as of 31 December	**14 116**	**14 009**

Movement in pension funds during the year

(Amounts in NOK thousands)	2024	2023
Pension funds 1 January	13 790	15 593
Expected return on plan assets	335	388
Contributions	410	1 568
Payments	(372)	(371)
Other	49	(371)
Remeasurement (loss)/ gain	16	(3 017)
Pension funds as of 31 December	**14 228**	**13 790**

Pension liability is classified in the balance sheet as follows

(Amounts in NOK thousands)	2024	2023
Pension funds	14 228	13 790
Pension obligations	(14 116)	(14 009)
Net pension asset / (liabilities)	**111**	**(219)**
Pension asset/(liability) is shown in the balance sheet as		
Pension assets	111	-
Pension liabilities	-	(219)

Assumptions

	2024	2023
Discount interest rate	3.90 %	3.10 %
Annual projected increase in salary	4.00 %	3.50 %
Annual projected G- regulation	3.75 %	3.25 %
Annual projected regulation of pension	2.40 %	1.80 %

The major categories of plan assets as a percentage of the fair value of total plan assets

	2024	2023
Equities	13.40 %	13.00 %
Bonds	6.70 %	4.60 %
Money market	5.50 %	11.50 %
Hold to maturity bonds	59.10 %	49.80 %
Loans and receivables	3.90 %	10.40 %
Real estate	10.90 %	10.70 %
Other	0.50 %	0.00 %

NOTE 23 - LEASES

The Group's right-of-use assets recognized are related to the leasing of vehicles; see note 10. Short-term leases have been expensed as incurred; see note 5. The Group's office lease is cancellable with 4 months' notice with no more than an insignificant penalty and is as such considered a short-term lease.

Lease liability

(Amounts in NOK thousands)	2024	2023
Lease liability 1 January	771	116
Additions lease contracts	-	1 085
Accretion lease liability, included in finance cost	33	9
Payments of lease liability	(305)	(439)
Total lease liability 31 December	**499**	**771**

Specification of lease liability in the balance sheet

(Amounts in NOK thousands)	2024	2023
Current*	305	305
Non-current	194	466
Total lease liability 31 December	**499**	**771**

* Current lease liability is included in other current liabilities; see note 17.

Future minimum lease payments under non-cancellable lease agreements (undiscounted)

(Amounts in NOK thousands)	2024	2023
Within a year	305	898
From year 2-5	255	560
Total	**560**	**1 458**

NOTE 24 - PAYMENTS TO AND FROM GOVERNMENTAL INSTITUTIONS

In accordance with the Accounting Act, section 3-3d, the Group has assessed its relations with and payments to and from governmental institutions. The Group's governmental relations are only with institutions in Norway. All relations and payments are in the ordinary course of business and related to i.a. license payments, payment of prospectus/financial authority fees, R&D projects grants, etc.

Estimated total payment from the Group to various Norwegian governmental institutions was NOK 0.5 million in 2024 (2023: NOK 0.6 million). Estimated total payment to the Group from various Norwegian governmental institutions was NOK 0 million in 2024 (2023: NOK 0 million).

NOTE 25 - COMMITMENTS AND CONTINGENCIES

Conditional liability Engebø
The Group has a conditional liability to the seller of the mining rights in the Engebø area of NOK 40 million that will be paid if and when commercial operation commences at Engebø. No liability has been recognized as per 31 December 2024.

The Group has a contingent liability of NOK 40 million to Vestland County Municipality related to contribution to the County Road at Engebø that will be paid if and when the improvement work on the County Road commences. The payment schedule is further dependent on if and when certain amounts have incurred by the County Municipality for road improvements.

NOTE 26 - EVENTS AFTER BALANCE SHEET DATE

In January there was a minor fire discovered in one of the drying machines at the Engebø facility. No one was injured due to the incident, and the incident was handled according to procedures. The fire has not caused any significant delays in the production ramp-up phase and has not resulted in any impairment of the drying machine in 2025.

Ivar S. Fossum retired from his position as CEO of the company 1 March 2025. New CEO, Finn Ivar Marum, assumed the position 1 March 2025. This has previously been announced 28 June 2024 and 5 December 2024, respectively.

In March 2025, the existing bond loan was increased with USD 33 million, priced at 101.00% of par. ERG received an inquiry from investors to potentially tap the existing bond with USD 20-25 million. The company and the manager evaluated and considered the opportunity to strengthen the liquidity in ERG in order to carry out the production ramp-up in an optimal way and at the same time obtain a liquidity buffer in case of any unforeseen events. Following discussions the tap was upsized to USD 33 million due to interest from existing international holders of the existing bond.

In March 2025, EFTA made an advisory opinion in the case between the Norwegian environmental organizations and the Norwegian state concerning the notion of "overriding public interest" of the waste permit given to Engebø Rutile and Garnet AS. EFTA's advisory opinion states that purely economic grounds does not constitute an overriding public interest, but that securing supply of critical raw materials in the EEA area may in certain circumstances constitute an overriding public interest. The ruling is an advisory opinion and is not legally binding for the Group. The Group is not a party in the case, and we are confident that the permit we have gotten from the Norwegian state is valid. The appeal between the Norwegian environmental organizations and the Norwegian state will be heard by the Borgarting Court of Appeal (Borgarting lagmannsrett) in June 2025.

In April, the Group has appointed Andreas Davidsen as new Chief Commercial Officer (CCO), effective from 1 July 2025.

In Q1 2025, there has been unforeseen challenges with design issues in the pump circuits, as announced 30 March 2024 in a notice to the stock exchange market. The solutions put in place did not work as expected and our contractors are currenctly working on new, permanent solutions. This has resulted in a delay in the production and shipment plans affecting the estimated revenues for 2025. No adjustments to the financial statement for 2024 have been made. The estimated effect on the financial statements is approximately a NOK 20 million increase in financial income due to a reduction of the royalty liability.

Corporate accounts for Nordic Mining ASA

INCOME STATEMENT

(Amounts in NOK thousands)	Note	2024	2023
Revenues from Group companies	3	9 366	44 370
Payroll and related costs	3	(11 126)	(15 082)
Other operating expenses	4	(24 610)	(13 309)
Operating loss		**(26 370)**	**15 979**
Impairment of investment and loans to subsidiary	5	(640)	(620)
Financial income	6	34 928	36 598
Financial costs	6	(1 008)	(1 177)
Profit/(loss) before tax		**6 910**	**50 780**
Income Tax	7	-	-
Net profit/(loss)		**6 910**	**50 780**
Allocation of profit/(loss):			
Allocated to/(from) other equity		6 910	50 780

BALANCE SHEET

(Amounts in NOK thousands)	Note	2024	2023
ASSETS			
Non-current assets			
Property, plant and equipment	10	2 150	2 150
Investment in subsidiaries	5	1 445 305	1 445 305
Long term receivables from group companies	8	518 067	487 220
Pension assets	3	111	-
Total non-current assets		**1 965 634**	**1 934 675**
Current assets			
Other receivables and prepayments	8	3 195	1 997
Cash and cash equivalents	9	92 870	112 817
Total current assets		**96 065**	**114 814**
Total assets		**2 061 698**	**2 049 489**

(Amounts in NOK thousands)	Note	2024	2023
SHAREHOLDERS' EQUITY & LIABILITIES			
Shareholders' equity			
Share capital	11	1 300 938	1 300 938
Share premium	11	276 410	277 928
Other paid-in capital	11	16 038	16 038
Other equity	11	456 992	449 765
Total equity		**2 050 378**	**2 044 670**
Non-current liabilities			
Net pension liabilities	3	-	219
Total non-current liabilities		**-**	**219**
Current liabilities			
Trade payable		4 439	1 092
Other current liabilities	12	6 881	3 508
Total current liabilities		**11 320**	**4 600**
Total liabilities		**11 320**	**4 819**
Total shareholders' equity and liabilities		**2 061 698**	**2 049 489**

Oslo, 24 April 2025
The Board of Directors of Nordic Mining ASA

Kjell Roland	Kjell Sletsjøe	Eva Kaijser	Benedicte Nordang	Tom Lileng	Finn Ivar Marum
Chair	*Deputy chair*	*Board member*	*Board member*	*Board member*	*CEO*

CASH FLOW STATEMENT

(Amounts in NOK thousands)	Note	2024	2023
Operating activities			
Profit/(loss) before income tax		6 910	50 780
Impairment of investment and loans to subsidiary	5	640	620
Transaction costs, share issue subsidiary		-	(34 796)
Non-cash financial items		(30 854)	(33 232)
Changes in assets and liabilities			
Receivables, operating receivables from/(to) subsidiaries, prepayments	8	(1 198)	1 591
Trade payables		3 347	(394)
Accrued expenses and other current liabilities	12	3 373	1 856
Difference between pension expense and payment		(14)	(1 056)
Net cash used in operating activites		**(17 796)**	**(14 631)**
Investing activities			
Investment in property, plant and equipment	10	-	(2 150)
Loans to subsidiaries	8	(640)	(1 018 643)
Transaction costs, share issue subsidiary		-	34 796
Net cash from/(used) in investing activities		**(640)**	**(985 997)**

(Amounts in NOK thousands)	Note	2024	2023
Financing activities			
Share issuance	11	-	1 021 926
Transaction costs, share issue	11	(1 518)	(41 501)
Net cash from financing activities		**(1 518)**	**980 425**
Net change in cash and cash equivalents		(19 954)	(20 203)
Cash and cash equivalents at beginning of period	9	112 817	132 320
Effect of exchange rate fluctuation on cash held		7	700
Cash and cash equivalents at end of period	**9**	**92 870**	**112 817**
Non-cash transactions			
Conversion of debt to equity in subsidiaries		-	943 113

NOTES TO THE FINANCIAL STATEMENTS

NOTE 1 – GENERAL INFORMATION

Nordic Mining ASA ("the Company") and its subsidiaries (together "the Group") is engaged in the exploration for and development of projects for high-end industrial minerals and metals. The address of Nordic Mining's office is Munkedamsveien 45, N-0250 Oslo, Norway.

These financial statements were approved for issue by the Board of Directors on 24 April 2025.

NOTE 2 – SUMMARY OF THE MOST IMPORTANT ACCOUNTING PRINCIPLES

The most important accounting principles that have been used in developing the Company accounts are described below. These principles have been consistently applied unless otherwise stated.

Basic principles
The Company accounts have been presented in accordance with the Norwegian accounting act and generally accepted accounting principles in Norway. The related notes are an integral part of the financial statements of the Company.
The annual accounts are based on the going concern assumption.

Investment in subsidiaries
Subsidiaries are companies controlled by the Company. Subsidiaries are measured at cost in the statutory accounts. The investments are measured at acquisition cost, unless impairment has been necessary. Such assets are deemed to be impaired at fair value when a decrease in value cannot be considered to be of temporary nature. Impairments are reversed when the basis for the impairment no longer applies.

The Company has performed an impairment test due to indicators of impairment being present at year end 2024 for the value of the investment in the subsidiary Engebø Rutile and Garnet AS. Indicators considered are delays in production and shipment volumes compared to original plans, resulting in a reduction of expected revenue generated from ERG in 2025. In addition, there has been an overall reduction in rutile prices from 2025 and onwards compared to previous price estimates, which affects the market outlook.

All impairment assessments require a high degree of estimation, including assessments of expected future cash flows from the mine and the estimation of applicable discount rates. Impairment testing requires long-term assumptions to be made concerning economic factors such as future production levels, market conditions, production expense, discount rates and political risk among others, in order to establish relevant future cash flow estimates. There is a high degree of reasoned judgment involved in establishing these assumptions. In our assessment of future cash flows, we have made assumptions on future production levels, marked conditions and prices, and production expenses. Future production levels are based on our internal financial model for the first five years and the UDFS for the remaining years of the mine. Market conditions and prices are based on offtake agreements for the first five years, and estimated market prices are based on an external marked expert, TZMI, for the remaining years of the mine. Production expenses are based on our internal financial model for the first five years and the UDFS for the remaining years of the mine.

The required return on equity is estimated using the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) to determine the required rate of return. The WACC calculation is sensitive to its input factors. The 10-year US government bond loan rate per 31 December 2024 is used as the risk free rate. The beta estimate is based upon industry levered beta and the market risk premium is the country risk. The debt interest is the weighted average of the IRR on the bond loan and the royalty loan. The WACC used is 16.5%. The impairment test if performed by comparing the equity value of ERG to the carrying amount of the investment in ERG. No impairment was recognized as a result of the impairment test.

Transactions in foreign currency
Transactions in foreign currencies are initially recorded in the functional currency rate at the date of the transaction. Monetary items denominated in foreign currencies are translated at the exchange rate at the balance sheet date. Foreign exchange gains and losses resulting from the settlement of such transactions and from the translation at year-end exchange rates of monetary assets and liabilities denominated in foreign currencies are recognized in the income statement.

Receivables
The Company's receivables are mainly receivables from group companies. Receivables are recognized initially at cost, and subsequently measured at amortized cost using the effective interest method if the amortization effect is material, less provision for impairment. A provision for impairment of trade receivables is established when there is objective evidence that the Company may not be able to collect all amounts due according to the original terms of receivables.

Cash and cash equivalents
Cash and cash equivalents consist of cash, bank deposits and other short term, easily convertible investments with maximum three months original maturity.

Loans
All loans and borrowings are initially recognized at cost, being the fair value of the consideration received net of issue cost associated with the borrowing. After initial recognition, interest-bearing loans and borrowings are subsequently measured at amortized cost using the effective interest method; any difference between proceeds (net of transaction cost) and the redemption value is recognized on the income statement over the period of the interest-bearing liabilities.

Trade payables
Trade payables are recognized initially at fair value and subsequently measured at amortized cost using the effective interest method, if the amortization effect is material.

Deferred tax
Income tax expense represents the sum of the taxes currently payable and deferred tax. Taxes payable are provided based on taxable profits at the current tax rate. Deferred taxes are recognized on differences between the carrying amounts of assets and liabilities in the financial statements and the corresponding tax bases used in the computation of taxable profit. Deferred tax liabilities are generally recognized for all temporary differences and deferred tax assets are recognized to the extent that it is probable that taxable profits will be available against which deductible temporary differences can be utilized. Deferred income tax is not recognized on temporary differences arising from initial recognition of an asset or liability in a transaction other than a business combination that at the time of the transaction affects neither accounting nor taxable profit nor loss. The carrying amount of deferred tax assets is reviewed at each balance sheet date and reduced to the extent that it is no longer probable that sufficient taxable income will be available to allow all or part of the asset to be recovered.

Revenue recognition
The primary revenue comes from sale of services to Group companies. Revenues are recognized in the accounting period in which the services are provided.

Pensions
The Company has a defined benefit pension plan and a defined contribution plan for its employees that meet the Norwegian statutory requirement. For the defined benefit plan, the cost of providing the benefits is determined using the unit credit method, with actual valuations being carried out at the end of each annual reporting period. Re-measurement, comprising actuarial gains and losses, the effect of asset ceiling (if applicable) and the return on plan assets (excluding interest), is reflected immediately in the statement of financial position with a charge or credit recognized in equity in the period in which they occur. Past service costs are recognized in profit or loss in the period of a plan amendment. Net interest is calculated by applying the discount rate at the beginning of the period to the net defined benefit liability or asset. For the defined contribution plan the cost is expensed as incurred.

Cash flow statement
The Company reports the cash flow statement using the indirect method. The method involves adjusting the result for the period for the effects of transactions without effect on cash and changes in assets and liabilities to show net cash flow from operations. Cash flow relating to investment activities and financing activities are shown separately.

Related parties
All transactions, agreements and business activities with related parties are processed on standard arm's length business terms. Parties are related if they have the possibility to directly or indirectly control the business or provide significant influence over the financial and operational decision of the business. The parties are also related if they are subject to "common control". The Company provides information in notes about transactions and balances with related parties.

NOTE 3 - SALARIES, RELATED PARTY AND MANAGEMENT COMPENSATION, AND PENSIONS

(Amounts in NOK thousands)	**2024**	**2023**
Wages and salaries	6 988	10 160
Social security costs	1 500	2 173
Pension costs defined benefit plan	391	512
Pension costs defined contritbution plan	266	182
Board members, etc	1 840	1 840
Other personnel costs	141	215
Total	**11 126**	**15 082**
Average number of full time employees	3.2	3.5

Reference is made to Note 4, 21 and 22 in the consolidated financial statements for information regarding salaries, related party and Senior Management, pensions etc.

The disclosure in Note 22 – Pensions regarding the defined benefit plan - relates in its entirety to Nordic Mining ASA as the subsidiaries only have defined contribution plans.

Revenues from group companies of NOK 9.4 million in 2024 (2023: NOK 44.4 million) consist of sale of services to group companies.

NOTE 4 – OTHER OPERATING EXPENSES

(Amounts in NOK thousands)	**2024**	**2023**
Leasing costs	2 253	2 283
Consulting and legal fees	7 229	3 416
Other costs	15 128	7 610
Total	**24 610**	**13 309**

Auditor fees

(Amounts in NOK thousands)	**2024**	**2023**
Statutory audit	1 190	1 344
Other attestation services	-	444
Total	**1 190**	**1 788**

The amounts exclude VAT.

NOTE 5 - INVESTMENTS IN SUBSIDIARIES

Nordic Mining ASA's investment in subsidiaries as at 31 December 2024 is shown in the following table:

(Amounts in NOK thousands)	**Location**	**Year incorp.**	**Share capital**	**Owner-ship**	**Equity 31.12.24**	**Net loss 2024**	**Carrying amount 31.12.24**
Engebø Rutile and Garnet AS	Oslo, Norway	2006	26 078	100 %	923 579	(91 158)	1 445 305
Nordic Titanium AS	Oslo, Norway	2011	125	100 %	54	(101)	-
Nordic Quartz AS	Oslo, Norway	2011	130	100 %	(43)	(393)	-
Total							**1 445 305**

Impairment
Management have performed an impairment test of the investment in the subsidiary Engebø Rutile and Garnet AS. The recoverable amount was determined to be the equity value of ERG. No impairment charge was recognized as a result of the impairment test. The equity value calculation is highly sensitive to the assumptions made on expected revenue, WACC and timing of the ramp up, as changes in these factors could result in an impairment. The test used assumptions as mentioned in note 2.

The Company has invested a total of NOK 640 thousand in the subsidiaries Nordic Quartz AS and Nordic Titanium AS during 2024. The amount has been written off at year end 2024 based on an evaluation of the underlying values in the subsidiaries.

NOTE 6 – FINANCIAL INCOME AND FINANCIAL COSTS

(Amounts in NOK thousands)	**2024**	**2023**
Interest income on bank deposits	4 069	3 363
Interest from Group companies	30 847	32 531
Foreign exchange gains	12	704
Finance income	**34 928**	**36 598**
Interest expense convertible loan	-	1 141
Foreign exchange losses	62	20
Other finance costs	946	16
Finance costs	**1 008**	**1 177**

NOTE 7 - TAXES

The Company has incurred tax loss carry forwards of NOK 242.8 million as per 31 December 2024. At this stage, the Company cannot substantiate that there will be sufficient future income to be able to realise the Company's unused tax losses, and thus the Company has not recognized any deferred tax asset as per 31 December 2024. There is no time limitation for utilization of tax losses carried forward in Norway.

Income taxes for the year

(Amounts in thousands)	**2024**	**2023**
Taxes payable	-	-
Deferred tax	-	-
Income tax expense/(income)	**-**	**-**

Tax impact of temporary differences as of 31 December

(Amounts in thousands)	**2024**	**2023**
Property, plant & equipment	2 300	2 296
Pensions	(25)	48
Tax loss carryforwards	53 427	54 772
Net deferred tax assets	**55 702**	**57 116**
Nominal tax rate (used to measure deferred tax items)	22 %	22 %
Recognized in the balance sheet:		
Deferred tax asset	-	-
Deferred tax liability	-	-

The Company recognized NOK 1.5 million in gross transaction costs in 2024 recorded directly in equity (in 2023: NOK 41.5 million) which is included in tax loss carry forwards.

The following table shows the reconciliation of expected tax using the nominal tax rate to the actual tax expense/(income):

(Amounts in thousands)	**2024**	**2023**
Net profit/(loss) before tax	6 910	50 780
Nominal tax rate	22 %	22 %
Expected tax expense/(income)	1 520	11 172
Non-deductible costs	17	13
Impairment of investment and loans to subsidary	141	136
Change in non-recognized tax assets on current year result	(1 678)	(11 321)
Tax expense/(income)	**0**	**0**

NOTE 8 - OTHER RECEIVABLES, PREPAYMENTS AND LOANS TO RELATED PARTIES

Other receivables and prepayments

(Amounts in NOK thousands)	**2024**	**2023**
Accounts receivable	144	332
Other financial receivables	900	904
VAT receivable	404	-
Prepayments	1 747	761
Totalt	**3 195**	**1 997**

Specification of intercompany loans/receivables

(Amounts in NOK thousands)	**2024**	**2023**
Engebø Rutile and Garnet AS, loan	518 067	487 220
Engebø Rutile and Garnet AS, accounts receivable	144	332
Nordic Quartz AS	-	-
Nordic Titanium AS	-	-
Nordic Ocean Resources AS		
Total	**518 211**	**487 552**
Classified as current liabilities	-	-
Classified as long-term receivables	518 067	487 220
Classified as current receivables	144	332

In 2024, a total of NOK 0.6 million in loans to and investments in Nordic Quartz AS and Nordic Titanium AS were impaired.

The average interest rate on the intercompany loans is 6.3% pa.

NOTE 9 - CASH AND CASH EQUIVALENTS

(Amounts in NOK thousands)	**2024**	**2023**
Bank deposits	92 870	112 817
Total cash and cash equivalents	**92 870**	**112 817**
Included in cash and cash equivalent - Employee witholding tax	408	407

NOTE 10 - PROPERTY, PLANT AND EQUIPMENT

(Amounts in NOK thousands)	**2024**	**2023**
Cost		
1 January	2 150	-
Additions*	-	2 150
Disposals	-	-
31 December	**2 150**	**2 150**

* Additions in 2023 is land. Land is not depreciated.

NOTE 11 - SHARE CAPITAL AND CHANGES IN EQUITY

Number of shares outstanding	Ordinary Shares
2023	
Opening balance	232 316 772
Share issuance	1 935 913 883
31 December 2023	**2 168 230 655**
2024	
Opening balance	2 168 230 655
Reverse split 20:1	(2 059 819 122)
31 December 2024	**108 411 533**

Reference is made to Note 14 in the consolidated financial statements for information regarding share issues. Reference is made to Note 20 for information regarding the 20 largest shareholders in Nordic Mining ASA as per 31 December 2024.

All shares have equal rights. Nominal value was NOK 12 per share at 31 December 2024.

Changes in equity

(Amounts in NOK thousands)	Share capital	Share premium	Other paid-in equity	Other equity	Total
Equity at 1 January 2023	**139 390**	**319 430**	**16 038**	**398 449**	**873 307**
Share issue	1 161 548		-	-	1 161 548
Transaction costs on share issue	-	(41 501)	-	-	(41 501)
Reduction of share premium to cover loss	-	-	-	-	-
Actuarial gains/losses (-) on pensions	-	-	-	536	536
Profit for the period	-	-	-	50 780	50 780
Equity at 31 December 2023	**1 300 938**	**277 929**	**16 038**	**449 765**	**2 044 670**
Share issue	-		-	-	-
Transaction costs on share issue	-	(1 518)	-	-	(1 518)
Actuarial gains/losses (-) on pensions	-	-	-	317	317
Profit for the period	-	-	-	6 910	6 910
Equity at 31 December 2024	**1 300 938**	**276 410**	**16 038**	**456 991**	**2 050 378**

NOTE 12 - OTHER CURENT LIABILITIES

The following table specifies amounts included in other current liabilities at 31 December:

(Amounts in NOK thousands)	2024	2023
Tax withholding and social security accrual	766	756
Employee salary and holiday pay accrual	736	889
VAT payable	-	241
Accrued expenses and other current liabilities	5 377	1 621
Total	**6 880**	**3 508**

NOTE 13 - FINANCIAL INSTRUMENTS AND RISK MANAGEMENT

Management of financial risk
Nordic Mining is exposed to various types of financial risk related to its financial instruments, market risk primarily related to currency risk related to bank deposits in foreign currency and floating interest rate on cash and cash equivalents, and liquidity risk.

Liquidity risk
Liquidity risk is the risk that the Company is not able to pay its financial obligations upon maturity. The Company has historically to a large degree used equity financing to meet liquidity demands related to financial obligations, cover operational losses and for investments.

For a more complete description of Nordic Mining Group's liquidity risk, reference is made to Note 18 in the consolidated financial statements and the Board of Directors' report.

Market risk
Variable interest risk
The Company is exposed to cash flow risk related to receivables from subsidiaries that has a fixed interest rate. Furthermore, the Company has exposure to the floating interest risk related cash or cash equivalent deposits.

Currency exchange risk
As per 31 December 2024, the Company has limited exposure to currency exchange risk. Cash holdings are placed in bank accounts in Norwegian Kroner (NOK), United States Dollars (USD) and Euro (EUR).

Credit risk
The Company does not have receivables from sales (receivables are primarily from companies within the Group). The Company has no or limited credit risk from external parties, but is exposed to credit risk through its loans to its subsidiary Engebø Rutile and Garnet AS.

Sensitivity analysis
The Company's result and equity is only to a limited extent exposed to changes in interest rate (bank deposit) and currency exchange rates.

NOTE 14 - EVENTS AFTER BALANCE SHEET DATE

Ivar S. Fossum retired from his position as CEO of the company 1 March 2025. New CEO, Finn Ivar Marum, assumed the position 1 March 2025. This has previously been announced 28 June 2024 and 5 December 2024, respectively.

For information on Group level, please see note 26 in the consolidated financial statements.

RESPONSIBILITY STATEMENT

We confirm to the best of our knowledge that the consolidated financial statements for 2024 have been prepared in accordance with IFRS as adopted by the European Union, as well as additional information requirements in accordance with the Norwegian Accounting Act. We confirm that the financial statements for the parent company for 2024 have been prepared in accordance with the Norwegian Accounting Act and generally accepted accounting practice in Norway, and that the information presented in the financial statements gives a true and fair view of the assets, liabilities, financial position and result of Nordic Mining ASA and the Nordic Mining Group for the period.

We also confirm to the best of our knowledge that the Board of Directors' Report includes a true and fair review of the development, performance and financial position of Nordic Mining ASA and the Nordic Mining Group, together with a description of the principal risks and uncertainties that they face.

Oslo, 24 April 2025
The Board of Directors of Nordic Mining ASA

Kjell Roland
Chair

Kjell Sletsjøe
Deputy Chair

Benedicte Nordang
Board member

Eva Kaijser
Board member

Tom Lileng
Board member

Finn Ivar Marum
CEO

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Medlemmer av Den norske Revisorforening

To the General Meeting in Nordic Mining ASA

INDEPENDENT AUDITOR'S REPORT

Report on the audit of the financial statements

Opinion

We have audited the financial statements of Nordic Mining ASA (the Company) which comprise:

- The financial statements of the Company, which comprise the balance sheet as at 31 December 2024 and the income statement and statement of cash flows for the year then ended and notes to the financial statements, including a summary of significant accounting policies, and
- The financial statements of the Group, which comprise the statement of financial position as at 31 December 2024, the statement of profit or loss, statement of comprehensive income, statement of changes in equity and statement of cash flows for the year then ended and notes to the financial statements, including material accounting policy information.

In our opinion:

- the financial statements comply with applicable statutory requirements,
- the financial statements give a true and fair view of the financial position of the Company as at 31 December 2024 and its financial performance and cash flows for the year then ended in accordance with the Norwegian Accounting Act and accounting standards and practices generally accepted in Norway, and
- the consolidated financial statements give a true and fair view of the financial position of the Group as at 31 December 2024 and its financial performance and cash flows for the year then ended in accordance with IFRS Accounting Standards as adopted by the EU.

Our opinion is consistent with our additional report to the board of directors.

Basis for opinion

We conducted our audit in accordance with International Standards on Auditing (ISAs). Our responsibilities under those standards are further described in the *Auditor's responsibilities for the audit of the financial statements* section of our report. We are independent of the Company and the Group in accordance with the requirements of the relevant laws and regulations in Norway and the International Ethics Standards Board for Accountants' *International Code of Ethics for Professional Accountants (including International Independence Standards)* (the IESBA Code), and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

To the best of our knowledge and belief, no prohibited non-audit services referred to in the Audit Regulation (537/2014) Article 5.1 have been provided.

We have been the auditor of the Company for 19 years from the election by the general meeting of the shareholders on 23 February 2006 for the accounting year 2006.

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Key audit matters

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the financial statements for 2024. These matters were addressed in the context of our audit of the financial statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters.

Accounting for costs related to mine under construction

Basis for the key audit matter
Nordic Mining ASA ("The Group") has during the year continued the construction work for the Engebø Project. The Group capitalized costs amounting to NOK 1 227.3 million as mine under construction and NOK 96.5 million as property, plant and equipment during the year.

Only directly attributable costs, including related borrowing costs, are to be capitalized. Due to the materiality of the amount and the judgement applied in determining capitalization versus expensing of cost incurred, we considered the capitalization as a key audit matter.

Our audit response
Our audit response included an assessment whether the costs meet the criteria for capitalization, evaluating the assumptions and methodologies used by management.

Further we had discussions with management, and we performed detailed testing of capitalized external and internal costs against supporting documentation including external invoices, interest calculations and allocation of payroll expenses for a sample of costs to assess that the criteria for capitalization was met.

We refer to note 9 and 10 in the consolidated financial statements.

Accounting for royalty financing agreement

Basis for the key audit matter
The Group has a royalty financing agreement with Orion Resource Partners which include annual royalty payments of 11% of the gross revenue from the sale of products from the Engebø Rutile and Garnet Project with an upper limit of 90 years. The Group has the option to reduce the royalty rate from 11% to 5.5% on certain conditions in 2028 or 2029.

As described in note 15, the royalty financing agreement is accounted for as a financial liability at amortized cost. When calculating effective interest management has applied estimates primarily related to future production plans and mineral prices over the lifetime of the royalty agreement. The Group's operational performance and external factors have a significant impact on the estimated future cash flows and therefore, the accounting for the royalty

Our audit response
Our audit response included, among others, consideration of methods and models used in the calculation of the expected future royalty payments, testing the model for clerical accuracy and corroborating obtained audit evidence from different sources. In addition, we compared expected production of minerals to approved budgets and forecasts.

To test price assumptions, we evaluated management's methodology to determine future commodity prices and compared such assumptions to external reports produced by a management appointed specialist for which we evaluated the competence, capabilities, and objectivity.

We refer to note 2 and 15 in the consolidated financial statements.

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financing agreement. Auditing management's estimate of the royalty is complex and involves a high degree of judgement.

We consider the royalty financing agreement to be a key audit matter given the significance, complexity and uncertainty of the estimates and assumptions used by management in the cash flow model.

Other information

The Board of Directors and Chief Executive Officer (management) are responsible for the information in the Board of Directors' report and the other information presented with the financial statements. The other information comprises information included in the annual report other than the financial statements and our auditor's report thereon. Our opinion on the financial statements does not cover the information in the Board of Directors' report and the other information presented with the financial statements.

In connection with our audit of the financial statements, our responsibility is to read the information in the Board of Directors' report and for the other information presented with the financial statements. The purpose is to consider if there is material inconsistency between the information in the Board of Directors' report and the other information presented with the financial statements and the financial statements or our knowledge obtained in the audit, or otherwise the information in the Board of Directors' report and for the other information presented with the financial statements otherwise appears to be materially misstated. We are required to report if there is a material misstatement in the Board of Directors' report and the other information presented with the financial statements. We have nothing to report in this regard.

Based on our knowledge obtained in the audit, it is our opinion that the Board of Directors' report

- is consistent with the financial statements and
- contains the information required by applicable statutory requirements.

Our statement on the Board of Directors' report applies correspondingly for the statement on Corporate Governance.

Responsibilities of management for the financial statements

Management is responsible for the preparation of the financial statements of the Company that give a true and fair view in accordance with the Norwegian Accounting Act and accounting standards and practices generally accepted in Norway, and for the preparation of the consolidated financial statements of the Group that give a true and fair view in accordance with IFRS Accounting Standards as adopted by the EU. Management is responsible for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Company's and the Group's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Company or the Group, or to cease operations, or has no realistic alternative but to do so.

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Auditor's responsibilities for the audit of the financial statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs will always detect a material misstatement when it exists.

Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with ISAs, we exercise professional judgment and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's and the Group's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Company's and the Group's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Company and the Group to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
- Obtain sufficient appropriate audit evidence regarding the financial information of the entities or business activities within the Group to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the group audit. We remain solely responsible for our audit opinion.

We communicate with the board of directors regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide the board of directors with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

From the matters communicated with the board of directors, we determine those matters that were of most significance in the audit of the financial statements of the current period and are therefore the key audit matters. We describe these matters in our auditor's report unless law or regulation precludes public disclosure about the matter or when, in extremely rare circumstances, we determine that a matter should not be communicated in our report because the adverse consequences of doing so would reasonably be expected to outweigh the public interest benefits of such communication.

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Report on other legal and regulatory requirement

Report on compliance with regulation on European Single Electronic Format (ESEF)

Opinion

As part of the audit of the financial statements of Nordic Mining ASA we have performed an assurance engagement to obtain reasonable assurance about whether the financial statements included in the annual report, with the file name 5967007LIEEXZXFVKO54-2024-12-31-0-en.zip, have been prepared, in all material respects, in compliance with the requirements of the Commission Delegated Regulation (EU) 2019/815 on the European Single Electronic Format (the ESEF Regulation) and regulation pursuant to Section 5-5 of the Norwegian Securities Trading Act, which includes requirements related to the preparation of the annual report in XHTML format and iXBRL tagging of the consolidated financial statements.

In our opinion, the financial statements, included in the annual report, have been prepared, in all material respects, in compliance with the ESEF Regulation.

Management's responsibilities

Management is responsible for the preparation of the annual report in compliance with the ESEF Regulation. This responsibility comprises an adequate process and such internal control as management determines is necessary.

Auditor's responsibilities

Our responsibility, based on audit evidence obtained, is to express an opinion on whether, in all material respects, the financial statements included in the annual report have been prepared in accordance with the ESEF Regulation. We conduct our work in accordance with the International Standard for Assurance Engagements (ISAE) 3000 – "Assurance engagements other than audits or reviews of historical financial information". The standard requires us to plan and perform procedures to obtain reasonable assurance about whether the financial statements included in the annual report have been prepared in accordance with the ESEF Regulation.

As part of our work, we perform procedures to obtain an understanding of the company's processes for preparing the financial statements in accordance with the ESEF Regulation. We test whether the financial statements are presented in XHTML-format. We evaluate the completeness and accuracy of the iXBRL tagging of the consolidated financial statements and assess management's use of judgement. Our procedures include reconciliation of the iXBRL tagged data with the audited financial statements in human-readable format. We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Oslo, 24 April 2025
ERNST & YOUNG AS

The auditor's report is signed electronically

Johan Lid Nordby
State Authorised Public Accountant (Norway)

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Third quarter results 2025

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Fourth quarter results 2025

Photos:
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ARTICLES OF ASSOCIATION

for Nordic Mining ASA per 11 March 2024

1. The name of the company is Nordic Mining ASA. The company is a public limited liability company.

2. The registered office of the company is in Oslo.

3. The object of the company is to carry out exploration for minerals and ores, mining activity, technology development, activities that may be associated herewith, and participation in other companies anywhere in the world.

4. The share capital of the company amounts to NOK 1,300,938,396 divided on 108,411,533 shares of a nominal value of NOK 12. The shares of the company shall be registered in the Norwegian Registry of Securities.

5. The board of directors of the company shall have from 3 to 8 members according to the decision of the shareholders' meeting. Two board members can jointly sign on behalf of the company.

6. The company shall have an election committee consisting of three members who shall be elected by the general meeting. The members of the election committee shall, when they are elected, be shareholders or representatives of shareholders of the company. The election committee shall make recommendations to the general meeting concerning the election of members and deputy members to the board of directors. The election committee shall also make recommendations concerning remuneration to such members. Members of the election committee are elected for a period of two years. The members of the board of directors which have been elected by the general meeting make recommendations for and adopt instructions for the election committee.

7. The shareholders' meeting shall deal with:

(i) Adoption of the annual accounts and annual report, including payment of dividends.

(ii) Other matters that pursuant to law are the business of the shareholders' meeting.

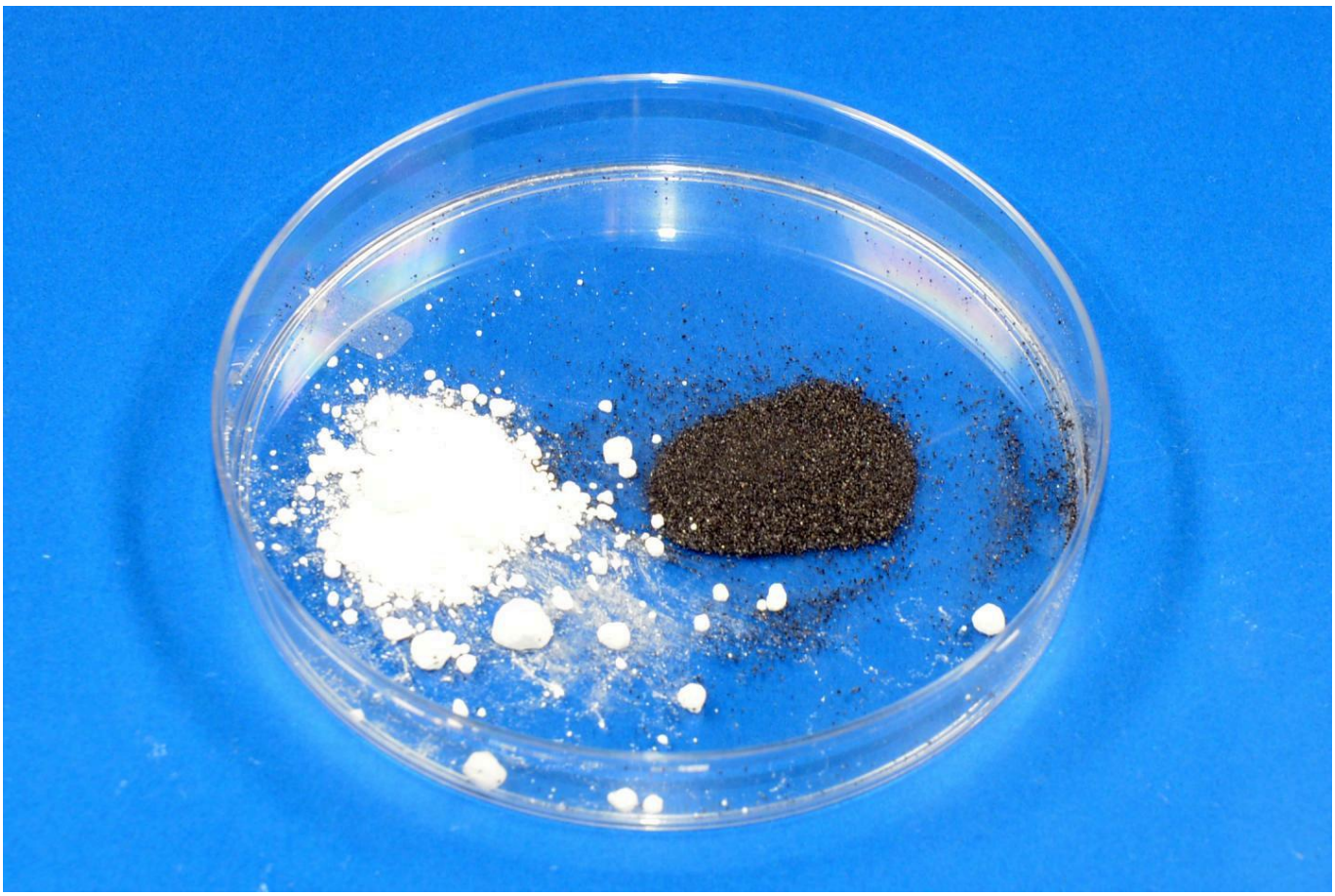
8. If a document that relates to an issue that the general meeting shall decide on is made available to the company's shareholders on the company's website, then such a document does not have to be physically sent to the shareholders of the company. However, such a document shall be sent to the shareholder free of charge if shareholders request it.

9. Shareholders that plan to attend a general meeting have to give notice to the company within 2 days of the general meeting.Shareholders who have not given such notice within 2 days of the general meeting may be denied entrance to the general meeting.

10. The board of directors may determine that the shareholders may cast advance votes in writing in matters to be considered by the general meetings of the company. Such votes may also be cast through electronic means. Voting in writing requires an adequately secure method to authenticate the sender. The board of directors may determine further guidelines for written advance voting. The summons to the general meeting shall state whether advance voting is allowed prior to the general meeting, and, if so, the guidelines for such voting.

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Titan



Det sorte er knust ilmenitt (titan-jern-oksid). Det hvite er titandioksid, hvor jernet er fjernet. Foto Solveig Sørensen, NGU.

Metallisk titan (Ti) er et kritisk råmaterial som er spesielt viktig for fly- og romfartsindustri. Ca 90% av verdens titan brukes imidlertid i oksidform (TiO_2) som hvitt pigment i f.eks. maling, plast, papir og kosmetiske produkter. Norge produserer titanmineralene ilmenitt og rutil, og har en prosessindustri som foredler titanmineraler til TiO_2.

Hva brukes titan til?

Titan brukes enten i sin oksiderte form (TiO_2) eller i metallisk form som titanmetall (Ti), til dels i ulike legeringer.

Den klart største bruken av titan er som TiO_2-pigment i maling, plast og papir. Av den globale produksjonen av titanmineraler brukes:

- 89% til TiO_2-basert hvitt pigment
- 6% foredles til titanmetall
- 5% benyttes i sveisematerialer og for andre formål.

Titanmetall har sin største anvendelse i luftfartsindustrien, hvor titan inngår i flyskrog, vinger, turbiner osv., men også forsvarsindustrien trenger titan til pansring og beskyttelse.

Ifølge den tyske geologiske undersøkelsen (BGR), utgjør titanmetall 13% av det totale materialbruk i luft- og romfartsindustrien, og 30% av verdien av råvarene. En rekke industriprosesser trenger titanmetall, og medisinalindustrien trenger metallisk titan til bl.a. implantater.

Titanmetall med 99,2% renhet er nesten like sterkt som stål og om lag halvparten så tungt. Videre er titanmetall 60% tyngre, men dobbelt så sterkt som de vanligste aluminiumslegeringene.

Titanmetall tåler svært høye temperaturer og er meget korrosjonsbestandig.

Hvilke mineraler inneholder titan?

Titan forekommer i naturen i ulike mineraler med ulike sammensetninger. De viktigste er:

- Ilmenitt $FeTiO_3$ er et vanlig mineral i magmatiske, metamorfe og sedimentære bergarter. Fargen er vanligvis svart. Ilmenitt utvinnes fra Titanias gruve i Tellnes i Rogaland.
- Rutil (anatas, brookitt) TiO_2 kan være rødt, blålig, brungul, brunrød eller fiolett. Rutil forekommer i visse metamorfe bergarter samt i sedimenter. Rutil utvinnes fra Nordic Mining sin gruve på Engebøfjellet.
- Leucoxen er et omvandlingsprodukt fra ilmenitt og titanittuten fast krystallstruktur. Leucoxen er et typisk omvandlingsprodukt av ilmenitt i sedimenter. Leucoxen utvinnes fra sandforekomster i bl.a. Afrika og Australia.
- Loparitt $(REE,Na,Ca)_2(Ti,Nb)_2O_6$, er et oksidmineral somforekommer i spesielle magmatiske bergarter. Loparittinneholder sjeldne jordarter, niob og titan og utvinnes i Russland.

- Perovskitt, titanitt og flere andre titanmineraler er rike på titan, men mineralene har ingen økonomisk betydning i dag.

Hvor finnes og utvinnes titanmineralene?

Titanmineraler utvinnes primært fra strandsand, enten langs dagens oseankyster (Australia, Senegal, Mosambik, Sør-Afrika m.fl.), eller fra fossile strandavsetninger, som f.eks. i Ukraina. Denne typen forekomster omtales i fagspråket som *placers*. Disse forekomstene kan ha lav gehalt, men er enkle å produsere, og kan inneholde både ilmenitt, leucoxen og rutil.

Enkelte plasser, som i Norge og Canada, utvinnes ilmenitt fra fast fjell. Tellnes-forekomsten i Rogaland inneholder ca 28% ilmenitt (18% TiO_2) og gruven leverer i underkant av 5% av verdensproduksjonen målt i TiO_2-innhold.

Nordic Mining er alene i verden som produsent av rutil fra en forekomst i fast fjell. Rutil utvinnes ellers utelukkende fra placers. Engebøforekomsten har en relativt høy gehalt av rutil, på ca 3,5% TiO_2 og en stor tonnasje på 256 millioner tonn. Rutil utgjør mindre enn 5% av verdensproduksjonen, resten er ilmenitt og mellomprodukter som leucoxen.

Titanmineraler prosesseres via ulike metoder til titandioksid og ev. titanmetall. Hvilke prosesseringsmetoder som anvendes og egnetheten for metallproduksjon avhenger av kjemien tiltitanmineralene.

For metallproduksjon er et høyt titaninnhold viktig. Rutil er det edleste naturlige titanråstoffet, og en stor del av de globale rutilressursene brukes derfor for produksjon av titanmetall eller i sveiseapplikasjoner med høye krav til innsatsfaktoren.

Hvorfor er titan kritisk?

Utvinning av titanmineraler, som ilmenitt og rutil, er nødvendig for produksjon av titanmetall, men ca 90% av all utvinning av titanmineraler går til produksjon av hvitt pigment. Resten brukes primært i sveiseapplikasjoner eller foredles til titanmetall.

EU har siden 2020 vurdert produksjonen av titanmetall som kritisk. Dette skyldes at metallet har stor økonomisk betydning for Europa samtidig som forsyningsrisikoen er høy. Fremstillingen av titanmetall er konsentrert på veldig få land og Kina står for 70% av den globale produksjonen.

Det er flere land som har gruver og utvinning, og forsyningsrisikoen knyttet til titanmineralene anses derfor som mindre. EU har siden 2011 vurdert den økonomiske viktigheten av

titanmineralproduksjonen for Europa som høy.

Titan ble regnet som et strategisk element under den kalde krigen, og utvikling av nye bruksområder ble blant annet drevet fram av romfartsindustrien.

Titanmineraler i Norge

Norge har hatt gruvedrift på titanmineraler siden slutten av 1700-tallet, først for jern og senere for titan.

Norge har en rekke store forekomster av både ilmenitt og rutil og to forekomster i drift.

De største titanmineralforekomstene i Norge inkluderer:

- Tellnes i Sokndal kommune i Rogaland drives av bergverksbedriften Titania. Titania eies av det amerikanske selskapet Kronos Inc. Gruven produserer ilmenitt og vanadium-holdig magnetitt, og har en sidestrøm av metallsulfider med nikkel, kobber og kobolt. I 2023 produserte gruven 630 000 t ilmenittkonsentrat tilsvarende ca 5% av verdens produksjon av titanmineraler.
- Storgangen i Sokndal kommune i Rogaland var i produksjon fra 1916 til 1965, før Titania flyttet aktiviteten til forekomsten på Tellnes, få km sørøst for Storgangen.
- Engebøfjellet rutil- og granatforekomst har vært i drift siden 2024 og er den eneste gruve i verden som utvinner rutil fra en forekomst i fast fjell. Gruven eies av Nordic Mining, som oppgir tonnasjen til 256 millioner tonn med ca 3,5% TiO2.
- Bjerkreim/Egersund i Rogaland. Bjerkreim-Sokndal-intrusjonen er den største lagdelte intrusjonen i Nord-Europa og inneholder flere langstrakte soner som er anriket i apatitt, ilmenitt og vanadium-holdig magnetitt. Prosjektet er under utvikling i regi av selskapet Norge Mineraler som per 2025 har boret nærmere 90 km i forekomsten.

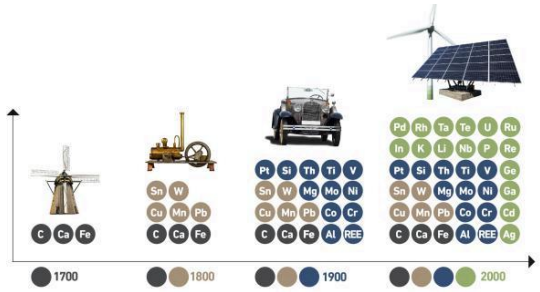
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24 October 2023

EU Affairs

Russia: Europe imports €13 billion of 'critical' metals in sanctions blindspot

 Pascal Hansens  Sigrid Melchior  Maxence Peigné  Harald Schumann

pour billions into mining firms linked to the Kremlin.

About EU Affairs

Since Russia's invasion of Ukraine in February 2022, the 27 EU countries have adopted 11 sanction packages, targeting raw materials including oil, coal, steel and timber. But minerals that the EU considers as "critical" raw materials – 34 in total – still flow freely from Russia to Europe in vast quantities, providing crucial funds to state enterprises and oligarch-owned businesses.

While some of its western allies have targeted Russia's mining sector – the UK recently banned Russian copper, aluminium and nickel – the EU has continued its imports. Airbus and other European companies are still buying titanium, nickel, and other commodities from firms close to the Kremlin more than a year after the invasion, Investigate Europe can reveal.

Between March 2022 and July this year, Europe imported €13.7 billion worth of critical raw materials from Russia, data from Eurostat and the EU's Joint Research Centre shows. More than €3.7 billion arrived between January and July 2023, including €1.2 billion of nickel. The European Policy Centre estimates that up to 90 per cent of some types of nickel used in Europe comes from Russian suppliers.

"Why are critical raw materials not banned? Because they are critical, right. Let's be honest," the EU's special envoy for sanctions, David O'Sullivan, pithily said at a September conference.

The Union is desperate for critical raw materials to achieve its aim of climate

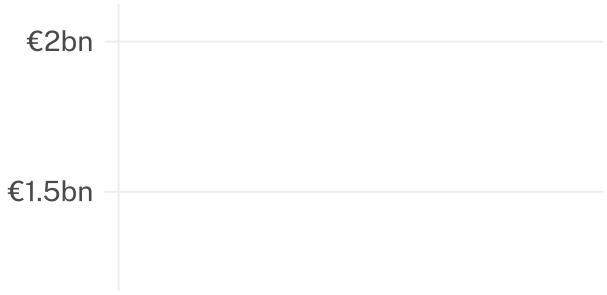
across the globe, and in high demand.

"The war in Ukraine has clearly shown the willingness of Russia to weaponise the supply of key resources. As Europeans, we cannot tolerate that," says Henrike Hahn, a German Green MEP working on the new Critical Raw Materials Act.

Russian critical raw materials still flow freely into the EU

Between March 2022 and July 2023, Europe imported €13.7 billion worth of critical and strategic raw materials from Russia.

Monthly EU imports of critical and strategic raw materials from Russia, in billion euros.



Sources: Eurostat and EU's Joint Research Centre

Europe's imports not only fund Russia's war economy, but also benefit Kremlin-backed oligarchs and state companies. Although the EU has targeted some shareholders, Russia's mining businesses have faced no

Analysis of Russian customs data shows that Vsmpo-Avisma, the world's largest titanium producer, sold at least $308 million of titanium into the EU via its German and UK branches between February 2022 and July 2023. It is part-owned by Russia's national defence conglomerate, Rostec. The two companies share the same chairman: Sergei Chemezov, a close Putin ally. The pair were KGB officers in East Germany in the 1980s.

Both Chemezov and Rostec are under EU sanctions and helped supply tanks and weapons to the Russian army. Brussels has not sanctioned Vsmpo-Avisma directly, but the US did ban exports to the firm on 27 September, saying it was "directly involved in producing and manufacturing titanium and metal products for the Russian military and security services."

Among Vsmpo-Avisma's largest European customers is Airbus, the aerospace giant partly owned by the French, German and Spanish states. Between the start of the war and March 2023, Airbus imported at least $22.8 million worth of titanium from Russia; a fourfold increase in value and tonnes compared to the previous 13 months.

From 14 March 2023, Vsmpo-Avisma stopped identifying buyers in customs filings but nothing indicates a significant change in trends. Titanium imports to France only slightly decreased between then and July 2023, and Airbus still listed the company as a supplier in July.

"We have no comment on the details and evolution of our titanium sourcing volumes," an Airbus spokesperson said. "Generally speaking, Airbus is currently ramping up commercial aircraft production and this is having a mechanical impact on its overall procurement volumes." Even though it will take time, the group is reducing its dependency on Russia, the spokesperson said, adding that a ban on Russian titanium for civil aviation

buyers in customs filings altogether. Yet the data still gives a scale of their fruitful relationship with the west. Nornickel, the world leader in palladium and high-grade nickel, exported $7.6 billion worth of nickel and copper into the EU via Finnish and Swiss subsidiaries between the start of the war and July 2023. It also sent over $3 billion of palladium, platinum and rhodium into Zurich airport. In 2022, almost 50 per cent of Nornickel's sales went to Europe. Brussels has not sanctioned the group nor its chairman and largest shareholder, Vladimir Potanin, an oligarch and former deputy prime minister under US and UK sanctions.



Between March 2022 and July this year, Europe imported €13.7 billion worth of critical and strategic raw materials from Russia.
Alexia Barakou

Aluminium giant Rusal also uses tax havens to funnel minerals to Europe, where it owns the EU's largest alumina refinery in Ireland and a smelter in Sweden. Its Jersey and Swiss-based trading houses brought at least $2.6 billion of aluminium into the bloc in the 16 months following the invasion of

Anti-corruption NGO Transparency International says it does not make sense that the sector has avoided sanctions given the known links. "They are part of the system and fueling Putin's war," says senior policy officer Roland Papp. "So it's perfectly logical to ban those critical raw materials from Russia, as we did for other sectors and goods."

Since the start of the war, other European buyers of Russian metals have included Germany's GGP Metal Powder ($66 million of copper), French arms-maker Safran ($25 million of titanium) and Greece's Elval Halcor ($13 million of aluminium). Dutch logistics firm C. Steinweg also handled at least $100 million of various critical metals on behalf of its customers.

Safran confirmed they are still buying titanium from Vsmpo-Avismo but are working to reduce their Russia purchases. GGP Metal Powder said "there is no real alternative to our supplier from Russia". C. Steinweg said they follow all rules and sanctions. Elval Halcor, Vsmpo-Avisma, Rusal and Nornickel did not reply to requests for comment.

> **“We've increased our dependence on Russia. It was an absolute and serious mistake.”**
>
> — Roland Papp, Transparency International

At the start of the war, Europe was relying on Russian producers for 30 per cent of its nickel, 35 per cent of its alumina and 15 per cent of its aluminium, according to an internal memo by trade body Eurometaux seen by IE. Russia accounted for 41 per cent of the world's palladium production, and up to 25 per cent of its vanadium output.

Savytskyi from Razom We Stand, a Ukrainian NGO. Moreover, "the low density of the population, authoritarian control and practical absence of environmental and human rights protections made investments in the mining of Russia's resources terribly attractive," he adds.

The EU's crippling dependency should have been curbed earlier, argues Transparency International's Papp. "We've had enough time to react. The annexation of Crimea dates back to 2014, the invasion of Georgia even dates back to 2008 15 years ago! And what have we done? We've increased our dependence on Russia. It was an absolute and serious mistake."

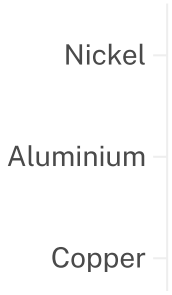
A Polish diplomat said Poland has pressed the EU to “decouple completely” from Russia in several areas, “but for the sake of unity and efficiency in adopting new sanctions packages we have agreed to postpone particular measures until further discussion.”

As EU sanctions require unanimity among all member states, divergent national economic interests can often water down packages. When the ninth set of sanctions banned fresh investments in Russia's mining sector in December 2022, it included an exemption to invest in some mining activities for some critical raw materials. As a result, European companies can still pour cash into Russian mines to extract nickel, titanium and other key metals.

Ukraine

The European Policy Centre estimates that up to 90 per cent of some types of nickel used in Europe comes from Russian suppliers.

EU imports of selected raw materials, March 2022 - July 2023, in billion euros.



Sources: Eurostat and EU's Joint Research Centre

The European Commission won't publicly comment on whether or not it has proposed a ban on critical raw materials. One reason could be that "sanctions are carefully designed to hit their targets while preserving EU interests," an EU source told IE.

Weaning the EU off Russia's critical and strategic materials will be difficult. Replacing suppliers and forging new international partnerships is an arduous process. Finding a raw material, such as titanium or copper, with a similar quality and price of those from Russia is also a challenge.

Imposing tariffs or severing ties too quickly could lead to a global price surge which would harm European buyers while benefiting Moscow. A ban could also prompt India, Iran, and China to intensify purchases, further

would be difficult to implement given global demand challenges and Europe's reliance on Russia. "Overall, with these specific materials, the monetary value of what Russia would lose from the EU import ban, might be smaller than the effect on the EU production," says Ukraine's former trade and economic development minister.

UN trading data shows that while EU imports of Russian copper, nickel and aluminium imports have declined in the past two years, nickel and aluminium revenues remained stable. Russia's nickel sales to the EU were worth $1 billion in the first half of 2021 and were $1.1 billion two years later.

The Union is now trying to reduce its dependency. In March, the European Commission presented its Critical Raw Materials Act (CRMA), a new legislation aimed at reducing EU dependency on third countries for critical raw materials.

"War in Europe is a risk which was not present in the last decades and Russia was known as a reliable supplier," says German MEP Hildegard Bentele, shadow rapporteur on the CRMA at the European Parliament. "The EU should take immediate action to support European companies to decrease and replace their CRM deliveries from Russia as soon as possible."

The High Representative of the Union for Foreign Affairs and Security Policy is expected to propose a 12th package of sanctions in the coming weeks, which will be then discussed by member states. Brussels hopes the package will renew pressure on the Russian economy and sap its fighting strength on the battlefields of Ukraine. Restrictions on critical raw materials does not seem to be on the table.

Editor: Chris Matthews
Graphics: Marta Portocarrero

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Brussels, 16.3.2023
SWD(2023) 161 final

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a Regulation of the European Parliament and of the Council

establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020

{COM(2023) 160 final} - {SEC(2023) 360 final} - {SWD(2023) 160 final} -
{SWD(2023) 162 final}

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GLOSSARY

Term or acronym	Meaning or definition
Raw materials	A substance in processed or unprocessed state used as an input for the manufacturing of intermediate or final products, excluding substances predominantly used for the production of food and feed or as fuel for the production of energy;
Critical raw materials (CRM)	Raw Materials defined as critical in the regulation according to the proposed methodology (i.e. supply risks and economic importance);
Strategic raw materials (SRM)	Raw materials defined as strategic according to the criteria established in the impact assessment, e.g. taking account foresight element and strategic applications;
CRM project	Any planned facility or planned extension of an existing facility active in extraction, processing or recycling of critical raw materials;
Exploration	Mineral exploration is the process of searching for any mineralisation under the ground that can be commercially extracted. Exploration activities, such as mapping, will start over a large area and then target smaller and smaller areas;
Extraction	The primary extraction of ores, minerals and plant products from their original source, including from a mineral deposit underground, mineral deposits under water, sea brine and trees;
Metallurgical processing	The concentration of an ore or secondary raw material by physical, chemical and biological processes, the separation, and the refining, including the modification of a material's chemistry for specific valorisation;
Refining	Step (mainly physical or chemical) of the metallurgical process where the impurities (or unwanted elements) are removed from the concentrated metal, metal alloy or metal compound;
Recycling	Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. Recycling can be "closed loop" or "open loop";
Recovery	Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy;
Ore	A naturally occurring solid material from which a metal or valuable mineral can be extracted profitably;

Mineral	A solid, naturally occurring inorganic substance which can contain a metal or metal compound of economic importance;
By-product	Subsidiary material from ore in which other materials are dominant. By-products are extracted in processing/refining and not directly mined for;
Substitution	Methods to replace or reduce currently used CRMs in materials and products, including by changes in composition of the product or replacement by other technologies;
Circular Economy	A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended, their use is optimised, and products and materials are maintained in their highest value function;[1]
UNFC	The United Nations Framework Classification for Resources (UNFC) is a framework that provides countries, companies, financial institutions and other stakeholders a tool for sustainable development of energy and mineral resource endowments;
SDG	Sustainable Development Goals;
Offtake agreement	A long-term contract between a company that manufactures or produce a given resource and a company that needs to buy that resource. It displays the buyer's commitment to purchase a certain amount of the producer's future output.

[1] Source: Circular economy: definition, importance and benefits | News | European Parliament (europa.eu)

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1. Political context

Raw materials are indispensable for the EU's industry and stand at the very beginning of each value chain. Amongst the non-energy, non-agricultural raw materials that are assessed by the European Commission, some are defined as critical based on objective criteria including their economic importance and their supply risk. Currently, the global production of CRMs is highly concentrated in few countries in the world, both at extraction and refining stages. The European supply of CRMs is therefore highly dependent on third countries, not always like-minded ones (see section 2.1 What is the problem?). Critical raw materials (CRMs) are often produced and used in relatively small quantities[2] but have special characteristics[3] that make them essential ingredients for products in strategic areas such as renewable energy, digital, aerospace and defence technologies. Well-known examples include the rare earths elements found in the permanent magnets used to manufacture wind turbines motors, lithium used for batteries, and silicon used for semiconductors.

Textbox 1: The EU List of Critical Raw Materials and the concept strategic raw materials

The Commission carries out a criticality assessment at EU level every 3 years, starting in 2011, which showed an increasing number of critical raw materials: 14 in 2011, 20 in 2014, 27 in 2017 (based on a revised methodology) and 30 in 2020. The 2020 list was accompanied by a foresight study on strategic raw materials for strategic value chains 2030-2050. In 2023, the Commission presented the 5th assessment (based on 2016-2020 data for 85 screened raw materials) and developed the second foresight study on strategic raw materials for strategic value chains.

The current CRM methodology covers a wide range of economic sectors and relies on two main criteria:

- Economic importance (EI), based on the value added of corresponding EU manufacturing sectors, corrected by a substitution index; and
- Supply risk (SR), based on supply concentration (at global and EU level, weighted by a governance performance index), corrected by recycling and substitution parameters.

Raw materials exceeding the thresholds set for both two criteria are deemed to be at high risk of supply disruption and at the same time economically important, and therefore defined as critical.

2023 CRMs vs. 2020 CRMs			
antimony	gallium	phosphate rock	vanadium
baryte	germanium	phosphorus	arsenic
bauxite	hafnium	PGM	feldspar
beryllium	HREE	scandium	helium
bismuth	lithium	silicon metal	manganese
borate	LREE	strontium	copper
cobalt	magnesium	tantalum	nickel
coking coal	natural graphite	titanium metal	~~*indium*~~
fluorspar	niobium	tungsten	~~*natural rubber*~~

Legend:
Black: CRMs in 2023 and 2020 ; Red: CRMs in 2023, non-CRMs in 2020 ;
~~*Strike:*~~ Non-CRMs in 2023 that were critical in 2020

[2] All the Metals We Mined in 2021 in One Visualization (visualcapitalist.com)

[3] For example, rare earth elements have special conductive, magnetic and fluorescent properties; lithium is an important component of rechargeable batteries because of its high electrode potential.

It is proposed in the preferred policy option to complement this backward-looking criticality assessment by a forward-looking methodology focused on strategic applications. This would lead to a slightly extended critical raw materials list (including besides the classically-defined critical raw materials also such raw materials that are projected to face significant future supply challenges while being essential to multiple strategic sectors – such as copper, nickel or aluminium) and a shorter list of **strategic raw materials** (including only those raw materials with the highest supply challenges and strategic importance). A set of general measures would apply to the list of critical raw materials while a set of more ambitious measures would apply only to the subset of strategic raw materials.

In light of these applications, critical raw materials are key to enable the European industry to meet the political goals of the EU. The European Green Deal[4], the REPowerEU Communication[5], the Joint Communication on Defence Investment Gaps Analysis and Way Forward[6] and the Digital Strategy[7] have all established objectives or targets to achieve the green and digital transitions and strengthen the EU's resilience and strategic autonomy, which depend on the availability of critical raw materials, while the European Commission has already began the implementation of the action plan set up in the 2020 Communication on Critical Raw Materials (see Annex 8 for additional details and lessons learnt).[8]

In 2022, the European Council's adopted the Versailles Declaration[9], which called to "take further decisive steps towards building our European sovereignty" and toward "reducing our dependencies". It called to secure EU supply of critical raw materials, particularly by building on the strengths of the Single Market. Similarly, the European Parliament called for an EU strategy for critical raw materials in its November 2021 resolution[10]. The Conference on the Future of Europe also recommended for the EU to reduce dependence on other countries for critical raw materials[11]. Against this background, the President of the European Commission announced in her State of the Union speech in 2022[12] a new legislative proposal, the European Critical Raw Materials Act, notably to identify strategic projects all along the value chain and to build up strategic reserves where supply is at risk. The initiative forms part of the Commission Work Programme for the first quarter of 2023[13].

This Impact Assessment supports the Commission's proposal for a Regulation, forming the core of the European Critical Raw Materials Act. This regulatory initiative alone, however, cannot ensure secure and sustainable supplies of CRM for the EU economy. Strengthened efforts to diversify international trade and investment, ensure undistorted international markets, the promotion of human rights, high social and environmental standards in partnerships and cooperation with third countries, as well as increased research and innovation efforts to substitute critical raw materials and minimise the environmental impacts of resource extraction, and work on skills and societal acceptance will also be necessary. These aspects are not expected

[4] COM(2019) 640 final, COMMUNICATION FROM THE COMMISSION, The European Green Deal

[5] COM(2022)230 Communication REPowerEU Plan.

[6] JOIN(2022) 24 final JOINT COMMUNICATION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the Defence Investment Gaps Analysis and Way Forward

[7] COM(2022) 4388 final COMMUNICATION TO THE COMMISSION European Commission digital strategy Next generation digital Commission

[8] 172 COM(2020) 474 - Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability

[9] Informal meeting of the Heads of State or Government, Versailles Declaration, 10 and 11 March 2022

[10] REPORT on a European strategy for critical raw materials - (2021/2011(INI))

[11] REPORT ON THE FINAL OUTCOME May 2022, Conference on the Future of Europe (5. Recommendations collected, A stronger economy, social justice, and jobs)

[12] 2022 State of the Union Address by President von der Leyen

[13] COM(2022) 548 final, Commission work programme 2023

to be part of the legislative proposal, but are developed in the accompanying Communication that forms part of the Act.

1.2. Policy context and non-regulatory actions

The European Commission has in place a dedicated strategy since 2008[14], which aims to ensure a fair and sustainable supply of raw materials from global markets, within the EU and through resource efficiency and the recycling of secondary raw materials. This initiative launched the assessment of raw materials' criticality every three years, starting in 2011 (c.f. textbox 1).

In 2020, the Commission presented a dedicated action plan in the Communication on Critical Raw Materials[15] to develop resilient value chains for EU industrial ecosystems; reduce dependency on primary critical raw materials through circular use of resources, sustainable products and innovation; strengthen the environmentally and socially sustainable responsible domestic sourcing and processing of critical raw materials in the European Union; and diversify supply with environmentally and socially sustainable responsible sourcing from third countries, strengthening rules-based open trade in raw materials and removing distortions to international trade.

1.3. Legal context

There is currently no regulatory framework aimed at creating a CRMs sustainable supply chain in Europe and hence increasing the resilience of the CRMs supply chain and reducing the supply risks s. However, a number of EU legal instruments lay down provisions that affect the EU's supply of CRMs. Those instruments relate, among other things, to the conditions and procedures for EU-based CRM projects to obtain a permit, and to the treatment of waste containing CRMs. Similarly, some existing instruments affect the CRM production in third countries and the conditions under which the EU conducts trade in CRM with those third countries. Any efforts to improve the EU's security of supply for CRMs considered in this initiative need to take into account and build on these existing rules and initiatives. These instruments are listed below and Annex 8 explains in detail how they relate to critical raw materials.

Interplay with existing instruments

- Firstly, a range of existing Directives include rules to structure Member States' conditions and procedures for obtaining permits for EU-based projects along the raw material value chain: Strategic Environmental Assessment Directive (SEA)[16]; Environmental Impact Assessment Directive (EIA)[17]; Industrial Emissions Directive (IED)[18]; Habitats and Birds Directives[19]; Water Framework Directive[20]; Environmental Liability Directive[21]
- Secondly, existing EU legislation on waste management includes rules both affecting the operation of EU-based mines regarding the handling of extractive waste and influence the potential to recover and recycle

[14] EUR-Lex - 52008DC0699 - EN - EUR-Lex (europa.eu)

[15] COM(2020) 474 - Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability

[16] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment

[17] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

[18] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions

[19] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

[20] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

[21] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage

critical raw materials from relevant waste streams: Waste Framework Directive (WFD)[22]; Extractive Waste Directive (EWD)[23]; Waste Electrical and Electronic Equipment Directive (WEEE)[24] ; End-of Life Vehicles Directive (ELV)[25].

- Thirdly, a number of EU and international legal instruments lay down provisions that affect the EU's external supply of CRMs. Those instruments aim to ensure undistorted trade and investment in CRMs with third countries, such as bilateral trade and investment agreements, or to protect EU industries from unfair competition from outside the EU, such as trade defence instruments (anti-dumping or anti-subsidies)[26], and WTO obligations.

Finally, there are EU instruments aimed at improving sustainability of the global industry and materials imported into the EU, some of them of legislative nature such as the Conflict Minerals Regulation27. The EU has an extensive network of bilateral trade and investment agreements28 that cover trade and investment in raw materials through general rules covering all goods and services or dedicated provisions aimed specifically at raw materials. The modern EU trade agreements include Trade and Sustainable Development chapters, highlighting how trade can be an important driver for sustainable growth both in the EU and in partner countries.

- Global Gateway is the EU plan for major investment in infrastructure development around the world. It will be used to deploy both soft and hard infrastructure. As such, Global Gateway will be instrumental to support investments in infrastructure projects relevant for our CRM supply chains, to increase global and EU supply and help diversification. The Global Gateway will be the vehicle to assist partner countries with concrete projects in infrastructure and connectivity, while boosting and leveraging concrete private sector investment projects along the critical raw materials value chain.

Interplay with ongoing initiatives

- The proposed Single Market Emergency Instrument (SMEI) includes in its scope critical raw materials, and its provisions, notably with regards to monitoring and stockpiling, can be activated in the vigilance mode and in the event of a Single Market emergency. Details regarding its interactions with the proposal assessed here are explained in the relevant sections, such as the problem section or section 5.2 and Annex 10.
- The proposed Batteries Regulation and Corporate Sustainability Due Diligence (CSDD) contain measures which when adopted will require companies to put in place human rights and environmental due diligence practices when, inter alia, sourcing critical raw materials from both the Single Market and the international markets.
- The proposed revision of the Industrial Emissions Directive (IED)[29] widens its scope to also cover the extraction and treatment of industrial minerals and metals.

[22] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

[23] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC

[24] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)[24]

[25] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles

[26] https://policy.trade.ec.europa.eu/enforcement-and-protection/trade-defence_en

[27] Regulation (EU) 2017/821 of the European Parliament and of the Council of 17 May 2017 ... and gold originating from conflict-affected and high-risk areas

[28] https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/negotiations-and-agreements_en

[29] Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste. COM/2022/156 final/3.

- The Commission's proposal for a Regulation on Forced Labour[30] covers also CRMs, and so does the EU Strategy on Rights of the Child[31].
- The proposed Ecodesign for Sustainable Products Regulation[32] will establish design requirements for products put on the EU market with the aim, inter alia, of extending the lifetime of products, increasing recyclability and recycled content, and making information relevant to circularity and sustainability available along value chains to businesses, consumers and authorities through Digital Product Passports based on digital markers and identifiers, thus contributing to reducing material demand, facilitating recovery of raw materials and increasing transparency and consumer awareness.
- The proposed Regulation on nature restoration33 aims, among others, at covering at least 20% of the EU's land and sea areas by 2030 with nature restoration measures, and eventually extend these to all ecosystems in need of restoration by 2050. The proposed Regulation builds on existing legislation. When adopted, the Regulation should work in synergy with other policy initiatives and legislation.

Regulatory gaps analysis

The CRM Act would be the first piece of EU legislation dedicated to CRMs. No other piece of legislation expressly targets the security of EU supply CRMs by introducing a dedicated monitoring, stockpiling and company risk preparedness system and contributing to the build-up of EU capacities along the value chain. The proposed Single Market Emergency Instrument covers some of these aspects, but most of its provisions only apply once vigilance or emergency mode has been triggered, and thus not address the problem in advance and structurally through a permanent CRM-centred mechanism. Environmental legislation ensures a high level of sustainability of CRM extraction and processing within the EU but is so far not complemented by measures that would encourage European industry to make use of the raw materials potential on EU soil as well as to further develop the processing and recycling stages of the CRM value chain. This initiative is expected to increase the share of such highly sustainable EU production. Waste legislation addresses the risks associated with waste and generally prioritises reuse and recycling, but its provisions do not sufficiently address the challenges specific to CRM recovery (see chapter 2.2.2.5).

Regarding sustainability, the Corporate Sustainability Due Diligence (CSDD) proposal, which covers CRM companies, would oblige companies to address adverse human rights and environmental impacts in their own operations, subsidiaries and value chains. It would apply on a company basis and ensure that adverse human rights and environmental impacts are monitored and addressed. The CSDD however would not apply on a product or material level, i.e. it would not allow buyers of CRMs to see and compare the environmental footprint associated to the product/material they are buying. In the case of climate impacts, for example, a CRM producer may be in full compliance with its legal obligations and have an overall decarbonisation strategy in place, but the CRMs it sells may nevertheless be associated with higher emissions than those produced by a competitor (e.g. due to lower ore grades, a more carbon-intensive energy mix or energy-inefficient production processes). Giving a buyer transparency over this may make him more willing to purchase the more sustainable type of CRM, but the CSDD does not provide for this.

Similarly, in the field of social impacts, the CSDD guarantees that CRM producers selling on the EU market respect the minimum standards imposed by international conventions, such as the prohibition of child and forced labour, but it does not incentivise compliance with higher standards, e.g. such developed by certification bodies (see Driver 3.1) on meaningful involvement of local communities and fair treatment of workers, in the production of a CRM.

In addition, while product-level footprint requirement (such as the carbon footprint included in the proposed Batteries Regulation and potentially under the revised Ecodesign framework) take into account the impact associated with CRM production at the point when they are incorporated into the regulated products, there are many instances where CRMs placed on the market in the EU are not covered: First, when CRMs sold in the

[30] 2022/0269 (COD)
[31] https://op.europa.eu/en/publication-detail/-/publication/bac6e66a-a3d9-11eb-9585-01aa75ed71a1/language-en
[32] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC. COM/2022/142 final
33 COM(2022) 304 final.

EU are thereafter incorporated into products intended for export; second, CRMs used in applications or products other than the set of regulated products (e.g. even for the "battery raw materials" lithium and cobalt, half of their EU consumption is related to other applications, such as ceramics or steel manufacturing). While the latter may shrink over time with the addition of more Ecodesign measures, these are unlikely to come close to covering all CRM applications in the foreseeable future. Furthermore, the implementation of Ecodesign measures for specific products can benefit from the availability of data on the environmental footprint of the CRMs incorporated in them, such that environmental footprints on both materials and products can work well together.

The Conflict Minerals Regulation addresses specifically four raw materials (tin, tungsten, tantalum and gold), two of which are critical, but its provisions are limited to diligence obligations on importers and smelters of these materials, with the narrow aim of preventing their sourcing from contributing to armed conflict and forced labour. It does not allow for comparison of environmental footprint, and does not include any measures to increase EU capacities along the value chain or improve monitoring for these four raw materials.

2. PROBLEM DEFINITION

A more detailed description of the problem context, problems, and their consequences and drivers is included in Annex 10.

2.1. What is the problem?

The overarching problem this initiative aims to address is the EU's lack of secure access to critical raw materials. Given the central importance of these materials to our green and digital transition, as well as critical sectors such as health and defence, a disruption in the supply of critical raw materials would have significant adverse consequences for the EU's industry, security and the achievement of its political goals.

A key component of this problem is that the EU currently relies almost exclusively on imports for many of these raw materials[34]; more importantly, within these imports, suppliers are highly concentrated[35], and the main suppliers are in many cases exposed to significant environmental, social and governance risks[36](see figure 1). These factors and the economic importance are in fact the main criteria in the EU's criticality assessment (see textbox 1).

In some cases, the supply share of one country is above 90%, for instance China for light rare earths, heavy rare earths, gallium and magnesium; Turkey for Boron.. For around a third of the minerals assessed in the criticality assessment, and half of the critical raw materials, EU supply is more concentrated than global supply (for bauxite, borate or manganese). This concentration expands along the value chain, with the processing stage being even more concentrated than the extraction stage for some materials, such as lithium, magnesium, or germanium. China controls 56% of the global capacity for refined lithium, 60% for refined cobalt, 58% for refined manganese[39]. In addition to the concentration of supply in single countries, some actors have expanded their dominance of the global value chain by gaining control economic activities and assets in third countries, such as China controlling cobalt mines in Congo (Chinese shareholders control two firms in Congo that together account for 13.8% of the world output of cobalt [37] (c.f. further details in Annex 10 – context).

This degree of concentration puts the EU's security of supply at risk, as dominance over CRM supply chains has been used already in the past, through export restriction for instance, to leverage the suppliers' interest

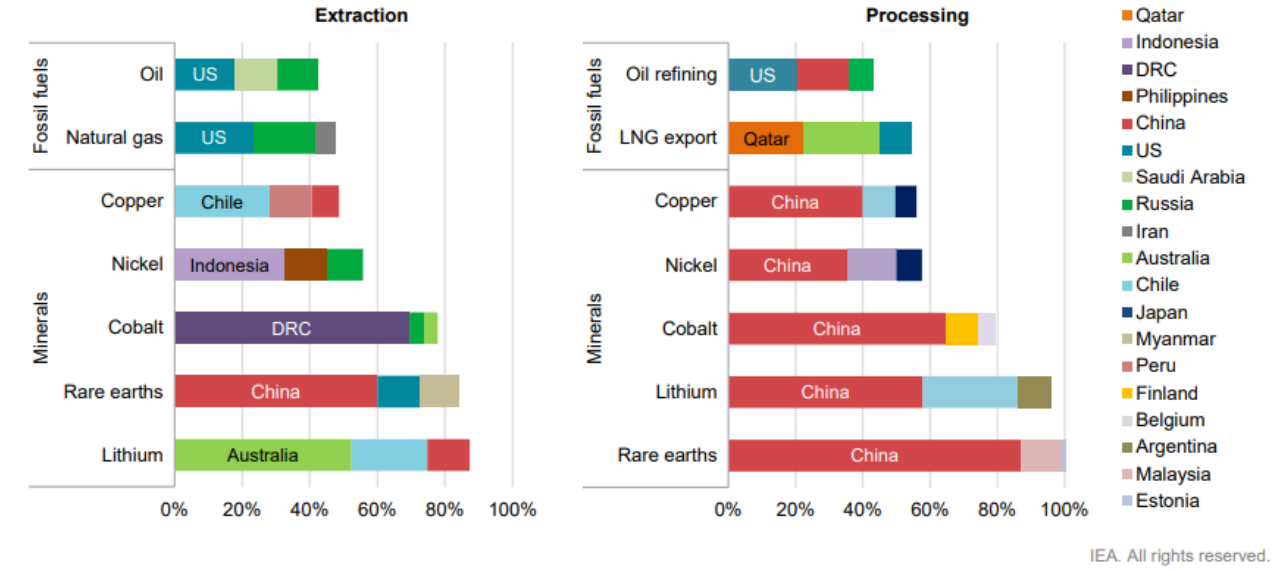
[34] In fact, for 28 out of 87 individual materials or groups assessed in the 202" Study on the EU's list of Critical Raw Materials, the import reliance is 100% at the extraction or processing stage, and above 80% for another 16 materials

[35] The share of the biggest supplier to the EU is 99% for the group of light rare earth elements (China), 100% for the group of heavy rare earth elements (China), 99% for borates (Turkey), 97% for magnesium (China), 79% for lithium (Chile) and 63% for Cobalt (DR Congo), source: Study on the EU's list of Critical Raw Materials (2023): Final Report, European Commission 2023.

[36] See IEA (2021) report on Clean Energy Minerals, page 126-131.

[37] "Who controls the world's minerals needed for green energy?" Luc Leruth (Tbilisi University) and Adnan Mazarei (PIIE), August 9, 2022

over the buyer country's industry (c.f. Annex 10, Consequences of the problem).[38]



Notes: LNG = liquefied natural gas; US = United States. The values for copper processing are for refining operations.
Sources: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020).

Figure 1: Share of top three producing countries in production of selected minerals and fossil fuels (IEA)[39]

This high level of supply concentration today poses a risk in itself, which the EU is seeking to address through global actions to increase the diversification of its industry's supply (see Textbox 2, in section 5.1 on the baseline scenario).

But even leaving supply diversification aside, the global market for CRMs faces significant challenges: The EU will require substantial additional amounts of critical raw materials for meeting the needs of the green and digital transitions, and in light of the increased defence needs in response to Russia's invasion of Ukraine. This will lead to vastly increased EU and global demand, while supply is constrained for several reasons (long project lead times, social resistance to increased extraction, limited circularity potential for key CRMs in the medium-term). At the global level, the International Energy Agency (IEA)'s 2021 Clean Energy Minerals report[40] predicts that total mineral demand[41] will increase by a multiple of between 2 and 4 times between 2020 and 2040,[42] and demand for battery-related materials such as lithium up to 42 times (different scenarios for demand expansion are assessed under textbox 3 in Annex 10.). This rise in demand creates a real risk of supply shortages and increased market volatility over the coming years. As projections point to this future demand/supply gap, the expansion of primary and secondary production in the EU to ensure a higher level of self-reliance appear as an important way of mitigating the problem's potential consequences.

[38] See IEA (2021) report on Clean Energy Minerals, page 126-131.
[39] IEA (2021): Clean Energy Minerals. The Role of Critical Minerals in Clean Energy Transitions – Analysis - IEA
[40] IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions
[41] Including chromium, copper, lithium, nickel, cobalt, manganese, graphite, molybdenum, platinum group metals, zinc and rare earth elements.
[42] Page 46 of IEA (2021): Clean Energy Minerals.

2.1.1. Consequences of the problem

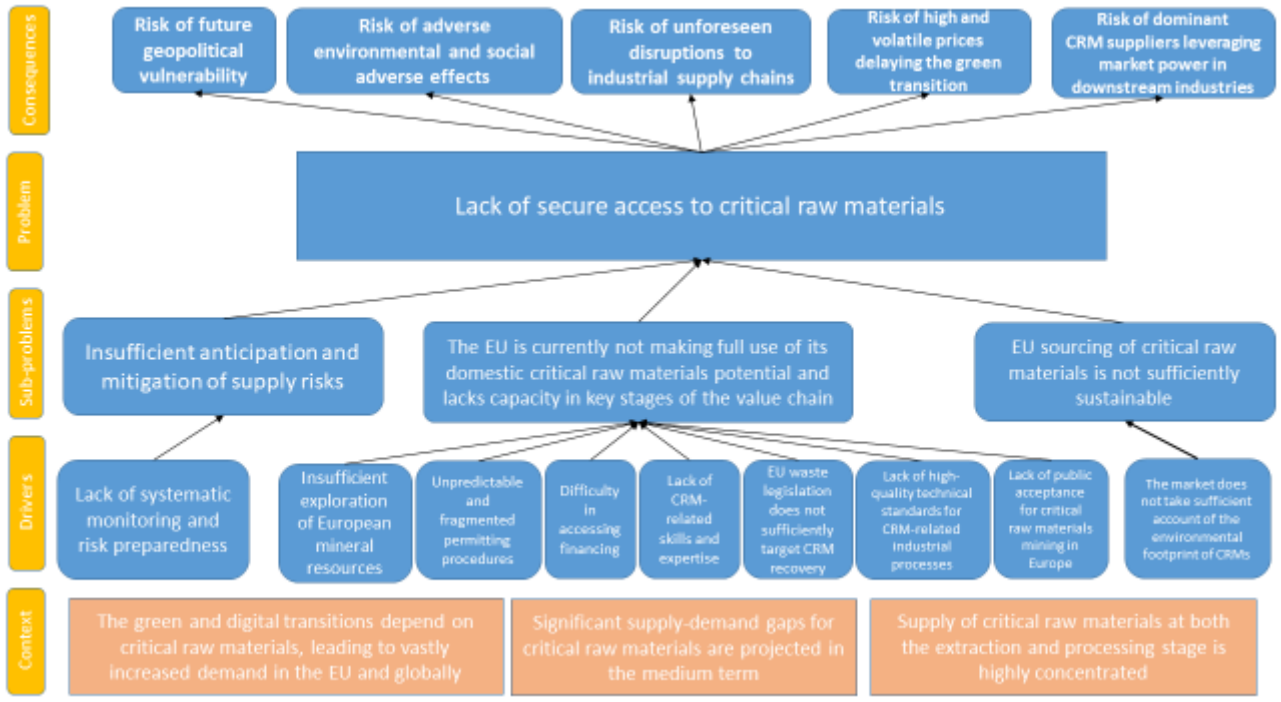
If the EU does not contribute to the required ramping up of CRM production globally by developing European sources, the EU's reliance on highly concentrated imports might continue with the following risks for the EU economy (explained in detail in Annex 10):

- Risk of geopolitical vulnerability
- Risk of adverse environmental and social adverse effects
- Risk of unforeseen disruptions to industrial supply chains
- Risk of high and volatile prices delaying the green transition

Risk of dominant CRM suppliers leveraging market power in downstream industries

PROBLEM TREE

-



2.2. What are the sub-problems and their drivers?

As stated above, the main problem relates to the overall lack of secure access to CRMs for the EU. In light of ongoing international actions (see textbox 2 in section 5.1), the sub-problems addressed below focus on analysing the main impediments to the development of a competitive European CRM value chain, as well as on risk preparedness of offtakes and the sustainability of CRM sourcing.

2.2.1. Sub-problem 1: Insufficient anticipation and mitigation of supply risks

2.2.1.1. Driver 1.1: Lack of systematic monitoring and risk preparedness

The recent experiences of Covid-19-related supply chain disruptions have created a rising awareness among EU companies of the need to develop risk management tools. Companies in the open public consultation

(OPC) reported having suffered from the price volatility (34%), supply disruptions (29%) and supply shortages (22%) in their supply of CRM in the last 5 years, while only 4% reported not having experienced any supply problems. Their supply of CRMs is deemed as being more at risk than their supply of other inputs by 26% of companies, with only 3% disagreeing[43]. Considering the wider issue of supply chain resilience, there is evidence that companies' inventories increased in response to the disruptions brought about by the Covid-19-related supply chain disruptions and in particular the chips-shortage.[44]A survey conducted by the German Chamber of Industry and Commerce (DIHK) among its member firms in the summer of 2021 finds that 57% of companies across all sectors intend to increase their stockpiling in order to secure their own production capacity. 17% of companies reported the use of recycling and substitution.[45]

However, risk management by companies might not be sufficient to address the growing challenges given the problem's geopolitical dimension and the often complex and opaque value chains for CRM markets, which require a level of sophistication that most companies do not possess. In the OPC, 56% of respondents agree or strongly agree that companies would benefit from public monitoring programmes, with only 3 % of respondents disagreeing.

At Member State level, only two governments have established institutions to monitor critical raw materials supply for their industry: Germany (German Mineral Resources Agency/DERA)[46] and France (French Observatory of Mineral Resources for Industries/OFREMI)[47]. Other Member States have geological agencies and expertise in ministries or advisory bodies but these do not, to the best of the Commission services' knowledge, systematically monitor global markets and the risks affecting domestic raw materials consumers.

At **European level**, the European Commission has developed the criticality assessment (described in textbox 1) to periodically review global production shares, EU imports, recycling rates, applications etc. for a broad set of raw materials and identify those that are the most critical, based on data from the preceding 5 years. The 2020 criticality assessment was accompanied by a 2030/2050 foresight analysis of critical raw materials used in strategic sectors and technologies[48]. These and further studies are contained in the Raw Materials Information System (RMIS).[49] The Commission also maintains several expert groups and networks involving experts, industry, civil society and national authorities to advise on its policymaking and to enable an exchange of information and best practices.

However, none of these frameworks provide operational capabilities to monitor markets in real-time, identify risks in the short- to medium-term future or support companies in their risk management efforts, nor do they establish an operational framework for coordination.[50] In the OPC, 53% of respondents agree or strongly agree that Member State authorities do not have in place sufficient monitoring mechanisms allowing them to assess supply risks and anticipate problems. 58% agree or strongly agree that Member State authorities do not sufficiently cooperate and coordinate in monitoring CRM supply chains.

[43] The other companies did not express an opinion on this question.

[44] Anecdotal: Chip Makers Stockpiled Key Materials Ahead of Russian Invasion of Ukraine - WSJ; Nintendo Appears To Be Stockpiling Raw Materials, Doubles Its 2019 Spending On Supplies | Nintendo Life; Comprehensive: New PMI Comment Tracker dataset reveals key insights into the global supply chain | S&P Global (spglobal.com)

[45] DIHK-Umfrage zu Lieferengpässen und Rohstoffknappheit

[46] BGR - Contact (engl.) (deutsche-rohstoffagentur.de)

[47] Launching of OFREMI: French Observatory of Mineral Resources | BRGM

[48] European Commission, Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020

49 Raw Materials Information System (europa.eu)

50 The Single Market Emergency Instrument partially covers such tasks, but only applies when a significant disruption is expected (vigilance mode) and does not provide expertise on critical raw materials markets. (see Annex 10)

In addition, companies' preparedness is mainly limited to large companies with experience and sophistication in managing CRM supply risks[51]. The costs of disrupted value chains for the wider economy can be massive; the insurer Allianz, for example, estimates that disruptions in the chips value chain in 2020 and 2021 cost EU-based carmakers around EUR 100 billion.[52] This is partly due to upstream producers not taking sufficiently into account the effects the disruptions of their inputs have on firms further down the value chain and therefore prepare for these situations on a level that is socially not optimal. Additionally, complex global supply chains make it harder for companies to spot risks earlier in the value chain, further aggravating the situation[53].

Member States' preparedness to supply disruptions is also uneven. In response to a targeted consultation[54], some reported the development of stockpiling systems to mitigate supply risks, rarely covering CRMs; most did not report any CRM-relevant stockpiles, whether because of confidentiality reasons or because they do not exist. Most Member States who replied to the questionnaire however supported further EU coordination on this matter (DE, EE, FR, PL, PT) to enhance their industry's resilience, given the rising importance of CRM in the economy, albeit the extent of the EU's role differs. At EU level, the proposed SMEI contains a mechanism to build national strategic reserves in the event of a threat/incident with potential to significantly disrupt the supply chain (Single Market emergency). Nonetheless, there is no permanent assessment and stockpile coordination specific to CRMs, which is a policy gap given the need for enhanced preparedness. Indeed, alike regular monitoring, risk assessment and stress tests, mitigation strategies such as stockpiling of CRMs (or diversification of suppliers when feasible) are considered as a way to cope with supply disruptions[55], whose frequency is expected to rise in a context of foreseen supply/demand gaps[56].

2.2.2. Sub-problem 2: The EU is currently not making full use of its domestic critical raw materials potential and lacks capacity in key stages of the value chain

The EU is currently a minor player in terms of critical raw materials production. This is true at both the extraction and the processing stage (see Annex 10 – context). While the quality and accessibility (given high population density and environmental protection areas in the EU) of geological occurrences (see Annex 10 – sub-problem 2) certainly plays a role in explaining the low investment into critical raw materials projects at the extraction stage, the same is not true for the later stages of the value chain: As discussed in textbox 4 of Annex 10, at the processing/refining stage, energy costs are the determining factor for location, while for recycling operations both energy costs and the availability of waste streams play a role. This is particularly evidenced by the case of China, which is dominant in processing for many critical raw materials without being the dominant country at the extraction stage (see figure 1 above).

51 KÖSTER, H., NEUBERT, F. P., DIERKSMEIER, K., ADELMANN, L., LENTGE, H., SCHMIDT, P. (2022): Securing raw material supply: Benchmarking of measures of foreign manufacturing companies and recommendations for action.

52 https://www.allianz.com/en/economic_research/publications/specials_fmo/Europe-automotives.html

53 On academic level, the propagation of supply shocks and costs of supply chain disruptions are studied by Carvalho et al. (2021) with the example of the Great East Japan Earthquake of 2011. They show that complex economic interlinkages between affected areas and non-affected areas aggravate the magnitude of the shock, doubling it. Carvalho et al., Supply Chain Disruptions: Evidence From the Great East Japan Eartquake, in Quarterly Journal of Economics (2021)

54 See Annex 2, Raw Materials Supply Group.

55 IEA (2021), The Role of Critical Minerals in Clean Energy Transitions, IEA, Paris

56 Supply chain challenges: Wind Turbines and magnets" Science for Policy Brief, 1 July 2022, Joint Research Center, European Commission". In "Criticalities in Supply Chains for REPowerEU Plan", JRC132109 Note: The over-proportional increase in demand for rare earth elements stems from the fact that in particular the offshore and large-scale wind turbines contain large amounts of rare earth elements.

2.2.2.1. Driver 2.1: Insufficient exploration of European mineral resources

Exploration is a precondition for any extraction project. As noted in Annex 10, exploration is a high-risk business and therefore structured in stages of increasing cost and certainty on the mineralogical and economical properties of the project.

At global level, exploration spending (public and private) for non-ferrous metals[57] is growing (after a slump in the early 2010s) and was estimated at USD 9.8 billion in 2019, while the share of EU was less than EUR 300 million. Within this sum, three Member States – Finland, Sweden and Spain – accounted for 50% of the total spending.[58] While the EU's exploration budget is increasing, it remains very low compared to other world regions, accounting for about 2% to 3% of global exploration expenditure in 2010-2022 (see Annex 10 – Driver 2.1) while the European continent represents around 7% of the Earth's landmass.

Since mining companies generally focus their exploration budget on a well-defined, small area covered by an exploration permit, public/general exploration is needed at regional level to define areas of mining interests for each specific mineral. Member States' spending for these regional (or, for smaller Member States, national) surveys existed until the end of 1980's and significantly decreased in the 90s onward.[59] In addition, these surveys were focused on materials of economic interest at that time and not on the critical raw materials needed today for the green and digital transition or for resilience and security purposes. Previous regional exploration surveys were also limited to the first few meters of the underground for technological and budgetary reasons. Advances in technological tools for raw material exploration at the end of the 1990s (mainly geophysical methods) have permitted to significantly enhance the knowledge on material resources potential, up to several hundred meters deep. The generalised lack of investments during the past decades on geological exploration by Member States (specifically on the critical raw materials and with the most advanced technology tools) has led to a general lack of knowledge regarding the true potential of critical raw materials in the EU to the present day. This impedes the further exploration by private companies on specific sites of mining interest and further exploitation.

Despite a current scarce mining industry, Europe has a long history of mining industry that resulted in the creation of a large amount of mining tailings[60] across the continent, mostly in closed mines. Since mining companies generally focused on one specific substance only (mostly a base metal), some of these mining tailings have been recently recognised as major potential sources of critical raw materials across the EU.[61] However, to which extent and for which elements the reprocessing of these mining tailings could be an economically viable source of critical raw materials remains mostly unknown due to a lack of proper exploration of mining tailings in the EU. Several Member States map the tailings, for instance the Polish Geological Survey has a dedicated web-tool showing identified sites.[62] The challenge is then to identify the critical raw materials in each of these tailings and develop a technology and business model to extract them. Several pilot projects of reprocessing mining tailings from selected sites to produce critical raw materials are currently underway in the EU (notably under the EIT Raw Materials NEMO project[63]), but delivering the full

[57] A class of metals that includes most CRMs, as well as the precious metals gold, silver etc., and the base metals aluminium, copper, zinc etc.
[58] S&P Global Market Intelligence, 2019
59 Regueiro y González-Barros, Manuel & Espi, Jose. (2019). The returns on mining exploration investments.. BOLETÍN GEOLÓGICO Y MINERO. 130. 161-180. 10.21701/bolgeomin.130.1.010.
60 Tailings are the waste materials left after the target mineral is extracted from ore.
[61] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills; pg. 93-98 of SCRREEN-D3.2-Identification-and-quantification-of-secondary-CRM-resources-in-Europe.pdf
[62] https://cbdgportal.pgi.gov.pl/haldy/
[63] Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy (h2020-nemo.eu)

potential of this source of critical raw materials would require a proper evaluation of the resources through specific exploration across Member States.

2.2.2.2. Driver 2.2: Unpredictable and fragmented permitting procedures

CRM exploration, mining, processing, refining and recycling, can have significant impacts on the environment and local communities.[64] Therefore, various areas of EU and national legislation set rules related to their planning and operation (an overview of relevant EU law is included in Annex 8) to mitigate the risk of causing significant adverse environmental effects. Compliance with these rules is ensured through the obligation to obtain several permits before starting operations. The costs and time associated with associated procedures and the likelihood of obtaining a permit are key considerations underlying CRM investment decisions. Currently, the unpredictability of the length of national permitting processes and of the criteria for the assessments and documentation required are often reported as barriers to increased investment[65]:

- For raw materials extraction projects, the MINLEX study showed that times to obtain a permit (related to all relevant rules, not only environmental) can vary between procedures from 3 months to 3 years.[66] More problematically, outliers can be found (for CRMs, for example, ongoing cases can be found lasting up to 4 years[67]). One reason for unpredictable timelines is that the procedure for performing the necessary environmental assessments is not consistently implemented. The average duration of the procedure provided for in the EIA Directive (for all projects in scope, including CRM projects), for example, was, according to the most recent data, approximately 11.6 months, but with figures ranging from 5 to 27 months.[68]
- Similarly, differences can be observed in the structure of the procedure, with various levels of authorities (local, regional, and national) involved in this process. The "one-stop shop" concept allows applicants to interact with a single authority and facilitates efficient coordination among authorities. Although EU law already facilitates use of a "one-stop shop", the MINLEX study showed that only some jurisdictions do so and that, without distinguishing per type of mineral, an average of 3 authorities were involved for exploration projects and an average of 4 authorities for extraction projects.[69]
- Environmental assessment procedures are organised differently across Member States also in terms of content. First, the number of different environmental assessments required differs between Member States. Second, there is often a lack of clarity about the scope and level of detail required in the environmental assessment leading to multiple exchanges and new requests between the developer and the competent authorities.
- Stakeholders also point out that responsible authorities sometimes lack sufficient expertise and resources.[70] It should also be noted that, in addition to the permitting procedure as such, judicial appeals can also lead to delays and often cause increased unpredictability.

[64] Mononen, Kivinen, Kotilainen, Leino (2022): Social and environmental impacts of mining activities in the EU. Study requested by the PETI Committee of the European Parliament. Social and environmental impacts of mining activities in the EU (europa.eu)

[65] For example, the length and complexity of permitting procedures was the main reason for the lack of private investment in CRM projects identified by respondents to the OPC. As one company respondent put it: 'Projects along the value chain – such as mining or secondary.

[66] MinPol/European Commission (2017): Legal framework for mineral extraction and permitting procedures for exploration and exploitation in the EU. Final report "Minpol (2017)" in the following.

[67] The Sakatti project in Finland and the Mina do Barroso project in Portugal, see more detail in Annex 10.

[68] GHK (2010), Collection of information and data to support the IA study of the review of the EIA Directive. The average duration of an EIA ranges from 7 months or less (4.75 in Estonia, 5 in Slovakia, 6.5 in Latvia, 7 in Greece) to more than 20 months (21 in Denmark, 27 in Spain). New figures are expected in 2024.

[69] Minpol (2017)

[70] This point was made in the position papers submitted by Junta de Andalucia, Aurubis AG, Vulcan Energy Resources and EIT Raw Materials.

2.2.2.3. Driver 2.3: Difficulty in accessing financing

The rapidly increasing demand for many raw materials needed for the green and digital transition and for strategic sectors relevant for security and resilience translates into massive investment needs, both globally and in Europe. According to estimations by Commission services, the investment needs to ensure the supply of 25% of European demand of the five main raw materials for batteries (lithium, cobalt, nickel, manganese and natural graphite) from domestic sources amount to EUR 7 billion by 2030 and 13.2 billion by 2040.[71] Assuming a share of public spending to realise these projects comparable to the American Battery Materials Initiative, public support of EUR 2.7 billion by 2030 and 4.7 billion by 2040 would be required[72].

Other strategic raw materials are also likely to require large investments in light of the green transition; e.g. copper for electrifying infrastructure, silicon for solar panels, platinum group metals for hydrogen electrolysis. The European Raw Materials Alliance[73] has identified potential investments of EUR 1.7 billion for rare earths extraction, refining and recycling as well as magnet production, which would ensure a supply of 20% of European demand along the value chain by 2030. For other CRM, their potential investment cases amount to EUR 3.1 billion, fulfilling between 20 and 60% of projected EU demand in 2030 for different relevant raw materials.[74]

Several CRM market-specific factors complicate access to (public and private) finance. The volatility of prices for CRMs makes it hard for investors in projects at all stages of the value chain to predict earnings, especially in the medium to long term. Meanwhile, given the long lead times and potential permitting delays (see previous chapter), significant investment decisions have to be taken years before a project starts gaining operational revenue. In addition, global markets for many critical raw materials are small, highly concentrated and opaque[75], increasing the risk premium that needs to be paid compared to other markets. To provide financing, the financial institutions need to possess in-depth knowledge about mining project development and global raw materials markets to be able to assess CRM projects. Maintaining this expertise in-house is difficult considering the small size of the European raw materials sector. While all such factors are not unique to the CRM market and investors routinely deal with such risks (ultimately, high returns on such projects should compensate for the risk taken and the resources invested), their aggregation does make the financing of CRM projects very costly and, given the limited overall size of the EU's mining, processing and refining industries, it can be hard to find any partners willing or able to provide the type of financing required.

Based on discussions Commission services had with various European public and private financial institutions, the following observations can be made on the state of financing for the different stages of the critical raw materials value chain:

- Exploration: Most exploration companies active in Europe are based outside of the EU. Most interviewed private and public financial institutions have not been involved in financing exploration projects and stated that this was due to the high risk involved. The European Bank for Reconstruction and Development (EBRD) is the only notable exception, with a team dedicated to this area and the ability to support such projects. Exploration financing mostly comes in the form of equity or quasi-equity to project companies set up *ad hoc*.

[71] Note that, as explained in Annexes 5 and 12, this refers to the refining and recycling stages for all five raw materials, while the cost of establishing 25% extraction in Europe is only included for lithium. This limitation is due to both the lack of information about extraction project costs and the limited potential for greater extraction in the EU of the other raw materials.
[72] The calculations can be found in the description of the driver in annex 5 and further methodological details in Annex 12
[73] https://eitrawmaterials.eu/wp-content/uploads/2021/09/ERMA-Action-Plan-2021-A-European-Call-for-Action.pdf
[74] Source: Overview of the current state of the investment pipeline provided by ERMA to Commission services (not public).
[75] https://www.ft.com/content/46e5c98e-f9cd-4e88-8cd5-23427522c093: Financial Times: Tesla supplier warns of graphite supply risk in "opaque" market. Syrah Resources says lack of transparency over pricing in China-dominated market poses challenge for financing.

- Extraction: While public institutions have limited capabilities to engage, some private financial organisations have dedicated metals and minerals investment team, usually requiring a large corporation to finance it though their balance sheet. Financing of junior miners is generally considered very risky and the private financial sector is not willing to engage. Furthermore, for mining projects in third countries, the involvement of an Export Credit Agency for risk sharing is key. Financing of investment projects would be usually done on a syndicated basis. Member States started to implement some measures to promote investments in the CRM field in third countries (including extraction)[76].
- Processing/refining: to finance processing/refining projects, a stable and secure supply of critical raw materials would have to be ensured, currently not the case for a number of critical raw materials. Financing of integrated projects (mining + processing/refining) is considered high-risk. Private financial institutions are willing to engage if a large established client with strong credit rating sponsors and finances the project through its balance sheet (corporate finance). The role of energy prices and the price volatility of the relevant critical raw materials has also been mentioned as important in determining the viability of European refining projects.[77]
- Recycling: The interviewed banks have little experience so far on this but generally are willing to engage. One of the main issues for the viability of this type of investment is the steady supply of material for recycling.

Overall, the results from the open public consultation and the targeted consultations of banks show that access to finance is considered a major barrier to investment in specific stages of the critical raw materials value chain in Europe[78]. In this Impact Assessment access to finance can refer both to a framework that allows to best assess the relevant funding and investment vehicles available as well as the provision of actual funds.

In section 5.2, pillar E.2, the Union funds available for CRM are listed. While some projects, especially for such involving recycling and located in an assisted area, should have several possibilities to attract funding, others, such as no less important extraction projects, especially such located in non-assisted areas, are likely to struggle to fill gaps in private financing with public funds.

Additionally, projects may sometimes struggle to identify available funds given difficulties in assessing their eligibility against the several conditions attached. While other countries' funding programmes are either targeted at raw materials (e.g. JOGMEC in Japan, see also Annex 7) or designed in a simple way (e.g. the US Inflation Reduction Act, using tax breaks), the EU has a variety of relevant programmes. This is a problem when, as is currently the case, there is no coordinating capacity to help CRM project developers find the right combination required to realise their projects financially.

CRM projects, especially at the refining and recycling stages, can be very energy-intensive. While it is assumed in this report that the extremely high energy prices seen in 2022 will not last into the medium term and more additions of affordable decarbonised sources to the energy mix will bring prices further down, it is likely that EU energy prices will stay higher than those in other regions. This constitutes a challenge for the CRM Act ambitions of building up additional capacity along the CRM value chain, particularly if prices stay high for long. The CRM Act itself will not be able to address this challenge, but the Commission is working

[76] Examples in this respect are the German UFK programme, which provides a government guarantee for privately financed projects in third countries provided that a long-term off taker agreement exists with a German client; and the French Bpifrance's Strategic Project Insurance, introduced in 2018, which provides an 80% insurance for projects located in France or involving a French business partner.

[77] See also the results of the public consultation.

[78] 51% of respondents to the open public consultation agree or strongly agree that accessing private financing for CRM projects in the EU is difficult and a challenge for the expansion of the EU's critical raw materials capacities; many respondents are neutral on this question; 9 % disagree or strongly disagree. 56% of respondents agree or strongly agree that there is a difficulty to access public funding in the EU; 4 % disagree or strongly disagree. 64% of the 259 respondents to the open public consultation agree or strongly agree that the price volatility or unpredictability poses a challenge to the roll-out of CRM projects in Europe. Some stakeholders make the point that the absence of mining activities in the EU taxonomy would make funding and investment unattractive (see Annex II).

on other files to improve the situation, for example by updating the EU's Temporary Crisis Framework (to become the Temporary Crisis and Transition Framework), (e.g., to offset the higher energy cost compared to its international competitors).

2.2.2.4. Driver 2.4: Lack of CRM-related skills and expertise

The mining sectors employs 3.7 million people worldwide (1.5 million in developed countries, 2.2 million in developing countries). Work force is considered one of the top business risks and opportunities in mining and metals[79]. The limited number of projects in the EU targeting the raw materials value chain has led to a skills shortage, as jobs related to mining (from mining engineers to expert in national administrations) have diminished in the past decades. Mining and metals companies are facing their greatest ever talent shortage following a massive wave of retirements and resignations. The emergence of the EU CRM value chain would create further demand for skilled workers, thereby posing a risk for shortage increase if no action is undertaken. The materials dimension of the battery value chain alone may create up to around 200 000 jobs in 2030 and 0.5 million jobs when in full transition (after 2030).[80]

2.2.2.5. Driver 2.5: EU waste legislation does not sufficiently target critical raw materials recovery

As most critical raw materials are metals, they are in theory highly recyclable. Currently, however, the share of recycled CRMs is very low (see Annex 10). This is due to a combination of factors: most CRMs are used in low concentrations as part of alloys or other mixtures, which make the recovery processes from end-of-life products technically and economically complex and difficult; the total amount of many CRMs used has also not been large in the past, as important markets (e.g. renewables, electric mobility, digital) have been growing at rapid rates in the past, and the materials are often bound in long-lived products (e.g. 20 or more years for a wind turbine); this means that when they are recovered, the so far small quantities often do not justify costly investments into developing targeted recycling processes and building and running industrial-scale operations. As a result, CRMs are currently often disposed of at the end of a product's lifetime, or non-functionally recycled (i.e. recycled in a way that does not make use of the special properties of the raw material). Moreover, current recycling practices and waste legislation often focus, to a large extent, on waste collection and de-pollution, and on overall mass recovery but too little on the recovery of trace metals such as CRMs.

The most important waste streams for CRM recovery (Extractive waste, batteries, electrical and electronic equipment (WEEE), end-of-life vehicles) are covered by dedicated sectoral legislation specifying (e.g. extended producer responsibility, specific treatment requirements, and collection and recovery targets). In addition, the Waste Framework Directive covers all waste streams horizontally (e.g. requiring Member States to draw up waste prevention and waste management plans). Apart from the proposed Batteries Regulation, these legislations do not specifically target the recovery of CRMs.[81]

An area of particular interest for CRMs is extractive waste. Historically most mining operations were targeted at high-volume commodities such as iron and copper. As CRMs commonly co-occur with these carrier metals, extractive waste may contain significant amounts of CRMs[82]. Jointly recovering and valorising base metals, CRMs and aggregates could be economically interesting[83], with the advantage that such operations take place on brownfield sites, lowering risk of environmental impacts and conflicting land-use interests. A barrier however lies in the lack of knowledge concerning CRMs in closed and abandoned mines, as well as the risk and liability assumed by a company re-mining a site with potentially unknown legacy. The Extractive Waste

[79] https://www.ey.com/en_gl/mining-metals/risks-opportunities Top 10 business risks and opportunities for mining and metals in 2023, Ernst and Young.
[80] Fraunhofer-institut für system und innovationsforschung ISI – Job preview study: job effects in the upstram battery value chain.
[81] See Annex 10 for more detail on the current shortcoming in terms of CRMs of existing waste legislation.
[82] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills; pg. 93-98 of SCRREEN-D3.2-Identification-and-quantification-of-secondary-CRM-resources-in-Europe.pdf
[83] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills

Directive currently regulates primarily how to minimise and manage waste generation and it requires Member States to draw up an inventory of closed and abandoned facilities, but it does not provide for incentives or information gathering to promote recovery of CRMs.

In the open public consultation, 66% of respondents agree or strongly agree with the statement that "EU waste legislation does not sufficiently incentivise the recovery and recycling of raw materials".

2.2.2.6. Driver 2.6: Lack of high-quality technical standards for critical raw materials-related industrial processes

The availability of high-quality technical standards is essential to ensure a level playing field in the single market for businesses and to underpin consumer confidence. Standards can help facilitate the creation of a transparent global market for critical raw materials. Currently, European and international standards only partially cover critical raw materials-related industrial processes, including processes involved in their extraction, processing and recycling.

At the level of the relevant European Standardisation Organisation CEN, a number of technical committees exist in charge of the standardisation of metals (aluminium, copper, nickel and steel) but critical raw materials are not covered by the work of these committees. As regards the international aspect, as highlighted in the recent EU Standardisation Strategy, other actors follow a more assertive approach to international standardisation than the EU and are taking the lead to promote their technological solutions.

At the level of the International Standardisation Organisation (ISO), standardisation efforts related to critical raw materials have been mainly instigated by non-EU countries. The Chinese standardisation body has initiated standardisation on rare earths (2015) and lithium (2020) within ISO, covering the whole value chain including upstream extraction and sustainability. On rare earths, the results to date indicate slow progress as concerns the sustainability aspects, and the level of ambition is lower than what is set out in the EU principles for sustainable raw materials.[84]It is to be noted that, since 2021, Standards Australia leads the ISO Strategic Group on Critical Minerals. The mandate of this group was to identify which minerals/metals could be standardised in ISO. [85]

There currently does not exist a common European strategy to ensure that standardisation efforts for critical raw materials sufficiently reflect the sustainability principles underlying EU legislation relevant for the critical raw materials value chain.

Driver 2.7: Lack of public acceptance for critical raw materials mining in Europe

The issues pertaining to permitting of critical raw materials projects are often intertwined with issues of lack of public acceptance. The Public Consultation showed that a lack of, or limited, public acceptance for new critical raw materials projects in EU was often driving away investments in the value chain (64 % of

[84] For REEs, actions focus on the whole value chain including rare earth mining, concentration, extraction, separation and conversion to useful rare earth compounds/materials (including oxides, salts, metals, master alloys, etc.), covering also sustainability of different processes.

[85] Although work is not yet finalised, several minerals or metals have been identified as being of a particularly strategic nature: cobalt, indium, vanadium, graphite, gallium, tungsten. Their mandate was extended by 12 months to summer 2023.

respondents agreeing or strongly agreeing). Licence to operate was reported as a main business risk[868788], other abuses of fundamental labour rights, such as child labour are prevalent[89]. This tarnishes the reputation of mining in Europe as well, where environmental impacts, worker rights and public participation are well-regulated (see discussion of the environmental legislation under Annex 8).

Improvement and better enforcement of environmental legislation, including post-concession management, should address concerns from society. Nevertheless, resistance to projects, particularly for extraction, still exists, driven partially by justified environmental concerns and partially by what has been termed "NIMBYism" – a situation where stakeholders agree on the need for such projects in general but are opposed to the siting due to local interests[90]. The European Federation of Geologists provided a list of the top 10 mining opportunities in the critical raw materials sectors that are stalled/on standstill due to permitting and/or social engagement issues. Such projects relate to the production of lithium, rare earths, nickel, graphite, copper.[91]

2.2.3. Sub-problem 3: EU sourcing of critical raw materials is not sufficiently sustainable

2.2.3.1. Driver 3.1: The market does not take sufficient account of the environmental footprint of critical raw materials

The CRM value chain is associated with a range of environmental impacts. For example, the production of rare earth elements (REEs), used for instance in electric motors and wind turbines, is associated with significant material and energy consumption and generates large amounts of air and water emissions and solid waste.[92] Similarly, the use of platinum group metals in electrolyte membrane fuel cells is the main determinant of the fuel cells' environmental footprint, considering the acidification impacts associated with the extraction of these metals.[93] The production of cobalt and lithium, essential for battery production, is amongst other things associated with significant greenhouse gas emissions.[94] Overall, it was estimated that greenhouse gas emissions associated with overall primary metal and mineral production accounted for approximately 10% of total global energy-related emissions in 2018.[95] Life-cycle analyses of the EU's material consumption and its environmental impacts suggest that it currently takes up a disproportionate share of the safe ecological operating space.[96]

If left unaddressed, the environmental footprint of CRM extraction and processing may cancel out, to an extent, the environmental benefits of their use in green technologies and could mean that decarbonisation comes at the cost of an increase of other detrimental impacts. It is unlikely that the market, left to its own devices, will

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[87] https://www.economist.com/middle-east-and-africa/2022/07/05/how-the-world-depends-on-small-cobalt-miners "Roughly 140,000-200,000 people in the Copperbelt work as artisanal miners. Most earn less than the equivalent of $10 per day, according to the Federal Institute for Geosciences and Natural Resources (bgr), an arm of the German government. That is still a better wage than most get in a country where 73% earn less than $1.90 a day."

[88] https://www.amnesty.org/en/documents/afr62/3183/2016/en/

[89] https://www.ilo.org/manila/publications/WCMS_720743/lang--en/index.htm

[90] See for example: NIMBYism Is Global, And That's A Problem For The Energy Transition (forbes.com); Rare-Earth NIMBY Activists Help China Dominate the Industry (foreignpolicy.com)

[91] European Federation of Geologists https://eurogeologists.eu/wp-content/uploads/2022/10/2022_EFG_List_Top10_Mining_Opportunities.pdf

[92] Navarro, Julio, and Fu Zhao. "Life-cycle assessment of the production of rare-earth elements for energy applications: a review." Frontiers in Energy Research 2 (2014): 45.

[93] Stropnik, Rok, et al. "Critical materials in PEMFC systems and a LCA analysis for the potential reduction of environmental impacts with EoL strategies." Energy Science & Engineering 7.6 (2019): 2519-2539.

94 Gregoir, L., and K. Van Acker. "Metals for clean energy: pathways to solving Europe's raw materials challenge." Eurometaux, KU Leuven (2022).

[95] Azadi et al. (2020). Transparency on greenhouse gas emissions from mining to enable climate change mitigation.

[96] JRC Publications Repository - Consumption and Consumer Footprint: methodology and results (europa.eu) (Note that this study does not separately show the impacts associated with the EU's consumption specifically of critical raw materials).

ensure that the impacts associated with the CRM value chain are properly identified and internalised. Steering the market toward more sustainable CRMs, however, has the potential to drive down impacts given the differences in the environmental footprint of CRMs available to EU buyers. This is evidenced, for example, by the difference in footprints observable between CRMs produced using different production methods[97]. It is also clear that the varying carbon intensity of the energy used in the extraction and refining of CRMs leads to varying environmental footprints[98]. In addition, recycled CRMs have generally a lower environmental footprint than primary materials, given the absence of the extraction phase and the higher purity of inputs (in cases where effective collection and sorting systems exist).

Even though stakeholders, including downstream users, state that they are willing to take into consideration the relative sustainability when procuring materials[99], the market response so far has resulted in the creation of different methods and initiatives, with a varied level of reliability and coverage.[100] The Commission has developed the Product Environmental Footprint (PEF) to provide a common and robust method to measure the footprint of different materials sold on the EU market and distinguish between the environmental impacts of these materials.[101] However, uptake of the PEF method for the assessment of CRM is still limited. In addition, different public and private certification systems with different scopes and coverage are currently available to show the sustainability of raw materials sold on the EU market.[102] Having different overlapping schemes to show sustainability of CRMs can lead to potential confusion and undermine their effectiveness. Without complete information, competition driven by sustainability is diminished to the extent that customers cannot make choices based on sustainability. In that regard, some stakeholders have underlined the need to assess the suitability of different certification schemes.[103] In addition, even where information is available, there is currently nothing preventing users of critical raw materials from procuring the most impactful (and often cheaper) materials. It can reasonably be assumed that, as long as the negative externalities of CRMs are not accounted for, at least some users will continue to be mainly driven by cost considerations, continuing to procure the most polluting CRMs. Sustainability chapters in trade agreements are meant to prevent a 'race to the bottom' and to sustainably trade natural resources, while encouraging trade in raw materials for the climate transition[104]. They are however limited to countries with which the EU has a FTA, and thereby do not cover all CRMs entering the EU market, constraining the EU's ability to incentivise a shift in the global production of CRMs toward more sustainable practices. Other international instruments (c.f. Annex 8) seek to ensure social and environmental due diligence practices for EU companies.

[97] On difference between brine and hard rock based lithium, see "Metals for clean energy'' report (Gregoir and Van Acker).'. On magnesium, see Ehrenberger, Simone. "Carbon Footprint of Magnesium Production and its Use in Transport Applications." (2020). For scandium, see Kaya, Şerif, et al. "Scandium recovery from an ammonium fluoride strip liquor by anti-solvent crystallization." Metals 8.10 (2018): 767. . For titanium, see Pal, Uday B. "A lower carbon footprint process for production of metals from their oxide sources." JOM 60.2 (2008): 43-47.

[98] See e.g. figure in Annex 10, source: "Metals for clean energy'' report (Gregoir and Van Acker)

[99] For example, 186 (72 %) out of 259 respondents to the PC agreed or strongly agreed that CRMs should be accompanied by information on their environmental footprint. Business interest is also driven by changing consumer preferences: based on a recent EU survey (Consumer conditions survey, European Commission, 2021.), the majority of EU consumers being "occasional" consumers of environmentally-friendly products (56%) and more than a quarter paying attention to the environmental impact of all or most goods and services (23%), and 67% EU citizens buy products that are better for the environment even if they cost more.

[100] There are currently 457 voluntary environmental labels worldwide and over a 100 in the EU (Ecolabel index 2020, http://www.ecolabelindex.com/), underpinned by non-comparable methods.

[101] Commission Recommendation of 16.12.2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations

[102] See e.g. the overview of different schemes provided in IEA, I. (2021). The role of critical minerals in clean energy transitions. World Energy Outlook Special Report, p. 240.

[103] See for example the Call for Evidence submission of the European Automobile Manufacturers' Association.

[104] Sustainable development in EU trade agreements (europa.eu)

2.3. How likely is the problem to persist?

The main problem identified, the lack of secure and sustainable access to critical raw materials is a forward-looking problem, as demonstrated above, and therefore, likely to persist in the case of no targeted intervention. As discussed in textbox 3 of Annex 10, technological innovation and behaviour patterns have the potential to affect the evolution of demand for critical raw materials. However, most projections show a significant increase for several critical raw materials that outpaces supply currently on-line or planned, thus likely leading to elevated prices, more frequent instances of supply disruption and heightened competition for available resources. These considerations mainly apply to the medium term (2030-2040), where large technological and social innovations are unlikely, and the major sectors driving critical raw materials demand (renewables, electric vehicles) are expected to continue growing. In the longer term, towards 2050, however, technological innovations spurred by scarcity and high prices, as well as the substantial amount of CRM-rich products reaching their end-of-life, are likely to alleviate the pressures while bringing the EU closer to a circular economy for metals (including many CRMs). Of course, new and currently unforeseen challenges could also develop within this longer timeline.

The new CRM production capacities created by third countries may have an effect on global markets, but as explained in Annex 10 – context, the presently known pipeline would not be sufficient to meet the gaps between supply and demand for some critical raw materials. In addition, these new supply sources may be reserved for domestic off-takers or for partners that can provide access to other critical raw materials in exchange. Additionally, acute crisis situations may trigger protectionist reactions, as observed with vaccines and personal protective equipment in the Covid-19 crisis, making agreements and memorandum of understanding for external supply ineffective.

As for the likelihood of the sub-problems and problem drivers to persist, anticipation and risk mitigation efforts by companies and Member States are likely to increase but only the most resourceful will be able to build an effective risk-preparedness system on their own. Smaller companies and Member States are likely to be disadvantaged in a crisis, even if the Single Market Emergency Instrument's provisions would mitigate the unequal impacts to a certain degree. There would be no coherent and systemic provision of information by public authorities to guide and alert companies and governmental bodies alike.

Without any further policy action, the EU is not likely to increase its production capacity along the critical raw materials value chain – in fact, processing/refining capacity in the EU is currently shutting down due to the high energy prices and the recovery is uncertain[105] – except in certain battery-related value chains such as lithium, which are benefiting from strong public support. Private investment and financing along the value chain may increase in response to rising critical raw materials prices, but in the absence of public investment into exploration, de-risking support and streamlined permitting procedures, investments are expected to remain far below what is needed to strengthen the EU's resilience.

Finally, as noted before, circularity will increase over time due to technological advancements and greater availability of waste containing critical raw materials, but for this development to achieve its full potential, accompanying changes to regulation putting a greater focus on CRMs and providing obligations or incentives to recover are required. Similarly, consumer expectations and industry initiatives will certainly increase transparency and sustainability of critical raw materials over time. Without public action, there is a risk of greenwashing and confusion that would be hard to overcome only by private initiative. Given the comparatively small market share of EU companies in the global raw materials value chains, international standards that might be in conflict with EU regulation and values are likely to be dictated by the dominant actors if the EU does not strategically coordinate and engage with international partners.

[105] Position paper by Eurometaux submitted in response to the Call for Evidence.

2.4. Lessons learnt from non-regulatory actions

The 2008 initiative proved to be a useful tool for the EU to begin considering access to critical raw materials as a strategic matter. The three dimensions outlines there have shaped the EU and wider society discussion around critical raw materials dependencies. The EU List of Critical Raw Materials has served as a reference for academia, stakeholders and even international partners. The 2020 Action Plan served to highlight new trends and contexts, such as the link of CRM dependencies with the green and digital transitions, and outline several concrete actions that could be taken without a dedicated regulatory framework. However, it also uncovered its limitations, with many actions having to be taken by other actors. Also, as demonstrated by the continued dependence on third countries and the rising number of raw materials present on the criticality list (from 14 in 2011 to 30 in 2020 and 34 in 2023), the underlying challenge is getting worse. Some limitations of the approach followed so far are noteworthy:

First, even though industrial alliances have identified investment pipelines that concern some CRMs (e.g., on rare earths), the financing tools are scattered around different EU, national and private investment vehicles and are still insufficient to cover the investment gaps (identified in Annex 12). In addition, conversely to renewable energies or Chips manufacturing[106], there is no framework in place to ensure that CRM projects overcome the difficulties encountered by the length or complexity of permitting processes.

Second, the non-regulatory actions have not been sufficient to encourage Member States in developing their knowledge of their geological resources on their territory or their capacity to monitor and prepare for supply disruptions.

Third, even though EU level monitoring through the criticality assessment has become a key framework for the analysis of CRMs, it remains a punctual exercise which does not itself take into account the strategic priorities of EU or national policies, for instance in terms of technologies.

Fourth, initiatives so far have not been able to tackle the increasing needs expressed by the industry and EU citizens to get access to sufficient information regarding the sustainability of CRMs.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The initiative intends to improve and ensure the Union's secure and sustainable supply of critical raw materials. Without such efforts, current supply and demand developments are likely to create a serious and structural risk of supply disruptions for a range of critical raw materials.

As CRMs are essential to the functioning of multiple strategic sectors, potential supply disruptions must be addressed in order to preserve a stable functioning of European markets. Therefore, the onset of supply disruptions, and of the associated shortages and prices volatilities, would be likely to trigger efforts at Member States' level to address their consequences (e.g. through stockpiling or export restrictions). Although justified in principle, such efforts have, if left uncoordinated, the potential to distort competition and create intra-EU restrictions to the free movement of goods. By aiming to structurally decrease the likelihood of supply disruptions, therefore, this initiative will contribute to ensuring the well-functioning of the Single Market.

[106] COM(2022) 46 final, Chips Act

In addition, in light of the significant economic impact of potential supply disruptions, it is likely that Member States will, in the absence of EU action, initiate measures to *ex ante* lower the risk of their occurrence.[107] While adequate with a view to addressing deficiencies at a national level, such measures could also lead to an incoherent response, thereby leading to less effective solutions and potentially fragmenting the Single Market or distorting competition. By proposing a coherent Union approach to improving and ensuring the security of supply of critical raw materials, this initiative will help prevent the potential distortion of competition and fragmentation of the Single Market likely to result from such uncoordinated actions and help to preserve a level playing field for businesses within the EU.

To set up a harmonised EU approach to decrease supply risks for critical raw materials, therefore, Article 114 of the Treaty of the Functioning of the European Union (TFEU) is the appropriate legal basis. In addition, regarding the amendments to existing legislation on waste management considered in this impact assessment, they would have to be based on the same legal basis as the legislation to be amended (Article 192 TFEU).

3.2. Subsidiarity: Necessity of EU action

No single Member State alone is capable of effectively addressing the growing critical raw materials supply risks – not least due to lack of geological occurrences in an individual Member State and to the substantial economies of scale in the critical raw materials value chain. The measures included in this initiative would not be as effective if implemented by Member States acting alone, as the problems they address concern the Single Market as a whole. They are not limited to single Member States or to a subset of Member States but to the EU industrial base and the EU-wide value chain of critical raw materials. In addition, approaches at Member States' level only are unlikely to be adequate to serve the needs of closely intertwined supply chains within the internal market.

3.3. Subsidiarity: Added value of EU action

Taking into account that supply chains are widely spread across Europe, EU action is essential to generate economies of scale, propose solutions that fit the scope of the problem and to limit, if not to avoid, the fragmentation of efforts and associated inefficiencies. In line with this logic, the proposed actions focus on areas where there is a demonstrable value added in acting at Union level due to the scale, speed and scope of the efforts needed. For example:

- actions aimed at mobilising investment in critical raw material projects along the value chain could be most effective designed and coordinated at Union level, given the scale of the investments needed and because the resulting capacities should serve the full internal market.
- actions aimed at improving monitoring capacities at Union level will achieve greater effectiveness than if left uncoordinated. Together, Member States and Commission will be better able to anticipate supply disruptions than through a patchwork of national efforts. The framework proposed should allow for a more efficient division of tasks and for the sharing of relevant information to prevent the duplication of efforts.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objective

The general objective of the Critical Raw Materials Act is to ensure the EU's secure access to critical raw materials, while incentivising the development of sustainable supply sources. This ultimately contributes to economic growth and high living standards in the EU, prevents disruptions and distress within the European

[107] For example, both Spain and France have announced future actions for ensuring supply of CRMs referring to many of the same fields of action as considered in this initiative, see Hoja de ruta para la gestión sostenible de materias primas minerales (miteco.gob.es) and Strategic metals: BRGM in the forefront of the actions announced by the State | BRGM.

single market and increases the competitiveness of European businesses, without neglecting the EU's role in promoting sustainable development and environmental protection globally.

Given the close link between CRMs and the green and digital transition, as well as the many geopolitical implications of critical raw materials supply, this initiative is indispensable to the achievement of the Commission priorities "A European Green Deal", "A Europe fit for the digital age" and "A stronger Europe in the world".

The initiative is expected to contribute to the achievement of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs), in particular SDG #7 Affordable and clean energy, SDG #8 Decent work and economic growth, SDG #9 Industry, innovation and infrastructure, SDG #13 Climate action.[108]

4.2. Specific objectives

The initiative pursues 3 specific objectives (SOs):

- SO1. Increase EU industry's awareness and mitigation of CRM-related risks in the global supply chain
- SO2. Increase the EU CRM value chain's capacity in the internal market, notably by:
    - *Increasing public and private exploration efforts*
    - *Streamlining permitting procedures*
    - *Improving financing conditions for investments along the critical raw materials value chain*
    - *Maximising the recovery of critical raw materials from relevant waste streams*
    - *Promoting high-quality technical standards for critical raw materials-related industrial processes*
- SO3. Reduce the environmental footprint of the EU's CRM consumption

Interaction between the specific objectives and trade-offs

There are many interactions between these specific objectives, both positive (synergies) and negative (trade-offs): Greater awareness of CRM-related risks in industry (SO1) for example is likely to increase companies' willingness to sign off-take agreements with and directly invest into CRM projects in the EU, where the risk of disruption is likely to be smallest, thereby contributing to increased EU capacities along the CRM value chain (SO2). Increasing EU capacities (SO2) in turn is likely to reduce the environmental footprint of the EU's consumption of critical raw materials (SO3) since the EU has a high level of environmental regulation and a relatively low-carbon energy mix. This is especially true for increased EU capacities at the recycling stage, which means a higher share of secondary CRMs, which inherently have a lower energy requirement and lower environmental footprint. Conversely, a reduced environmental footprint (SO3) can be expected to increase societal acceptance for investment into critical raw materials production in the EU (contributing to SO2).

While synergies between the three specific objectives dominate, trade-offs come into play when these are pushed to the extreme: Banning all imports of CRMs from relatively unsustainable sources, for example, would certainly reduce the EU's environmental footprint (SO3) but be very detrimental to its security of supply (the general objective) and to industry's risk mitigation efforts (SO1). Similarly, an exclusive focus on increasing EU capacities along the CRM value chain (SO2), if achieved by lowering environmental standards in the EU, would likely increase the EU's environmental footprint (contrary to SO3). Therefore, a balanced approach has to be pursued, especially with respect to specific objective 3. Such an approach involves balancing the negative impacts associated with any material consumption on the one hand with the clear economic and environmental benefits of that material consumption (e.g. realisation of the green transition). It also involves having a realistic view of the state of sustainability around the world today, while ambitiously charting a path towards solutions that avoid these trade-offs – for example, low-impact mining techniques,

[108] More a more extensive overview of the impact of the critical raw materials value chain on SDGs, see: Raw Materials Information System (europa.eu), How can mining contribute to the Sustainable Development Goals? | Africa Renewal (un.org)

energy-efficient processes and ultimately the circular economy, which can provide the lowest-impact and at the same time most secure raw materials. The measures in place to ensure the development of specific objective 3 should therefore always consider the need for ensuring the main objective of supply security.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

5.1. What is the baseline from which options are assessed?

The potential impacts of the policy options are measured against the current dynamic baseline scenario that consists of no additional EU actions, meaning no change to the currently existing or proposed regulatory framework and the wider policy approach on critical raw materials. This notably relates to the implementation of the 2020 Action Plan on Critical Raw Materials.

As noted in section 2.3, "How likely is the problem to persist?", demand for critical raw materials is expected to grow rapidly and outpace supply, thus leading to increased prices and supply risks for critical raw materials needed for the green, digital and resilience ambition of the EU in the medium term (around 2030). However, in the longer term, secondary supply from recycling is forecasted to increase and become a relevant factor for many critical raw materials around 2040 and further increase towards 2050, thus alleviating pressures, as long as its potential is tapped into. Thus, this approximate development of demand and primary and secondary supply over the coming decades should be taken as the baseline. This means that the urgency and potential benefit of this initiative is greatest when considering the medium-term (2030) perspective. However, should also not be taken for granted that the issues would resolve themselves in the long-term, as projections may be assuming precisely that policy action will be taken at some point, For instance, . increase in circularity observed over time may be difficult to attribute to the circularity-related actions proposed, since they would affect the speed and size of the transition towards circularity rather than the direction per se.

Looking more concretely into the problem drivers and associated objectives, the monitoring and risk preparedness framework of the EU and its Member States (Driver 1.1./SO1) would remain unchanged in the baseline option – implying a continuation of current voluntary coordination, public raw materials intelligence agencies only being active in a few countries and no strategic stockpiles for critical raw materials. Meanwhile, private companies may increase their risk anticipation and mitigation efforts but this is likely to be limited to leading large companies with the sufficient resources and the power to impose e.g., diversification conditions on their suppliers. The Single Market Emergency Instrument would be assumed to be in force and thus provide a vigilance and crisis response framework, triggered in case of foreseen (vigilance mode) or actual (emergency mode) disruptions to critical raw materials supply. Stockpiles would be built up during the vigilance mode and released during the emergency mode, and information requests and priority-rated orders could be made to companies producing or possessing stocks of the critical raw materials currently disrupted. However, no efforts would have been made to build up strategic stockpiles before the onset of a crisis, and, given the insufficient capacities along the critical raw materials value chain (see next paragraph), as well as the lack of support for companies to manage critical raw materials supply risks, only very few companies would be able to respond to an information request or priority-rated order.

Investment into the critical raw materials value chain (SO2) would remain limited in the baseline scenario, except in the battery-related value chains where the coordinated effort of the European Battery Alliance to support investments (including through public subsidies and a dedicated regulatory framework – the Battery Regulation) and bring off-takers together with potential producers would continue. Some critical raw materials projects currently in the potential pipeline would advance after securing financing and passing lengthy permitting procedures, but many projects will likely not be realised in the absence of additional policy action. Continued high energy prices could lead to definitive closures of European refining plants, which would affect critical raw materials directly but also could have indirect effects through a loss of metallurgical expertise that can be transferred across raw materials sectors. European downstream industries would largely continue to source from outside the EU and be affected by supply disruptions, relying only on their individual negotiating

power, as well as potential use of trade defence instruments and dispute settlement under WTO or bilateral free trade agreement rules. Overall, import dependence would likely increase.

Regarding circularity, the availability of waste in the baseline scenario would develop as in the "intervention scenario" but no regulatory incentives would be given to focus on the recovery of CRMs. Notably, critical raw materials recovery from extractive waste would be realised in some projects, as is already the case today, but not on a systematic scale, given the lack of information and the risks associated with re-opening a closed site. Overall, the contribution of secondary critical raw materials to satisfying demand would increase, but at a slow pace.

As regards environmental footprint (SO3), increasing sustainability concerns are likely to continue driving the development of private certifications schemes and assessment methods as well as an increasing willingness to procure relatively sustainable CRMs. However, there is a risk that the effectiveness of such efforts would be undermined if methods and certification schemes contradict each other. In the absence of a harmonised approach, customer confidence could be too low to effectively implement those preferences and information could remain incomplete. It should also be noted, that where a product-level footprint exists for a product containing CRMs (as is e.g. the case for larger batteries), there would be an incentive to procure sustainable CRMs for that specific application (to the extent that the relevant products are intended for the EU market). The proposed inclusion of extraction and treatment of industrial minerals and metals the scope of the Industrial Emission Directive would improve the environmental footprint of CRMs produced in the EU. A number of European legislative initiatives in force and under adoption and the implementation of positive agenda in cooperation with third countries to improve the governance of extractive industry would improve the sustainability of local production, imports and foreign investments[109]. However, those measures would not cover all CRMs, the whole value chain or all sustainability issues, and are not all legally binding. Therefore, buyers of CRMs driven solely by price considerations will continue to at least partly procure CRMs with a high environmental footprint. Furthermore, international standards may not adequately reflect EU values in terms of sustainability and circularity and may be ineffective to ensure the EU's policy objectives are achieved.

The problem addressed with this initiative is inherently international in nature because 1) other countries face the same challenges of supply security, and 2) the EU relies substantially on external sources for CRM supply. Therefore, the following considerations need to be taken into account both in the baseline scenario and across the 3 different policy options.

First, the impact of actions by other global actors also has to be considered: Already today, relevant actions by partners and competitors can be observed, as discussed in Annex 7, including financial support for foreign or domestic critical raw materials projects, the conclusion of new partnerships, which are likely to lead to a greater degree of diversification over time at the global level, though it is uncertain to what extent the new capacities would be available to EU actors.

Second, the EU's global actions to diversify its supply chain must also be considered across all options as such efforts aim to reduce the dependencies on concentrated supply sources. Because those actions are ongoing, as described in Textbox 2, and since the path forward follows clear priorities already set out in the 2020 CRM Action Plan and in the EU's 2022 Trade Policy Review, they are considered as being included in each of the policy options presented below. This impact assessment's ability to assess directly their impact is furthermore limited by the fact that such actions are not only EU driven but also depend on the third country's policy (i.e. for the conclusion of a FTA or Strategic Partnership).

Textbox 2: The EU's international actions on raw materials – the baseline also underpinning different options

[109] Those instruments are developed in the Annex 8 "Interplay with other legislation and policies", particularly under the heading "International instruments".

In view of reducing the supply risks from abroad, the EU has been pursuing two main actions: developing partnerships on raw materials value chains with resource rich countries, as announced in the 2020 Action Plan for CRMs adopted in September 2020 (action 9) and negotiating trade agreements to facilitate trade and investment in CRM in third countries.

The partnerships on raw materials value chains with resource rich countries are cooperation instruments of non-binding nature and have a rather holistic approach. Although the ultimate objective of the partnerships is about integration of the raw materials value chains between the partner country and the EU, they are comprehensive, and cover aspects such as research and innovation and leverage of ESG (environmental, social and governance) standards. For the EU the sustainability of supply is as relevant as the security and this model of cooperation covers these two angles, thus creating mutually beneficial partnerships.

The partnerships with developed countries are usually based on three pillars: integration of raw materials value chains – the business-oriented pillar; cooperation on research and in innovation along the raw materials value chains – to develop cutting edge and clean technologies and solutions for the raw materials value chains; and cooperation on ESG standards – that aims at improving sustainability along the raw materials value chains, in its three dimensions. The partnerships with developing countries are based on five pillars: to the three pillars above it adds a pillar on capacity building, training and skills along the raw materials value chains and a pillar on deployment of the necessary hard and soft infrastructure to support projects development.

The partnerships have a roadmap associated, that identifies concrete actions to be developed under each pillar. Some of the actions can be crosscutting. To develop the roadmap, in agreement with the partner country, the EU consults its Member States and the industry, bringing together relevant existing and planned actions, within a true Team Europe approach. The Global Gateway[110] is instrumental in the implementation of the roadmaps. The implementation. The implementation of the roadmaps is monitored and updated as agreed with the partner country.

So far, the EU has established partnerships with Canada (June 2021), Ukraine (July 2021), Kazakhstan (November 2022) and Namibia (November 2022). The EU is currently negotiating partnerships with Norway and Greenland. The EU is also participating in a working group on a raw material supply chain track within the EU-US Trade & Technology Council and is cooperating with like-minded countries under the multilateral and US-initiated Minerals Security Partnership (MSP). Building on the existing initiatives, the EU will also work with like-minded partners to establish a Critical Raw Materials Club to ensure the secure, sustainable and affordable globally supply of raw materials essential for the twin transition[111].

At this stage, it is not possible to assess the benefits of this recent strategy. However, by virtue of example, the partnership with Canada is enabling the development of different investment projects which would in turn benefit both the EU and Canada's CRM value chain. For instance, within the context of the pillar on the "Integration of Canada-EU Raw Materials Value Chains", the current ERMA pipeline includes five advanced projects coordinated by Canadian companies in partnership with their European partners, for a total investment value exceeding EUR 2 billion. Four of these projects deal with exploration and mining of primary resources including critical (e.g. lithium and rare earths) and non-critical materials (molybdenum), while the fifth one focuses on the rare earth permanent magnet value chain. Financing solutions are beings sought for four of these projects. In addition, six other projects in exploration, mining and processing are being evaluated, bringing the total investment potential to over EUR 3.2 billion by 2030. Two of the projects are located in Canada and one in Greenland, and all rely on joint technical expertise, machinery and

[110] The European Commission and the EU High Representative have set out the Global Gateway, a new European strategy to boost smart, clean and secure links in digital, energy and transport sectors and to strengthen health, education and research systems across the world.

[111] COM(2023) 62 final, A Green Deal Industrial Plan for the Net-Zero Age

technologies from both Canada and Europe. The other projects are located in Europe, with one of them sourcing its raw materials also from Africa.

In addition, EU makes use of its trade bilateral agreements to deepen trade and investment links with certain partners. These legally binding agreements provide new export and import opportunities by eliminating tariffs and quotas. Some of the EU's trade agreements also have an Energy and Raw Materials chapter with provisions that aim at facilitating trade and investment in the context of CRM supply chains for example by: ensuring a level playing field for EU and domestic operators and facilitating EU companies to invest, such as when applying for an authorisation for exploration or production; by increasing the legal certainty for operating easily an economic activity by limiting the capacity of third countries to introduce trade barriers such as export restrictions, export taxes, export licenses, import/export monopolies or dual pricing as well as by facilitating customs procedures; by improving the legal environment for protecting intellectual property rights; by ensuring the sustained efforts by our trading partners to implement social and environmental international standards.
The recent trade agreements with Mexico, the United Kingdom, New Zealand and Chile already contain a dedicated Energy and Raw Materials chapter.

5.2. Outline of the policy pillars

On the basis of the mapping of problem drivers (see Section 2.2), different pillars were identified that should form part of an initiative aiming to address all the identified problem drivers by achieving the general and specific objectives detailed in section 4. These generally follow a 1-to-1 correspondence, with the exception of the two horizontal pillars (A and B), which provide the overarching scope and objectives of the initiative. These pillars are implemented by different approaches (which, bundled together, compose the three policy options described in section 5.3 and assessed in section 6. The approaches are described in more detail in annex 5.

TABLE 1. OVERVIEW OF OBJECTIVES, DRIVERS AND PILLARS

Objective	Problem driver	Pillar
[horizontal]	[horizontal]	A. Definition of critical and strategic raw materials
		B. Setting strategic raw materials targets
SO1. Increase EU industry's awareness and mitigation of CRM-related risks in the global supply chain	1.1 Lack of systematic monitoring and risk preparedness	C. Governance • C1. Monitoring and risk assessment • C2. Company risk preparedness • C3. Strategic stocks
SO2. Increase the EU CRM value chain's capacity in the internal market	2.1 Insufficient exploration of European mineral resources	D. Exploration
	2.2 Unpredictable and fragmented permitting procedures	E. Support to the value chain • E1. Permitting procedures • E2. Access to finance
	2.3 Difficulty in accessing financing	
	2.5 EU waste legislation does not sufficiently target CRM recovery	F. Waste legislation

	2.6 Lack of high-quality technical standards for CRM-related industrial processes	G. Standards for the critical raw materials value chain
SO3. Reduce the environmental footprint of the EU's CRM consumption	3.1 The market does not take sufficient account of the environmental footprint of CRMs	H. Environmental footprint of critical raw materials

5.2.1. TABLE 3: OVERVIEW OF POLICY APPROACHES PER PILLAR

Pillars	**Policy approach 1**	**Policy approach 2**	**Policy approach 3**
A. Defining critical and strategic raw materials	Legal definition of critical raw materials [discarded at an early stage]	Legal definition of strategic raw materials [discarded at an early stage]	Legal definition of both critical and strategic raw materials
B. Setting strategic raw materials targets	Developing a framework to set EU-level guiding targets for strategic raw materials regarding capacity	Setting EU-level targets obliging the governance structure to work toward them through Strategic Projects proposals (c.f. pillar E) and performance review(	Setting national targets for strategic raw materials based on national resources and existing capacities [discarded at an early stage]
C. Governance	Tasking expert groups RMSG and EIP on raw materials to carry out tasks on monitoring and risk assessment [discarded at an early stage]	Developing a dedicated EU CRM board supported by a network of national agencies and operational capacity within the Commission	Developing an operational capacity as a separate structure to implement the CRM Act's provisions
C.1 Monitoring and risk assessment		Developing monitoring capacities and risk assessment	Approach 2 + Developing monitoring and risk management capacities
C.2 Strategic stocks		Ensuring EU-level coordination and stock assessment for the stockpiling of strategic raw materials	Approach 2 + Enabling the common purchase of strategic raw materials
C.3 Company risk preparedness		Developing requirements on company diversification and stockpiling	Approach 2 + providing direct support to foster companies' resilience

D. Exploration	Requirement for Member States to report on the mapping and evaluation of the strategic (and critical) mineral resources and extractive waste areas in the EU	National requirement to report on, develop and implement national exploration programmes for strategic (and critical) mineral resources and extractive waste.	Approach 2 +Obligation to report to the governance structure on the land use decisions applicable to known deposits containing strategic raw materials
E. Support to the value chain	Requiring Member States to set up strategies to work towards achieving more stable and secure supply of CRM	Developing Strategic Projects, in Europe and partner countries abroad	Developing Strategic Projects with stronger support, in Europe and partner countries abroad
E.1 Permitting procedures	CRM projects to be considered in spatial planning	Approach 1 + Mandatory measures to make permitting for Strategic Projects more predictable	Approach 2 + Require Member States to dedicate sufficient resources to their permitting
E.2 Access to finance	Encourage the setting up of an Investment Platform for the CRM value chain and leverage finance through existing instruments	Approach 1 + Promote and advise the setting up of a dedicated CRM fund to combine Member State funding with contributions from existing EU funds. It should be able to provide loans and equity to projects in all stages of the CRM value chain, in compliance with State Aid rules. Grants could be considered as well, depending on the types of resources available	Approach 1 + Set up a dedicated CRM Fund with new Commission contribution and Member State contribution, managed by governance structure. It should be able to provide loans, equity and grants to projects in all stages of the CRM value chain, in compliance with State Aid rules
F. Waste legislation	Adoption of a Recommendation and announcements of future CRM circularity actions	Approach 1 + Targeted amendment of the Extractive Waste Directive and certain circularity provisions in the CRM Act	
G. Actions on standards for the critical raw materials value chain	Increase efforts to have EU rules and principles reflected in international standards	Approach 1 + Mandate development of standards and standardisation deliverables regarding relevant industrial processes	Approach 2 + Set essential requirements for regarding relevant industrial processes and mandate development of related harmonised standards [discarded at an early stage]
H. Environmental footprint of critical raw materials	Set minimum requirements for certification schemes for sustainable CRMs	Approach 1 + Require declaration of environmental footprint for CRMs sold in the EU	Approach 2 + Putting in place a mechanism for setting performance classes and maximum thresholds

5.2.2. Pillar A – Defining critical and strategic raw materials

At EU level, the Commission currently performs the criticality assessment (described in detail below) and conducts a foresight exercise on critical raw materials used in strategic sectors and technologies. However, the list of critical raw materials currently does not have legal status and only limited implications.

5.2.2.1. Approach 1: Legal definition of critical raw materials, based on the current criticality assessment methodology and covering the whole EU economy

This approach would consist in defining the scope of the regulation and all its measures based on the current criticality assessment methodology. The methodology covers a wide range of economic sectors and would continue to rely on the criteria:

- economic importance (EI), based on the value added of corresponding EU manufacturing sectors and corrected by a substitution index; and
- supply risk (SR), based on supply concentration (at global and EU level, weighted by a governance performance index) corrected by recycling and substitution parameters.

Raw materials exceeding the thresholds set for both criteria are considered at high risk of supply disruption (based on their supply concentration, weighted with governance indicators) and of high economic importance, and would therefore be defined as critical.

5.2.2.2. Approach 2: Legal definition of only strategic raw materials based on multi-criteria analysis including supply and demand foresight and relevance for strategic applications

Under this approach, a new concept of "strategic raw materials" would be introduced. This concept would take into account better the foresight perspective, and provide a stronger focus on applications considered strategic, such as renewable energy, electric mobility, aerospace and defence, digital or medical technologies. The list of raw materials identified as strategic would be enshrined into law and set a narrow scope for the measures proposed under this initiative. It would be shorter than the current list of critical raw materials and would likely overlap with it, but not fully be a subset as some raw materials that are strategically important and likely to face future supply challenges (e.g. copper, nickel and aluminium) are currently too diversified to pass the supply risk threshold of the criticality assessment.

The methodology to define strategic raw materials would build on the data collected for the criticality assessment but apply also more subjective/qualitative factors, notably relevance for strategic applications and forecasted demand growth. It would be applied to the full set of assessed raw materials, not only the ones currently identified as critical. As this would be a new concept and as important data has yet to be gathered, the exact methodology is not yet defined, but the following is a list of the factors considered for inclusion:

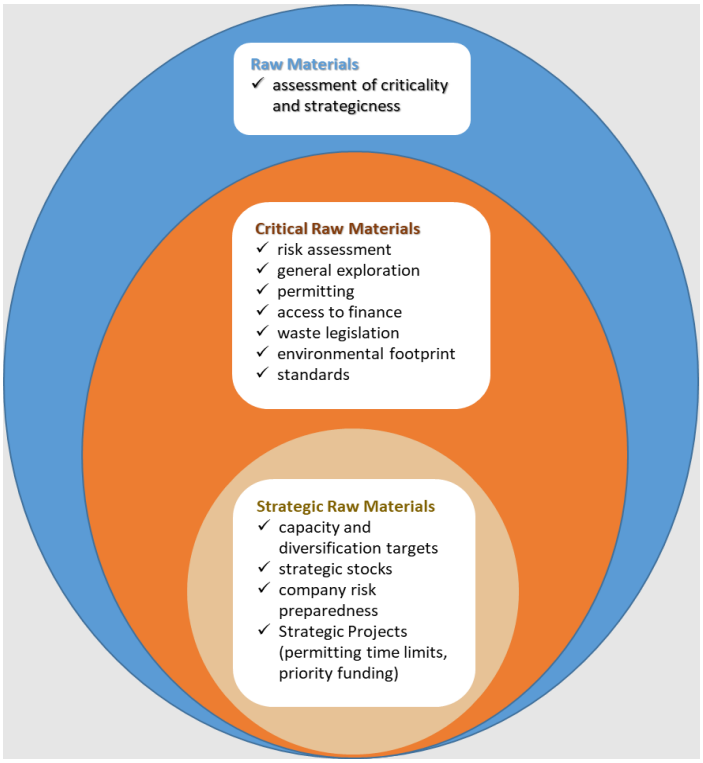
- Relevance for strategic sectors and technologies:
- Future supply and demand forecasts for 2030:
- Production volumes:
- Other potential factors:
    - A governance structure (cf. Pillar C) would monitor a full list of non-energy, non-agricultural raw materials, compiling databases (annually) on current EU production, imports, exports, consumption, recycling etc. for all raw materials.

5.2.2.3. Approach 3: Legal definition of both critical and strategic raw materials, with concentric circles of policy measures' scope

Under this approach, both of the concepts/lists described above would be given legal status. The list of critical raw materials identified based on the above-described criticality assessment would be amended to include all

strategic raw materials identified based on the above-described multi-criteria assessment, such that strategic raw materials would be a subset of critical raw materials. The thus slightly enlarged list of critical raw materials would define the overall scope of the Critical Raw Materials Act

The following figure maps the measures described under other pillars against the set of all screened raw materials, critical raw materials and strategic raw materials:



5.2.3. Pillar B – Setting strategic raw materials targets

5.2.3.1. Approach 1: Developing a framework to set EU-level guiding targets for strategic raw materials regarding capacity

First, this approach would set **headline targets** for the development of EU capacity per strategic raw material by 2030, e.g. the EU is able to meet 30% of its needs for a specific strategic raw material by 2030. Headline targets would be set specifically for strategic raw materials for which the investment needs and potential capacities are more clearly identified, e.g. lithium and rare earths.

Then, to achieve such headline targets, more specific **value chain targets** would be set, where appropriate, for extraction, refining and recycling:

In terms of time horizon, the first value chain targets would be set for 2030, and would have to be announced within one year of entry into force of the regulation. In 2030, following an assessment by the governance structure, new targets would be set for 2040, and similarly for 2050.

When set, the value chain targets would have to take into account:

- Existing EU targets for the deployment of EU renewable energy (Renewable Energy Directive), as it drives the need for green technologies containing strategic raw materials. SRM needs created by defence or digital strategies would also be taken into account.

- Existing recycling targets (recycled content or waste recovery), which could drive the EU's ability to meet EU recycling capacity targets (e.g., in the Batteries regulation
- The geological endowment of Member States and the EU as a whole, as reported in pillar D, for the setting of extraction targets, taking into account the feasibility studies operated by private or public bodies.
- The industrial capacity of Member States and the EU as a whole so as to determine refining/processing and recycling targets.
- The existing and planned projects pipelines, as reported by the relevant industrial alliances as well as by the Member States to the governance structure.
- The expected growth of EU demand for the strategic raw materials on which targets are set.
- The concentration of global supply for the strategic raw material.

5.2.3.2. Approach 2: Setting EU-level targets obliging the governance structure to work toward them through Strategic Projects proposals (cf. pillar E) and performance review

Conversely to approach 1, the targets would be directly set in the Regulation, at different value chain stages. They would be aspirational targets, with a double role:

1) Provide a common objective for public policies and private actors to work toward their achievement;
2) Serve as a criteria for the selection of Strategic Projects, which would have to demonstrate that their future output will serve to develop such targets.

The target levels would be formulated with headline figures, and would ensure that, for each strategic raw material and by 2030,

- Union extraction capacity is able to extract the materials needed to cover at least X % of Union's annual consumption of refined materials, to the extent that the Union's known reserves allow for this;
- Union refining capacity is able to refine at least X % of the Union's annual consumption of refined materials;
- Union recycling capacity is able to produce secondary materials covering at least X % of Union's annual consumption of refined materials;

In addition, compared to approach 1, the Commission would have a formal role in tracking progress towards the targets, based notably on the state of exploration of national resources of critical raw materials; on the advancement of Strategic Projects (cf. Pillar E), and on whether their development is impeded by specific factors, notably permitting bottlenecks, lack of investment, etc.

If it is apparent that EU capacities are not developing sufficiently to meet the EU-wide targets, the Commission would assess the necessity for adopting new measures.

5.2.3.3. Approach 3: Setting national targets in the regulation for strategic raw materials based on national resources and existing capacities

Under this approach, Member States would be imposed country specific targets at different value chain stages for strategic raw materials with a view to decrease the vulnerabilities and to increase the resilience, after the governance structure's initial assessment of their industrial capacity and mineral resources. Those targets would be adopted through delegated act. The Commission would jointly agree, no less than 6 months after the first 2030 review, on a set of measures to unlock the Member State's potential and contribution to achieving the targets.

If, in a subsequent review of the Member State's performance 2 years after the first review, no further progress has been made, the Commission should assess the origin of this lack, notably to determine the origin of it. In

the event where permitting bottlenecks are the concern, the Member State would be compelled to review its permitting procedures and allocate sufficient resources to the public authorities in charge.

5.2.4. Pillar C – Governance structure

This pillar seeks to enable the EU to increase its ability to foresee and mitigate structural supply shocks before they materialise, notably by enabling Member States and companies to build up their resilience through appropriate tools. The scope, depth, speed and efficiency of such tools are inherently linked to the governance structure that would be charged with carrying out the tasks specified in the subsequent (sub)pillars (C.1, C.2, C.3) on monitoring and risk-assessment, strategic stocks and risk preparedness. Therefore, the approaches proposed are bundled together as part of options 1, 2 and 3, and the resources are adapted according to the scope of the tasks proposed.

5.2.4.1. Approach 1: Tasking expert groups RMSG and EIP on raw materials to carry out tasks on monitoring and risk assessment

Under this approach, the Commission would rely on its existing expert groups (RMSG, EIP on RM) to develop relevant tasks on monitoring and risk assessment. The relevant experts would meet at technical level fora focusing discussion and exchanges on structural issues pertaining to the critical raw materials value chain, providing advice to the Commission on different pillars.

5.2.4.2. Approach 2: Developing a dedicated EU CRM board supported by a network of national agencies and operational capacity [within the Commission]

Under this approach, the Commission would propose to set up a EU CRM board composed by representatives of Member States and the Commission. This board would be in charge of building on the existing resources within the Commission and Member States administration to carry out the tasks described in the subsequent pillars (C1, C2, C3). Based on the contributions of the actors below, the board would issue advice to the Commission on particular actions, such as on defining strategic raw materials and setting targets for them on EU supply capacity and EU diversification, as well as on building up strategic stocks, and on proposing Strategic Projects (as per pillar G and K). The board would adopt its rules of procedure at its first meeting and the Commission would provide a common secretariat for the board and the network described below.

For tasks pertaining to the definition of strategic raw materials and their targets, as well as regular market monitoring and forecasting for the selected raw materials, the board would rely on the secretariat with intelligence capacity and a network of national ~~supply~~ agencies established by the regulation. Member States would appoint representatives from the relevant authorities, and their national intelligence or other relevant raw materials agencies. In the event where a Member State would not have a national supply and intelligence agency on critical raw materials or equivalent, it would nominate a representative from the authority in charge of geological or mineral resources. The Member State would also be encouraged to gather the necessary resources for assessing its own territories and developing its expertise in the sector.

Approach 3: Developing an operational capacity as a separate structure to implement the CRM Act's provisions

This approach would consist of creating a full-fledged operational capacity on critical raw materials, that is external to the Commission itself and is set on a permanent basis rather than relying on regular cooperation of Member States and European capacities as provided by the board and network under approach 2.

There are different formats that this operational capacity could take, such as the creation of a dedicated decentralised EU agency on critical raw materials or the creation of a dedicated directorate on critical raw materials in an existing agency.

The operational capacity would ensure the exchange of information, cooperation and coordination with the relevant governance bodies that deal with the vigilance and crisis response for raw materials.

5.2.5. Pillar C.1 Monitoring and risk assessment

5.2.5.1. Approach 2: Developing monitoring capacities and risk assessment

This approach would define precise monitoring tasks that would be carried out by the EU CRM board (i.e. the governance structure set out in approach 2 of Pillar C). The approaches 2 and 3 develop a more comprehensive and permanent framework dedicated to critical and strategic raw materials, ahead of crisis, while taking the instruments proposed in the SMEI into account (c.f., early warning mechanism, in approach 2).

Scope: With the support of the Commission, the board, with the support of the network, would develop a market monitoring capacity related to the critical raw materials industrial value chain, focussing on risks that may disrupt, compromise or negatively affect the supply of critical raw materials.

Means and actions: Through the network, the board would ensure to the best extent possible the coordination of research activities of national agencies on a specific material or value chain and the subsequent knowledge sharing amongst them in order to avoid overlap and gain added value in depth and knowledge. To develop such capacity, there is a parallel need to ensure information sharing from Member States and companies operating in the CRM value chain.

Deliverables:

First, this monitoring would feed into the determination of critical and strategic raw materials, that the Board would propose to the Commission (c.f. Pillar A) and would better inform subsequent policy decisions. It would be used to publish more regular information on monitoring through the publication of regular reports on the state of critical and strategic raw materials supply chain. The Commission would develop and run stress test of strategic raw materials value chain to estimate the likelihood and impacts of a future disruption (model-based, scenario-based, exercises with participating companies).

5.2.5.2. Approach 3: Developing monitoring and risk management capacities

In addition to the monitoring and general risk assessment provided by approach 2, this approach would ensure the development of targeted risk assessment as well as of risk management tools, thereby supporting the resilience of European companies.

Means and actions: Targeted risk assessment would be carried out by the operational capacity (cf. approach 3 of Pillar C) which would:

- **Conduct real time monitoring** of the CRM value chain (screening of news reports, business intelligence, high-frequency customs data),
- **Conduct direct stress tests** on strategic raw materials value chain at a more frequent pace, coordinating with Member States supply agency but with additional capacity to run them itself ;
- **Develop an Early warning mechanism (EWM)**: based on the monitoring, information gathering and stress test, the operational capacity would develop a EWM that indicate that a strategic raw material is at risk of imminent shortage or disruptions.

In addition to the coordination and information sharing tasks mentioned in approach 2, this approach would include **information request** from large companies operating in a strategic raw materials value chain in order to ensure a higher degree of information on the state of supply chains.

5.2.6. Pillar C.3 Companies' risk preparedness

5.2.6.1. Approach 2: Developing requirements on company diversification and stockpiling

Under this approach, specific requirements would be set on companies to ensure their preparedness and resilience. Under those requirements, large companies (>250 staff) which consume strategic raw materials as a primary input for their production would have to comply with at least one of the following obligations:

1) Ensuring a diversified source of suppliers if it relies on strategic raw materials (when the market structure allows);
2) Ensuring a sufficient level of strategic stocks of strategic raw materials equal to 60 days of consumption;

If they cannot ensure and demonstrate their adherence to one of those measures, companies would have to then report to the Member States in which they are established explaining the reasons for their non-compliance.

Those companies would also have to develop an in-depth audit of their supply chain under the form of a stress test, to assess regularly their vulnerability under different supply scenario and the suitability of their risk mitigation strategies.

Member States would be responsible for ensuring the implementation of these obligations.

5.2.6.2. Approach 3: Developing requirements on company diversification and stockpiling while providing direct support to foster companies' resilience

This approach would contain the measures developed in approach 2. In addition, to enable large companies to meet these obligations and to support SMEs in undertaking such efforts (even if SMEs would not face those obligations), this approach provides that the operational capacity advise companies on relevant strategies to enable them to mitigate supply chains risks. This support model could be defined in the legislation laying out the operational capacity's tasks.

Such advisory structure, inspired by the services some national agencies offer to companies, would allow for all EU companies operating across the critical raw materials value chain to benefit from direct advice.

5.2.7. Pillar C.2 Strategic stocks

5.2.7.1. Approach 2: Ensuring EU level coordination and stock assessment for the stockpiling of strategic raw materials

This approach would develop a mechanism to ensure higher coordination of strategic stockpiles amongst EU Member States, following the steps presented below.

1) After the establishment of the list of strategic raw materials, **Member States would be required to report** (with the highest level of confidentially and security) to the Commission on the organisation and on the state of their stockpiles for the strategic raw materials.

2) The Commission **would review the common state** of stockpiles and assess the potential convergences and overall levels of stockpiles across the EU, against a benchmark of what is considered as a safe level of stockpiling.

3) A review of the state of play and implementation of the Commission's recommendation would take place regularly occur to monitor progress. The SMEI framework, including the definition of targets under the mechanism set in the vigilance mode, and the coordinated release under the Single Market emergency phase, could still apply to critical and strategic raw materials in the event of a crisis or threat.

5.2.7.2. Approach 3: Enabling the common purchase of strategic raw materials

In addition to approach, this approach would mean that the operational capacity would foster the development of stockpiles of strategic raw materials. Based on the needs expressed by interested companies, the operational capacity (cf. approach 3 of Pillar C) would purchase through a joint procurement mechanism, appropriate quantities of strategic raw materials.

The interested companies would be financing the purchase of the stockpiles, as they are voluntary, albeit at lower costs given the fact that common purchasing would enable marginal saving. In addition, it would have to be assessed whether any financial instrument developed in pillar E.2 would be able to de-risk companies engaged in stockpiling by contributing to this mechanism.

5.2.8. Pillar D – Exploration efforts in the EU

The approaches developed below cover the early stages of the exploration activities related to mineral resources. They aim to enable further exploration activities by ensuring additional coordination or availability and reliability of data.

5.2.8.1. Approach 1 - Requirement on Member States to report on the mapping and evaluation of the critical raw material resources and extractive waste areas in the EU

With this approach, Member States would have to periodically report on the exploration activities carried by public entities and non-confidential information of exploration activities carried by companies, targeting critical raw materials.

This includes, but not only, existing public exploration programmes of mineral resources, targeting primary deposits (either currently or historically exploited or not) and/or secondary deposits (extractive waste of closed or abandoned facilities). Information on secondary resources should consider the volume, grades, mineralogy, technology feasibility and characteristics of the deposits, when available.

Member States would also have to periodically report, using the UNFC classification system, on results from public and private exploration activities (when available) that have already estimated mineral resources (measured, indicated or inferred) or reserves (proven or probable) according to existing national or international reporting codes.

5.2.8.2. Approach 2 – Requirement on Member States to report on, develop and implement national exploration programmes for critical raw material resources and extractive waste.

Under this approach, Member States would be compelled to implement identified actions, even if the extraction or reprocessing of extractive waste is not part of their industrial or economic strategy. The development of the knowledge produced would then be available for future generations and enable the development of the EU critical raw materials value chain.

- **Develop and implement public exploration programmes**

Member States would have to develop and implement programmes for the public exploration of mineral resources. The public exploration campaign would include geological mapping at a suitable scale, thematic mapping in particular hydrothermal alteration and structural maps, geochemical campaigns of soils, sediments, rocks and extractive waste, aerial geophysical surveys.

- **Reporting on critical raw material resources and extractive waste areas in the EU**

With this approach, Member States would have to periodically report on the exploration activities carried by public entities and non-confidential information of exploration activities carried out by companies, targeting critical raw materials. This includes, but not only, public exploration programmes of mineral resources, targeting primary deposits (either currently or historically exploited or not) and/or secondary deposits (extractive waste of closed or abandoned facilities).

- **Reprocessing existing geochemical and geophysical data sets**

Member States hold substantial repositories of raw geochemical and geophysical data from past public exploration campaigns or acquired in the context of past exploration permits. This data, together with new data acquired through public exploration programmes, could be reprocessed with new and innovative algorithms and processing methodologies. Under this approach, Member States would be compelled to develop and implement adequate policies to reprocess existing and newly acquired geochemical and geophysical data.

- **Developing predictivity maps**

Member States would be compelled to develop and implement adequate policies, such as a dedicated programme, to produce and update predictivity maps for critical raw materials in order to improve the knowledge of the mineral potential present in the EU.

- **Publication of data**

The results of the exploration activities promoted by Member States through the actions presented above, would have to be periodically reported to the governance structure.

Finally, this approach would, alike approach 1, encourage Member States to take due account of the occurrence of mineral resources containing critical raw materials (c.f., pillar A) when taking measures regarding land use that might affect the exploitability of the deposits.

5.2.8.3. Approach 3: Obligation to report to the governance structure on the land use decisions applicable to known deposits containing strategic raw materials

In addition to approach 2, approach 3 would require Member States to inform other EU countries and the Commission through the governance structure of their intention to adopt a land use decision that would affect the potential to exploit of a known mineral deposit containing strategic raw materials, allowing for comments and discussion in the relevant fora.

5.2.9. Pillar E – Support to the value chain

5.2.9.1. Approach 1: Requiring Member States to set up strategies to contribute to a stable and secure supply of CRMs

Under this approach, each Member State would be required to create a strategy outlining the ways and timeline how it can contribute towards achieving a more stable and secure supply of CRM in the EU, by identifying and supporting projects that are important across the CRM value chain. No specific legal notion of strategic projects would be established under this approach.

5.2.9.2. Approach 2: Identify Strategic Projects, in Europe and partner countries abroad

Under this approach, Strategic Projects would be established with legal consequences regarding permitting and access to finance as outlined in pillars E.1 and E.2.

Companies and investors, would be able to submit their proposals to the Commission. To be eligible, projects would have to fulfil general minimum criteria, among them a meaningful contribution to the targets set under Pillar B, positive spill-over effects beyond the Member State where they are located and a positive outlook regarding long-term economic viability. The governance structure might apply more specific criteria per step of the value chain for each raw material mentioned in the list of targets.

a business plan evaluating the financial viability of the project, including an overview about the secured funding and the remaining financing needs and estimated time-to-market.

an assessment of the level of public acceptance of the project and, where relevant, a plan for ensuring it, including actions (additional to what is already required) such as awareness campaigns to educate and inform the public of the importance of CRMs for the green transition and how these CRMs could be obtained in the EU in a responsible way or setting up mitigation and compensation mechanisms to ensure that the project contributes to the general development of the relevant area.

The Commission would then share the application with the Member State where the project is intended to take place and ask for its general approval within one month for the project to receive the status of Strategic Project. Where it refuses, it would have to present its substantiated reasoning to the Commission who could request the Board to discuss these reasons. Where the Member State accepts, the Commission would check the application for the fulfilment of the minimum criteria. In case of many applications, the Commission would be able to prioritise applications for projects active on specific parts of the value chain in order to work towards a balanced representation of projects along all strategic raw materials along the value chain. The Commission would then assess the projects in consultation with the Board. For projects that fulfil the criteria, the decision to assign them the status of Strategic Project, this would be published as a Commission decision.

Projects outside of the EU could also be labelled as Strategic Projects. To be eligible, those projects would also have to fulfil general minimum criteria, among them high environmental and social performance and contribution to the targets laid out in pillar B. They would also need the support of one or more European companies that have committed to purchase at least e.g. 50% of the production of the respective strategic raw materials for e.g. 180 months for use in Europe. The projects should in principle be located in countries with which the EU has concluded a Free Trade Agreement with a chapter on raw materials or a Strategic Partnership. To ensure compliance with ESG criteria, the project would need to show sufficient evidence that it would qualify for a recognised certification scheme, if recognised. Otherwise, the same process would apply. The respective third country would be closely involved to ensure compliance on the ground. The board might also coordinate with the Global Gateway governance, which could help leverage EU Member States funds for projects outside the EU.

5.2.10. Pillar E.1 – Permitting procedures

Raw materials operations in the EU are subject to a comprehensive legislative framework that is meant to minimise a project's adverse environmental impacts and ensure involvement of all relevant stakeholders in the permit-granting process. This framework is an essential achievement, which this initiative should build on. However, the unpredictability of permitting procedures in terms of duration and outcome has been shown to discourage much-needed investment into the European raw materials value chain. Against this background, this section sets out different possible approaches to speeding up permitting processes and making them more predictable.

5.2.10.1. Approach 1: CRM projects to be considered in spatial planning

Intervening in an early phase, well-designed spatial planning has the potential to reduce land use conflicts and point project developers to suitable sites, which in turn is likely to accelerate permit-granting procedures. Analogous to Union legislation on the deployment of renewable energies, therefore, Member States'

competent national authorities at national, regional and local level would be required to take into consideration and provide for the realisation of CRM projects when developing spatial plans.

Given the potential effects on the environment of CRM projects, Member States should, when developing those spatial plans, apply the Strategic Environmental Assessment (SEA) Directive[11].

5.2.10.2. Approach 2: Mandatory measures to make permitting for Strategic Projects more predictable

This approach includes the measures set out in Approach 1.

In order to ensure a secure investment climate for Strategic Projects (see Pillar G) in particular, a general requirement would be set for Member States to ensure that administrative procedures for their approval are streamlined and expedited at the appropriate administrative level.

In order to put such streamlining into practice, Member States would also be required to take the following concrete measures in relation to Strategic Projects:

- allocating the status of the highest national significance possible under national law to Strategic Projects for the purpose of permit granting processes;
- applying a joint procedure combining all relevant assessments for a given project;
- designating a 'one-stop shop', in the form of a competent authority which should be the sole point of contact for project promoters during the entire process
- adhering to specific time limits for different stages of the permit granting procedure;
- allowing documents to be submitted digitally;
- making available a manual of procedures for project developers.

As regards the duration, there would be an overall time-limit set for overall permit granting procedure (covering the period from the date of acceptance of the submitted application file until a comprehensive decision) for Strategic Projects (e.g. 18 months).[112] More specific time limits would also be introduced pertaining to specific steps of the permitting process.

The above-mentioned time limits would be without prejudice to potential delays caused by judicial or non-judicial appeals. However, Member States would be required to, where available under national law, apply urgency procedures for possible litigation related to the permit granting process.

Lastly, this approach would provide direction to Member States on the application of substantial permitting conditions. The nature protection rules that are integral part of the relevant permitting conditions (i.e. the Birds, Habitats and Water Framework Directives) provide that projects considered to be in the overriding public interest can be allowed to go forward even in the case of limited adverse impacts on the environment.

5.2.10.3. Approach 3: Require Member States to dedicate sufficient resources to their permitting

This approach includes the measures set out in Approach 1 and 2.

It would also introduce a requirement on Member States to dedicate sufficient resources to permitting procedures for Strategic Projects. Following the example similar provision in the field of competition and consumer protection law, Member States would, more in particular, be required to ensure that responsible

[112] Similar to the time limit included in the TEN-E Regulation for cross-border energy infrastructure projects (18 months) or the RED II Directive for renewable power plants (24 months).

authorities have a sufficient number of qualified staff and sufficient financial, technical and technological resources necessary for the effective performance of their functions.

5.2.11. Pillar E.2 – Access to finance

5.2.11.1. Approach 1: Encourage setting up of Investment Platform, leveraging finance through existing instruments

Under this approach, no new funding instruments outside the possibilities of the current framework would be established, but the Commission would work towards an extended use of the existing possibilities and to tie them as closely as possible to the Strategic Projects. This would include fostering the setting up of an investment platform under InvestEU, which specifically supports CRM projects. This would require an Implementing Partner that has a valid Guarantee Agreement with the Commission (e.g. the Agreement with the EIB that administers 75% of the Commission's guarantee allows to fund raw materials projects), which enables the EU guarantee and helps attracting additional funding from private and public sources. Under InvestEU a wide variety of financial instruments can be provided, for example loans, equity or hybrid products. An InvestEU Advisory Hub on CRM would be set up to support provide technical assistance and advisory services to project promoters (as well as financial intermediaries), including for the creation of the investment platform. Additionally, the use of other existing funds for domestic use (RRF, Innovation Fund, Cohesion Funds, etc.) should be promoted and fostered for these projects. For CRM projects abroad funds aiming at international spending would be used (NDICI, EFSD+, IPA, etc.).

5.2.11.2. Approach 2: Dedicated CRM Fund with Member State contributions and limited EU contribution from existing sources

In addition to approach 1, the Board, with a dedicated standing sub-group consisting of financial experts from the Member State as well as the Commission, would provide support to Strategic Projects in access to finance. It would point to existing sources that could provide funding, including on level of the Member State, international financial institutions, national promotional banks and the Union.

The support from public sources would be applied to crowd-in private money and increase the leverage. It would focus on filling the remaining gap where the market struggles to finance it due to market failures.
Despite these efforts, significant gaps would persist in the funding landscape. For example, cohesion funding provides only limited opportunities for investment in wealthier regions of the EU, where geological resources for extraction, or energy availability for refining may be better; most other relevant funds are directed either at innovative projects or projects directly contributing to positive environmental and climate impacts (without considering the role of CRMs in enabling clean technology). Importantly, current funding conditions do not address strategic autonomy as a goal (even though the Trade Policy Review and other official strategy papers have endorsed this concept) while investments in areas such as CRMs are essential for this objective. An important project about, for example, rare earth extraction in the north of Sweden would therefore still struggle to attract funding.

Where public support qualifies as State Aid, existing State Aid rules would be respected. The support from public sources would be applied to crowd-in private money and increase the leverage. It would focus on filling the remaining gap where the market struggles to finance it due to market failures. Supported projects would also need to show their long-term economic viability under functioning market conditions, the aim would not be to support that permanently require operational support.

Therefore, the Commission would work with interested Member States to set up a dedicated CRM Fund to further support CRM projects, including Strategic Projects. This Fund would require Member State contributions and a contribution of existing EU sources to leverage this money with private financing[113].

To ensure the European dimension and to get closer to closing the large investment gap as shown in the access to finance part of the problem section, existing European resources would also be used. The necessary mix of different financial instruments would depend on the project's specificities, notably the stage of the value chain (e.g. risk capital, loans). The Fund's purpose would be to support the CRM value chain in Europe and partner countries abroad, in particular Strategic Projects, and to generate a return on investment. The Fund should be able to provide loans and equity to projects along the entire CRM value chain, focussing on Strategic Projects. Grants should also be considered but depend on the type of financial resources and set up of the Fund.

The support from public sources would be applied to crowd-in private money and increase the leverage. It would focus on filling the remaining gap where the market struggles to finance it due to market failures. Supported projects would also need to show their long-term economic viability under functioning market conditions, the aim would not be to support that permanently require operational support.

5.2.11.3. Approach 3: Dedicated CRM Fund with additional Commission contribution and Member State contribution

In addition to approach 1, the Commission would set up a dedicated CRM Fund that combines new EU money with Member State contributions, leveraging private investments to support CRM projects along the value chain in Europe and abroad, prioritising Strategic Projects. It could be managed by the governance structure (i.e. the board or operational capacity, cf. Pillar C). The CRM Fund would be able to provide loans, equity and grants for investment support, in compliance with State aid rules.

This Fund would provide a common European approach to funding CRM projects. With the appropriate endowment, it would be able to provide more and riskier financing, and could also be less bound by profitability considerations and operate more freely (compared to the fund considered under approach 2) to effectively address proven market failures.

5.2.12. Pillar F – Waste legislation

5.2.12.1. Approach 1: Adoption of a Commission Recommendation targeting small consumer electronics and announcements of future CRM circularity actions

- The Commission would adopt (as part of the CRM Act package) a Recommendation on take-back schemes for small consumer electronics, to improve the return of used and waste mobile phones, tablets and laptops, which contain significant amounts of critical raw materials.
- The Communication accompanying the CRM Act would announce that the upcoming (Q2 2023) joint review of the Directive on end-of life vehicles and the Directive on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability (3R) will include provisions to support recovery of CRMs from end-of-live vehicles and use of recycled CRM content in new vehicles.
- The Communication accompanying the CRM Act would announce (for Q1 2024) upcoming secondary legislation under the current WEEE Directive to amend its Annex VII on selective treatment for materials and components of WEEE to include a list of CRM-rich electrical and

[113] Depending on the design and governance of the upcoming Fund, its support may qualify as State aid, in which case State aid rules will apply.

electronic equipment and components thereof. It would also announce the launch of a preparatory study for the identification of such CRM-rich EEE and components.

- The Communication accompanying the CRM Act would announce an upcoming review of the WEEE Directive, assessing possibilities of introducing information requirements (on CRMs contained in electrical and electronic equipment), design requirements (for dismantlability of CRM-rich components) – in synergy with Ecodesign provisions – and separate collection and recovery targets for a list of CRM-rich electrical and electronic equipment.
- The Communication accompanying the CRM Act would announce actions to introduce EU end-of-waste criteria for the most important waste streams containing CRMs.
- The Communication accompanying the CRM Act would announce (for Q2 2024) a proposal to introduce specific waste codes for Lithium-ion batteries and intermediate waste streams ("black masses") under the European List of Waste.
- The Communication accompanying the CRM Act would announce (for Q2 2023) the launch of an Ecodesign preparatory study on potential product-specific requirements on recycled content and on scarce, environmentally relevant and critical raw materials, which would be followed up by implementing measures. It would also note the possibilities to set relevant requirements for CRM-rich products under the proposed Ecodesign for Sustainable Products Regulation.

These measures would need further analysis in dedicated assessments.

5.2.12.1.1. Approach 2: Targeted amendment of the Extractive Waste Directive and certain circularity provisions in the CRM Act

- The Commission would adopt (as part of the CRM Act package) an amending Directive to the Extractive Waste Directive, to introduce targeted changes aimed at increasing CRM recovery from extractive waste. The two main measures would be to require:
    1. operators of extractive waste sites to perform an economic pre-feasibility study of the potential to recover CRM from the extractive waste generated (as part of the waste management plans under Article 5), and
    2. Member States to create a database of all closed extractive waste sites, search administrative records and perform geochemical sampling to identify quantities and concentrations of CRMs on these sites, and publish such information in order to encourage CRM recovery projects on those closed waste sites.

The CRM Act would include an obligation for Member States to develop national circularity strategies, addressing areas of national competence, such as waste collection and treatment systems, national R&I programmes for CRM recycling technologies and CRM substitution, and to gather data on the most important product and waste streams and stocks containing CRMs on their territory.

5.2.13. Pillar G - Actions on standards for the critical raw materials value chain

5.2.13.1.1. Approach 1: Increase efforts to have EU rules and principles reflected in international standards

This approach would include several actions to leverage this position specifically in relation to critical raw materials, with the aim of ensuring that the principles and values underlying relevant EU legislation are reflected in international technical standards on CRMs, especially standards for ensuring the sustainability of industrial processes involved in the CRM value chain.

This approach would promote a more strategic and coordinated approach to international standardisation activities by helping Member States, EU standardisation bodies and EU industries more effectively coordinate and share resources in support of international standardisation processes.

5.2.13.2. Approach 2: Mandate development of standards regarding relevant industrial processes

In addition to approach 1, this approach would look beyond the EU's contribution to international standardisation efforts by also providing direct support for the development of European standards and standardisation deliverables on the sustainability of CRM-related industrial processes.

Based on the priorities set by the HLF and ERMA working groups, the Commission would request CEN to develop e,g, technical specifications, technical reports, workshop agreements or European standards.

The development of standards following the mandate provided by the Commission to standardisation bodies is likely to take up to three years.

5.2.13.3. Approach 3: Set essential requirements regarding relevant industrial processes and mandate development of related harmonised standards

In addition to approach 1, this approach would include the setting of essential requirements related to the sustainability of CRM-related industrial process, e.g. on the water use and resource efficiency of extraction and recycling processes for lithium. Following a similar approach to the New Legislative Framework, the Commission would issue standardisation mandates for CEN to develop harmonised European standards, providing a presumption of conformity with the requirements to which they are linked.

In addition to operationalising such requirements (allowing responsible economic operators to more easily apply them and competent authorities to more easily enforce them), the creation of harmonised European standards would provide an even stronger basis for European leadership in international standardisation fora.

5.2.14. Pillar H – Environmental footprint of critical raw materials

5.2.14.1. Approach 1: Set minimum requirements for certification schemes for sustainable CRMs

This approach focusses on the reliability of general environmental claims (e.g. 'this lithium was produced using sustainable practices') made by operators selling CRMs on the EU market. The availability of specific qualified information on the environmental footprint is addressed in Approach 2 below

5.2.14.2. Approach 2: Require declaration of the environmental footprint of CRMs sold in the EU

In addition to approach 1, this approach would entail requiring economic operators to declare the environmental footprint of CRMs they sell on the EU market, as a market access requirement. This will help bring about transparency on the environmental footprint of CRMs and help shift the Union market towards lower impact CRMs, regardless of where they are produced.

This requirement would only apply for CRMs for which there are material-specific calculation rules available. Before mandating the rules for the calculation of the environmental footprint of CRMs, a consultation process with industry and Member States seems necessary to fine-tune those rules and clarify how they will be maintained over time. The material-specific calculation rules would therefore be provided by means of implementing acts prioritising CRMs with relatively higher demand and environmental impacts.

Given the wide variety of environmental profiles of the different CRMs, the Commission would be empowered to, when specifying calculation rules, allow the footprint declaration to be limited to one or a subset of impact categories where this is justified based on the environmental profile of the different materials

The calculation rules would be based on the Product Environmental Footprint (PEF) method.[1]

The requirement would in principle not apply to final products containing relevant CRMs. However, where the footprint of CRMs included in product is specifically referenced in any relevant product documentation, it would be required to justify that claim and refer to the declared footprint of the CRMs used.

5.2.14.3. Approach 3: Putting in place a mechanism for setting performance classes and maximum thresholds for environmental footprint

In addition to approach 1 and 2, this approach would consist in introducing a mechanism to set footprint performance classes to further support market differentiation and the setting of maximum footprint thresholds for specific CRMs placed on the EU internal market. Such measures could have adverse effect on the security of supply for CRMs. Therefore, in light of this risk and in order to avoid any negative effect on supply security, the following measures would be gradual, progressive and evidence-driven. Indeed, for each maximum footprint threshold, there should be dedicated assessments conducted.

This approach would contain the following gradual steps: First, as there is not yet sufficiently detailed statistical information on the relative footprints of CRMs, the Commission would gather such information through the declarations proposed in approach 2 through secondary legislation. Second, once sufficient market knowledge is acquired through step 1, relevant CRMs would be categorized in an A-G scale based on their footprint. Third, a threshold would be identified, which would correspond to correspond to the limit values of the lower or lowest classes in the performance class scale.

The introduction of maximum thresholds the third step would only be possible when accompanied by a proportionate and dedicated assessment, which would take into account the relative distribution of the footprint values for the relevant CRMs placed on the Union market, the extent of progress in the reduction those footprints as a result of the information requirement referred to in approach 2, and the effective and potential contribution of a threshold to the Union's environmental and climate objectives. In addition, this assessment would take close account of the potential effects of thresholds on EU imports of the relevant CRMs, ensuring that the level of the thresholds is set so as to prevent potential bottlenecks for EU supply of CRMs.

This approach would steer relevant economic operators to reduce the environmental footprint associated with their CRMs and would ban from the market those materials with the relative highest footprint. Economic operators should be given sufficient time to adjust their production facilities.

As explained, this measure would need further analysis in dedicated assessment.

Interaction of approach 2 and 3 with other initiatives: The measures outlined in approaches 2 and 3 related to the environmental footprint of CRMs are in full coherence with existing initiatives related to the life-cycle impacts of products and materials, and would help contribute to achieving similar environmental aims.

Batteries Regulation: the recently adopted batteries regulation contains similar measures, focusing on the carbon footprint of larger batteries placed on the EU market, i.e. combining information requirements with potential thresholds to be set gradually. Such batteries include several critical raw materials, including lithium and cobalt, and the footprint of such materials would be included in a battery's overall footprint. Footprint requirements on critical raw materials contained in batteries add value for several reasons. Firstly, they would apply also to CRMs sold on the EU market for other applications than battery manufacturing.[114] Secondly, a material-level footprint would also cover the EU market for battery materials used to produce batteries intended for export (to which the Battery Regulation does not apply). Lastly, the availability of footprint

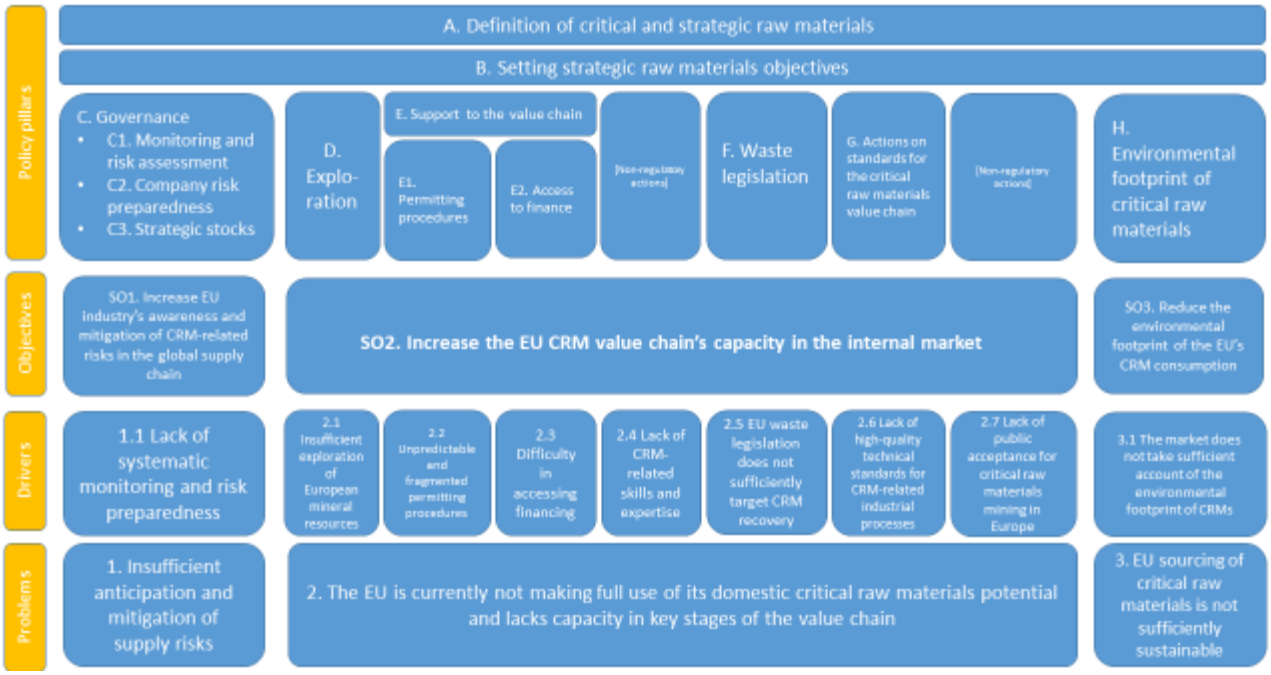
[114] Globally, 56% of lithium is used for rechargeable batteries, other primary uses are within the glass- and ceramics industry and for lubricating greases. Similarly, 49% of cobalt is used for rechargeable batteries. Other uses of cobalt are in superalloys and composite materials for e.g. turbine engines and cutting tools. See https://ecodesignbatteries.eu/sites/ecodesignbatteries.eu/files/attachments/EDbatteryFollowupWP4finalpreprint.pdf

information will be beneficial for battery manufacturers that need to calculate the footprint of their batteries intended to be placed on the EU market. Both sets of calculation rules are intended to be based on the PEF method and it should be ensured that they are complementary.

Ecodesign for Sustainable Products Regulation (ESPR): the proposed revision of the current ecodesign directive is intended to widen its scope beyond energy-related product to allow the setting of wide range of requirements on a broad range of products, in order to improve their environmental sustainability, and provides for the introduction of a Digital Product Passport. Although the product parameters to be regulated (either by information or performance requirements) should be determined at product-specific level, the possible parameters include the carbon and environmental footprint of products. However, it is important to note that the ESPR is proposed to focus only on final products (e.g. fridges) and intermediate products (e.g. steel). As such, it does not allow to set footprint requirements for CRMs. Where the ESPR imposes a footprint requirement on a product containing CRMs for which a footprint requirement also applies, the material-level footprint information can feed into the product level footprint calculation.

Corporate Sustainability Due Diligence Directive (CSDD): The CCSD applies only to companies of certain size, including those active in the raw materials sector, and requires companies and their directors to, *inter alia* set up due diligence processes that should include identification and prevention actual or potential adverse human rights and environmental impacts in the company's own operations, its subsidiaries and its value chains. This initiative may not lead to the availability of complete product-level footprint information as the scope of environmental impacts to be taken into account is determined by a list of relevant international treaties, and does not encompass all PEF impact categories. However, where relevant, the calculation of a material-level footprint could contribute to the effective implementation of a due diligence policy.

Carbon Border Adjustment Mechanism (CBAM): The recently adopted CBAM is intended to address greenhouse gas emissions embedded in certain carbon intensive imported goods, in order to prevent the risk of carbon leakage. CBAM was designed to function in parallel with the EU's Emissions Trading System (EU ETS), to mirror and complement its functioning for imported goods. Given this specific aim, CBAM will not lead to making the footprint of all relevant goods placed on the EU transparent nor will there be any thresholds for embedded emissions. In addition to this fundamental difference, it should be noted that the current scope of the CBAM does not include an CRMs and that the CBAM only focusses on a single PEF impact category (climate change).



5.3. Description of the policy options

The approaches for each pillar were used to define realistic policy options, which represent combinations of different approaches.

In order to avoid an unmanageable multiplicity of options, measures were combined into the three distinct options that represent different levels of political ambition. The combination of measures has been designed to ensure adequacy between the scope of the tasks established and the level of resources required to perform them. The tasks defined in monitoring, stockpiling or companies' risk preparedness pillars, for example, are intrinsically linked to the governance structure's ability to deliver them, and are therefore more ambitious under option 3 which foresees the creation of an external operational capacity to perform them. This is meant to avoid the risk of under-implementation of the measures presented.

For some of the pillars, the choice of the preferred policy approach is straightforward considering the stakeholders' feedback, proportionality and subsidiarity of measures. In such cases, some of the approaches are not included in any of the options, and annex 5 explains for each of them why they were discarded at an early stage. For others, in particular for far-reaching measures, the views of different stakeholders including Member States and businesses differ, hence the different approaches for these blocks have been included in the different policy options.

For the reasons provided in the Section 5.1, the measures presented below mainly focus on European value chain; global value chain of critical raw materials remain nonetheless covered by dispositions on monitoring or on environmental footprint.

The overview of the composition of the policy options resulting from the analysis in section 5.2 is presented in the table below. These three policy options will be analysed in detail in section 6.

TABLE 2. OVERVIEW OF POLICY OPTIONS			
Pillars	**Policy option 1**	**Policy option 2**	**Policy option 3**
A. Defining critical and strategic raw materials	*Approach 3:* Legal definition of both critical and strategic raw materials		

B. Setting strategic raw materials targets	*Approach 1:* Developing a framework to set EU-level guiding targets for strategic raw materials regarding capacity	*Approach 2:* Setting EU-level targets obliging the governance structure to work toward them through Strategic Projects proposals (c.f. pillar G) and performance review	
C. Governance	*Approach 2:* Developing a dedicated EU CRM board supported by a network of national agencies and operational capacity within the Commission		*Approach 3:* Developing an operational capacity as a separate structure to implement the CRM Act's provisions
C.1 Monitoring and risk assessment	*Approach 2:* Developing monitoring capacities and risk assessment		*Approach 3:* *Approach 2* + Developing monitoring and risk management capacities
C.2 Strategic stocks	*Approach 2:* Ensuring EU level coordination and stock assessment for the stockpiling of strategic raw materials		*Approach 3:* *Approach 2* + Enabling the common purchase of strategic raw materials
C.3 Company risk preparedness	*Approach 2:* Developing requirements on company diversification and stockpiling		*Approach 3:* *Approach 2* + providing direct support to foster companies' resilience
D. Exploration efforts in the EU	*Approach 1:* Requirement for Member States to report on the mapping and evaluation of the strategic (and critical) mineral resources and extractive waste areas in the EU	*Approach 2:* Requirement for Member States to report on, develop and implement public exploration programmes for strategic (and critical) mineral resources and extractive waste.	
E. Support to the value chain	*Approach 1:* Requiring Member States to set up strategies to work towards achieving more stable and secure supply of CRM	*Approach 2:* Strategic Projects, in Europe and in third countries	
E.1 Permitting procedures	*Approach 1:* CRM projects to be considered in spatial planning	*Approach 2:* *Approach 1* + Mandatory measures to make permitting for Strategic Projects more predictable	*Approach 3:* *Approach 2* + Require Member States to dedicate additional sufficient staff to their permitting handling
E.2 Access to finance	*Approach 1:* Encourage the setting up of an Investment Platform for the CRM value chain and leverage finance through existing instruments	*Approach 2:* *Approach 1* + Promote and advise the setting up of a dedicated CRM fund to combine Member State funding with contributions from existing EU funds, in compliance with State Aid	*Approach 3:* *Approach 1* + Set up a dedicated CRM Fund with new Commission contribution and Member State contribution, managed by governance structure, in compliance with State Aid

		rules. It should be able to provide loans and equity to projects in all stages of the CRM value chain. Grants could be considered as well, depending on the types of resources available.	rules. It should be able to provide loans, equity and grants to projects in all stages of the CRM value chain.
F. Waste legislation	*Approach 1* Adoption of a Commission Recommendation targeting small consumer electronics and announcements of future CRM circularity actions	*Approach 2:* *Approach 1* + Targeted amendment of the Extractive Waste Directive and certain circularity provisions in the CRM Act	
G. Actions on standards for the critical raw materials value chain	*Approach 1:* Increase efforts to have EU rules and principles reflected in international standards	*Approach 2:* *Approach 1* + Mandate development of standards and standardisation deliverables regarding relevant industrial processes	
H. Environmental footprint of critical raw materials	*Approach 2:* Set minimum requirements for certification schemes for sustainable CRMs + Require declaration of environmental footprint for CRM sold in the EU	*Approach 3:* *Approach 2* + Putting in place a mechanism for setting performance classes and maximum thresholds (through delegated acts)	

5.4. Aspects of the main problem tackled through actions outside the scope of this impact assessment

The pillars and approaches identified above are not per se sufficient to tackle the overall problem described in section 2. They are constrained to the options and measures that can be best tackled through direct regulatory actions, and that mainly focus on domestic dimensions, notably the reinforcement of the European value chain, its resilience to supply disruptions and the sustainability of its supply. Other actions are necessary to contribute to the main objective, notably on external diversification; skills and research and innovation. In all cases, actions are already ongoing, but should be further strengthened in the context of the Critical Raw Materials Act in order to

- **Ensure the diversification of EU supply**

Another key action to directly target the lack of supply security remains the pursuit of a diversification strategy, as engaged with Strategic Partnerships since the 2020 Critical Raw Materials Action Plan or through Free Trade Agreements (c.f. Section 5.1). The Communication attached to the Critical Raw Materials Act will contain new initiatives that aim to address this matter directly. (c.f. Section 5.1).

- **Develop adequate skills to support the CRM value chain**

Ongoing actions are contributing to developing the right skill sets for the CRM value chain to develop in the EU, responding to the identified problem driver 2.4. For instance, the EU-funded research project "Intermin"[115]

[115] https://interminproject.org/, co-funded under Horizon 2020 from 2018 to 2021.

identified, in particular for the mining sector, a shift towards higher cognitive and complex problem-solving skills, the need to re-skill and up-skill the workforce, the need to support mobility and rotation, the need to attract talents from other sectors and the need to increase collaboration with universities. It also underlined the need for social skills in the sector, for instance skills related to mining rehabilitation and waste management[116].The Communication will include other actions to tackle this issue, while in parallel promoting the development of relevant skills in the public sector.

- **Strengthen EU efforts in research and innovation**

Ongoing actions are supporting research and innovation efforts to ensure the deployment of adequate technologies, such as more sustainable exploration, mining, processing, refining, recycling opportunities or substitution development, responding to the identified problem driver 2.5.

For instance, under the 2021-2024 Work Programmes of Horizon Europe, calls for proposals on Raw Materials are placed under Cluster 4 (Digital, Industry and Space). In total, the Commission has devoted around EUR 550 million for raw materials R&I in exploration, extraction, processing, refining, recycling, substitution, Earth Observation and policy support actions in this period. Initial R&I results are expected in 2026 when first projects will finish their work. Their further uptake to a more developed Technology Readiness Levels or implementation by the industry will be a necessary activity at that stage.

The uptake of results is an issue for projects originating from H2020, where around EUR 600 million was devoted to around 70 technology projects in raw materials. For instance, a rare earths separation technology has been positively tested in certain sites and now requires ore input from full scale extraction activity. However, this can only happen when the mining site obtains necessary permits to start extraction activity. Thus, the regulatory measures to strengthen the EU's CRM value chain will also allow to validate such research and innovation actions.

Regarding substitution, following the magnesium shortage in 2021, the EU funded a project to substitute magnesium in aluminium alloys for light weight mobility applications. The results are expected in 2024, three years after the shortage on the market. A more forward-looking approach to substitution, covering also a broader set of raw materials and applications, could be a priority for future R&I projects.

The Communication will announce actions to strengthen the EU's leadership in the support for R&I projects on raw materials, notably by improving the coordination and coherence between regional, national and EU funding for critical raw materials R&I.

- **Address the lack of public acceptance**

The measures on R&I and skills (presented above), as well as on the environmental footprint of CRMs and circularity of CRMs (see policy pillars and options in the next chapters) will contribute to reducing the environmental impacts associated with the CRM value chain. This, combined with more proactive communication by companies and policymakers on the high level of environmental protection in the EU, can contribute to addressing the lack of public acceptance for CRM projects in the EU identified as problem driver 2.7. Similarly, the development of strategic raw materials targets clearly linking the availability of CRM to the EU's green and digital transition objectives, the selection of Strategic Projects, and the general discussion around the measures taken under this initiative should contribute to raising awareness on the important role of CRM in our economy and society.

[116] https://interminproject.org/wp-content/uploads/The-skills-needed-in-the-mining-sector-in-the-21st-century.pdf

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?[117]

The impacts of the different policy options are assessed below based on the results of the open public consultation, internal analysis and external studies. Only the relevant types of impacts affecting each pillar are assessed. Overall, the initiative is not expected to have an impact on fundamental rights. It is also considered that all measures that include or imply information sharing or reporting should be implemented in line with the principle of digital by default.

Stakeholders overall call for additional EU support in the area of critical raw materials. 59% of the 259 respondents to the public consultation (OPC) agree or strongly agree that industry is not able to tackle critical raw materials sourcing challenges on the global market without further EU policy intervention, and 72% agree or strongly agree that EU policies are currently insufficient to effectively manage supply chain disruptions, shortages and prices hikes.

6.1. POLICY OPTION 1

6.1.1.Economic Impacts

6.1.1.1. Impact on companies

Under option 1, companies would benefit from incremental support to develop the EU value chain and ensure their resilience, as analysed below.

There would be two **lists of raw materials** (Pillar A), one of critical and one of strategic raw materials, each based on a transparent methodology, and each defining the scope of different measures under the following pillars (see Annex 9). Most stakeholders support complementing the current critical raw materials list with a list of strategic raw materials to provide focus for actions under this initiative. 70% of all OPC respondents said it would be useful to guide investment decisions of companies and financial institutions and that it should be used to target public support at EU and national level.

Companies would benefit from the alignment of EU support toward strategic raw materials through the dedicated EU supply capacity **targets** (Pillar B. Those targets, albeit aspirational under this option, would also focus and guide investors' decisions. 73% of respondents in the public consultation agreed or strongly agreed that setting EU objectives for increasing domestic production capacity along different stages of the value chain (exploration, extraction, refining, recycling) to guide national and European efforts in relation to the materials on the strategic list would be helpful.

Option 1 would enable the development of **monitoring capacities and risk assessment ahead of crisis** (Pillar C.1), based on a network of Member States agencies and internal capacity in the Commission. Stakeholders indicated strong support for enhanced cooperation between national authorities or agencies in charge of critical raw materials (data exchange, common monitoring, etc.): 82 % of respondents agreed or strongly agreed that such measures would support the EU CRM value chain. Stakeholders also converged on focusing the scope of the monitoring on projects evolution, demand and supply developments, and trade flows (further details in annex 2).

Limited administrative cost is associated with the reporting obligations for large companies operating in the critical raw materials value chain: it is estimated at EUR 49.000 in total for all 64 companies concerned to report twice a year to the governance structure (see calculations in Annex 4). The monitoring tools developed above would directly benefit companies by enabling cost saving measures on their own monitoring system, thereby lowering or offsetting the costs created by information requests. Overall, companies of all sizes would

[117] Note: It is advisable to read the detailed description of policy approaches in section 5.2 and for more details in annex 5 in order to understand better the exact measures being assessed in the following.

directly benefit from the regular publication of up-to-date information on supply risks that would enable them to tailor their mitigation strategies, as indicated by 70% of respondents in the public consultation.

This option's measures on **strategic stockpiling** (Pillar C.2) relate to the coordination of national stockpiles for strategic raw materials, which would not have a direct impact on companies. This option is the most supported by stakeholders, with 41% preferring an EU level guidance on voluntary stocks at national level. Member States showed overall support for this coordination in the response to an RMSG survey on stockpiling, and the European Parliament also called on the Commission in its 2021 report to encourage "Member States to carry out strategic stockpiling as part of a coordinated approach". Conversely, "mandatory stockpiling" was the least supported option in the open public consultation with only 14% of respondents in favour (7% for companies).

Coordination would bring additional benefits by incentivising Member States to strengthen their strategic stocks, adding an extra-layer of security for the companies whose value chain comprise strategic raw materials. It would also respect subsidiarity with regard to the building or maintenance of stockpiles up to Member States without adding additional targets. This coordination amongst national stockpiles ahead of any crisis would also ensure a better crisis preparedness in the event of activation of any vigilance or crisis response framework mechanism which can cover raw materials (including strategic raw materials), whether it is a horizontal instrument like the SMEI or sectoral one like Chips Act. A coordinated EU approach to the stockpiling of strategic raw materials also appears as a key element ahead of the new orientations on critical minerals and materials of the International Energy Agency (IEA)[118], of which 20 EU Member States are members. The launch of an "IEA voluntary critical minerals security program" that comprises stockpiling would benefit from a coordinated EU participation.

To ensure **companies' risk preparedness** (Pillar C.3), this option would ensure that companies using SRM invest in their resilience and take into account the real costs of SRM production, through actions on diversification, stockpiling or other mitigation strategies, notably the conduct of stress test to assess the vulnerability of their supply chains. It would also ensure companies using SRMs to support the emergence of an EU value chain and achieve diversification of their supply by purchasing, when available, from European sources. The direct adjustment costs for all the companies affected (large companies using SRM in strategic sector) in the Single Market would be EUR 1 million per year (see Annex 4).

Regarding **exploration** (pillar D), stakeholders (e.g. EuroGeosurveys, the association of geological surveys of Europe) indicated their support for availability and EU level harmonisation of geological data in line with United Nations Framework Classification for Resources (UNFC) and the INSPIRE directive.[119] This would have positive effects for companies along the value chain, as it would foster additional investment in the extraction stage.

The requirement for Member States to set up strategies to **support the value chain** (pillar E) and contribute to the overall European targets would raise awareness on the risks related to CRM supply and prompt the consideration of policy levers available in Member States (e.g. mining laws, investment support). If well-crafted and implemented, these strategies also help companies implement relevant projects and reduce their supply dependencies.

Regarding **permitting** (pillar E.1), this option is expected to have a positive effect on companies by decreasing the cost and duration of completing permitting procedures. The structural integration of CRM projects into spatial plans combined with the application of the SEA Directive to those plans is expected to decrease the costs of individual permitting procedures for companies. The SEA Directive provides for an overall and cumulative assessment of the environmental impacts of planned activities. As such, it would provide a

[118] 2022 IEA Ministerial Communiqué - News - IEA

[119] See EuroGeosurveys position paper submitted in response to the Call for Evidence.

framework for the easier identification of areas suitable for CRM projects or of less harmful alternatives for associated activities and infrastructure at an early planning stage. It would also provide an information basis for subsequent more specific environmental assessment performed by project developers. The extent of the cost decrease (including administrative costs) is difficult to quantify, as it is highly case-specific depending on the extent to which project developers make use of spatial plans and the related information.

The setting up of an InvestEU platform and stronger use of existing financing instruments to improve **access to finance** (Pillar E.2) would lead to a more effective use of resources to support the EU CRM value chain. In particular, domestic projects could be supported through a dedicated InvestEU platform and projects in third countries could benefit from greater use of EU external financing instruments. This option would create benefits for companies operating in the CRM value chain due to improved access to finance and for companies further downstream due to increased accessibility of CRMs. Given the magnitude of the investment needs and the possibilities of InvestEU platforms, a total size of EUR 1 billion would represent an ambitious, though feasible, target for the InvestEU platform120. Compared to the investment needs outlined above, this would equal to 14% of the investment needs in battery raw materials for a domestic production share of 25% by 2030, excluding the riskiest undertakings requiring grants, Hence, that would contribute to making Europe's supply more secure, but not by much. This option would not result in additional cost for companies and enjoys broad support with stakeholders: 73% of 259 respondents support targeting existing EU funds to finance CRM projects of particular strategic relevance.

On **waste legislation** (Pillar F), this option would provide only non-binding measures (a Commission Recommendation) and announcements for future actions (outside of the scope of this Impact Assessment). If the Commission Recommendation on take-back schemes for small consumer electronics is effective, it could lead to an increase of the currently very low collection rate of such waste products and thus create economic opportunities for the recovery of CRMs by recycling companies.

Regarding **standards** (Pillar G), increasing efforts to have EU rules and principles reflected in international standards would facilitate increased transparency and sustainability of CRMs placed on the EU market. In addition, it is expected to help ensure that relevant international standards reflect or do not conflict with EU rules, thereby preventing a potential burden for EU and global companies active on the global market.

Regarding **environmental footprint** (Pillar H)[121], this option would generate additional cost for companies selling CRMs in the EU. First, all companies that choose to make general claims would have to make use of certification schemes, the one-off adjustment cost is estimated to be in the range of EUR 3.75 – 10 million for those companies (see Annex 4). In addition, for materials for which calculation rules are available, operators would be required to declare the environmental footprint. This is estimated to create a one-off administrative cost of EUR 14.55 million for all companies selling those CRMs (see Annex 4). Companies procuring CRMs would also benefit from easier access to quality information on the sustainability of CRMs.

Taken together, the measures considered under PO1 would help boost investment in the EU CRM value chain. By facilitating access to finance, making exploration easier, taking account of CRM projects in spatial planning, and making the environmental footprint of CRMs transparent, PO1 would make it easier for companies to build a business case for new EU-based CRM projects.

6.1.1.2. Impact on SMEs

The InvestEU guarantee (Pillar E.2) contains a specific window for supporting SMEs, which the Commission would work towards using as well. As junior miners (most often SMEs) and exploration projects often struggle to attract adequate funding, the use of this window would be particularly beneficial for SMEs.

[120] The InvestEU platform of the Chips Fund, based on the already existing budgetary guarantee, totals EUR 1.5 billion.

[121] See Annex 4 on methodology for assumptions.

SMEs would also particularly benefit from the enhanced availability of monitoring and information regarding the supply chains of critical and strategic raw materials, as they generally do not have the resources to invest into their own monitoring and risk preparedness systems. Out of the 81 companies/business organisations which answered the OPC, 32 are SMEs, and 44% agreed that they would benefit from public monitoring to inform them about risks of supply chains disruption (6% disagreed, the rest being neutral or with no opinion). 59% of SMEs agree that an EU-wide governance capacity with monitoring tasks could help strengthen the value chain resilience. Only a slight majority of SMEs agreed that companies lack sufficient information on supply risks to take preventive measures (28% agree and 22% disagree), but 72% support measures that would enable them to benefit from such information. Finally, similar to the results for all companies, only 3% of SMEs favoured mandatory strategic stocks while 43% supported EU-level guidance on strategic stockpiling.

6.1.1.3. Impact on competitiveness

By strengthening EU **companies' preparedness** in case of supply disruptions, this option would increase their competitiveness compared to other actors not benefiting from such support.

The creation of an InvestEU platform would improve **financing** conditions for some projects and thus improve the competitiveness of the companies operating them. This would lead to slightly higher and more stable availability of critical and strategic raw materials and would therefore increase the cost- and international competitiveness of the European downstream users of those materials marginally.

Having EU rules reflected in global **standards** would also help EU companies' competitiveness. The size of these effects is however likely to be minor under this option.

Regarding **environmental footprint** (Pillar G), this option would have a positive impact on the competitiveness of companies that sell or produce CRMs in a more sustainable manner. The companies' benefits would depend on the impact categories the footprint focusses on. It could for example include refiners that use decarbonised energy to lower emissions or mining companies applying less invasive methods of extraction. Those companies would be able to display their credentials to potential buyers without unreliable certification schemes or footprint information creating potential confusion. Companies with low sustainability would evidently lose relative competitiveness under this option (though to a limited extent as purchases of low-performing or uncertified CRMs would not be prohibited), but thanks to the introduction of a clear and reliable methodology, they would have a clearer view of how to improve their sustainability performance to increase their competitiveness in the future. On the negative side, to the extent that the cost of footprint calculations is reflected in the price of CRMs, this measure could have a negative effect on the competitiveness of downstream sectors using those CRMs compared to third country companies able to source CRMs without this cost increase. Quantifying the economic impact of this measure on CRM prices has not been feasible since no methodology is available to estimate the effect in isolation from other cost drivers. More analysis is needed and any introduction of maximum carbon thresholds via secondary legislation will be subject to a proportionate and dedicated impact assessment. Assessments carried out for platinum can be used to get an indication of the potential cost increase. With the full cost of footprint calculations (for all companies) estimated at 0.07% of the European market value (see Annex 4), it potentially translates into an equivalent price increase for EU downstream users in case the full price increase is passed on.

In light of such costs, there is the possible risk that third country operators will divert their exports of CRMs to other jurisdictions without the requirement to declare the environmental footprint in order to avoid the costs associated with calculating this footprint (potentially partially cancelling out the benefits of improved supply security). However, whether this risk materialises will be highly case-specific and will depend on the extent to which other jurisdictions will introduce footprint-related measures, the relative importance of selling on the EU market for an exporting company and on whether the additional costs of a footprint declaration would outweigh the costs of diverting exports.

6.1.1.4. Impact on competition

Given the limited ambition of most actions included in this option, and the absence of a selective procedure to identify strategically important projects benefiting from privileged permitting procedures and access to special funding, it is not expected to have significant impacts on competition. All information and support provided under the monitoring and company risk preparedness pillars would be open to all companies without discrimination.

6.1.1.5. Impact on international trade

Large EU companies using CRM would have to ensure a higher level of supply diversification, to the extent possible (**pillar C.3)**. Such efforts would help support the EU's engagement in the world, as EU companies would become drivers in the quest for new supply sources.

On standards (Pillar G), the drive for further EU coordination and actions in the international standards setting bodies would contribute to increasing the quality and availability of standards, contributing to the development of more sustainable global CRM value chain at the global level.

Regarding **environmental footprint** (Pillar H), this option would mean that companies importing CRMs into the EU would also need to comply with the recognised schemes for making general environmental claims and to declare the footprint of their materials. This would make the sustainability of all CRMs on the EU market, including those of third country origin, more transparent and allow the relative footprint of materials to become an object of competition on the EU market. This additional transparency on the supply's sustainability may lead to a demand-led drive from the European downstream users for more sustainable CRMs, benefiting (in a relatively mild manner) third countries that produce CRMs more sustainably while hurting those that produce less sustainably. The costs for companies operating in the EU market, whether European or from third countries, would be the same.

6.1.1.6. Impact on Member States (public authorities)

In total, PO1 would require at least 4 to 7 FTEs (full time equivalent[122]) per Member State that would be split by (see for more detail Annex 11):

- 2 FTEs per year for participation to the governance structure;
- 1/4 FTE per year for the coordination of strategic stocks;
- 1/2 FTE per year for the coordination of data on exploration activities;
- 1 to 3 FTEs per year to design and implement strategies supporting the CRM value chain;
- Additional FTEs (not quantified) to enforce environmental footprint obligations.

A measure of particular relevance to Member States is stockpiling. In this respect, option 1, which includes EU-level coordination and information exchange regarding national stockpiles is favoured by public authorities over the alternatives: 46% of public authorities responding to the open public consultation assessed as appropriate EU-level guidance on voluntary storage to be organised at national level, while EU-level coordinated mandatory storage was widely rejected by public authorities. EU-level coordination and information exchange would diminish overlapping measures and enable additional efficiencies gains across EU Member States, thus leading to cost savings, which are however not directly quantifiable.

[122] A full-time equivalent, sometimes abbreviated as FTE, is a unit to measure employed persons or students in a way that makes them comparable although they may work or study a different number of hours per week. Glossary: Full-time equivalent (FTE) - Statistics Explained (europa.eu)

6.1.1.7. Impact on the Commission (budgetary implications)

In total, PO1 would require around 27 FTEs for the Commission, that would be split by (see for more detail Annex 11):

- 2 FTEs for ensuring the secretariat of the governance structure, in addition to EUR 75.000 per year of organisational costs.
- 17 FTEs for implementing monitoring, data gathering and risks assessment tasks, based on similar tasks performed by existing units in the Commission), which can be split as:
  - 10 FTEs for market monitoring;
  - 1 FTE for the management of studies and contracts;
  - 1 FTE for the building of a data set on projects;
  - 5 FTEs for the coordination of information from Member States.
- 3 FTEs for the coordination of national stockpiles information and the development of guidance when possible.
- 1 FTE to coordinate the submission of national exploration activities.
- 3 FTEs for assessing the suitability of environmental footprint, developing calculation methods and monitor the application of the measures.
- 1 FTE to enforce actions on standardisation.

6.1.2.Social Impacts

On **waste legislation** (Pillar F), this option would improve the collection of mobile phones, tablets and laptops, which tend to be the most prominent CRM-containing products in people's lives. Besides the increased recovery of CRMs, this action would increase convenience for consumers and increase awareness of the relevance of CRMs for citizens' everyday lives.

Regarding **environmental footprint** (Pillar H), depending on the strategy to be followed by CRM producers, this approach may alter the relative balance of manufacturing jobs between different regions of the EU, as companies seek production sites that allow them to achieve lower footprints. However, this advantage may be offset to some extent by the possibility to purchase green energy certificates, depending on whether such possibility will be permitted by the calculation rules.

6.1.3.Environmental Impacts

Regarding **permitting** (Pillar E.1), the measures are expected to have a positive impact on the environment. Structural integration of CRM projects in spatial plans and the application of the SEA Directive to those plans would benefit the environment by allowing authorities and project developers to have a better view of the overall and cumulative impacts of potential projects. It will help developers to identify suitable sites as well as the least impactful alternatives. This can provide the framework for the identification of areas suitable for CRM projects, but also less harmful alternatives for associated activities and infrastructure at an early planning state which subsequently decrease the risk of future conflicts between competing uses.

On **waste legislation** (Pillar F), this option would likely increase the recovery of critical raw materials from small consumer electronics. By reducing the need for primary raw materials by enhancing the use of secondary raw materials, the overall environmental impacts of CRM decreases.

Regarding **standards** (Pillar G), increasing efforts to make international standards reflect EU rules and principles has the potential to decrease the environmental impact of CRM production globally. The impacts of projects taking place in jurisdictions with a less comprehensive environmental framework than the EU might be lowered, to the extent that those standards are applied.

Regarding **environmental footprint** (Pillar H), this option would have positive impacts by allowing EU buyers to more effectively reduce the environmental footprint of their consumption. By ensuring that general sustainability claims are based on trustworthy and comprehensive certification schemes and by ensuring CRMs are accompanied by a footprint based on transparent, reliable and comparable methods (based on the EU Product Environmental Footprint[123]), sustainable purchasing decisions will more likely lead to a real reduction in negative environmental impacts. The environmental benefits of this measure would depend on the extent to which buyers drive their consumption decisions based on the information provided.

Overall, this option is expected to cause **no significant harm** as it does not promote projects that can affect the environment; it only provides tools that can improve the value chain marginally, without lowering any environmental *acquis.* The provisions on exploration only relate to the sharing of information. This option can conversely have a positive effect on the environment as described in the paragraph above.

6.2. POLICY OPTION 2

6.2.1. Economic Impacts

6.2.1.1. Impact on companies

The coverage of the measures, based on a **list of critical and strategic raw materials** (Pillar A), remains the same as under option 1.

Regarding **targets** (Pillar B) directly set in the regulation, this option would provide greater security for companies, which would be able to set goals on long-term investment plans. They are likely to affect the behaviours of companies operating along the CRM value chain, to the extent that they would be clear criteria for the selection of Strategic Projects. Therefore, companies that would like to develop a project benefiting from the Strategic Project status would be incentivised to focus, to the extent possible, on the strategic raw materials as they are covered by the targets. In terms of the overall volume of such investments required to achieve the targets, the analysis of investment needs (cf. driver 2.3/Annex 10) estimates that for example investments of EUR 1.7 billion along the rare earths value chain would be required to achieve an EU target of supplying 20% of its own needs by 2030, and that investments of EUR 7 billion would be required to supply 25% of the EU's battery raw materials needs by 2030. While different regulatory and non-regulatory measures would be required to unlock these investments, the setting of targets would provide the overarching political mechanism to identify which changes are necessary and coordinate action to follow-through on them.

The costs and benefits of the **governance structure** (Pillar C) and of the sub-pillars on **monitoring, stockpiling and company risk preparedness** (Pillar C.1, C.2 and C.3) are the same as in option 1.

On **exploration** (Pillar D), this option would benefit companies operating in the early stages of the critical raw materials value chain by providing access to the relevant mineral data, thereby de-risking investment into targeted exploration. By ensuring that Member States develop actions in exploration, this option is likely to enable further investment and decrease costs. Mining companies active in targeted exploration would benefit from the regional exploration data (geophysical and geochemical) acquired by Member States and reuse it for their benefit, representing a range of several thousands to tens of thousands of euros savings (depending on the size of the exploration permit).[124] Overall, stakeholders' responses to the call for evidence support those measures. For example, the Swedish (SGU) and Finnish (GTK) geological surveys and the association of the geological surveys of Europe (EuroGeosurveys), as well as several private actors, supported promoting an efficient and harmonised delivery of Member States' exploration and mining data. In the public consultation,

[123] Commission Recommendation of 16.12.2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations.

[124] Order-of-magnitude estimation based on expert knowledge within the Commission services.

78% of 259 respondents agreed or strongly agreed with the idea of strengthening exploration and documentation of critical raw materials in secondary deposits and waste streams.

This option would introduce the concept of **Strategic Projects** (Pillar E). This would result in stronger support for the CRM value chain in the EU and in third countries and with that a more secure availability of CRM for downstream user in the EU. By ensuring that these projects are realised, this option would concretely contribute to achieving the targets for EU capacities along the value chain (extraction, refining, recycling). Under this option, projects are selected for support on the basis of their potential contribution to the EU targets. Assuming that this requires, on average, a capacity increase of 20 percentage points across value chain stages, it is estimated that up to 120-180 Strategic Projects (or 12 SPs per strategic raw material, assuming a list of 12-15 strategic raw material), divided evenly per value chain stages (extraction, refining, recycling), would receive support between entry into force of the Regulation and 2030 (or 24-36 per year, see more details in Annex 4). This would benefit the companies implementing the project, their off-takers and the wider ecosystem downstream benefiting from more secure supply of critical raw materials. The estimated investment needs for battery raw materials of EUR 7 billion by 2030 and EUR 13.2 billion by 2040, and the overall market size of batteries in the EU (estimated at EUR 250 billion already by 2025)[125] indicate the possible magnitude to which Strategic Projects would contribute. Using the estimates above on the size of the InvestEU platform, there would still be EUR 6 billion left to bridge the needs for the battery raw materials value chain, for example by a European fund consisting of Member States' contributions. And this would not yet include investments in rare earths and other strategic raw materials that are fundamental for other clean technologies necessary for the green transition such as renewable energy equipment. The majority of the respondents in the Public Consultation agree that identifying Strategic Projects would be beneficial for financial and permitting decisions. 86% out of 259 respondents agree or strongly agree that identifying Strategic Projects across the critical raw materials value chain with strong environmental and social performance contributes to reducing EU dependencies. 71 % out of 259 respondents agree or strongly agree that strategic projects and partnerships outside of the EU should also benefit from de-risking if they comply with social and environmental standards and can contribute to secure EU supply.

Regarding **permitting** (Pillar E.1), this option is expected to have the effects described under option 1, as well as additional positive effects on companies developing Strategic Projects by streamlining their permitting procedures across Member States. [126] A mandatory integration of procedures and assessments reduces the administrative burden for developers compared to an approach where the assessment and permitting responsibilities are allocated to several separate entities (e.g. reduced environmental assessment costs as a single assessment report would be prepared). Cost savings will be particularly significant in Member States where such procedures are not yet in place and for certain types of projects, e.g. projects related to industrial activities (i.e. also subject to the IED) and projects with significant impacts on biodiversity. Mandatory scoping for Strategic Projects is expected to have no net effect on the burden for project developers. Although there are extra costs involved for procedures in Member States where scoping is not mandatory, those costs are likely to be offset by time savings during the drafting of the EIA report, as the analysis of irrelevant information would be avoided. Lastly, the possibility to submit documents digitally and to consult a manual of procedures for Strategic Projects would likely further reduce burden for project developers and contribute to the implementation of the digital by default principle.

[125] Building a European battery industry - European Battery Alliance (eba250.com)

[126] The assessment below is based on the assessment of similar measures in the impact assessment accompanying the 2012 proposal for revision of the EIA Directive - https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012SC0355&from=EN#page=38&zoom=100,27,726

This approach is also expected to reduce the average length of permitting procedures, as regards new Strategic Projects, by one-third (33.33%). This is based on the experience of the TEN-E Regulation[127], which includes very similar provisions on permitting, which managed to decrease the average duration of permitting procedures (including the pre-application stage) for trans-European electricity infrastructure projects from more than 6 years in some Member States to 4 years.[128]This measure benefits from a strong level of stakeholder support: 73 % of 259 respondents agree or strongly agree Strategic Projects benefit from streamlined and quicker permitting procedures.

Increasing the speed and predictability of permitting, notably by considering them as of public interest, is also expected to contribute to de-risking this early step and make investments in Strategic Projects more likely. Pre-bankable projects, before the obtainment of a permit, often struggle to obtain funding due to the high uncertainty involved. The measures outlined in this option would provide a clearer picture for economic operators of permitting timelines and procedures for Strategic Projects. In addition, setting the proposed minimum requirements for national permitting procedures for Strategic Projects would increase harmonisation between Member States and contribute to improving the functioning and efficiency of the single market, as developers and business in general would benefit from a more level playing field and less distorted market conditions.

A **fund at European level** (Pillar E.2) with contributions from interested Member States on top of a contribution from existing EU funds would strongly support the development of European CRM projects, benefitting businesses. The benefit to companies would depend on the size of the fund, which is not clear at this stage and depends on Member States' willingness to contribute. Compared to funds set up individually by Member States, for example via their promotional banks, this option would deliver the clear advantage of taking the whole European value chain into account.

As analysed in driver 2.3, the investment required for the refining and recycling of 25% of the EU's needs for battery raw materials plus the extraction of the lithium needed would amount to EUR 7 billion by 2030 and EUR 13.2 billion for 2040. Full self-sufficiency would require EUR 27.9 billion and EUR 52.2 billion, respectively. Other CRMs are likely to require large investments as well to gain a certain level of self-sufficiency along the value chain. Targeting existing EU funds to finance CRM projects as well as increasing financial support from national and promotional banks receives strong support from stakeholders[129].

On **waste legislation** (Pillar F), in addition to the effects described under option 1, this option would introduce an increased focus on CRMs within the waste management plans of extractive waste site operators, including obliging them to assess the feasibility of CRM recovery from the generated waste. This would create only very limited administrative costs, since a pre-feasibility study is a very simple assessment, and the underlying data on mineral concentrations is already available from the feasibility studies performed by extractive waste site operators for other purposes. The benefits would also accrue to these companies, as they would be the first to perform the CRM recovery operations when the pre-feasibility study indicates potential to do so profitably –

[127] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013

[128] See Support to the evaluation of Regulation (EU) No 347/2013 on guidelines for trans-European energy infrastructure - Publications Office of the EU (europa.eu), p. 69.

[129] In the public consultation, 73% of respondents agree or strongly agree that "targeting existing EU funds that have the possibility to finance critical raw materials projects of particular strategic relevance identified under the future legislation" would facilitate access to finance for CRM projects. 71% would like "Increased financial support from national and European promotional banks for critical raw materials projects" and 68% are positive about "a dedicated financial platform to de-risk critical raw materials projects by blending private, national and EU funding". In the position papers submitted, several stakeholders suggest financial de-risking to take place through guarantees or contracts for difference (Deutsche Bank AG, Ragn-Sells and European Geothermal Energy Council in response to the Call for Evidence.), and they express their wish for simpler and more automatic mechanisms to qualify for public support (Norsk Hydro ASA in response to the Call for Evidence).

insofar the obligation is designed to be complied with at a minimal cost and intended primarily to put a focus on this aspect for companies' own potential benefit.

The recycling capacity targets to be achieved by the EU are not binding but general objectives guiding the selection of Strategic Projects. Insofar, they would not affect companies directly, except to the extent that companies propose Strategic Projects in the recycling stage, in which case they could benefit from the permitting and financing benefits described above.

The measures on **standards** (Pillar G) under this option would, in addition to the impacts of option 1, have a positive impact on companies, including SMEs, in that they help ensure a level-playing field in the single market for businesses and underpin consumer confidence. Promoting the development of technical standards on relevant industrial processes would increase transparency and sustainability of CRMs over time.

Regarding **environmental footprint** (Pillar H): on top of the economic impact described for option 1, the introduction of minimum thresholds may induce additional costs for economic operators, as certain processes need to be adapted and electricity supply needs to be reconsidered, in order to reduce relevant footprints. Depending on the stringency of the proposed thresholds, manufacturing processes for CRMs farthest from best-in-class might need substantial investments. However, those costs would be calculated in a dedicated impact assessment, as explained in section 5.2, pillar H, given that the threshold would be introduced by secondary legislation.

The administrative impact is expected to be fairly similar to the one described under option 1. Market access would become conditional on the declaration demonstrating that certain thresholds have been attained, but the effort for the declaration itself would remain the same. If performance classes are introduced, the third-party verification costs may slightly increase, as the number of data points to be verified would be higher in order to increase precision.

Taken together, the actions proposed under this option would lead to a generally larger availability of CRMs in the economy as well as increased security of supply. All these effects would benefit downstream users of CRMs as well as firms even further down the value chain and even consumers. The larger supply would help to bring down world market prices leading to greater competitiveness of the green and digital technologies in the scope of this proposal. Especially in times of tight global supply chains, these measures would produce tangible benefits by protecting the European economy to a larger degree from shortage of crucial inputs.

6.2.1.2. Impact on SMEs

On **exploration** (Pillar D), as suggested by stakeholders (e.g., European Federation of Geologists[130]), this approach would bring positive benefits to SMEs by providing additional data that could de-risk their activities: though SMEs are the main actors operating in this early stage of the value chain, they have less resources and capacities to undertake risk-heavy exploration operations.

SMEs would benefit from the **monitoring** (Pillar C.1) and **access to finance** (Pillar E.2) dimensions as explained in PO1 In addition, SMEs would also benefit from the increased funding opportunities offered by the fund. In the public consultation, SMEs are adamant about the difficulty to access private financing for CRM projects (62% agreeing; 0% disagreeing) and to access public funding (80% agreeing; 3% disagreeing). For them the lack of support from public financial institutions (34%) and the higher production cost in the EU (31%) are among the main reasons for the difficulties in accessing private finance. The effects on SMEs are assessed in more detail in Annex 6.

[130] See their position paper submitted in response to the Call for Evidence.

6.2.1.3. Impact on competitiveness

The availability of additional data and mapping of EU mineral resources as provided per P**illar D** would also support the competitiveness of the value chain; equipped by additional information, companies would benefit from a de-risking at the early exploration stages that would then trickle down along the value chain.

In general, the designation of Strategic Projects (pillar E) with streamlined **permitting** and improved **access to finance**, would lead to increased production of SRMs in Europe and like-minded third countries and therefore to greater supply security for European downstream manufacturers. This concerns both the companies directly procuring the SRMs, such as those producing permanent magnets or batteries, as well as those further down the value chain, such as producers of wind turbines. This should give those companies a competitive advantage over competitors in other world regions with less supply security and allow to catch-up to regions were this is already the case. Especially, the competitiveness of SMEs in those sectors would benefit as they tend to be less likely to be able to weather supply chain disruptions for key inputs on their own. More Strategic Projects would also lead to more production of strategic raw materials in general. This higher supply would lead ceteris paribus to lower prices for key inputs for downstream producers and boost their cost competitiveness vis-à-vis producers using less SRMs as input.

Regarding **environmental footprint** (Pillar G), this option would, in addition to option 1, create a framework for setting thresholds for the environmental footprint. Such measures would increase the competitiveness of relatively sustainable CRMs. On the negative side, for downstream users, in addition to option 1, producers (e.g. such using renewable energy in their operations) no longer able to buy certain CRMs, would also reduce access to CRMs for downstream users in cases where most production is subject to low performing and potentially cheaper CRMs to which third country companies might still have access All such impacts would be taken into account in the assessments for preparing the delegated acts introducing any concrete, and this effect could be increased in case the share of such materials that would otherwise be exported to the EU would be diverted to third country markets, potentially decreasing prices for third country downstream users be jeopardised by such thresholds. However, as this discussion refers to delegated acts to be developed and properly assessed ex-ante in the future, it is beyond the scope of this IA.

On the negative side, environmental footprint requirements might prevent downstream users from acquiring the cheapest (but environmentally damaging) products containing critical raw materials. This could harm their competitiveness in the short run vis-à-vis competitors from jurisdictions where such rules do not apply. Therefore, it is important that all such impacts would be taken into account in the assessments for preparing the delegated acts introducing such thresholds and the impacts would be carefully weighed against each other. Taking that into account, the competitive position of European downstream producers would not weaken significantly.

As explained in problem section 2.3, high energy prices threaten the competitiveness of energy-intensive activities in Europe, including extraction, refining and recycling of critical raw materials. While the CRM Act itself will not be able to address this challenge, the Commission is working on other files to improve the situation, for example by updating the EU's Temporary Crisis (and Transition) Framework e.g. to offset the higher energy cost compared to its international competitors.

While the high energy prices over the course of 2022 present a case of market failure, there is a risk that the energy prices in the EU continue to be higher than in other regions of the world which impacts the competitiveness of the energy intensive CRM value chain. While the CRM Act aims to make the production of energy in the EU in general cheaper in the future, it does not provide for measures to tackle these challenges in the short term. Here, other EU initiatives like the revision of the Temporary Crisis Framework (soon to be Temporary Crisis and Transition Framework) or the Carbon Border Adjustment Mechanism should provide or allow for the provision of support to those projects. For the unlikely case of, for example, significantly higher energy prices threatening competitiveness in Europe even in the long run, this structure would create

the risk that some projects might be supported operationally in the long term, despite all safeguards. In that case, however, not only the CRM value chain but also the entire European energy-intensive industry might be in danger of disappearing.

6.2.1.4. Impact on competition

The special status granted to Strategic Projects (Pillar E) with respect to permitting and, to a limited extent, funding included in this option means that benefits would be awarded selectively. However, a transparent process based on clear criteria and the involvement of the Commission along Member States in the projects' selection would ensure that the beneficiaries are those where the benefits to the entire Single Market are greatest.

The pooling of Member State contributions with existing EU resources into one European fund (Pillar E.2) ensures a stronger focus on benefits to the entire Single Market dimension than if some of them would simply set up such a fund on their own; however, Member States with a greater financial capacity would likely be able to fund a greater number of projects of their choice. Here, the relative magnitude of the EU contribution determines how much the European dimension can be taken into account. State Aid rules would continue apply and thus minimise the risk of such distortions.

6.2.1.5. Impact on international trade

The positive benefits of **targets** (Pillar B) for the EU supply diversification are the same ones as for option 1 as the mechanism for setting the targets and reviewing MS performance only applies to the targets for EU supply capacity. The impact of EU supply capacity **targets** (Pillar B) and of the development of the EU value chain on international trade and on third countries would be limited; while the EU would increase the relative share of its own production in its consumption, the rise in demand for CRM would still allow all international actors to export them.

Overall, policy and regulatory measures aiming to increase sustainable primary and secondary production will both benefit the EU market and the global availability of CRMs, hence mitigating supply risks.

On **environmental footprint** (pillar H), the information-gathering obligations are likely to lead firms in third countries to replicate these calculations at minimal additional cost for CRMs sold elsewhere, such that the European information requirements could have global impacts and set an industry standard. While this transparency is not likely to change the market and international trade in CRMs immediately, it should incentivise private companies to ensure more environmentally sustainable raw material supply. This, with the set of other measures, should lead to a gradual demand-driven shift towards more sustainable forms of production – e.g. using renewable energy for on-site operations, instituting closed-loop water recycling, or committing to rehabilitation post-closure – to set own production apart from competitors. This shift to more sustainable forms of production, to the extent it occurs, would take place not only in the EU but also in third countries catering to the EU market. This would benefit local populations and the environment in those third countries.

Once sufficient data will be collected and while ensuring that security of supply would not be jeopardised, thresholds could be set based on an ex-ante proper impact assessment. Placing CRMs on the EU market would be possible for the best performing materials where thresholds are set. In comparison with policy option 1, this would have commensurately greater positive and negative (depending on a country's relative performance) impacts on third countries. Since a dedicated assessment will be made at material-specific level before introducing a possible threshold, unintended consequences (notably on availability/security of supply of CRMs) should be prevented. Any such measure would also be compatible with applicable trade rules and international agreements, such as the WTO and the GATT rules. Indeed, requirements would apply in a proportionate manner both to European producers and to importers and would therefore not be discriminatory

as they would target products wherever they may come from, whether produced in the EU or in third countries. The precise impacts on third countries, or precisely on the economic operators active in them, would be heterogeneous and depend on their capabilities for production along the CRM value chain, their commitment to high but at least improving ESG standards, and their current position in the market. Especially trade relations with countries with high environmental standards and underused potential for CRM production would benefit whereas currently large suppliers are likely to lose relative market share. Given the dramatic increase in the demand projections for several CRMs, this would likely not lead to a decrease in trade volumes in absolute terms.

It should also be noted in this context that potentially decreasing demand for relatively unsustainable CRMs (enabled by the greater transparency on environmental footprint) need not affect any third country negatively, as not the country of origin of the CRMs but their environmental footprint are targeted. Third countries with overall low environmental performance today could invest into improving this performance and thereby benefit from the measure.

6.2.1.6. Impact on Member States (public authorities)

In total, PO2 would require at least 4 FTEs per Member State, that would be split by (see for more detail Annex 11):

- 1/4 FTE per year for reporting on the state of CRM projects on their territories;
- 2 FTEs per year for participation to the governance structure;
- 1/4 FTE per year for the coordination of strategic stocks;
- 1/4 FTE to contribute to the development of EU-targets and report on them.
- Additional FTEs (not quantified) to enforce environmental footprint obligations.
- 1 FTE per year to develop and implement national circularity strategies.

Additional 25 FTEs are required for the development of exploration programmes, which would be a one-off cost[131]. In addition, costs can be expected to finance obligations on exploration, as the option would for all Member States combined a one-off cost of EUR 82 million for aerial geophysical survey and EUR 80 million for geochemistry mapping survey to cover the EU. The costs of provisions on permitting for Strategic Projects are assessed to be minimum and avoid duplications in the procedures.

Similarly, 3-4 FTEs per Member State would be required to implement new obligations under the Extractive Waste Directive (one-off costs).

However, in addition to coordination and information exchange with regards to monitoring, or the coordination of stockpiles, this option would also provide Member States with a strategic and coherent framework to support the CRM value chain, with positive effects on their supply chain's solidity and their industry's resilience.

Further details of PO2's impacts on Member States are available in Annex 11.

6.2.1.7. Impact on the Commission (budgetary implications)

In total, PO2 would require around 31 FTEs for the Commission, that would be split by (see for more detail Annex 11):

- 2 FTEs for ensuring the secretariat of the governance structure, in addition to EUR 75.000 per year of organisational costs.

131 It is to be noted that the FTE costs for exploration programmes and exploration costs described above are dependent upon a Member State's size, its geological endowment and existing administrative and research capacities.

- 17 FTEs for implementing monitoring, data gathering and risks assessment tasks, based on similar tasks performed by existing units in the Commission), which can be split as:
    - 10 FTEs for market monitoring;
    - 1 FTE for the management of studies and contracts;
    - 1 FTE for the building of a data set on projects
    - 5 FTEs for the coordination of information from Member States
- 3 FTEs for the coordination of national stockpiles information and the development of guidance when possible;
- 2 FTEs to coordinate the submission of national exploration activities;
- 1 FTE to support the board in the selection of Strategic Projects;
- 3 FTEs for assessing the suitability of environmental footprint, developing calculation methods and monitor the application of the measures;
- 2 FTEs to enforce actions on standardisation and prepare standardisation requests.
- 1 FTE to ensure the enforcement of Member States obligation under the Extractive Waste Directive.

The additional costs of policy option 2 for the Commission are detailed in Annex 11.

6.2.2. Social Impacts

Strategic Projects (Pillar E) would create economic value and jobs locally. It is not feasible at this stage to assess the number of jobs created and their repartition but the generally lower economic development in former mining regions (discussed in option 1), which could be revitalised especially through re-mining projects suggests that such projects could contribute to generating new opportunities and increasing cohesion. These investments would create jobs in areas with high unemployment rates and bring needed resources that then will spur further economic activity locally whilst harnessing and upgrading the existing skills of the labour force in the area. Low estimate point at 3 840 potential direct job per year for the development of the Strategic Projects, and eventually to above 100 000 direct and indirect jobs if over 100 Strategic Projects are selected to meet EU targets during the implementation of the Regulation. (c.f. Annex 4).For partner countries, this would include capacity building going beyond the extraction phase where feasible.

On **waste legislation** (Pillar F), this option would likely lead to greater societal awareness by engaging Member State governments to develop strategies to recover critical raw materials from all waste streams economy-wide.

6.2.3. Environmental Impacts

The Climate law requires that an assessment is concluded to determine the initiative's coherence with the climate neutrality objective by 2050. It is to be noted that the main underlying motivation for securing CRM supply under the CRM Act is the fact that the world's reliance on fossil fuels heavily contributes to climate change and that the shift to replace these drivers with more sustainable sources of energy production is therefore of great importance. Critical raw materials are crucial inputs for the strategic technologies needed to make the green transition happen, such as wind turbines, solar panels and batteries. By securing a greater supply security for Europe and more availability in general, this option is consistent with the climate-neutrality objective of the Climate law as it would contribute to a better investment climate for the European clean technology sector and therefore to the higher availability and deployment of renewables. This would help in the fight against climate change and would contribute to substantial environmental benefits. This issue also has a global dimension: increasing global supply of critical raw materials would make renewables more competitive on world markets and contribute also outside of Europe to the fight against climate change.

On **exploration** (Pillar D), the impact of this policy option on the environment are minimal as the measures proposed do not include the drilling phase of exploration but rather relate to studies, coordination of information and targeted assessment.

Regarding **permitting** (Pillar E.1), the measures considered focus on improving procedures, and are without prejudice to the substantial conditions set out in relevant national and EU legislation (the considerations linked to public interest are dealt with below in the context of the "Do no significant harm" principle). In addition, some measures in particular are expected to have a positive impact on the environment (in addition to the impacts of option 1)[132]:

- A mandatory scoping procedure would help clarify the environmental issues to be covered in the assessment report, e.g. the most important impacts, preferred methodologies, and relevant information sources, thereby likely increasing the quality of the resulting report and help provide robust evidence for the final decision in Member States where it is not yet mandatory.
- The creation of a one-stop shop and streamlining of different assessments is likely to have a positive impact on the environment, as it enables a more comprehensive information base for decision-making.

On **waste legislation** (Pillar F), this option would go substantially further than option 1 in amending waste legislation and requiring Member States to develop strategies to increase recovery of critical raw materials. In the absence of an elaborate economic model, it cannot be assessed how impactful these changes will be quantitatively, but the focus many stakeholders, including NGOs,[133] put on creating an open database of extractive waste sites and establishing recycling targets for critical raw materials, indicates that these are generally considered effective measures that could make a difference. As explained in the problem section under driver 2.6, increased recovery of critical raw materials, and thus reduced demand for primary critical raw materials production, can significantly reduce environmental impacts. Since the new mine operator would be responsible for closure and after-closure management of the new operation, re-mining of abandoned waste sites would provide a solution to ensure their rehabilitation, which has significant benefits for biodiversity.[134]

On **environmental footprint** (Pillar G), this option would have, compared to option 1, additional positive impacts, as companies (especially relatively unsustainable companies) would be confronted with the risk of their CRMs not being allowed in the Union market if thresholds are not attained, and would therefore reduce production, thus lowering environmental impacts.

Regarding **standards** (Pillar H), this option would, in addition to option 1, also provide European standards and standardisation deliverables on relevant industrial process. These would be available to EU companies and further help them implement sustainable practices and increase transparency.

Overall, since no environmental legislation is weakened and the streamlining of permitting procedures is targeted towards reducing administrative delays and increasing the resources dedicated to ensuring a proper assessment of projects along the CRM value chain, **no significant harm** (DNSH) to the environment is expected under this option. Indeed, Strategic Projects would have to comply with all relevant nature protection legislation, including environmental assessment requirements, although different assessment would be required to be bundled.

The signalling that Strategic Projects may be of overriding public interest does not go beyond the current environmental legislative framework; it does not bypass the necessity for a case-by-case assessment or for meeting the conditions set out in the relevant Directives.

As the technical guidelines on DNSH provide, conducting an environmental impact assessment does not automatically entail that no significant harm is done, but it constitutes a "strong indication for the absence of significant harm for a number of the relevant environmental objectives". In addition, as the measures presented

[132] The assessment below is based on the assessment of similar measures in the impact assessment accompanying the 2012 proposal for revision of the EIA Directive – see footnote 93.
[133] See joint position paper submitted by Friends of the Earth Europe, European Environmental Bureau, Power Shift and the Centre for Research on Multinational Corporations (SOMO) in response to the call for evidence.
[134] https://www.cbd.int/development/doc/Minining-and-Biodiversity.pdf

aim to secure the CRM needed notably to ensure greater electrification (due to their presence in energy storage or renewable energy technologies), they also contribute to the environmental objective of climate change mitigation as part of the DNSH evaluation. Also, while extraction activities can affect the habitat or water conditions surrounding the operations, measures pertaining to the environmental footprint of CRM would incentivise the adoption of the best available levels of environmental performance in the sector, hence contributing to mitigate potential environmental harm. In addition, the development of Strategic Projects inside the EU would ensure a lesser reliance on supply from third countries, hereby ensuring that the additional capacities are developed in compliance with EU environmental *acquis*, and reducing environmental impacts in third countries. Lastly, environmental impacts would also be reduced due to measures promoting greater use of secondary raw materials, greater transparency on the environmental footprint of critical raw materials and more ambitious sustainability standards.

6.3. POLICY OPTION 3

6.3.1. Economic Impacts

6.3.1.1. Impact on companies

On **the list of critical and strategic raw materials** (pillar A) and **setting strategic raw materials targets** (pillar B), this option has the same impact as option 2.

On the **governance** aspects (pillar C), industrial actors or business associations favour the creation of a dedicated agency, such as the operational capacity (Euromines, EIT Raw Materials[135]), as they argue it would help in the development of CRM projects and provide relevant expertise to the EU institutions and industry.

Indeed, this operational capacity would enable the development of **stronger monitoring and risk management capacities** (pillar C.1), notably by developing tools such as early warnings of imminent vulnerability of a supply chain, which 63 % of 259 respondents supported, or periodic supply chain stress testing of selected CRMs (52 % of respondents agreed that it would allow to better anticipate supply chain disruptions, with only 7% disagreeing). The costs here are the same as for options 1 and 2 as they only concern large companies.

On **strategic stocks** (pillar C.2), the operational would enable companies to buy strategic stocks at better prices (due to joint purchase), resulting in cost savings. Since it is not a purchasing obligation but an incentive based on companies expressed needs, no costs on companies are quantified for this option. Stakeholders are supportive of avoiding centralized storage and favour a decentralized approach[136] that does not add burden for companies: mandatory stocks are the least favoured option among stakeholders when asked about the organisation of strategic stocks (14 %). Given the high financial burden induced by stocks, companies would welcome stronger EU support.

On **company risk preparedness** (pillar C.3), the operational capacity would provide for direct support to enable risk mitigation strategies. Large companies comprising a strategic raw material in their value chain would have to bear additional costs given the obligations to adopt at least one mitigation strategy (explained in annex 4). Given that this measure is not prescriptive on the exact nature of the strategy to adopt, it is not possible to assess its costs directly. Stakeholders were generally opposed to the addition of new requirements on companies, such as mandatory stockpiling, if those were not met with corresponding incentives. Some large

[135] See respective position papers submitted in response to the call for evidence.
[136] This point was notably made in the position papers submitted by the German automotive (VDA) and defence (BDSV) industry associations submitted in response to the call for evidence.

companies are also already adopting these mitigation strategies depending on which ones they consider as the most efficient137.

On **exploration** (pillar D), the positive benefits of this option are the same as for option 2.

The impact related to the **selection of Strategic Projects** (pillar E) is the same for companies.

Regarding **permitting** (pillar E.1), this option has the same impact as under option 2. This approach would also provide additional certainty to developers and related investors that Strategic Projects' applications will be effectively handled by national authorities.

Regarding **access to finance** (pillar E.2), a CRM Fund set up with additional European money (see section 5.2) would enable to bring enough resources to link the Fund closely to the concept of Strategic Projects. This would increase incentives to apply for the Fund and for Member States to make efforts that projects on their territory are included. The European involvement should also ensure that not only the selection of Strategic Projects is performed by a governance structure ensuring that the common European interest is pursued, but also that these Strategic Projects are supported financially in a manner proportionate to their importance to the whole of the EU. This way it can be best ensured that the cross-border value chains and the needs of the entire European economy are adequately affected, rather than the risk of some Member States trying to mostly pursue their own interests. This fund is also very likely to be larger than the fund explained in option 2, so a higher degree of supply stability is possible. This fund would also be better suited to distribute funding via grants to support the CRM value chain even more effectively, in line with State Aid rules, where a particular strategic European interest exists.

68 % of 259 respondents agree or strongly agree that a dedicated financial platform to de-risk critical raw materials projects that meet certain requirements (e.g., high environmental and social standards, while contributing to EU supply) by blending private, national and EU funding would be useful.

On **waste legislation** (pillar F) and **environmental footprint** (pillar H) and this option has the same impact as option 2.

For **standards** (pillar G), this option would have the same impact as option 1 and 2 combined.

The actions proposed under this option would ensure an even larger availability of CRMs generating even larger benefits for downstream users and the wider economy. Key green and digital technologies would become more competitive and the resilience in crises of global supply chain tensions increased.

6.3.1.2. Impact on SMEs

SMEs would particularly benefit from the measures developed on **monitoring, risk management, strategic stocks and the company risk preparedness** (pillar C.1, C.2 and C.3). Indeed, conversely to larger companies, SMEs that are active in a sector where strategic raw materials are required are less likely to already have in place contingency measures. They would benefit from the early warning mechanisms or the stress tests**,** as well as from the ability to jointly purchase stocks of strategic raw materials and from the consulting on their risk preparedness proposed by the **operational capacity**. This would directly strengthen their resilience ahead of any supply shock, thereby avoiding them to suffer the mitigation costs of a crisis. In the public consultation, a slight majority agreed that companies generally don't have contingency plans to deal with supply disruptions (37% agreement vs. 22% disagreement)

[137] KÖSTER, H., NEUBERT, F. P., DIERKSMEIER, K., ADELMANN, L., LENTGE, H., SCHMIDT, P. (2022): Securing raw material supply: Benchmarking of measures of foreign manufacturing companies and recommendations for action.

6.3.1.3. Impact on competitiveness

The more ambitious measures in pillar E with a European CRM Fund including new funding would contribute even more than option 2 to increasing the cost- and international competitiveness of European downstream producers as well as the international competitiveness and capacity to innovate for firms along the CRM value chain. These benefits would apply especially to SMEs due to their generally more difficult access to finance as well as vulnerability to supply disruptions. The considerations regarding energy prices discussed in option 2 apply here as well.

On **exploration** and **environmental footprint** (pillars D and H), this option would have the same impact as option 2. However, this option would further foster the competitiveness of EU industries by providing them with strong **monitoring** resources (pillar C.1) while supporting their eventual purchase of strategic raw materials **stockpiles** (pillar C.2) and their risk mitigation strategies (pillar C.3), making them more resistant to supply shocks and shortages.

6.3.1.4. Impact on competition

The same impacts as discussed under option 2 would apply, but a **CRM Fund** (pillar E.2) with a stronger EU role (backed by its financial contribution) would better ensure a level playing field in the Union.

6.3.1.5. Impact on international trade

Qualitatively, the same impacts as discussed under PO2 would apply, though to a stronger degree due to increased funding and support for Strategic Projects that improve EU supply security.

6.3.1.6. Impact on Member States (public authorities)

Under this option, the direct cost induced on Member States would remain the same as for option 2 (32 to 33 FTEs, plus cost induced by exploration programmes). Indirect costs would however be higher as they would directly relate to the contribution of Member States to the EU budget so as to allow the financing of an EU operational capacity on CRMs. Assuming that the resource obligation for national authorities would translate into the allocation of 0.5 FTE per Strategic Projects, this option would entail a recurrent cost of 12-18 FTEs in total for all Member States (assuming a number of 24-36 SPs per year, see Annex 4). However, this cost would differ between Member States depending on the amount of SPs taking place on their territory and their current staffing.

6.3.1.7. Impact on the Commission (budgetary implications)

The impacts on the Commission of this operational capacity ensuring the governance and the implementation of tasks (pillars C, C.1, C.2, C.3, with also a role in D and E) are more significant than for the other 2 options as it would require the creation of a full-fledged external operational capacity with significant staff. For the first year of establishment, the staffing implication would be limited to a seconded Head of Unit and 20 FTEs (or equivalents). In this phase, the operational capacity would draw on the expertise available in the Commission services. At operating speed, the operational capacity, whether an agency or a department in another agency, would have around 100 FTEs, shared amongst 4 units of 25 FTEs: Member States coordination, Intelligence and monitoring, Risk assessment and preventive measures, and Stockpiling coordination, with posts transferred from the relevant DGs or post creation; and with the possibility to hire seconded national experts with relevant expertise in risk assessment, project management and stockpiling. All the staff costs related to sub-pillars C.1, C.2 and C.3 are accounted for in this assessment.

In addition, the budgetary costs related to the capacity's administration (recruitment of new staff, rental of premises - unless the host country or existing agency would provide for it -, furniture and IT costs) would represent EUR 25 to 27 million[138].

In addition to the creation of this operational capacity, this option would require 4 FTEs (1 FTEs for ensuring the implementation under the extractive waste directive; 3 FTEs for assessing the suitability of environmental footprint, developing calculation methods and monitor the application of the measures; and 2 FTEs to enforce actions on standardisation and prepare requests).

As under option 2, the management of the **CRM Fund** (pillar E.2) would need to be paid by keeping a share of the funds under management. The funds to be invested would need to come from the existing Commission budget or additional funding sources. The EU contribution in this option would require new EU resources. In the description of driver 2.3 in the problem section, the needs for public support to the permanent magnet value chain and to the refining, recycling and (partially) mining of battery raw materials are estimated to be at EUR 2.7 billion by 2030 and EUR 4.7 billion by 2040.The actual needs are likely to be much higher, given the many other important CRM use cases.

6.3.2. Social Impacts

Through stronger support for **Strategic Projects**, this option would also create greater economic and social opportunity in the regions in which they are located. Since overriding public interest does not change rules on community involvement, this option should not lead to greater adverse impacts.

6.3.3. Environmental Impacts

This option would be contributing even more to the overall goals codified in the European Climate Law, compared to option 2 (c.f. section 6.2.3 for additional details).

Regarding **permitting** (pillar E.1), this option has the same impact as under option 2.However, the increased roll out of Strategic Projects to boost the production of CRMs, including CRMs essential for technologies enabling the energy transition, will facilitate the transition to climate neutral economy, and thereby further contribute to the development of the climate law's objectives.. Moreover, it is likely to be the case that if a project cannot be implemented in the EU, a similar amount of CRMs will need to be produced elsewhere including potentially in jurisdiction with no or lower environmental standards.

Regarding **environmental footprint** (pillar G), this option has the same impact as option 2. For **standards** (pillar H), this option would have the same impact as option 1 and 2 combined. Overall, **no significant harm** to the environment is expected under this option. Indeed, substantial requirements of permitting and corresponding legislation are not changed, so the analysis of option 2 remains valid; however, additional resources provided by Member States in the permitting process for Strategic Projects are likely to ensure a higher degree of scrutiny regarding the respect of environmental legislation.

7. HOW DO THE OPTIONS COMPARE?

Effectiveness: PO3 is likely to be most effective in meeting the objective of increasing EU industry's awareness and mitigation of CRM-related risks (SO1) given the added value of an external operational capacity, its additional resources and increased range of tasks, notably on monitoring, strategic stocks, risks preparedness and fund management. The governance structure proposed in PO1 and PO2 would however also

[138] The costs are adapted to 2022 prices and use as a baseline the EUR 22 to 24 million estimated in the European Labour Authority's impact assessment from 2018 for the creation of an agency of a similar size - (SWD(2018)68)

support the objective by providing enhanced stockpiling coordination, additional monitoring and further incentives for companies' risk mitigation strategies.

PO2 and PO3 are likely to be most effective in meeting the objective of supporting the EU CRM value chain (SO2). To increase exploration efforts in the EU, PO2 and PO3 present a more effective mechanism to foster national exploration and mapping, compared to PO1, which rather focuses on coordination and data exchange. To streamline permitting procedures and improve access to finance, PO2 and PO3 introduce the concept of Strategic Projects, which would entail privileged treatment in permitting and support in access to finance, while PO1 only contains general and likely less effective measures. With respect to increasing investment, PO3 is expected to be the most effective, as it would provide additional financial resources, but PO2 already provides a framework for SP selection and streamlined permitting, which is the necessary first step and likely the maximum achievable given the set level of resources available. Of course, the final outcome and effectiveness of the measures on finance will depend predominantly on the amount of funding made available, but this cannot be assessed at this point in time. In supporting circularity, the Recommendation and announcements of future actions under PO1 are less effective than the regulatory measures proposed in PO2 and PO3. All options also provide for effective tools to meet the need for standards for CRM-related industrial processes, although PO2 and PO3 enable stronger standards-development and better ensure their availability and suitability for EU companies compared to PO1.

On SO3, all options make the environmental footprint of CRMs transparent for buyers and help shift the market towards more sustainable CRMs. However, information requirements alone are not expected as such to lead to the behavioural change needed to reduce footprints in line with Union objectives, which is better achieved by PO2 and PO3 as these allow for the setting of thresholds to address the most polluting CRMs.

It is to be noted that all options also convey a time dimension. On standards, PO2 and PO3 are likely to take longer to fulfil the actions added on top of PO; on environmental footprint, measures allowing for the display of information of the CRM's environmental footprint will require the development of a dedicated methodology and the establishment of performance classes, which will require resources over time.

Efficiency: PO3 is more costly than PO1 and PO2 to meet the objective SO1 as they do not require the creation and financing of an external capacity but only the reinforcement of internal capacity and the creation of a dedicated board overseeing a network.

Regarding SO2, on exploration, PO2 and PO3 provide for a comprehensive approach that is however most costly than PO1. Regarding permitting, the PO2 is deemed more efficient than PO1 as, despite requiring limited additional resources from Member States, it has much greater benefits for project developers in terms of investment certainty. PO3 could be more effective, but would increase the pressure on national resources, thus reducing its efficiency. For circularity, PO2 and PO3 introduce light obligations on Member States and companies, which promise a significant additional benefit in terms of potential CRM recovery, which makes them very efficient actions. On standards, PO2 and PO3 would require more efforts from the Commission and relevant standardisation bodies than PO1, but with a higher likelihood of enabling the development of standards supporting the industry's competitiveness and the development of sustainable techniques, which makes them very efficient.

Regarding environmental footprint (SO3), PO2 and PO3 are considered more efficient as they allow for the setting of thresholds to address the most polluting CRMs, in as long as they do not negatively impact security of supply, i.e. do not create substantial cost. Here, not only domestic costs but also impact on trade are taken into account.

Proportionality/subsidiarity: Regarding targets, PO2 and PO3 go beyond PO1 in instituting additional review of the targets process, which makes them more demanding but still proportionate. When it comes to objective SO1, PO1 and PO2 provide necessary margin of manoeuvre to Member States and companies and focus on coordination and incentives, while PO3 imposes stronger requirements on companies.

Regarding objective SO2, requirements on exploration and on permitting in PO2 and PO3 remain proportionate to meet the objective, but impose further obligations on Member States. PO3, however, would to some extent limit Member States' discretion regarding permit-granting and the application of nature protection legislation, as well as their staffing decisions. For investment, all options are proportional as they are dependent upon the prior mobilisation of resources tailored to the needs of the value chain stages. Regarding circularity, PO1 only provides voluntary guidance to Member Statas whereas PO2 and PO3 in addition impose requirements to develop strategies and provide information on Member States and companies, but leaving them broad room in terms of follow-up and implementation.

On measures pertaining to environmental footprint (SO3) and standards on CRM industrial processes (part of SO2), all options are considered to be proportionate and respect subsidiarity principles, given that requirements and standards are adapted to the entire single market.

Coherence assessment:

In terms of overall coherence, the options are in line with the different European strategies and regulatory framework. They are all seeking to reinforce the Union's ability to meet EU Green Deal objectives and enable the deployment of clean energy as prescribed by the climate law, while respecting the "Do no significant harm" principle; the only difference across options here relates to their degree of ability to achieve the main objective. PO2 and PO3 also include amending EU waste legislation to ensure its coherence with the need to reinforce the EU's secondary supply of CRMs. In addition, the gaps analysis of this assessment demonstrates that on matters such as the sustainability of CRM, there is no EU instrument aiming at achieving this objective in a similar way with a similar scope (for CRMs placed on EU market), although complementarity with the batteries regulation or the ESPR have been considered. Matters related to monitoring or strategic stocks are designed so as to complement rather than overlap with any dispositions of the Single Market Emergency Instrument. In addition, this initiative is complementary to other initiatives announced under the Green Deal Industrial Plan[139], such as the Net Zero Industry Act, which will aim to develop the industrial manufacturing of key technologies for the green transition. Overall, the options are built in such a way so as to ensure conformity with international obligations and to contribute to the UN SDGs.

In terms of internal coherence, the options are built in such a way that actions undertaken to meet one specific objective should not come at the expense of another specific objective. As discussed in chapter 4, security of supply and sustainability may have opposing effects if one is pushed to the extreme. This is why the elaborations on pillar H (environmental footprint measures) describe (notably in section 5.2) how, prior to the introduction of any threshold limiting market access for less clean producer, a dedicated assessment will have to be conducted to ensure the absence of risks to EU supply security, hence ensuring that coherence is taken into account. However, the information requirements contained on option 1 for pillar H ensure a slightly higher coherence than options 2 and 3, meaning that a trade-off has to be made around this pillar regarding the different specific objectives.

	Effectiveness in meeting objectives			**Efficiency**	**Proportionality/ subsidiarity**	**Coherence**
	SO1	**SO2**	**SO3**			
Option 1	++	+	+	+	++	++
Option 2	++	++	++	++	+	+

[139] COM(2023) 62 final, A Green Deal Industrial Plan for the Net-Zero Age

Option 3	+++	+++	++	+	-	+

Legend: +- no / neutral impact; + minor positive impact; ++ positive impact; +++ significant positive impact; - minor negative impact; -- negative impact; --- significant negative impact

In order to reflect the different components of the specific objective 2, the effectiveness of each option has been assessed for each of the pillars that compose it:

Specific Objective 2: effectiveness of meeting the objectives for the different components					
	Exploration	**Permitting**	**Access to finance**	**Circularity**	**Standards**
Option 1	+	+	+	+	+
Option 2	++	++	++	+++	++
Option 3	++	+++	+++	+++	++

For **companies,** all options would result in positive impacts as they all allow for stronger support to the value chain than the baseline scenario, which would not only benefit companies operating directly in the CRM value chain but also downstream companies and the wider economy. The impacts of the options would have positive spill-overs on the security of supply of both primary and secondary critical raw materials, particularly of strategic raw materials, which would secure the deployment of green technologies or technologies needed in health, defence or digital industries. Though it allows for stronger support to the CRM value chain, PO2 and PO3 also require additional contributions from companies (information request and stress tests to conduct on large companies for PO2 and PO3, additional requirements on environmental footprint for PO2 and PO3) The public consultation shows that companies would support stronger actions developed in PO2 and PO3, however, given the additional benefits that such actions would allow. **Member States** have expressed stronger support for the set of measures developed under PO2, whether it is in terms of governance, monitoring or coordination of stockpiling, but also on strategic projects and circularity. They would however face additional costs in PO2 and PO3, since it provides for more stringent obligations and additional resources to implement the proposed measures. **Civil society** would benefit rather from PO2 and PO3 that best ensure the availability of the critical and secondary raw materials that are necessary to deploy green technologies, while ensuring a higher level of transparency on the sustainability of CRMs. They would also enjoy the benefits from the greater availability security of jobs both along the CRM value chain and downstream sectors.

8. PREFERRED OPTION

Following the analysis of the impacts of each policy option, as well as their ability to meet the general and specific objectives in the most effective and efficient manner while respecting proportionality, coherence and subsidiarity, this impact assessment considers that PO2 would be the preferred option.

First, PO2 is the option whose measures receive most support from stakeholders and Member States, as it adds only limited additional burden while also being proportionate.

Second, while it would require some resources and efforts from different stakeholders, the overall costs and impacts of PO2 are significantly smaller compared to PO3, while still being sufficiently efficient in tackling the problem drivers (which are not as effectively addressed in PO1).

Third, and most importantly, PO2 manages to effectively meet the general and specific objectives, also for the different components of SO2. It brings clear added value to the functioning of the Single Market and has positive economic impacts for CRM producers and downstream sectors by ensuring industrial resilience and enabling the development of EU CRM value chain. Its social impacts on jobs and cohesion of EU regions are also positive. Its positive environmental impacts are enabled by the measures on circularity, environmental footprint of CRMs, and the support to technical standardisation. It has to be noted that PO3 is assessed as more effective to meet the objectives given the additional resources and support that an operational capacity would entail, notably on permitting and on access to finance, as demonstrated by table above. However, the current budgetary context does not allow for the creation of such an entity at the time, despite support for a more ambitious governance option notified by some stakeholders. At the time of drafting, PO2 is therefore more efficient to meet the objectives and form the best performing package when considering the benefits in terms of effectiveness, efficiency and subsidiarity. No alternative combination of policy options would have allowed to effectively meet the specific objectives.

Proposing PO3 without ensuring the required of financial and human resources would lead to significant delays in implementation and undermine the delivery of some tasks.

Finally, while this impact assessment presents a coherent and effective approach to tackle the identified problems, political arbitration on some of the measures may remain affected by parallel on-going policy developments. The overall outcome of the initiative will depend to a large extent on whether Member States and other EU initiatives make funding available to support the Strategic Projects.

8.1. The economic and environmental model for the EU CRM value chain

As discussed in chapter 4, the main objective of the CRM Act is to ensure the EU's secure supply of CRMs, while incentivising the further development of sustainable supply sources. The main tool for this is strengthening the EU's capacity along the CRM value chain (specifically targeted by SO2). Under the preferred option, such value chain would be enabled in different ways both regulatory and through factors outside of this initiative (e.g. measures to tackle high energy costs, stronger use of the trade policy toolbox, increased investment in skills and R&I).

A key aspect of the long-term economic viability of the EU CRM value chain is political commitment: By setting targets (pillar B), investors receive assurance that measures (regulatory and financial) will be taken to guarantee the viability of their investments. More concretely regarding the measures in this initiative, the monitoring and risk preparedness actions (pillar C) would create demand from governments and companies to purchase secure CRMs, which will likely benefit most projects located in the EU.

The permitting provisions (pillar E1) are likely the most direct factor reducing costs and thereby making CRM projects in the EU more viable, and depending on the availability of financial resources, the access to finance actions will compensate for the remaining cost gap (pillar E2). Various actions announced under the circularity/waste pillar (F) would provide incentives specifically for projects at the recycling stage. Economic footprint measures (pillar H) should also increase the willingness of customers to pay for sustainable CRMs, where EU CRM projects likely have a frontrunner position due to the high level of regulation in the EU.

In this way, the pillars work together to address different barriers to the economic viability of an EU CRM value chain. The economic model for the EU CRM value chain can thus be described as one that relies not on satisfying demand from the cheapest sources, but on a joint effort by public and private actors to secure the existence of a fully developed EU CRM value chain even at higher costs. To some extent, these higher costs can be borne by downstream industries, who – in response to the experience of recent supply chain disruptions, and to increasing customer sustainability demands – should increasingly be willing to pay a premium for secure and sustainable CRM supplies. EU CRM producers in turn will likely have a head start in catering to this demand, by virtue of being subject to strong environmental regulation, and the existence of the interconnected European internal market that guarantees supply security. However, it should not be ignored

that a gap may persist between downstream industry's willingness to pay and the higher cost of CRM production in the EU. This is where public support – by the EU by Member States, in line with State Aid rules – comes in. While financial resources are not made available in this initiative itself, the framework created by it can dock into existing or future funds where a financing gap to realise the targets of this initiative is identified. Over time, the need for such support should decline, as the increasing availability of secondary raw materials and reduced energy costs due to renewable energy sources should reduce the role that energy costs and geological occurrences (weak points in the EU's current position on CRM markets) play while increasing the importance of Europe' leadership in recycling. These measures and developments should ensure the long-term economic viability of the CRM value chain in Europe, which is crucial for the security of supply of downstream users.

8.2. REFIT (simplification and improved efficiency)

The changes to existing legislation that this initiative would provide are limited to waste legislation (pillar F, laid out in detail in section 5.2). The measures are designed to consist in targeted amendments to existing provisions, thus not presenting significant choices in the context of the overall regulation and not requiring extensive analysis or stakeholder consultation. As they clearly relate to critical raw materials and, considering the growing importance of secondary supply, are an essential part of the solution to the problem this initiative revolves around, it is considered appropriate to assess them as part of this Impact Assessment and to consider them outside of the scope of REFIT.

8.3. Application of the 'one in, one out' approach

The initiative is in the scope of the "one in, one out" approach.

The administrative costs for businesses that would result directly with this initiative are very limited and relate to:

- ongoing costs:
    - reporting obligations of a small number of large companies operating in the CRM value chain, estimated at EUR 49.000 in total for all 64 companies concerned to report twice a year to the governance structure (see calculations in Annex 4). while reporting would remain voluntary for other companies. The costs induced are likely to be offset for the same companies, which would benefit, under certain conditions (e.g., having their projects labelled as strategic) from efficiency gained from the streamlining of permitting obligations.
    - reporting for large companies using Strategic raw materials (manufacturing) (on stress tests) -estimated at EUR 38.000 pear year
    - reporting available information on critical raw materials content of waste streams and composition of the waste EUR 700 000 for existing mining sites
- One-off costs to declare the environmental footprint. This is estimated to create a one-off administrative cost of EUR 14.55 million for all companies selling those CRMs.

No reductions of administrative costs for companies have been identified.

The adjustment costs for businesses resulting from this initiative consist of:

- Additional requirements on conducting a risk assessment under the form of a stress test for large companies in strategic sectors using strategic raw materials, estimated at EUR 1 million per year in the EU Costs related to certification of general sustainability claims and to the studies required for underlying environmental footprint. This one-off adjustment cost is estimated to be in the range of EUR 3.75 – 10 million for companies (see Annex 4).

The initiative does not foresee any cost applicable to citizens.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

The Commission will carry out an evaluation of the effectiveness, efficiency, coherence, proportionality and subsidiarity of this legislative initiative and present a report on the main findings to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions four to six years after the date of application of the legislative act. The Commission may propose report how to improve the CRM Act.

This review mechanism is similar to the review mechanisms included with the Commission proposal for a Regulation establishing a Single Market Emergency Instrument and repealing Council Regulation (EC) 2679/98140 as well as with the Commission proposal for a Regulation of the European Parliament and of the Council establishing a framework of measures for strengthening Europe's semiconductor ecosystem (Chips Act)[141].

The Commission and Member States will regularly monitor the application of the legal acts, in particular the effectiveness of the measures to monitor structural supply challenges if critical raw materials faced by the EU industry.

In addition, the achievement of EU supply capacity targets, as explained in pillar B (section 5.2) would be used to monitor the success of the initiative. The success of this initiative would be measured in terms of greater security of supply (which is not per se measurable but relevant aspects, such as the share of EU production and of global supply concentration can be measured, as they are already in the criticality assessment), the scale (in terms of financial volume) and speed (in terms of permitting delays) of investments in the EU CRM value chain within the EU. The contribution of secondary CRMs is also an important indicator of success, as is the distribution between high and low environmental performance scores, gathered through the environmental footprint measures. Through increased domestic production and circularity, as well as through constructive interaction with external CRM producers – aided by the incentives provided by the environmental footprint system – the EU's supply of CRMs would also be more sustainable.

Concretely, the following indicators to determine the initiative's success could be developed as follows:

Specific objective	Indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target	Data quality rating
1	Diversification level of companies	% Size of supply coming from only one source	Companies survey	Every 3 years (adapt with report)	Defined per company	Reduction of companies' supply concentration	Low
2	Extraction/refining and recycling capacity (3 distinct indicators)	% compared to EU consumption of refined material	Criticality assessment	Defined in criticality assessment (every 3 years)	2023 criticality assessment provides the baseline for each material	Increase of EU capacity along the value chain	High

[140] COM(2022)459

[141] COM(2022)46 final.

2	Number of Strategic Projects in EU	[number]	Commission	Yearly report to Board	0	Increase for the number of projects in the different value chain stages	High
2	Number of Strategic Projects in third countries	[number]	Commission	Yearly report to Board	0	Increase of Strategic Projects to ensure diversification	High
2	Average permitting time for Strategic Projects	Length in months	Member State	Report to the board every three years	NA (no Strategic Project now)	Reduction of process length toward the timescale prescribed	High
2	Existence of national/regional programmes for exploration of strategic and CRM resources in MS	Number of programmes in each MS	Report by each Member State	Yearly	Review of existing national/regional programmes in MS one year after the CRM Act entered to force.	Each MS should have an updated national/regional programme I	High
2	Recycling input rates	% End of life recycling input rate	Criticality assessment based on material system analysis	Defined in criticality assessment	2023 criticality assessment provides the baseline for each material	Increase	High
3	Environmental footprint of CRMs	(Depends on indicator chosen, e.g. carbon footprint in gCO2-eq./kg of material)	Commission	Every three years (after entry into force of calculation rules for information requirements)	Depends on the indicator and the material in question	Depends on indicator	High

ANNEX 1: PROCEDURAL INFORMATION

1. Lead DG, D*e*cide Planning/CWP references

The European Critical Raw Materials Act is part of the 2023 CWP under the Commission's priority 'A Europe fit for the digital age'. The lead DG for this initiative is the DG for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW). The Directorate in charge is Directorate I –Ecosystems IV: Mobility & energy intensive industries. The initiative is encoded in Decide Planning with the reference PLAN/2022/1733.

2. Organisation and timing

The Secretariat-General set up the Inter-service Steering Group to assist in preparing the initiative in Q3 2022. There have been four ISSG meetings. The last ISSG consultation took place on 13 December 2022. A written consultation on the revised IA, following the RSB's negative opinion, was conducted from 31 January to 2 February 2023. A positive opinion with reservations was issued by the RSB on 16 February 2023.

The Call for Evidence and Public Consultation for this initiative were published on 30 September 2022 and was open to feedback from all stakeholders for a period of eight weeks, until 25 November 2022. The timing for adoption of the new act by the Commission is Q1 2023.

3. Consultation of the RSB

A meeting with the RSB took place on 18 January 2022. The RSB issued a negative opinion on 20 January 2022, following which this Impact Assessment was revised as follows:

RSB Recommendations	**Revisions introduced**
The report should provide more clarity on the policy context, the lessons learned from past actions and the planned interaction with parallel measures, including in the sustainability, external, development, trade and research policy areas. The report should be more specific on the regulatory gap to be tackled, particularly in the sustainability area. The impact of environmental legislation and public attitudes on EU CRM production should be also covered when presenting the problem drivers.	The report further expands on the context and past actions, with more detailed discussion of the 2008 raw materials initiative and the 2020 Action Plan, and the lessons learnt (Annex 8). Textbox 2 in chapter 5 provides an overview of the EU's international actions on critical raw materials, and chapter 2.1 provides more details on the international dimension of the problem, which are central to the problem and previously only figured in Annex 10. The international dimension is considered as a baseline scenario, but since these actions are continuous and are in place whichever policy options is chosen, they are also further assessed in the relevant impact sections (impact on international trade) in chapter 6. More generally, the non-regulatory dimensions have been integrated throughout the document, including by adding the lack of skills and the lack of public acceptance as drivers in chapter 2, and by listing trade, R&I and skills as aspects of the main problem

	tackled through the overall initiative (new chapter 5.4). We have expanded the detailed discussion of interactions with existing and proposed legislation in Annex 8 and synthesised the most relevant interactions in a section on "regulatory gaps analysis" under chapter 1.2, with a special focus on sustainability legislation, notably CSDD.
The report should present a clear and consistent set of general and specific objectives and a timeline (or major milestones) by which these should be achieved. Specific objectives should be formulated in a way that they do not pre-empt the choice of policy options. Trade-offs (and any resulting prioritisation) as well as synergies between objectives, such as security of supply, EU industry competitiveness, EU's decarbonisation efforts and environmental and sustainability impacts should be explained clearly. The report should also be clearer on the envisaged economic and environmental model for the EU CRM ecosystem and value chain (e.g. improved autonomy of CRM extraction and refining in Europe, mainstreaming of circular economy models, more reliable and sustainable sourcing from third countries, increased use of alternative solutions). On this basis, it should explain what success would look like and how it would be measured.	The objectives were rearranged (section 4). The general objective of the Critical Raw Materials Act is to ensure the EU's secure access to critical raw materials, while incentivising the development of sustainable supply sources. This ultimately contributes to economic growth and high living standards in the EU, prevents disruptions and distress within the European single market and increases the competitiveness of European businesses, while not neglecting the EU's role in promoting sustainable development and environmental protection globally. The specific objectives have been rephrased and condensed into three specific objectives that do not prejudge the solutions proposed: SO1. Increase EU industry's awareness and mitigation of CRM-related risks in the global supply chain SO2. Increase the EU CRM value chain's capacity in the internal market SO3. Reduce the environmental footprint of the EU's CRM consumption Potential trade-offs are explained upfront in chapter 4.2 on specific objectives. The report further elaborates on how success of the initiative could be monitored, notably by the number of Strategic Projects and the achievement of the value chain targets (pillar B) (chapter 9). The envisaged economic and environmental model for the EU CRM value chain was further detailed in a new chapter 8.1, which also comments on its long-term economic viability.
The measures considered under the policy options need to be presented in a clearer way. Measures which will be subject to analysis in later initiatives (such as certain waste measures and environmental footprint thresholds) can be referenced and would not need to be analysed in depth in this report. The report should provide greater clarity on the nature, types of targets, the supporting analysis required and the envisaged target setting	In section 5.2, the report developed further the details of the different measures composing the policy options, following additional reflections in the drafting of the legal text and consideration for the subsidiarity of the measures, notably for: - Targets (headline value chains target for extraction, refining and recycling instead of a complex target setting process);

process. The concept of strategic projects should be developed in more concrete terms. The report should clarify the streamlining of permitting processes related to strategic projects and how these would respect the subsidiarity principle. Diversification measures would need further precision on issues such as offtake agreements, private and public stockpiling. The role of the sustainability footprint and how it would work inside and outside the EU should be more thoroughly explained.	- Strategic Projects (more agile selection of projects rather than a list-based approach and possibility for Member States to object to a project being granted strategic status; clarification of the main criteria for selection, including EU added value and long-term viability); - Permitting (clarification of the requirements that would apply to Member States for Strategic Projects' permitting, at different stages of the process; clarification of how subsidiarity is ensured, i.e. by allowing Member States to object to a project being granted strategic status); - Diversification measures (providing clearer requirements on a limited set of companies, while providing them with the possibility to explain why compliance is not possible); - Stockpiling measures (the different obligations that apply to private or public stockpiling are further elaborated) - Circularity and waste measures (further explanation of which measures would come in the Act itself and which would come at a later stage, and some changes to the measures included, reflecting the evolving discussions in legal drafting); - The details pertaining to the functioning of environmental footprint have also been further explained (the measure does not ban all relatively unsustainable CRMs but, as a first step, creates transparency allowing customers to choose how they value sustainability in comparison to other aspects such as price and availability, and only in a second step, provides the possibility to impose thresholds, based on a dedicated IA, that could exclude the most unsustainable CRMs from the EU market. This second step would only apply after sufficient information is gathered at the transparency stage, and only where significant disruptions to the EU

	industry's green and digital transition or other key industrial assets can be excluded.)
The report should be clearer on the investment necessary to deliver on the objectives and the envisaged funding structure. It should clarify the role of and financial support to strategic projects, the envisaged mix of national and EU level funding and the role of State aid. It should explain how the long-term economic viability of high investment measures and strategic projects will be ensured.	Estimates regarding the investment necessary to deliver on the objectives were included in Annex 10 (Driver 2.3 Difficulty in accessing finance) and Annex 12 (Estimation of investment needs). These have now been better linked to the main text and complemented by some estimates of a suitable size of an InvestEU platform, notably in sections 6.1.1.1 and 6.2.1.1 on impact on companies. The option on access to finance is now further explained: the preferred option relates to the development of a framework that allows to best assess the relevant funding and investment vehicles available for a dedicated Strategic Project (chapter 6). It is also specified whether the measures relate to investment support or to the long-term operations of the Strategic Projects. The report discusses high energy prices in chapter 2, under Driver 2.3 "Lack of access to finance" and in section 6.2.1.3 on impacts.
The report should better assess impacts of options on third countries and trade, including compliance with international and WTO standards. It should further assess the potential economic benefits and be clearer on the overall impacts of EU industry competitiveness (including for SMEs) as well as the EU based CRM ecosystem. The overall compliance with the 'do no significant harm' principle should be further developed, as well as explaining the role of the measures for the EU's overarching green transition strategies.	The assessment of impacts has been strengthened to the extent feasible. Quantitative information has been added to further explain the benefits of the options, notably on Strategic Projects' job creation potential (see Annex 3 and Annex 4) Throughout chapter 6, additional information on cost- and international competitiveness, including for SMEs, has been added in the assessment of impacts. The effects of high energy prices have also been discussed (Chapter 2, subproblem 2). In addition, the report further assesses the impact on third countries and trade (WTO compliance, notably in Section 6 under the different policy options impact on international trade) as well as on competitiveness. Further details were added on the contribution of the options towards the goals set out in the European Climate Law and on their compliance with the "do no significant harm" principle, notably by explaining which criteria could be affected by the measures, also taking into account compliance with environmental acquis (see Environmental Impact for the different options.)

The comparison of options should include the coherence dimension. This should allow for a reflection of the main trade-offs as indicated above and overall consistency with existing and parallel measures. The effectiveness comparison should be based on a revised set of specific objectives. The preferred package of measures should be further justified. 3 The report should also clarify the overall net impacts on main parameters. Costs and benefits should be quantified to the extent possible and the table in annex 3 further elaborated, including on the One In: One Out requirements	The report further explains that the combination of approaches into options are shaped not only based on the degree of ambition and stakeholders' feedback, but also on the available set of resources to implement each option's provisions (Chapter 5.3 Description of the policy options) The report comprises a new coherence dimension that allows to better detail the comparison of options and show the trade-offs, both between the options and across EU policies (chapter 7). It is also better explained why policy option 2 is the preferred package. The overall net impacts were adapted with the addition of new qualitative benefits, notably in its effect on the one in one out requirements (c.f. Annexes 3 and 4) Additional costs were added to reflect the changes of one of the pillars (C.3), by calculating the number of companies affected by risk assessment obligation (stress test) (c.f. Annexes 3 and 4; and 6.1.1.1 impact on companies) The comparison of costs and benefits was expanded in the Chapter 8.2, Application of the 'one in, one out' approach was explained in section 8.2 and in Annex 3.

Further to this resubmission, the Impact Assessment received a positive opinion from the RSB on 16 February 2022, with comments, which were addressed as follows:

RSB Recommendations	**Revisions introduced**
The report should provide a more coherent description of the overall policy context and include for example the Global Gateway. It should better explain the link and coherence with the flanking measures envisaged in parallel to this initiative, such as on research and trade. The link between this initiative and the battery regulation should also be clarified, since similar mechanisms apply and certain CRMs are covered also by the battery act with a risk of redundancy. Strategic partnerships, which are not specified as a policy option in the intervention logic, should not be assessed in the impacts section but clearly explained as flanking measures and in the context section and included in the baseline scenario.	The Global Gateway was mentioned in the interplay with existing instrument of section 1.3 The overall policy context was ed by adding a section 1.2 on the policy context and previous nonregulatory actions taken in the area of critical raw materials. The link and coherence with the parallel measures on research and trade was further explained in section 5.4, underlining that ongoing work was already under way regarding skills, research and innovation or trade, but that the accompanying communication would further propose measures to reinforce those aspects, which were identified in the problem section.

Lessons learnt should be activated for the purpose of the policy context and problem definition.	The link with the battery regulation was further evidenced by integrating the description of the environmental footprint pillar in the main text, as it contains a paragraph explaining the link between the coherence between the two approaches. The parts on the impact Strategic Partnerships of were conscribed to the section 5.1 on the baseline scenario. Lessons learnt were included in the main text. In section 2.4, after having explained the likelihood of the problem persisting.
The report should better explain to what extent the problem of sustainable sourcing of CRMs linked with the main problem of lack of secure access to CRMs for the EU	A sentence was added in section 4.2 at the end of the specific objectives to specify that measures to ensure higher sustainability of CRM production should always consider the need to ensure supply security in parallel.
The content of the options and functioning of the key measures should be better presented in the main report. While the overview of policy options gives a broad idea of the available policy choices, these need also to be explained in a clear, but concise manner in the option definition section with corresponding references to the detailed description currently contained only in an annex. The report should explain what is behind each measure presented under each option (e.g. strategic projects, access to finance , etc), how they are intended to function and what they are expected to deliver. Policy measures which will require further analysis (certain waste measures and thresholds for the environmental footprint) should be clearly indicated in the preferred option section.	The content of the options was introduced in the main report, in section 5 It was specified that for some pillars, such as on environmental footprint and circularity measures, additional analysis would be required (in section 5).
(4) The report envisages financial support as a permanent feature of EU CRM value chains. It should explain how this long term framework for economic operators will ensure that public funding is used fully in line with principles applying to EU funding and State aid and sound economic incentives continue to apply. It should assess potential risks relating to permanent funding structures and specify under which conditions financial support could be granted.	Section 5.2 and annex 5 explain in the approaches which envisage financial support that such support should only be granted in case of market failures and where projects show long-term viability, in line with existing state aid rules. This should prevent the establishment of permanently supported projects under normal conditions. The unlikely case of sound projects requiring permanent support, for example due to permanently significantly higher energy costs, is assessed in the part on competitiveness for option 2.

(5) The report should clarify by when the envisaged technical standards for critical raw materials value chain could be realistically expected to be available, what the related uncertainty is and how this has been reflected in the impact analysis. (from entry into force)	The average time to develop dedicated standards was included in the corresponding options in section 5.
(6) The report should provide a more granular comparison of the effectiveness of options in terms of achieving the specific objective to increase the EU CRM value chain's capacity. This objective is very broad in terms of relevant measures that could contribute to it and thus requires a set of more specific criteria based on their difference in delivery on effectiveness which could be measured. On this basis the report should better justify the choice of the preferred option, including by explaining whether alternative combinations of option packages of measures (other than the three presented) have been assessed.	The specific objective 2 on supporting the EU value chain was further completed by its different components (section 4.2). To that end, the effectiveness of options was also further analysed in a granular way with the addition of a dedicated table in section 7, and this reasoning was included in the preferred option's section, notably underlining that no other combination of options would have performed better.

Evidence, sources and quality

Evidence and data that were used in this Impact Assessment included:

A. Academic studies and literature on the effect of previous crises on critical raw materials, as well as existing position papers and other documents drawn up by relevant stakeholders;
B. Newspaper articles and press materials. The references are cited in the main text of the report as appropriate.
C. Internal studies of Commission services, and notably of the Joint Research Centre.

The Impact Assessment further relies on the information received from consultation activities as detailed in the synopsis report contained in Annex 2 of this Impact Assessment

ANNEX 2: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

In the context of the Impact Assessment on the European Critical Raw Materials Act, various consultation activities were conducted between September and November 2022. The purpose of the consultation was to collect evidence and views from a broad range of stakeholders, giving them an opportunity to provide relevant data and information on the problems and potential solutions to secure the supply of critical raw materials in the EU. While attempting to reach the widest possible range of stakeholders, the results of the consultation activities represent only the opinions of the respondents. This Annex presents the results of the consultation activities carried out.

The consultation activities included:

- A call for evidence published for feedback from the 30th of September to the 25th of November 2022,
- A public consultation published in the "Have your say" portal containing multiple choice and open questions covering regulatory and non-regulatory measures, running in parallel with the call for evidence.
- Questionnaires on "Permitting in the EU Member States" and on "Stockpiling of raw materials in the EU Member States" shared on the 28th of October with the Raw Materials Supply Group (RMSG).

Concerning the call for evidence and the public consultation, both were open to the public. The consultation process through the RSMG group targeted Member States, stakeholders and experts.

1. Overview of the participants

For all stakeholder activities, the main stakeholder groups addressed were:

- National authorities responsible for the survey, exploration and overall management of raw materials and mineral resources;
- Non-Governmental Organisations representing civil society;
- Associations representing industry, businesses and professionals;
- Businesses, including Small and Medium-sized Enterprises (SMEs);
- Social partners;
- Academic experts on non-energy extractive industries, research community;
- EU citizens.

For the call for evidence, 310 answers were received coming mainly from companies and business associations (144), followed by EU citizens (54), NGOs (49), Academia and others (39), public authorities (12), environmental organisations (5), trade unions (3) and non-EU citizens (2). There were responses from stakeholders from 19 Members States and 12 non-EU countries. In addition, 190 policy papers were submitted. Most responses came from Belgium, Germany and Spain. Among non-EU countries, Norway accounts for the largest number of responses. Most of the contributions presented a favourable attitude towards the upcoming act and welcomed the European Commission's initiative.

For the open public consultation, 263 answers were received coming mainly from business associations/companies/business organizations (164), followed by non-governmental organisations, EU citizens, public authorities and other stakeholders. 49 stakeholders attached a policy paper to their answers. The majority of respondents represent a large (250 or more employees) organization (81 out of 259 respondents; 31 %). 12 % (32 out of 259) of the respondents are from medium-sized organizations (50 to 249 employees), 20 % (53 out of 259) are from small organizations (10 to 49 employees) and 26 % (67 out of 259) are from micro-enterprises (1 to 9 employees).

Regarding the questionnaires on permitting procedures and stockpiling policies sent to the members of the Raw Materials Supply Group, input from 9 Member States, 2 non-Member States and 4 business associations was received.

2. Replies to the Call for Evidence for an Impact Assessment on the European Critical Raw Materials Act

The Commission consulted stakeholders to provide evidence for the impact assessment on the European Critical Raw Materials Act via the have-your-say portal. This consultation was open to the public. A total of 310 responses were received, and 115 policy papers were submitted.

Stakeholders were requested to give their views on the problems and initial solutions via regulatory and non-regulatory measures identified by the European Commission. The regulatory dimension was built around four main pillars as follows:

- Pillar 1. Defining priorities and objectives for EU actions,
- Pillar 2. Improving the EU's monitoring, risk management and governance in the field of CRM,
- Pillar 3. Strengthening the EU's critical raw materials value chain (mining, refining, processing, recycling) in a global context,
- Pillar 4. Ensuring a sustainable level playing field across the Single Market.

In addition, the following non-regulatory measures were also presented:

- Strengthening the EU external actions,
- Accelerating research and innovation,
- Enabling the development of skills needed for the critical raw materials value chain.

General priorities

A vast majority welcome the initiative and support the need to secure the supply of raw materials for the digital and green transition through a new regulation. A small number of stakeholders, mainly from the aggregates industry, pointed out their preference for the legal instrument to be a Directive, in order to better adapt the upcoming Act to Member States' specificities.

Overall, stakeholders acknowledge the necessity for the EU to overcome the challenge of critical raw materials dependency by diversifying the supply chain and increasing EU capacities while ensuring both the competitiveness of EU industry and supply chain sustainability. For almost every business, barriers to the development of CRM projects in Europe, such as the lack of available funding and complex and long permitting processes, are the main concern. NGOs and citizens most frequently mentioned the absence of measures targeting the demand side of CRM consumption and the need to ensure high environmental and social standards as well as transparent governance processes. A small group of EU citizens' responses also showed their opposition to the current regulation. In addition, national authorities and experts' groups focussed on the need to enhance EU geological data and improve monitoring and governance capacities, with differing positions on the need for a network of national agencies or a transnational EU agency.

Many respondents mentioned the need for consistency with other EU legislation, showing awareness of the interconnections between critical raw materials and EU energy, corporate governance, human rights and environmental, health and products regulation such as the Water Framework Directive (WFD), the Environmental Impact Assessment Directive (EIA), the Habitats Directive, the EU Industrial Emissions Directive, the Waste Electrical and Electronic Equipment (WEEE), the Extractive Waste Directive (EWD), the Waste Shipment regulation, the End of Life Vehicles Directive (ELV), the Registration, Evaluation, Authorisation and Restriction of Chemicals directive (REACH), the Renewable Energy Directive (RED), the Batteries Regulation, the proposal for a Directive on Corporate Sustainability Due Diligence (CSDD), the

Supply Chain Sourcing Obligations Act, article 191 of the Treaty on the Functioning of the European Union, the Packaging and Packaging Waste Directive, the Trans-European Energy Infrastructure (TEN-E) Regulation, the Ecodesign Directive, the proposal for an Ecodesign for Sustainable Products Regulation, and the proposal for a Regulation on Prohibiting products made with forced labour on the Union market.

Regulatory Measures

Pillar 1. Defining priorities and objectives for EU actions.

Stakeholders support a sound, data-based and transparent definition of critical raw materials. Stakeholders call to ensure that the list of raw materials is flexible and easily reviewed over time to be able to answer quickly and efficiently in times of crisis. In addition, most stakeholders suggest to broaden the scope of the list, calling to anticipate the future needs of the digital and green transition as well as strategic dependencies in other sectors such as defence or health. In this context, a reassessment of the methodology to define criticality is suggested, with proposals varying across stakeholders. Also, most of the feedback from businesses underlines new materials to be considered under the scope of criticality with copper, aluminium and nickel commonly repeated.

Only few respondents address EU objectives to increase domestic production. Among those that do, setting a 2030 EU target on critical raw materials is suggested to send a strong signal to Member States and European industries and work towards more strategic autonomy.

Pillar 2. Improving EU's monitoring, risk management and governance in the field of CRM

Stakeholders acknowledge the lack of unified governance and up-to-date data on raw materials across the EU. A general call is made for strengthening and improving the coordination and monitoring capacities in Europe. Most research institutions support harmonising reporting on the basis of the United Nations Framework Classification for Resources. National authorities and sectoral associations mostly agree with granting monitoring tasks to geological agencies across Europe and implementing a coordinated network, with partial alignment on the need for a governance body. Several companies and associations suggest the creation of an independent EU agency that would help develop projects in the EU as well as providing expertise to European institutions and companies.

On stockpiling, respondents' views are cautious, with national authorities raising questions about administrative feasibility and additional costs for Member States while businesses stress adverse impacts on prices and administrative burdens.

Civil society supports collection and open access to data, while most companies mention additional administrative burden and believe that building a common European database should include provisions ensuring that sensitive information is not disclosed.

Pillar 3. Strengthening the EU's critical raw materials value chain

Stakeholders, and businesses in particular, emphasize a lack of funding incentives, as well as delays, uncertainties and complexities in the permitting procedures as major barriers to project development. It is considered a priority to streamline permitting procedures. On the financing side, several businesses suggest the inclusion of mining in the EU sustainable finance taxonomy, financial support via State aid under the Guidelines on State aid for climate, environmental protection and energy or the creation of Important Projects of Common European Interest for critical raw materials, the creation of a dedicated EU fund and the use of financial instruments such as EIB and EBRD loans and public guarantees. The received feedback shows that strategic projects are welcome as long as they do not impact negatively on prospective non-strategic mining projects.

The majority of civil society and NGOs think that priority should be given to secondary raw materials value chains to build a raw materials circular economy. On the specific actions aiming at promoting the extractive industry, civil society showed environmental and social concerns, calling to secure 'no-go zones' for extractive activities at EU level and ensure public participation and the respect of ESG standards for strategic projects.

Pillar 4. Ensuring a sustainable level playing field across the Single Market

Stakeholders generally agree that measures tackling waste and circularity need to be improved, especially when addressing recycling and recovery of end-of-life products. Responses show that economic feasibility combined with a lack of technological maturity are considered major obstacles. The feedback shows commitment from all stakeholders, with several calls for binding targets on recycling and material recovery from waste, as well as on better eco-design requirements. In particular, industrial associations operating in the recycling, batteries and renewable energy sectors call for paying closer attention to waste streams with forecasted growth, such as end-of-life vehicles or waste of electrical and electronic equipment. In addition, many respondents express their concern about waste leakage to third countries, which hinders access to waste resources and decreases industries' competitiveness.

Finally, many stakeholders call for ambitious, transparent and harmonised ESG standards to ensure the respect of responsible mining principles and European competitiveness. Overall, stakeholders support the enforcement of existing standards such as the Initiative for Responsible Mining Assurance in the upcoming act.

Accelerating research and innovation & skills

Feedback underlines a real need for research and innovation across the whole supply chain of critical raw materials. Stakeholders' priorities vary across groups with civil society calling to prioritize investments on secondary raw materials and substitution technologies while businesses want to tackle technological challenges in their respective industrial sectors, and national authorities and expert groups focus on new technologies and knowledge gaps, with national authorities focusing on exploration activities. Respondents call for new R&I programmes and additional competitive grants for ongoing EU research programmes.

In addition, a small group provided feedback on the need to re-skill and up-skill European workers ahead of the latest innovations and expected increasing demand in the raw materials sector.

3. Public Consultation

Overview

The public consultation questionnaire includes questions on general challenges regarding raw materials but also on specific issues ranging from EU policies to monitoring and permitting processes on mining to circularity.

General Challenges

A vast majority believes that EU possibilities to source CRM (primary, secondary, refining, processing) are currently underexploited or insufficient.

Most respondents either agree or strongly agree with statements that refer to underexploited opportunities of critical raw materials (CRM) within the EU. 170 (66 %) respondents out of 259 agree or strongly agree that the potential to extract CRM from primary sources within the EU is currently underexploited. More respondents (218 out of 259 respondents; 84 %) agree or strongly agree that the re-use and recycling opportunities within the EU are currently underexploited and only 2 respondents disagree or strongly disagree with the statement.

Further answers received on the following statements regarding the underexploited opportunities for CRM sourcing within the EU:

- 186 (72 %) out of 259 respondents agree or strongly agree that EU's processing and refining capacities for CRM are currently underexploited.
- 167 (64 %) out of 259 respondents agree or strongly agree that the potential to diversify the EU's external supply of critical raw materials is currently underexploited.
- 109 (42 %) out of 259 respondents agree or strongly agree that the potential to substitute critical raw materials is currently underexploited in the EU. Almost the same number of participants (110) responded without stating an opinion (e.g., neutral, no opinion).
- 138 (53 %) out of 259 respondents agree or strongly agree that the potential to increase efficiency of critical raw materials use is currently underexploited in the EU.
- 154 (59 %) out of 259 respondents agree or strongly agree that the industry is not able to tackle critical raw materials sourcing challenges on the global market without further EU policy intervention.
- 194 (75 %) out of 259 respondents agree or strongly agree that current EU policies on critical raw materials are insufficient to effectively manage supply chain disruptions, shortages and price hikes.

Current EU policies

The respondents overall agree that current EU policy actions contribute to secure the EU's supply of CRM. The following actions are supported:

- Establishing and updating the critical raw materials list - 169 (65 %) out of 259 respondents agree or strongly agree
- Developing the European Raw Materials Alliance – 161 (62 %) out of 259 respondents agree or strongly agree
- Concluding strategic partnerships with resource rich third countries – 149 (58 %) out of 259 respondents agree or strongly agree
- Developing a transparent and stable trade framework for facilitating trade in raw materials, including through free trade agreements with resource rich third countries – 150 (58 %) out of 259 respondents agree or strongly agree
- Funding research and innovation on resource efficiency, recycling and substitution of critical raw materials through Horizon Europe – 184 (71 %) out of 259 respondents agree or strongly agree
- Developing and coordinating knowledge through research projects, such as the raw materials information system – 179 (69 %) out of 259 respondents agree or strongly agree

Lack of investment into the EU supply chain

The topic of financing receives similar answers as most respondents see difficulties with financing and funding. The fear of reputational damage seems to be less important than the lack of public acceptance for new CRM projects:

- Difficulty to access private financing for critical raw materials projects – 133 (51 %) out of 259 respondents agree or strongly agree; 23 (9 %) disagree or strongly disagree
- Difficulty to access public funding in the EU for critical raw materials projects – 145 (56 %) out of 259 respondents agree or strongly agree; 10 (4 %) disagree or strongly disagree
- Lack of technical standards for processes along the critical raw materials value chain – 73 (28 %) out of 259 respondents agree or strongly agree; 56 (22 %) disagree or strongly disagree; 130 (50 %) express no opinion
- Fear of reputational damage for companies – 87 (34 %) out of 259 respondents agree or strongly agree; 22 (8 %) disagree or strongly disagree; 150 (58%) express no opinion

- Lack of or limited public acceptance for new critical raw materials projects in EU – 165 (64 %) out of 259 respondents agree or strongly agree; 22 (8 %) disagree or strongly disagree
- Unfair competition from third countries – 158 (61 %) out of 259 respondents agree or strongly agree; 19 (7 %) disagree or strongly disagree
- Price volatility and unpredictability – 165 (64 %) out of 259 respondents agree or strongly agree; 14 (5 %) disagree or strongly disagree
- Lack of skilled workforce to design and operate critical raw materials projects – 133 (51 %) out of 259 respondents agree or strongly agree; 28 (11 %) disagree or strongly disagree
- Lack of available technologies to carry out critical raw materials projects in line with the required environmental standards – 91 (35 %) out of 259 respondents agree or strongly agree; 72 (28 %) disagree or strongly disagree

The main problem about the difficulty to access private funding is the length and complexity of the permitting process (for exploration and extraction). Further explanation was given for some stakeholders, this relates to the fact that the absence of mining activities from the EU taxonomy makes funding and investment unattractive.

Permitting emerges as a major bottleneck in the open public consultation among stakeholders. Permitting processes are perceived as *"lengthy, complex and can be easily derailed at several stages"*[1]. Hence, stakeholders call for acceleration of these processes, "while ensuring a coherent level of sustainability performance"[2]. At the same time, there is a call for transparency and guidance[3] in permitting processes, for instance in form of a common platform created by the EU, where member states could exchange experience and knowledge linked to permitting processes[4].

- **Definition of critical raw materials**

On the definition of critical raw materials, stakeholders either propose new elements that should be added to the list of critical raw materials, such as sylvinite, sulphur[5], phosphate rock[6] and potassium[7], or stress the general need for a better and clearer methods of criticality assessments. Several stakeholders also underline the need to take future demand into account[8] as well as propose a review of the materials currently understood as "fundamental/strategic/essential/priority or other"[9].

Implementing a list with strategic raw materials would be beneficial for future decisions according to the respondents. A specific list of raw materials of strategic importance for the EU (and thus deserving priority attention) would:

- guide investment decisions of companies and financial institutions – 182 (70 %) out of 259 respondents agree or strongly agree
- target public support at EU and national level – 182 (70 %) out of 259 respondents agree or strongly agree
- Setting EU objectives for increasing domestic production capacity along different stages of the value chain (exploration, extraction, refining, recycling) to guide national and European efforts (i.e. in relation to the materials on the list) - 188 (73 %) out of 259 respondents agree or strongly agree

- **Setting critical raw materials objectives**

The list of raw materials of strategic importance for the EU can also be used to set EU objectives for increasing domestic production capacity along different stages of the value chain: 188 (73 %) out of 259 respondents agree or strongly agree with the statement.

- **Monitoring and risk assessment (and governance)**

On **monitoring**, the answers are highly distributed. On the question of whether companies would benefit from public monitoring programmes, 146 (56 %) out of 259 respondents agree or strongly agree. Only 8 (3 %) respondents disagree or strongly disagree on that matter. The answers on the question if companies lack sufficient information on supply risks for them to take preventive measures were distributed quite evenly: 29 % agree or strongly agree, 25 % disagree or strongly disagree, 24 % are neutral and 22 % express no opinion. The answers on the matter if companies generally do not have in place contingency plans to deal with supply disruptions are more distributed as well: 34 % agree or strongly agree, 23 % disagree or strongly disagree 21 % are neutral and 22 % express no opinion. However, regarding the competences of the member states, the answers are quite clear again:

A. Member State authorities do not have in place sufficient monitoring mechanisms allowing them to assess supply risks and anticipate problems – 138 (53 %) out of 259 respondents agree or strongly agree
B. Member State authorities do not sufficiently cooperate and coordinate in monitoring critical raw materials supply chains – 150 (58 %) out of 259 respondents agree or strongly agree

More cooperation between national authorities and EU-wide governance would also be beneficial for the EU's value chain of CRM according to the respondents:

- Enhanced cooperation between national authorities or agencies in charge of critical raw materials (data exchange, common monitoring, etc.) - 213 (82 %) out of 259 respondents agree or strongly agree
- A dedicated EU-wide governance capacity tasked with monitoring actions and strengthening the EU value chain – 177 (68 %) out of 259 respondents agree or strongly agree
- Better access for companies to monitoring information at EU or at national level to enable them to identify vulnerabilities in their supply chains – 182 (70 %) out of 259 respondents agree or strongly agree

Regarding the subjects of monitoring, the respondents assess that CRM projects in the EU and supply and demand developments are the most important aspects to monitor while price developments are the least important ones:

- Prices of critical raw materials – 125 (48 %) out of 259 respondents agree or strongly agree, 116 (45 %) out of 259 respondents expressed a neutral or no opinion
- Demand developments at national, European and global levels – 197 (76 %) out of 259 respondents agree or strongly agree
- Supply developments of critical raw materials (including forecasting) - 195 (75 %) out of 259 respondents agree or strongly agree
- Trade flows of critical raw materials – 192 (74 %) out of 259 respondents agree or strongly agree
- Progress of important critical raw materials projects in the EU – 204 (79 %) out of 259 respondents agree or strongly agree

Many respondents would welcome an early warning system by public authorities; stress testing supply disruptions is also seen positively, albeit slightly bit more reserved:

- Early warnings by public authorities of imminent vulnerability of a supply chain – 162 (63 %) out of 259 respondents agree or strongly agree
- Periodic supply chain stress testing of selected critical raw materials at EU level to better anticipate supply chain disruptions – 134 (52 %) out of 259 respondents agree or strongly agree, 107 (41 %) out of 259 respondents expressed a neutral or no opinion

Several stakeholders agree that *"while monitoring of prices and market fundamentals is important, monitoring must be accompanied with forecasting of future supply needs and capacities."*[10] At the same time, there are opinions that the public authorities and member states should conduct monitoring by themselves and communicate any potential disruptions in supply or anticipated issues to the concerned companies[11]. From the social point of view, stakeholders believe that monitoring and control should be implemented along the life cycle of the mines as well as several years after their closure in order to be credible[12]. The data and its quality are considered highly important, and companies call for implementation of mechanisms that would allow access to reliable information from resource-rich countries[13]. Inputs from EU citizens also uncover a need for close monitoring of the amount of critical raw materials used as well as how much of these had been recycled[14]. Finally, suggestions for monitoring include gaining a better overview of the public perception of exploration activities in general but also in relation to specific projects[15].

- **Strategic stocks**

Even though strategic stocks are generally welcome by the respondents, some answers were more reserved:

- Provisions to increase strategic stocks of critical raw materials at EU, national or industry level – 129 (50 %) out of 259 respondents agree or strongly agree, while 15 disagree or strongly disagree (10%)
- 105 (41 %) out of 259 respondents expressed a neutral or no opinion

Regarding the organisation of strategic stocks, most respondents would prefer an EU level guidance on voluntary stocks at national level (41 %). Mandatory stocks are the least favourable options among the respondents (14 %). Only 9 (11 %) out of 81 business associations and company/business organisations that answered the question have a strategic stock.

Coordination of stockpiling at an EU level is favoured as it is viewed as costly, and support from the EU is thus welcomed[16]. For instance, companies from the PV industry perceive stockpiling as a major financial burden in an already competitive industry environment[17]. Coordination is called for also in order to prevent supply shocks and mitigate geopolitical risks[18]. Any discriminatory practices are strongly discouraged, which is where management on an EU level could step in to ensure equal conditions and treatment among the member states[19]. Strategic stockpiling is thus often supported, but in a way in which it would not pose too great an administrative and financial burden for companies[20]. However, there are also opinions favouring strategic stockpiling being initiated at the national level on the basis of national security, while keeping the stockpiling on a voluntary basis[21].

- **Company risk preparedness**

Business associations and company organisations also stated that within the last five years 'strong volatility in prices' was the biggest problem in relation with critical raw materials supply (35 %). Other problems are supply disruptions (27 %) or supply shortages (23 %).

- **Exploration efforts in the EU**

As regards to exploration efforts in the EU, the public consultation shows a range of different opinions among stakeholders. Overall, respondents point out the untapped potential of the European bedrock, with gaps in the availability of up-to-date and relevant geological data. Stakeholders highlight deficient national funding for exploration projects and an urgent need to speed up investments on modern and efficient technologies. While non-governmental organisations call for environmental protection and community consultation, several business associations and companies call for financial or additional support from the EU to promote local exploration activities. The environmental and social concerns include a need for increased engagement with local communities, workers and other stakeholders in exploration and production processes[22].

At the same time, many stakeholders stress the need for exploration and mining projects not to be carried out in sensitive or particularly sensitive endangered habitats[23], and for NO-GO zones to be established[24].

On the other hand, businesses but also some EU citizens point on the need to educate the public *"on the urgent need for local exploration and sourcing of critical raw materials, the environmental advantages of sourcing these materials in the EU's highly regulated jurisdictions as opposed to loosely monitored third countries"*[25]. Increased action to counter misinformation and disinformation on the exploration and mining industries is called for, along with financial support and a clearer overview of available funding to be provided by the EU in the field of exploration[26]. Also, according to some stakeholders, *"deposits which are easy to access become depleted, and so exploration needs to be deeper and in more remote locations"*[27].

- **Support to the value chain**

The majority of the respondents agree that identifying strategic projects would be beneficial for financial and permitting decisions. 184 (71 %) out of 259 respondents agree or strongly agree that strategic projects and partnerships outside of the EU should also benefit from de-risking if they comply with social and environmental standards and can contribute to secure EU supply. Furthermore, identifying strategic projects could be beneficial for the EU's industry according to the answers received.

- Identifying Strategic Projects across the critical raw materials value chain with strong environmental and social performance and contributing to reducing EU dependencies – 223 (86%) out of 259 respondents agree or strongly agree
- Ensuring that these Strategic Projects benefit from easier access to public and private finance – 193 (75 %) out of 259 respondents agree or strongly agree

    - *Permitting procedures*
- Ensuring that these Strategic Projects benefit from streamlined and quicker permitting procedures – 190 (73 %) out of 259 respondents agree or strongly agree

Among the received answers, Spain and Sweden were mentioned the most in context of difficult permitting procedures. However, many respondents sent the exact same answer: 'National permitting requirements are complicated to navigate, but they are fit for purpose for national or regional needs and should remain national competence'

    - *Access to finance*
- Regarding policy options in order to facilitate access to finances for CRM projects the following answers were received:
- Public support to bring together downstream users and project promoters to facilitate the conclusion of long-term supply contracts and offtake agreements – 143 (55 %) out of 259 respondents agree or strongly agree
- Target existing EU funds that have the possibility to finance critical raw materials projects of particular strategic relevance identified under the future legislation – 185 (73 %) out of 259 respondents agree or strongly agree
- Increased financial support from national and European promotional banks for critical raw materials projects – 183 (71 %) out of 259 respondents agree or strongly agree
- A dedicated financial platform to de-risk critical raw materials projects that meet certain requirements (e.g., high environmental and social standards, while contributing to EU supply) by blending private, national and EU funding – 175 (68 %) out of 259 respondents agree or strongly agree
- Explore opportunities offered by the existing State aid rules for critical raw materials projects, such as Important Projects of Common European Interest, State aid Framework for research, development and innovation, Regional Aid Guidelines, Guidelines on State aid for Climate, Environmental

protection and Energy or relevant State aid General Block Exemption Regulation provisions – 168 (65 %) out of 259 respondents agree or strongly agree

- Support a level playing field to promote transparency and good governance with partner countries, aiming to gather sustainable and responsible investments and partnerships in the sector – 203 (78 %) out of 259 respondents agree or strongly agree

Multiple stakeholders agree that *"mining and quarrying extraction projects are highly capital intensive and, in some instances, would require priority financing from EU and national tools"*[28]. They believe that EIB and EBRD should be more active in de-risking priority projects and in financing projects related to primary raw materials[29]. There are also requests of funds or tax rebates for companies that make an active effort to apply a circular approach in the design of their products with the aim of reducing the consumption of critical raw materials or replace some of them with non-critical ones[30]. At the same time, incentivising individuals and businesses financially is highly supported, along with a more transparent pricing mechanism and a liquid market for the content of purchased products[31]. Businesses also believe that *"market incentive and deterrent programs will encourage private investment in critical minerals projects"*[32]. Responses also reflect the current energy crisis, causing high energy costs and posing a vital issue for the industries. Consequently, stakeholders ask for a higher financial support as *"new investments need certainty that low carbon energy sources will be available and affordable in Europe"*[33]. Financial de-risking is suggested to take place via different public guarantees such as contracts for difference, public indemnities, green investment funding leveraged through the Sustainable Finance Taxonomy, but also the European Sovereignty Fund as a source of a sustainable pan-European financial de-risking scheme[34]. In general, more clarity on public funding opportunities is desired[35].

- **Targeted revisions of waste legislation**

Most respondents agree that the legislative situation within the EU should be improved in order to promote and incentivize secondary resources and circularity:

- EU product legislation does not sufficiently incentivize the use of secondary raw materials in products – 152 (59 %) out of 259 respondents agree or strongly agree
- EU waste legislation does not sufficiently incentivise the recovery and recycling of raw materials – 171 (66 %) out of 259 respondents agree or strongly agree

Regarding the challenges of shipping waste containing CRM, the following responses were received:

- Shipments of waste containing critical raw materials between Member States are difficult, which limits possibilities for viable recycling projects – 136 (53 %) out of 259 respondents agree or strongly agree, 11 (4 %) out of 259 respondents disagree or strongly disagree
- Export of waste containing critical raw materials increases the shortage of critical raw materials in the EU and limits potential for circularity – 156 (60 %) out of 259 respondents agree or strongly agree

Most respondents would also welcome targets for waste operators and other requirements regarding sustainability, circularity and recycling. Overall, the responses are positive or neutral, with only few people disagreeing or strongly disagreeing with the statements.

Regarding the development of targets for waste operators, the following responses were received:

- there should be targets for the recycling efficiency of critical raw materials from different waste streams (electronics, vehicles, etc.) - 142 (55 %) out of 259 respondents agree or strongly agree
- there should be targets for the material recovery of critical raw materials from different waste streams (electronics, vehicles, mining waste etc.) - 164 (63 %) out of 259 respondents agree or strongly agree

Regarding recycling, the following answers were received:

- Requiring Member State to design waste management plans including specific measures to promote the recovery of critical raw materials, from historical mining waste – 176 (68 %) out of 259 respondents agree or strongly agree
- Setting design requirements for products containing critical raw materials to increase their ease of dismantling and recycling – 173 (67 %) out of 259 respondents agree or strongly agree
- Setting minimum content of recycled critical raw materials in relevant products – 115 (44 %) out of 259 respondents agree or strongly agree, 82 (32 %) out of 259 respondents expressed a neutral or no opinion
- Setting design requirements for products containing critical raw materials to increase the length of product life – 129 (50 %) out of 259 respondents agree or strongly agree
- Strengthening support for EU research and innovation funding on recycling and material recovery technologies for critical raw materials – 226 (87 %) out of 259 respondents agree or strongly agree
- Strengthening exploration and documentation of critical raw materials in secondary deposits and waste streams – 201 (78 %) out of 259 respondents agree or strongly agree

There is a call for waste management on both the European and member states level. While on the level of member states, some stakeholders call for *"waste management plans with specific measures to promote the recovery of critical raw materials from historical mining waste, mandatory reporting, and setting clear binding targets for waste operators handling critical raw materials from different waste streams"*[36], others propose an introduction of recycling obligations and fixed recycling targets applicable both within the EU and internationally[37]. Some major bottlenecks connected to waste management have been identified, such as transport of waste between different member states, which is considered to be a complex process leading to an administrative overburden, but also the collection and treatment of waste, where harmonised procedures are supposedly lacking[38]. The potential to identify critical raw materials from mining waste is also considered important and underexploited[39], together with assistance to utilise products that would otherwise be waste[40]. Efforts to boost the recovery and recycling rate of the resource flows are called for, along with the mining waste valorisation, which should include consistent mapping of former mining waste and assessing legislative bottlenecks[41].

- **Actions on standards for the CRM value chain**

Majority of stakeholders agree on the need for mining in the EU to be done with commitment to, and enforcement of, high environmental and social standards[42] and, in general, for harmonised and consistent application of environmental and social standards across all member states and regions of the EU[43]. Multiple stakeholders agree that: *"a lack of technical standards is not the challenge, but rather the quality of the standards and their transparency and enforcement. The EU, Member States and companies should embrace new legislation and update and enforce existing EU legislation to ensure high social and environmental standards"*[44]. Production in Europe is perceived as more sustainable, both with respect to social and environmental standards, but stakeholders underline the need for investments to reach the desired volumes[45]. In addition, standards for recycling processes such as dismantling are also called for as binding minimum standards would ensure high-quality recyclate in the recycling and related value chain processes [46]. Some stakeholders also support companies to engage in standardization as, in their opinion, uniform standards increase efficiency and contribute to greater security and trust[47].

- **Sustainability of critical raw materials**

To ensure that critical raw materials meet European sustainability standards, respondents agree or strongly agree that CRM should be accompanied with information on the environmental footprint of producing those materials (186 (72 %) out of 259 respondents) and on the ethical sourcing of those materials (180 (70 %) out of 259 respondents).

A majority of stakeholders are committed to comply with the environmental and social protection rules in a strict way. Their goals include an improvement of sustainability in mining projects, as well as a social acceptance of the mining industry, value sharing, transparency and cooperation with the local society in the process[48]. They often perceive the improvement of the sustainability performance of European raw materials value chains as a vital part of their strategies[49]. As mentioned above, recycling efforts form a significant part of the sustainability goals of stakeholders, including proposals of EU wide campaigns on the importance of recycling raw materials[50]. Many stakeholders also call for assurance that projects follow the due diligence requirements set out under the EU Corporate Sustainability Due Diligence Directive (CSDD)[51]. An overall call for exploring technologies which are linked to decarbonisation efforts and require less resources is very much present[52]. Stakeholders express the need for a better guidance from the EU when it comes to available sustainable substitutes, as one of them claims that *"the policies set forth would need to define an EU-based recycling management strategy and ensure to the maximum that the raw materials recycled at end of life remain in the EU and can feed into the EU production processes again"*[53].

- **Skills along the CRM value chain**

On skills, many respondents suggest an exchange programme with countries that have the knowledge of mining and refining certain CRM (e.g. battery-grade lithium) in order to slowly build up knowledge within the EU. Another suggestion is to facilitate the visa and working permits for non-EU citizens as the current process is apparently complex. An often-mentioned aspect is about increasing the knowledge about raw materials within the society, especially young people in order to attract the next generation to the industry of mining and metallurgy. Many respondents suggest more funding towards re-skilling programmes as well.

The respondents were also asked to specify what policy measures would have the highest impact on their organization. Many respondents claim that a faster and easier permitting process and a better access to funding/financing would positively impact them the most. Different objectives (set incentives, stop waste exports, strengthen recycling capacities, mandatory recycling targets, etc.) were also mentioned in order to support circularity and recycling. A company called BE1 Geoconsulting AB also mentioned concerns about the critical raw materials list manipulating the market and thus having a negative impact.

- **EU external action**

Majority of respondents agree (39%) or strongly agree (13%) that the EU lacks a strategy for increasing the diversification of the EU industry supplies from third countries. The feedback to the question on whether potential to extract critical raw materials from primary sources in third countries is currently underexploited was non-conclusive, as 23% of respondents agree (9% strongly agree), but 19% were neutral and 19% did not know/no opinion and 15% disagree (7% strongly disagree). The problem seems to be more pronounced in global refining and processing capacities, where 34% agree and 14% strongly agree that global processing and refining capacities for critical raw materials are currently insufficient. More exchanges and cooperation between Third Countries and the EU/Member States authorities on critical raw materials (data exchange, common monitoring, etc) are needed, as 39% agree and 15% strongly agree that they are not sufficient.

When asked about the underlying reasons for supply chains disturbances and supply constraints of raw materials, respondents identified the following: increased geopolitical tensions (73% of all replies), volatile trading conditions (44%), untransparent market mechanisms (36%), insufficient global production (35%) and market manipulation (35%).

In terms of policy suggestions, 45% of respondents agree and 26% strongly agree, that the EU should strengthen the ongoing strategic partnerships on critical raw materials and conclude additional ones with resource rich third countries. Some stakeholders indicated that the EU should focus on new partnerships with regions that can deliver supply in the short terms (next 5+ years). 38% agree and 35% strongly agree that such

partnerships should rely on clearly established pillars, such as integration of raw materials value chains, research and innovation cooperation and alignment on environmental, social, and governance (ESG) criteria and standards. 48% agree and 22% strongly agree that partnerships on raw materials value chains with developing countries need to include a pillar for capacity building, skills and training and one for deploying infrastructure.

34% agree and 25% strongly agree that the EU should diversify its global supply through its free trade agreements and trade relations. Many respondents were asking for faster ratification of existing trade agreements (Mexico, Chile, Mercosur, New Zealand), speedy conclusion of ongoing trade negotiations (Australia, India and Indonesia). It is also important to work together with likeminded partners and initiatives, such as MSP were mentioned as good examples. Many respondents emphasised the importance of free trade agreements and strong chapters on raw materials. Since 2015, the EU proposes a dedicated chapter on Energy and Raw materials in all its negotiations and such chapters are being negotiated currently with Australia, India and Indonesia (finalised with Chile), however the EU would have to quickly conclude/start to apply those agreements and communicate more and better on these chapters, as only 14% agree and 5% strongly agree that these provisions (on investments, licensing and standardization) have the necessary disciplines to unlock the potential in opening access and encouraging investment in raw material, while 37% of respondents did not know/ had no opinion.

Majority of respondents (36–49%) did not know/had no opinion on trade barriers, but from the ones that agreed or strongly agreed, export taxes (25% agree and 8% strongly agree) and export monopolies/qualified exporters lists (28% agree and 9% strongly agree) were selected as having the most trade distortive effects on EU business.

In addition, a limited number of stakeholders were calling for strong trade defence instruments to tackle unfair trade practises, as well as emphasis on Economic, Social and corporate Governance (ESG) standards when sourcing raw materials abroad. Some stakeholders underlined the need for special attention to EU circular economy.

3. Questionnaires on "Permitting in the EU Member States" and on "Stockpiling of raw materials in the EU Member States" shared on the 28th of October with the Raw Materials Supply Group (RMSG)

Permitting in the EU Member States

Stakeholders offered several concrete proposals and avenues that could enrich the policies adopted in the CRM Act. In terms of permitting, some were of the opinion that *"there is no need for special treatments in terms of permitting of certain selected projects, but the emphasis should rather be on encouraging each Member State to make general adjustments in the national permitting processes to make them more predictable, streamlined and efficient"*[54]. They also shed light on how the current permitting processes work in different member states, often relying on approvals and permits provided by the municipal authorities. Some stakeholders report to be "often frustrated" by the administrative processes, governmental approvals and environmental permits/authorisation processes[55]. Also, permitting processes in Member States are perceived to be disparate as they depend on the different national legislation and the Member States internal structures[56]. As mentioned in one of the responses, *"EU legislation and in particular the transposition and case-by-case interpretation when it comes to mining projects should be equipped with guidance to address contradicting objectives and inconsistencies that could form an obstacle to permitting to ensure predictability and efficiency"*[57]. Although not directly linked to the details of permitting processes, some Member States stress that the general opinion of the civil society is negative towards mining activities and operations, which affects mining regulations that

are being adopted, or at least their public perception[58]. Thus, there is a call for creation of conditions for the development of communication programmes in order to increase social mining acceptance[59].

Stockpiling of raw materials in the EU Member States

There is a call for a better definition of what stockpiling means and whether it refers to produced raw materials or also strategic reserves still to be mined[60]. At the same time, there are doubts concerning the financial aspects of stockpiling, whether in relation to investors and the assurance that they would not lose income due to stockpiling, or related to the whole structure of stockpiling managed at the EU level and the implications relevant for the Member States[61]. As in the case of permitting, stakeholders including Member States provided an insight into how stockpiling is organised locally, also informing that some of them currently do not have any stockpiling systems established[62]. In some cases, stockpiling (in general, not necessarily for metals and minerals) is under supervision of a government body or an agency[63]. Stakeholders also provided either concrete lists of raw materials that should in their opinion be stockpiled or labeled all critical raw materials as necessary to be stockpiled at the EU level[64]. Some Member States support the idea of stockpiling being managed by a dedicated EU body[65].

ANNEX 3: WHO IS AFFECTED AND HOW?

Practical implications of the initiative

Businesses

As detailed above, businesses would be subjected to limited information requirements, notably contributing to the monitoring capacity (only for large companies operating in CRM value chain) and providing information on the critical raw materials content of EEE put onto the market (as a new category within the existing reporting of EEE producers) and of extractive waste generated (only for operators of currently operating extractive waste sites). Other measures comprised in the preferred option only include rules for how claims on sustainability and environmental footprint more specifically should be made, thus imposing higher costs on companies when they choose to make such claims, but in doing this also increases the trust of customers, which would ultimately benefit businesses (especially the most sustainable ones).

In terms of benefits, the measures proposed would improve substantially the information basis for companies to manage their critical raw materials supply risks, and therefore likely save costs and improve businesses' competitiveness in case of a disruption. Additional benefits to companies, notably a consulting capacity for critical raw materials risks and the possibility to join a common purchasing infrastructure, would only occur under option 3, as they rely on the existence of a well-equipped operational capacity.

Also, the proposed measures would streamline permitting, put in place a Fund to de-risk investments, and thus reduce significantly the project development cost of projects along the value chain – creating economic opportunities that businesses can benefit from.

In addition, companies further down the value chain, operating in sectors such as renewable energy, digital industries, defence and aerospace or health, would also benefit from the availability of the materials used in the technologies they rely on.

Citizens

Citizens are not directly affected by most of the proposed measures, with the exception being on recycling and sustainability. For the former, they would be incentivised through take-back schemes for small electronics, and potential other measures proposed in Member States' CRM recovery strategies, to contribute to collection and thus an improved recycling value chain; for the former, they would benefit from better information on the sustainability of critical raw materials included in their products, and through their consumer choices, could drive change towards more sustainability. Indirectly, they would benefit from the added supply security enabling the development of ecosystems, notably for renewable energy but also for other ecosystems that are at the backbone of our economy.

Member States

Member States will play an important role in the implementation of this initiative. Under the preferred option, they will be part of the governance structure, take part in the assessment and selection of Strategic Projects, and contribute to the development of a stronger monitoring capacity, while taking part in the EU level coordination of stockpiling. They would have to develop incentives for companies to diversify their supply or stockpile of strategic raw materials. In addition, they would be required to invest resources into exploration and develop strategies to recover critical raw materials from waste.

Commission

Under the preferred option, the Commission will have to develop a number of implementing rules and coordinate and support the governance structure, with notably higher capacity in monitoring, stockpiling

coordination, etc. As a results, this impact assessment provides an estimate of how many resources would be needed for the development of the governance structure, responsible for monitoring critical raw materials market and coordinating strategic stocks, data on exploration and the monitoring of Strategic Projects. How such resources would be allocated is left to subsequent decisions made by the Commission.

Summary of costs and benefits

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	***Amount***	***Comments***
Direct benefits		
Monitoring/ strategic stocks, companies' risk preparedness	Not quantifiable: but access to information and preparedness solutions.	Those measures would enable the companies to be more prepared ahead of any supply challenge that might occur in the CRM value chain and to better resist to them. It relates to the cost of not acting, which is very high if and when a supply disruption materialises.
Exploration	Negligeable: <10 k€ that can be saved.	The main benefit of exploration at national level is to put in evidence metal anomalies that will encourage local exploration by mining operators and will trickle down to support further investment down the value chain.
Strategic Projects	This assessment considers that at least 3840 direct jobs (lowest estimate) could be created per year through the development of Strategic Projects.	
Access to finance	Not quantifiable, but benefits generated by improved access to finance for producers along CRM value chain.	De-risking of financial investment would also enable the uptakes by further private investment sources as well. The overall benefits of this pillar will however be directly dependent on the size of the funds that can be made available.
Permitting provisions	Not quantifiable but benefits generated by time-gains, investment stability, etc. Permitting delays can put the whole operations of a company on pause for years depending on the waiting time. In extreme cases, the company is dissolved before the permit issuance due to its inability to sustain the costs of waiting.	Benefits of streamlined permitting notably for companies developing a Strategic Projects
Provisions on circularity: recycling and waste	Framework for MS to work on circularity, notably on collection, public procurement and R&I, which should increase circularity,	

	with all its environmental and security benefits; the amended Extractive Waste Directive would provide important access to information on CRM recovery potential from extractive waste sites, which should encourage the opening of new "re-mining" projects	
Provisions on standards	Standards to guide processes of activities along the CRM value chain. Such standards would develop the competitiveness of the EU CRM industry by supporting the development of more efficient and sustainable processes.	
Provisions on environmental footprint	The competitiveness of companies that sell or produce CRM with in a more sustainable way would increase by comparative advantage. These benefits would trickle down the value chain: downstream users will be able to use information on the sustainability of the CRM they purchase to make green claims about their products that contain them. Customers will directly benefit from this increased competition fostered by the sustainability of the products.	
Indirect benefits		
Monitoring/stockpiling/companies preparedness	Contribution to the stability of the value chain of critical and strategic raw materials	Contribution to the stability of the value chain of critical and strategic raw materials
Support to the value chain	Indirect benefits of providing security of supply for the ecosystems that rely on technologies of which strategic raw materials are a part of, needed for green and digital transitions as well as resilience. These positive effects would then trickle further down the entire economy.	These measures would contribute to achieving the EU Green Deal objectives, amongst other objectives of the digital transition or of resilience.
Administrative cost savings related to the 'one in, one out' approach*		
(direct/indirect)	Permitting streamlining for Strategic Projects will substantially reduce the administrative burden on companies benefiting from those measures.	It is not possible to quantify these benefits, as they differ from MS to MS and company to company.

	Monitoring measures (e.g. with the creation of a monitoring dashboard, available digitally to all companies) will lower's companies administrative costs of gathering data, including in interaction with public authorities, and building their own monitoring systems without a common basic information offer from the public system set up under pillar C.	No clear monetary equivalent, but certainly an important cost saving for companies.
	The creation of a publicly and digitally accessible database of closed extractive waste sites, including valuable information from permitting files and geochemical campaigns, will allow companies interested in recovering CRMs from these sites, to directly access this information instead of having to correspond with authorities with uncertainty surrounding access to confidential information etc.	The monetary equivalent of these benefits is not possible to quantify without knowing the amount of information that MS will include and the number of companies interested in such operations, but it can be considered a significant reduction in administrative burden.

*(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate which stakeholder group is the main recipient of the benefit in the comment section;(3) For reductions in regulatory costs, please describe details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.;); (4) Cost savings related to the 'one in, one out' approach are detailed in Tool #58 and #59 of the 'better regulation' toolbox. * if relevant*

II. Overview of costs – Preferred option							
		Businesses		**Administrations** (Member States)		**For the Commission**	
		One-off	**Recurrent**	**One-off**	**Recurrent**	**One-off**	**Recurrent**
Set of measures in policy option 2	Direct adjustment costs	EUR 3.75 – 10 million for certification related to general sustainability claims	EUR 1 million per year in the EU for conducting risk assessment (stress test) for companies using strategic raw materials in the manufacturing of strategic technologies	- exploration: 10 FTE for aerial geophysics (already operative in some MS) ; 10 FTE for geochemical survey (also already operative in some MS) ; Data reprocessing and predictivity maps: 1 unit of 5 FTE. (Some MS already have those capacity, notably for geochemical survey) - 182,4 Million EUR to cover the whole EU for exploration (dependent upon MS existing	- 1/4 FTE per year for reporting on the state of CRM projects on their territories; - 2 FTEs per year for participation to the governance structure; - 1/4 FTE per year for the coordination of strategic stocks; - 1/4 FTE to contribute to the development of EU-targets and report on them; - 1 FTE per Member State to develop and implement the national circularity strategy (recurrent costs);		Around 31 FTEs for the Commission, that would be split by: - 2 FTEs for ensuring the secretariat of the governance structure, in addition to EUR 75.000 per year of organisational costs. - 17 FTEs for implementing monitoring, data gathering and risks assessment tasks, based on similar tasks performed by existing units in the Commission), which can be split as: o 10 FTEs for market monitoring; o 1 FTE for the management of studies and contracts; o 1 FTE for the building of a data set on projects o 5 FTEs for the coordination of information from Member States - 3 FTEs for the coordination of national stockpiles information and the development of guidance when possible; - 2 FTEs to coordinate the submission of national exploration activities; - 1 FTE to support the board in the selection of Strategic Projects; - 3 FTEs for assessing the suitability of environmental footprint, developing calculation methods and monitor the

				capacity and surface covered) - 3-4 FTE per MS to create the database of closed and abandoned waste sites and fill it with data from permitting files and geochemical campaigns	- Additional FTEs (not quantified) to enforce environmental footprint obligations.		application of the measures; - 2 FTEs to enforce actions on standardisation and prepare standardisation requests. - 1 FTE to ensure the enforcement of Member States obligation under the Extractive Waste Directive. - 3 FTEs to develop the methodology and run the data-collection exercise underlying the national recycling targets.
	Direct administrative costs	EUR 700 000 for existing mining sites of reporting available information on critical raw materials content of waste streams and composition of the waste 14.55 million for studies underlying environmental footprint claims (total figures for all companies expected to make	Administrative cost of reporting for large companies operating along the strategic raw materials value chain [up to EUR 49.000 for the whole EU if the information is not already available]		2 FTE per MS (reporting) - 1/4 FTE per MS on the transmission of information on strategic stockpiles - 1/4 FTE for the reporting of the Commission on the development of incentives for companies' resilience - 1/2 FTE for the classification and		

		claims)	Administrative costs of reporting for large companies using Strategic raw materials (on stress tests) – EUR 38.000 pear year		reporting to the Commission of obligations under exploration		
	Direct regulatory fees and charges						
	Direct enforcement costs						- 1 FTE to increase enforcement of Member State obligations under the Extractive Waste Directive
	Indirect costs						
Costs related to the 'one in, one out' approach							
Total	Direct adjustment costs	EUR 3.75 – 10 million for certification	EUR 1 million				
	Indirect adjustment costs						
	Administrative costs (for offsetting)	EUR 15,25 million	EUR 87.000 per year				

III. Overview of relevant Sustainable Development Goals – Preferred Option(s) (to adapt, this is an example)		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
SDG #7 Affordable and clean energy, SDG #13 Climate action	Enable the development of clean energy that relies on critical raw materials (such as wind turbines, batteries and electronic motors, etc), thereby reducing the impact on climate. It will also contribute to incentivising higher sustainability of CRM production through environmental footprint.	
SDG #8 Decent work and economic growth	The support for the CRM value chain is expected to leverage positive impacts on employment, reskilling and upskilling, particularly in former and current industrial regions. This will also have positive impacts over the whole value chain.	
SDG #9 Industry, innovation and infrastructure	The proposal is expected to strengthen industrial resilience, whether by better preparing companies or by directly increasing the availability of supply of CRM that the industry needs.	

ANNEX 4: ANALYTICAL METHODS

The analysis contained in this Impact Assessment builds on data collected from desk research (academic studies, economic reports, media items, existing impact assessment reports such as for the SMEI proposal), input from stakeholder outreach activities and Commission officials' expert knowledge. Information has been analysed against the main problems identified for the purpose of this initiative, the problem drivers as well as stakeholder positions. Whenever possible, the Impact Assessment provides a quantitative analysis of benefits and costs relating to the main economic and social impacts. The cost/benefit analysis, however, is not fully comprehensive due to significant data gaps. The evidence base of the report is limited due to the short time available to request information beyond questions identified early on in the call for evidence and the public consultation, and the lack of a supporting study. The views of stakeholders are transparently reflected in the Impact Assessment. It should be noted that the aim of this assessment is to provide ranges of the magnitude of potential impacts generated by each policy option, rather than exact monetisation.

Impacts section

Pillar C

Cost of governance

The cost for running the **governance structure** (pillar C)**,** and particularly the board, are assessed based on the standard budget for a meeting for a meeting with 27 MS experts of EUR 15 000, as developed in the SMEI impact assessment. The cost for the governance structure to develop monitoring capacities (pillar C.1) are assessed in comparison with the size of HERA.2 Intelligence Gathering, Analysis and Innovation Unit, which performs similar tasks as the one proposed in option 2.

Cost of information requirements

The costs for the reporting obligations on companies (**monitoring,** pillar C.1) over 250 employees is based on day spent by one employee per company, twice a year; the number of companies concerned is assessed based on the number of companies active in the EU in the extractive sector for the mining of metal, and non-ferrous metal ores, as well as the manufacturing of weapons and ammunition (given the high CRM content of their productions) which equals to around 64 companies in 2020 in the EU. The total cost of information requirement is assessed based on the reported cost of a manager (OIOO tariffs – EU average of 47,78e/hour for ISCO 1) in a company operating in the sector. It is assumed, based on internal analysis that the time spent on reporting is of an average of 1 day. Based on the administrative burden calculator, is of EUR 764*64 companies= EUR 48 896 for a reporting twice per year for all concerned companies in the EU (rounded up at EUR 49 000).

Cost of company risk preparedness

The costs induced on companies for their risk preparedness do not consider obligations linked to building of strategic stocks or of diversification, given that companies retain the possibility of explaining why they are not able to comply with the obligation.

The costs therefore concern the conduct of a stress test to ensure the resilience of their value chains, for those who use strategic raw materials as an input for the manufacturing of technologies in key sectors (hence excluding the extractive industry but includes the processing industry). The NACE costs concern for this assessment are:

- 24.41 - Precious metals production
- 24.42 - Aluminium production
- 24.44 - Copper production
- 24.45 - Other non-ferrous metal production
- 26.11 - Manufacture of electronic components
- 27.11 - Manufacture of electric motors, generators and transformers
- 27.12 - Manufacture of electricity distribution and control apparatus
- 27.20 - Manufacture of batteries and accumulators
- 28.11 - Manufacture of engines and turbines, except aircraft, vehicle and cycle engines
- 30.30 - Manufacture of air and spacecraft and related machinery
- 30.40 - Manufacture of military fighting vehicles

Eurostat simulation then provides for around 193 companies corresponding to those NACE code (up to one decimal place) with above 250 employees in 2021 in the EU (Statistics | Eurostat (europa.eu))

If those companies do not use any of the strategic raw materials in their consumption, they would be exempted from any obligation under those pillars.

Adjustment costs for companies to operate a similar risk management system could amount to EUR 5/000 for large companies (according to the CCSD impact assessment142) Based on that, we could take the following assumptions for the whole single market: EUR 5.000 X 193 = EUR 965.000 per year in the EU (rounded up at EUR 1 million).

Administrative costs for companies to report on such a risk management system to their Member States every 2 years would be the following: 193 x 8 hours of work x 47.8 (average hourly wage for senior officials and managers) = EUR 75.347 every two years, EUR 37.673 per year in the EU (rounded up at EUR 38.000).

Pillar D

Cost for exploration obligations

The figures developed as regards the costs induced on Member States by the **exploration obligations** rely on the inside analysis of the Commission based on the assessment of costs of ongoing projects (in the EU or world bank projects) which were expanded to cover the EU as a whole.

Pillar E

For the assessment impacts related to the **support to the value chain** (pillar G), the following assumptions were made:

Number of Strategic Projects (SPs)

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The number of SPs used for the assessment of impacts was based on estimation of the number of strategic materials for which projects are needed, the targets for the different value chain stages included under Pillar B, and the average contribution of a project to meeting those targets:

- Based on current information on projected supply-demand gaps and the needs of strategic sectors, the number of strategic raw materials (SRM) is, from now until 2030, estimated to be within the 10-15 range;

- Pillar B provides that the Board will propose to the Commission EU capacity targets (expressed percentage of EU needs covered by EU capacities) per SRM and stage of the value chain. For this calculation, it is assumed that those targets will have a 2030 horizon and will on average require a capacity increase of 20 percentage points (given the targets of 10% for extraction and recycling capacity, the target;

- To estimate the average contribution of SPs to this increase, we took lithium as a proxy.[143] The expected annual capacity of lithium extraction projects can be up to 20,000 tonnes lithium carbonate equivalent (LCE), which represents roughly 5% of EU needs in 2030. Oftentimes, an extraction project is linked to a single refining project. From a permitting point of view these are then viewed as two distinct projects. Based on this, it is assumed that a single SP will on average contribute 5 percentage point in terms of capacity.

Based on these estimations, it is therefore assumed that per material we need 4 projects per step of the value chain to realise a 20 percentage points increase. Taking into account three steps of the value chain (i.e. extraction (including mineral processing), refining and recycling), this equal 12 projects per material). The overall amount of SPs is estimated at 120-180 (or 24-36 per year, if the proposal enters into force in 2025).

Benefits of Strategic Projects

Based on planned or currently existing facilities in the EU (Spain, Finland, Sweden) and equivalent economies worldwide (i.e., US - Bureau of Labor Statistics), it is expected that:

-Each strategic project in extraction will bring individually 200 new jobs with an employment multiplier of 4.7 for indirect jobs (supplier jobs and induced jobs).

-Each strategic project in refining will bring 180 new jobs with an employment multiplier of 4.8 for indirect jobs.

-Each strategic project in recycling will bring 100 jobs with an employment multiplier of 4.8 for indirect jobs

The overall impact of strategic projects on employment would be ranging from 110 000 to 165 000 direct and indirect jobs.

For direct jobs, the lower estimate that is proposed is: 24 projects per year (see above) X (200+180+100)/3 = 3 840 potential direct job per year – assuming the projects would not have happened without dedicated support. However, it is worth noting that these projects might help to

[143] Lithium is one of the materials with highest expected demand increases in absolute and relative terms, and levels of contribution of single projects can be assumed to be relatively and safely taking as a proxy.

secure or develop a significant number of employments in the downstream industry. The last Raw Material Scoreboard of the European Commission (2020) indicates the mining and quarrying industry in the EU represents 280 000 employments (for a 4,8 B€ added value) but help to support 2 million employments and EUR 120 billion of added value in the relevant raw manufacturing sector.

Pillar H

For the costs of the measures related to **the environmental footprint** (pillar H) the following assumptions were made:

Number of relevant environmental profiles

For the number of CRMs with separate environmental profiles ('types') potentially sold on the EU market, we made assumptions based on the example of the global market for lithium. It is assumed that all types are potentially sold in the EU. There are currently less than 20 active mining operations for lithium.[144] Given the sharp increase in demand for lithium and ongoing exploration, the amount of active mines is expected to increase at least 5-fold toward 2030 to roughly 100 active operations (also including new recycling operations).[145] Given that primary lithium originating from a specific operation is usually going to the same refinery (often attached to the site) and that there are generally less refineries than active mines, it can be assumed that there as many relevant types as there are mining operations.

In the absence of detailed information per materials, this number is taken as a proxy for other CRMs such as REEs and PGMs with strategic applications (both of which currently have a lower amount of operations than lithium), for which the number of operations is also expected to grow sharply from a low base. Assuming that the Commission will, towards 2030, develop 10 sets of calculation rules (through implementing act) for different CRMs (NB: a single CRM might require different calculation rules for different sub-categories e.g. neodymium is a sub-category of REE), this means that there would be roughly 1000 relevant profiles.

Cost of using a recognised certification scheme

There is no statistical info available for the amount of environmental claims made in a B2B context. For the share of companies making B2B claims for CRMs, we therefore developed an assumption starting from a survey with SMEs that included environmental information provided in a B2B context[146]. Among the SMEs responding to the survey (600), 20% declared to communicate on environmental performance in a B2B context. Assuming that the share of large companies communicating in a B2B context is higher, we assume that 25% of such companies will make environmental claims. Taking a conservative approach, it is assumed all of these claims include also general claims. Based on the number of relevant profiles, this translates into 250 relevant claims.

Based on the only currently available price example[147], certification for the mining stage is expected to be a one-off cost of between EUR 10.000 and 30.000, depending on the size of the operation. For some of the CRMs that are placed on the market with a general claim, there will have been other steps involved, for example processing or refining. Considering that many more

[144] Mineral Commodity Summaries 2022 - Lithium (usgs.gov), U.S. Geological Survey, Mineral Commodity Summaries, January 2022.
[145] See e.g. Almost 400 new mines needed to meet future EV battery demand, data finds - TechInformed for a more conservative.
[146] *Assessment of different communication vehicles for providing Environmental Footprint information*, London School of Economics for DG Environment, 2018.
[147] See IRMA Certification Fee Policy_May2021 (responsiblemining.net).

potential impacts and a larger land area is associated with mining, the additional cost of additional value chain stages in the certification is assumed to be 50% compared to only considering mining. The cost is therefore assumed at between EUR 15.000 and 40.000. It is conservatively assumed that all CRMs for which general claims are made are processed materials. The cost associated would therefore be in the range of EUR 3.75 – 10 million.

Cost of conducting a PEF study based on harmonised calculation rules

The harmonised calculation rules to be provided would resemble closely the function of PEF Category Rules (PEFCR) and the cost can thus be assumed to be the same at the cost of conducting a PEF study based on a PEFCR[148]. Considering the assumptions above regarding the amount of active operation and integration of refining, it is assumed that most companies will a single or several PEF studies, and potential economies of scale are not taken into account.

Expert cost: consultants / experts are charging on average EUR 15.000 for a single PEF study. This cost is identical whether the company uses in-house expertise or a contractor. If the life cycle model of the applicable representative product (RP) is available in a simple-to-use software, this halves costs, as there is no need to adjust the otherwise available RP model in a generic life cycle assessment (LCA). This results in more efficient data input and less need for senior expertise.

Flanking measures such as making availability of simplified calculation tools can reduce the cost for a single study in line with the license cost (known license costs in the range of EUR 1.500 – 2.000, unless the tools would be used as part of an external expert support contract and then be factored in substantially cheaper, as the license would be used by the expert for many studies per year – see more below). Taking a conservative approach, we assume a tool is not available.

When assessing related expert costs, we consider that license fees are paid per user and for a year (EUR 5.000 one-time cost); and the number of studies that the expert can do in a year using that license, with an expert cost of €1,000/man-day. The cost per use is on average EUR 50 per study. This results in overall study expert cost of **EUR 7.550** (€15.000*50%+€50).

Data collection costs (both in-house and secondary data from data suppliers) are estimated based on the expected effort of data collection. This is estimated to take approximately 5 person-days, i.e. EUR 5.000 for a single PEF study. The costs for collection of data might be further cut down through an automatic collection system; we have however no available data in this regard. Furthermore, the expertise might vary depending on the data to be gathered. We are using a conservative estimate, which might be over-estimated.

Based on information from several consultants, the cost of supplier-specific datasets or datasets for missing materials is on average EUR 5.000 per dataset. As to the secondary EF datasets, these are assumed to be free of charge (same as currently and under all sub-options). The data collection costs are therefore estimated to EUR **5,000** per study.

Verification costs for a single-product PEF can be estimated at approximately **€2,000,** based on input from practitioners.

The total cost for conducting a PEF study based on a PEFCR for a single CRM type is therefore estimated to **EUR 14,550** (€7.550+€5.000+€2.000).

The cost associated would therefore be **EUR 14.55 million** (1000 *14.550).

[148] The text is closely based on DG ENV analysis and assumption in the context of the green claims initiative.

Relative burden on footprint cost for platinum[149]

The EU demand for platinum is 64 tonnes compared to world production of 178 tonnes (roughly 36%). As the global market value of this production is 5.8 billion, the EU market value is estimated at 0.36 x 5.8 billion, I.e. roughly EUR 2.1 billion.

As the cost for 10 CRMs was estimated above at 14.55 million, the assumed percentage of the footprint cost is 2.1 billion / 1.45 million, equalling roughly 0.07%.

ANNEX 5: OVERVIEW OF POLICY APPROACHES

9.1.1. Pillar A – Defining critical and strategic raw materials

At EU level, the Commission currently performs the criticality assessment (described in detail below) and conducts a foresight exercise on critical raw materials used in strategic sectors and technologies. These exercises and the data provided serve to raise awareness for raw materials supply risks among companies, the research community and the wider public, and the list of critical raw materials is used in the Commission's policymaking process, notably to prioritise support to research and innovation under Horizon Europe and to direct international engagement, including in the negotiation of free trade agreements. However, the list of critical raw materials currently does not have legal status and only limited implications. The foresight exercise meanwhile is currently limited to projecting demand for critical raw materials in strategic sectors and does not allow to identify which raw materials may become critical in the future or otherwise pose risks not reflected in the backward-looking criticality assessment; it also currently does not have any legal or policy implications.

9.1.1.1. Approach 1: Legal definition of critical raw materials, based on the current criticality assessment methodology and covering the whole EU economy

This approach would consist in defining the scope of the regulation and all its measures based on the current criticality assessment methodology. The methodology covers a wide range of economic sectors and would continue to rely on the criteria:

- economic importance (EI), based on the value added of corresponding EU manufacturing sectors and corrected by a substitution index; and
- supply risk (SR), based on supply concentration (at global and EU level, weighted by a governance performance index) corrected by recycling and substitution parameters.

Raw materials exceeding the thresholds set for both criteria are considered at high risk of supply disruption (based on their supply concentration, weighted with governance indicators) and of high economic importance, and would therefore be defined as critical.

The data would continue to be provided by an established process within the European Commission (GROW, JRC), using historical and stakeholder-validated data (from the last 5 available years) from official statistics and data providers. The criticality assessment has served as a basis for the EU List of critical raw materials updated every 3 years since 2011.

[149] Figures taken from the Commission factsheet on criticality for the 2020 CRM list, p. 415.

In the past, the lists' relevance has proven to be valid for the following 3-5 years and has been a useful tool for directing investment across the EU, raising awareness of strategic dependencies in industry, informing the EU trade policy and focusing international partners on our needs, but also in development of the EU legislation. The assessment vastly improved the Commission's intelligence on a wide range of raw materials and informed general and professional public.

The Commission has performed the 5th criticality assessment for the EU on 87 screened raw materials. Compared to the list of 30 CRMs in 2020, the 2023 list qualifies 34 CRMs as critical, moving above the threshold: Arsenic, Feldspar, Helium, Manganese, Copper and Nickel while natural rubber and indium move out of the list. From the new screened materials, none of them have been considered critical. Approach 2: Legal definition of only strategic raw materials based on multi-criteria analysis including supply and demand foresight and relevance for strategic applications.

*9.1.1.2. **Approach 2:** Legal definition of only strategic raw materials based on multi-criteria analysis including supply and demand foresight and relevance for strategic applications*

Under this approach, a new concept of "strategic raw materials" would be introduced. This concept would take into account better the foresight perspective, and provide a stronger focus on applications considered strategics, such as renewable energy, electric mobility, aerospace and defence, digital or medical technologies. The list of raw materials identified as strategic would be enshrined into law and set a narrow scope for the measures proposed under this initiative. It would be shorter than the current list of critical raw materials and would likely overlap with it, but not fully be a subset as some raw materials that are strategically important and likely to face future supply challenges are currently too diversified to pass the supply risk threshold of the criticality assessment.

The methodology to define strategic raw materials would build on the data collected for the criticality assessment but apply also more subjective/qualitative factors, notably relevance for strategic applications and forecasted demand growth. It would be applied to the full set of assessed raw materials, not only the ones currently identified as critical. As this would be a new concept and as important data has yet to be gathered, the exact methodology is not yet defined, but the following is a list of the factors considered for inclusion:

- Relevance for strategic sectors and technologies:
    - The strategic sectors and technologies would be renewable energies and e-mobility (lithium batteries, hydrogen electrolysers, fuel cells, electric motors, wind energy, photovoltaics) as well as aerospace and defence, digital and medical technologies.
    - The joint foresight report of JRC and GROW (in preparation) on "Supply chain and future demands analysis of strategic technologies and sectors in the EU" should serve as the base for identifying the raw materials for the selected technologies.
    - Proposed indicator: count of high relevance of each raw material to selected technologies, e.g. 9 for Copper, 2 for PGMs (platinum and iridium), according to preliminary calculations.
- Future supply and demand forecasts for 2030:
    - Global Demand 2030/2020: ratio between the forecasted future global demand (2030) and current reported demand (2020), from various sources.
    - Global Demand-Supply Gap 2030 (in tonnes): difference between the forecasted future global demand (2030) and future supply (2030) , from various sources.

- Future EU demand (2030): based on the joint foresight report of JRC and GROW (in preparation) on "Supply chain and future demands analysis of strategic technologies and sectors in the EU".

- Production volumes:
  - Rationale: Given the widely different market sizes of critical raw materials production, ramping up production to meet rising demand is more challenging for larger-volume raw materials, where e.g. increasing supply by 10% requires several mega-mines to be opened, whereas increasing demand for smaller-volume materials can be satisfied by just one medium-sized mine, or even just by introducing an additional processing step on an existing site in the case of by-products contained in carrier raw materials (e.g. gallium as a by-product of aluminium production). A logarithmic measure would be used to capture the variation in orders of magnitude.
- Other potential factors:
  - Supply risk (SR) parameter from the current criticality methodology
  - Import Reliance (IR) parameter from the current criticality methodology
  - Form of production: main product/co-product/by-product. By-products face higher supply risks than main products or co-products, for example if the main material production stops (Aluminium/Gallium, Copper/Cobalt) or the price of the by-product does not justify an expensive separation (Indium or Germanium from Zinc, Rare earths from Iron ore).
  - Reserves: economically extractable geological resources in tonnes. Main source is USGS, but data is not available for all minerals and metals.

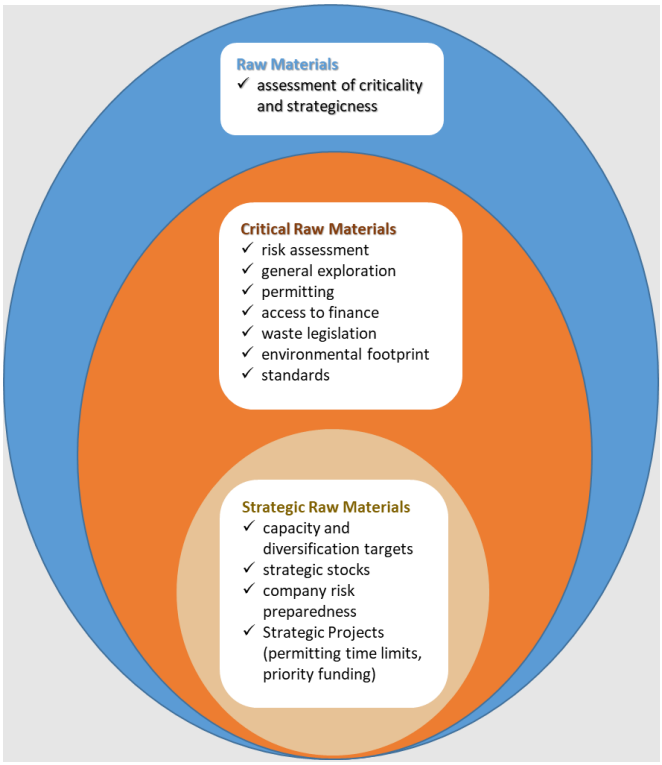
- A governance structure (cf. Pillar C) would monitor a full list of non-energy, non-agricultural raw materials, compiling databases (annually) on current EU production, imports, exports, consumption, recycling etc. for all raw materials. It would also identify which applications are (or will be) dependent on the availability of the raw materials. It would conduct foresight at different time horizons on EU and global demand and supply of all RMs (taking into account different technological scenarios and material efficiency/substitution possibilities, e.g. by assigning probability weights to the scenarios; for supply, taking into account current production and announced new projects). This would be coordinated closely with/via the EC's RMIS, as part of the EC's operational capacity. The gathered information would be made available to the Advisory Group of the Single Market Emergency Instrument.

It is expected that following this methodology, approximatively between. 10-15 strategic raw materials would be identified.

9.1.1.3. Approach 3: Legal definition of both critical and strategic raw materials, with concentric circles of policy measures' scope

Under this approach, both of the concepts/lists described above would be given legal status. The list of critical raw materials identified based on the above-described criticality assessment would be amended to include all strategic raw materials identified based on the above-described multi-criteria assessment, such that strategic raw materials would be a subset of critical raw materials. The thus slightly enlarged list of critical raw materials would define the overall scope of the Critical Raw Materials Act, providing for actions related to monitoring, exploration, recycling or carbon footprint, while the most costly or ambitious measures (such as stockpiling coordination and streamlined permitting and priority funding access) would only apply to the shorter list of strategic raw materials. The figure below shows this visually and Annex 9 provides a detailed overview of the scope for each pillar.

The following figure maps the measures described under other pillars against the set of all screened raw materials, critical raw materials and strategic raw materials:



To operationalise this approach, the following would apply:

- The proposal should include an empowerment for the Commission to adopt delegated acts regularly updating the list of critical and strategic raw materials, specifying the frequency of such an update (e.g. every 3 or 5 years[150], with the possibility of an ad hoc update when deemed necessary);
- The methodology to be used by the Commission when updating the list of critical and strategic raw materials should be specified in the legal proposal, as well as the potential revision of the methodology.
- A governance structure [see pillar C] would monitor a full list of mineral and metal raw materials, compiling databases (annually) on current EU production, imports, exports, consumption, recycling etc. for all raw materials. It would also identify which applications are (or will be) dependent on the availability of the raw materials. It would conduct foresight at different time horizons on EU and global demand and supply of all RMs (taking into account different technological scenarios and material efficiency/substitution possibilities, e.g. by assigning probability weights to the scenarios; for supply, taking into account current production and announced new projects). This would be coordinated closely with/via the EC's RMIS, as part of the EC's operational capacity.
- A first list of critical and strategic raw materials should be included in an Annex to the legal proposal.

Discarded approaches: Approach 1 is discarded at an early stage, as it would not provide sufficient focus for more ambitious measures (e.g. strategic stocks, streamlined permitting and

[150] Note: The European Parliament, in its November 2021 Resolution on "A European strategy for critical raw materials" asked for 2 years, but this would decrease stability of the list for investors. DG GROW experience shows that 3-5 years would be optimal.

financing support for Strategic Projects) and thus apply them too broadly. Also, the critical raw materials list would continue not to include such important raw materials as copper, nickel or aluminium that do not pass the supply risk threshold in the backward-looking criticality assessment but are essential for the green transition and face significant supply challenges (see chapters 2.1.1.1 and 2.1.1.2).

Approach 2, namely limiting the scope of the entire initiative to a new, shorter of strategic raw materials, is discarded at an early stage, as it would mean that no legal status would be given to the list of critical raw materials and as such not even "lighter" measures such as an early-warning system, targeted exploration or recycling targets could apply to the non-strategic critical materials, despite their identified supply risk and overall economic importance. Introducing a new concept with legal consequences while maintaining a non-regulatory criticality assessment would also likely overshadow the latter and could thus undermine the credibility of the criticality exercise developed over the last 10 years, and exclude non-strategic but economically important sectors (e.g. construction, chemicals, manufacturing).

9.1.2. Pillar B – Setting strategic raw materials targets

9.1.2.1. Approach 1: Developing a framework to set EU-level guiding targets for strategic raw materials regarding capacity

First, this approach would set **headline targets** for the development of EU capacity per strategic raw material by 2030, e.g. the EU is able to meet 30% of its needs for a specific strategic raw material by 2030. Headline targets would be set specifically for strategic raw materials for which the investment needs and potential capacities are more clearly identified, e.g. lithium and rare earths.

Then, to achieve such headline targets, more specific **value chain targets** would be set, where appropriate, for the following stages of the value chain:

- Extraction, e.g.: by 2030, at least X% of EU demand for primary raw materials should come from European sources, comprising Overseas countries and territories of EU Member States and EEA countries.
- Refining, e.g.: by 2030, at least X% of EU demand for processed materials should be covered by European sources.
- Recycling, e.g.: by 2030 and by 2050, the EU should cover at least X% of its total demand through its own secondary production.

In terms of time horizon, the first value chain targets would be set for 2030, and would have to be announced within one year of entry into force of the regulation. In 2030, following an assessment by the governance structure, new targets would be set for 2040, and similarly for 2050.

When set, the value chain targets would have to take into account:

- Existing EU targets for the deployment of EU renewable energy (Renewable Energy Directive), as it drives the need for green technologies containing strategic raw materials. SRM needs created by defence or digital strategies would also be taken into account.
- Existing recycling targets (recycled content or waste recovery), which could drive the EU's ability to meet EU recycling capacity targets (e.g., in the Batteries regulation

- The geological endowment of Member States and the EU as a whole, as reported in pillar D, for the setting of extraction targets, taking into account the feasibility studies operated by private or public bodies.
- The industrial capacity of Member States and the EU as a whole so as to determine refining/processing and recycling targets.
- The existing and planned projects pipelines, as reported by the relevant industrial alliances as well as by the Member States to the governance structure.
- The expected growth of EU demand for the strategic raw materials on which targets are set.
- The concentration of global supply for the strategic raw material.

Though the exact level of targets to be defined would be adopted by the process described below, it is useful to estimate preliminary size of such targets for the purpose of this impact assessment. Examples of target levels could include:

- As a headline figures, the European Raw Materials Alliance has identified a pipeline of projects that would ensure 20% of EU demand in rare earth permanent magnets by 2030;
- Other investment cases from ERMA assess the possibility of reaching 20 to 60% of EU sourcing for some materials;
- Other stakeholders assess that:
  - For raw materials likely to become strategic, 50% of EU sourcing is achievable for the refining stage, and 25% for the extraction stage, with the exception of some materials (depending on geological endowment), based on the data provided by some studies[151;]
  - Higher targets (up to 75% of EU sourcing) could be achieved for the recycling of materials by 2030 provided the materials are already well integrated in the recycling and industrial capacity loops;
- For battery raw materials, the investment needs of the existing projects pipeline could cover 20% of EU demand with EU sourcing by 2030, and attain higher level by 2040/2050. Some stakeholders foresee possible targets based on the existing pipeline, e.g. for processed lithium, 50 to 60% of EU needs could be covered by 2030.

The mechanism to set target would be the following: the governance structure would propose to the Commission value chain targets for all strategic raw materials, 1 year after entry into force of the regulation, based on the first reporting of Member States to the governance of their 1) mineral resources (pillar F) and 2) project potential in their territory along the value chain (Pillar G) and 3) project potential in third countries, with the help of ERMA and EBA. The Commission would take note of the proposals from the governance structure, which would hold a strategic meeting on how to ensure the application of these targets, notably in the selection of Strategic Projects in or outside the EU. When a new strategic raw material is identified, the governance structure would meet to define its target.

9.1.2.2. Approach 2: Setting EU-level targets obliging the governance structure to work toward them through Strategic Projects proposals (cf. pillar E) and performance review

Conversely to approach 1, the targets would be directly set in the Regulation, at different value chain stages. They would be aspirational targets, with a double role:

[151] KU Leuven, Metals for Clean Energy - Pathways to solving Europe's raw materials challenge, 2021

1) Provide a common objective for public policies and private actors to work toward their achievement;
2) Serve as a criteria for the selection of Strategic Projects, which would have to demonstrate that their future output will serve to develop such targets.

The target levels would be formulated with headline figures, and would ensure that, for each strategic raw material and by 2030,

- Union extraction capacity is able to extract the materials needed to cover at least X % of Union's annual consumption of refined materials, to the extent that the Union's known reserves allow for this;
- Union refining capacity is able to refine at least X % of the Union's annual consumption of refined materials;
- Union recycling capacity is able to produce secondary materials covering at least X % of Union's annual consumption of refined materials;

The level of such targets is coherent with the estimate of stakeholders and with the potential projects pipeline. Targets for extraction would need to take into account the geological resources available and the economic feasibility of extraction. When setting those targets, it is worth noting that they refer to EU annual consumption in 2030, which is set to increase for most materials concerned, thereby requiring additional EU efforts for meeting them.

In addition, compared to approach 1, the Commission would have a formal role in tracking progress towards the targets, based notably on the state of exploration of national resources of critical raw materials; on the advancement of Strategic Projects (cf. Pillar E), and on whether their development is impeded by specific factors, notably permitting bottlenecks, lack of investment, etc.

If it is apparent that EU capacities are not developing sufficiently to meet the EU-wide targets, the Commission would assess the necessity for adopting new measures.

9.1.2.3. Approach 3: Setting national targets in the regulation for strategic raw materials based on national resources and existing capacities

Under this approach, Member States would be imposed country specific targets at different value chain stages for strategic raw materials with a view to decrease the vulnerabilities and to increase the resilience, after the governance structure's initial assessment of their industrial capacity and mineral resources. Those targets would be adopted through delegated act. The Commission would jointly agree, no less than 6 months after the first 2030 review, on a set of measures to unlock the Member State's potential and contribution to achieving the targets.

If, in a subsequent review of the Member State's performance 2 years after the first review, no further progress has been made, the Commission should assess the origin of this lack, notably to determine the origin of it. In the event where permitting bottlenecks are the concern, the Member State would be compelled to review its permitting procedures and allocate sufficient resources to the public authorities in charge.

Discarded approach: Approach 3 is discarded early as it is perceived as too intrusive for Member States, which remain the responsible authority for their mineral resources. This approach would therefore not respect necessary standards of subsidiarity. In addition, Member States do not have the same level of same mineral resources and of industrial capacity. While national targets would have to take into account such differences, they would also place an uneven burden on some Member States compared to others.

9.1.3. Pillar C – Governance structure

This pillar seeks to enable the EU to increase its ability to foresee and mitigate structural supply shocks before they materialise, notably by enabling Member States and companies to build up their resilience through appropriate tools. The scope, depth, speed and efficiency of such tools are inherently linked to the governance structure that would be charged with carrying out the tasks specified in the subsequent (sub)pillars (C.1, C.2, C.3) on monitoring and risk-assessment, strategic stocks and risk preparedness. Therefore, the approaches proposed are bundled together as part of options 1, 2 and 3, and the resources are adapted according to the scope of the tasks proposed.

9.1.3.1. Approach 1: Tasking expert groups RMSG and EIP on raw materials to carry out tasks on monitoring and risk assessment

Under this approach, the Commission would rely on its existing expert groups (RMSG, EIP on RM) to develop relevant tasks on monitoring and risk assessment. The relevant experts would meet at technical level fora focusing discussion and exchanges on structural issues pertaining to the critical raw materials value chain, providing advice to the Commission on different pillars, e.g., on the definition of critical and strategic raw materials, on the establishment of dedicated targets, on the state of supply chains of critical raw materials, on strategies that companies could develop to mitigate supply risks and on strategies that Member States could adopt with regards to strategic stockpiling. Such exchanges would support the Commission in its work on critical raw materials act and the gathered information would also be made available to the governance structures of vigilance and crisis management mechanisms dealing with raw materials..

9.1.3.2. Approach 2: Developing a dedicated EU CRM board supported by a network of national agencies and operational capacity [within the Commission]

Under this approach, the Commission would propose to set up a EU CRM board composed by representatives of Member States and the Commission. This board would be in charge of building on the existing resources within the Commission and Member States administration to carry out the tasks described in the subsequent pillars (C1, C2, C3). Based on the contributions of the actors below, the board would issue advice to the Commission on particular actions, such as on defining strategic raw materials and setting targets for them on EU supply capacity and EU diversification, as well as on building up strategic stocks, and on proposing Strategic Projects (as per pillar G and K). The board would adopt its rules of procedure at its first meeting and the Commission would provide a common secretariat for the board and the network described below.

For tasks pertaining to the definition of strategic raw materials and their targets, as well as regular market monitoring and forecasting for the selected raw materials, the board would rely on the secretariat with intelligence capacity and a network of national agencies established by the regulation. Member States would appoint representatives from the relevant authorities, and their national intelligence or other relevant raw materials agencies. In the event where a Member State would not have a national supply and intelligence agency on critical raw materials or equivalent, it would nominate a representative from the authority in charge of geological or mineral resources. The Member State would also be encouraged to gather the necessary resources for assessing its own territories and developing its expertise in the sector.

For those tasks, the board would also be able to consult relevant expert groups, such as the EIP on RM or the RMSG, to ensure that civil society, industrial stakeholders, including SMEs, and NGOs are heard in the relevant discussions. For the tasks pertaining to the building of strategic stocks and corresponding obligations, the board would have to convene Member States' authorities or

agencies in charge of emergency and stocks, which are different from the supply and intelligence agencies mentioned above.

For tasks pertaining to the selection of Strategic Projects and to the definition of strategic raw materials and their targets, the board would also be able to consult industrial alliances for raw materials (ERMA) or batteries (EBA), which would notably contribute to the identification of investment needs or potential Strategic Projects alongside Member States, as well as the different geological surveys and the relevant permitting authorities. Tasks linked to raw materials value chains knowledge would interact with the EC's RMIS.

The board would also be able to invite to dedicated meetings third parties from EEA countries, neighbourhood countries or countries having a Strategic Partnership on raw materials or an FTA with a chapter on raw materials; or relevant international organisations. In such case, the meeting would be dedicated to the assessment of a Strategic Project in a third country and how to best support it; or any other matter related to the international dimension of diversification and of the critical and strategic raw materials value chain, notably in cooperation with the Global Gateway governance. The board would also ensure the exchange of information, cooperation and coordination with the relevant governance bodies that deal with the vigilance and crisis response for raw materials. To support the operative tasks described above and in the subsequent sub-pillar, the board would still rely on the expertise of the European Commission, whose resources would be adapted to the scope and depth of such tasks.

9.1.3.3. Approach 3: Developing an operational capacity as a separate structure to implement the CRM Act's provisions

This approach would consist of creating a full-fledged operational capacity on critical raw materials, that is external to the Commission itself and is set on a permanent basis rather than relying on regular cooperation of Member States and European capacities as provided by the board and network under approach 2.

There are different formats that this operational capacity could take, such as the creation of a dedicated decentralised EU agency on critical raw materials or the creation of a dedicated directorate on critical raw materials in an existing agency. These different formats are however not analysed separately in detail as it is assessed that the costs and efficiency would only marginally differ from one to another (as demonstrated by the impact assessment relative to the creation of a European Labour Authority[152].

Alike the board defined in approach 2, this operational capacity would be able to rely on the expertise of existing expert groups, industrial alliances, Member States representatives and agencies, etc., but it would be able to carry out the tasks determined above independently, though in coordination so as to avoid overlaps.

The operational capacity would ensure the exchange of information, cooperation and coordination with the relevant governance bodies that deal with the vigilance and crisis response for raw materials.

The tasks that the operational capacity would carry out are spelled out in subsequent pillars but would also include the definition of strategic and critical raw materials and corresponding targets, the development of monitoring, risks assessment and stockpiling capacities as well as the selection

[152] Impact assessment report - SWD(2018)68 p56, table 4

of strategic projects. Although the tasks are similar to those proposed for the board (approach 2), they would here be wider in scope and depth.

Discarded approach: Approach 1 is discarded, as in comparison with the two approaches developed afterward, it does not provide for substantial additional benefits and does not allow to tackle the problem drivers. Indeed, the format of expert groups favour the development of an inclusive discussion, with a wide set of stakeholders, but does not allow for the development of an operational capacity capable of carrying out the tasks. Consequently, adding new tasks to the existing expert groups would not differ substantially from the baseline scenario. It is therefore proposed that only the approaches 2 and 3 of the subsequent pillars (C1, C2, C3) are analysed, considering the need to align the scope of the tasks with the resources provided by the governance structure. This is why no approach 1 is mentioned for these pillars.

9.1.4. Pillar C.1 Monitoring and risk assessment

9.1.4.1. Approach 2: Developing monitoring capacities and risk assessment

This approach would define precise monitoring tasks that would be carried out by the EU CRM board (i.e. the governance structure set out in approach 2 of Pillar C). The approaches 2 and 3 develop a more comprehensive and permanent framework dedicated to critical and strategic raw materials, ahead of crisis, while taking the instruments proposed in the SMEI into account (c.f., early warning mechanism, in approach 2).

Scope: With the support of the Commission, the board, with the support of the network, would develop a **market monitoring capacity** related to the critical raw materials industrial value chain, focussing on risks that may disrupt, compromise or negatively affect the supply of critical raw materials. This work would contain an element of foresight and a focus on strategic applications of the materials monitored. The scope of such work would comprise both the state of supply chains within the internal market and in the global value chain, taking due considerations of the evolution of trade flows as well. It would also ensure a regular annual intake of information to ensure coordination across Member States with regards to different stages of the CRM value chain.

Such EU-wide capacity is supported by stakeholders, with 177 (68 %) out of 259 respondents agreeing or strongly agreeing that a dedicated EU-wide governance capacity tasked with monitoring actions would benefit the EU CRM value chain.

Means and actions: Through the network, the board would ensure to the best extent possible the **coordination** of research activities of national agencies on a specific material or value chain and the subsequent knowledge sharing amongst them in order to avoid overlap and gain added value in depth and knowledge. To develop such capacity, there is a parallel need to ensure **information sharing** from Member States and companies operating in the CRM value chain.

First, Member States would have an obligation to report at least annually to the governance structure on the following topics:

- The state of exploration, extraction, processing and recycling projects in the UNFC format (NB: such reporting is also partially accounted for in pillar D on exploration; the costs for such reporting are therefore not accounted for under this pillar).
- A risk assessment of their domestic CRM value chain as reported by their own analysis and by surveying large companies operating in their country in such value chain, for which the burden would be limited to a minimum;

Second, companies operating in a critical raw materials value chain or smaller companies would be surveyed on a voluntary basis by the Commission through external support. All information gathered would have to be treated in full confidentiality and with appropriate level of security, as established by the governance structure, and should be aggregated in order not to display sensitive commercial information or information affecting security and public order.

Deliverables:

- First, this monitoring would feed into the determination of critical and strategic raw materials, that the Board would propose to the Commission (c.f. Pillar A) and would better inform subsequent policy decisions.

Second, this monitoring capacity would be used to publish more regular information on monitoring through the publication of regular reports on the state of critical and strategic raw materials supply chain (a monitoring dashboard), with the main risks outlined to companies so that they can best adapt their resilience strategies. Such work could also be useful to support the screening of foreign direct investment: the assessment of whether an acquisition is problematic or not becomes more apparent after a relevant mapping of the value chain.

Third, to the extent possible in terms of resources, the Commission would develop and run**stress test of strategic raw materials value chain** to estimate the likelihood and impacts of a future disruption (model-based, scenario-based, exercises with participating companies). Such stress test would be developed based on the following stages: select the strategic raw materials for study, estimate risks per different scenario, incorporate supply and demand forecasts and potential gaps, determine materials necessary for finished goods / services, apply market responses to shortage or shock, analyse shortfall risk to the strategic sectors and the whole economy, identify mitigation options and assess their feasibility to prioritize them. To ensure that the stress tests can cover at least each strategic raw materials every three year, the Commission would ensure that the coordination of joint or complementary research by existing national agencies in the network. The results of those stress tests would be commonly published and made publicly available, for instance on the monitoring dashboard, to ensure that it benefits economic operators.

Under this approach, no dedicated CRM early warning mechanism would be developed, since the mechanism developed in the proposed SMEI (Article 8) could cover critical or strategic raw materials in the contingency planning framework. The mechanism allows for the notification of a Member State to the Commission of any incidents that significantly disrupt or have the potential to significantly disrupt the functioning of the Single Market and its supply chains (significant incidents). The information and intelligence gathered under this approach would however feed in the governance structure and Member States, which could then be used for this SMEI's *Ad hoc alerts for early warning.* With due consideration for the SMEI mechanism, this approach would still have to ensure that the different actors in place (Commission, CRM Board, Member States, governance bodies of SMEI, CHIPS Act or HERA) are informed whenever the monitoring provisions would lead to the assessment of a potential risk to the EU supply.

9.1.4.2. Approach 3: Developing monitoring and risk management capacities

In addition to the monitoring and general risk assessment provided by approach 2, this approach would ensure the development of targeted risk assessment as well as of risk management tools, thereby supporting the resilience of European companies.

Means and actions: Targeted risk assessment would be carried out by the operational capacity (cf. approach 3 of Pillar C) which would:

- **Conduct real time monitoring** of the CRM value chain (screening of news reports, business intelligence, high-frequency customs data), using those data to determine the monitoring dashboard described above.
- **Conduct direct stress tests** on strategic raw materials value chain at a more frequent pace, coordinating with Member States supply agency but with additional capacity to run them itself ;
- **Develop an Early warning mechanism (EWM)**: based on the monitoring, information gathering and stress test, the operational capacity would develop a EWM that indicate that

a strategic raw material is at risk of imminent shortage or disruptions. The definition of this mechanism should be adopted by the Commission on the advice of the operating structure within 6 months of entry into force of the regulation, and could be modified as necessary. If triggered, Member States would be informed as well as large companies that are users of SRMs; EWD results wouldhave to be made public for companies, including SMEs, to benefit from it.

- Provide direct advice to the EU industry on supply risks and sourcing of raw materials, and facilitate interactions between the raw materials suppliers and the EU end users.

In addition to the coordination and information sharing tasks mentioned in approach 2, this approach would include **information request** from large companies operating in a strategic raw materials value chain in order to ensure a higher degree of information on the state of supply chains.

9.1.5. Pillar C.3 Companies' risk preparedness

9.1.5.1. Approach 2: Developing requirements on company diversification and stockpiling

Under this approach, specific requirements would be set on companies to ensure their preparedness and resilience. Under those requirements, large companies (>250 staff) which consume strategic raw materials as a primary input for their production would have to comply with at least one of the following obligations:

1) Ensuring a diversified source of suppliers if it relies on strategic raw materials (when the market structure allows);

This should comprise a diversification both in terms of suppliers but also in terms of third countries on which the concerned EU economic operators could be dependent on for their supply. Indeed, if supply is fully concentrated in a single country but on different suppliers, it would still be at risk in the event of some form of supply risks. For instance, the energy curtailment in China that affected the country's magnesium producers simultaneously, putting EU users at risk of overall supply cut. It is certain that this diversification would have to take due account of the availability and affordability of other supply sources.

2) Ensuring a sufficient level of strategic stocks of strategic raw materials equal to 60 days of consumption;

If they cannot ensure and demonstrate their adherence to one of those measures, companies would have to then report to the Member States in which they are established explaining the reasons for their non-compliance.

Those companies would also have to develop an in-depth audit of their supply chain under the form of a stress test, to assess regularly their vulnerability under different supply scenario and the suitability of their risk mitigation strategies.

Member States would be responsible for ensuring the implementation of these obligations.

9.1.5.2. Approach 3: Developing requirements on company diversification and stockpiling while providing direct support to foster companies' resilience

This approach would contain the measures developed in approach 2. In addition, to enable large companies to meet these obligations and to support SMEs in undertaking such efforts (even if SMEs would not face those obligations), this approach provides that the operational capacity advise

companies on relevant strategies to enable them to mitigate supply chains risks. This support model could be defined in the legislation laying out the operational capacity's tasks.

Such advisory structure, inspired by the services some national agencies offer to companies, would allow for all EU companies operating across the critical raw materials value chain to benefit from direct advise.

9.1.6. Pillar C.2 Strategic stocks

9.1.6.1. Approach 2: Ensuring EU level coordination and stock assessment for the stockpiling of strategic raw materials

This approach would develop a mechanism to ensure higher coordination of strategic stockpiles amongst EU Member States, following the steps presented below.

1) After the establishment of the list of strategic raw materials, **Member States would be required to report** (with the highest level of confidentially and security) to the Commission on the organisation and on the state of their stockpiles for the strategic raw materials. Such reporting would include the strategic raw materials that are stockpiled, the stock levels compared to their industry's demands, and the planned allocation of stockpiles in the event of a shortage.

2) The Commission, with the support of the board (cf. approach 2 of Pillar C)**, would review the common state** of stockpiles and assess the potential convergences and overall levels of stockpiles across the EU, against a benchmark of what is considered as a safe level of stockpiling Where possible and relevant, the Commission would propose targeted recommendations for the Member States to reinforce its resilience on those matters.

3) A review of the state of play and implementation of the Commission's recommendation would take place regularly occur to monitor progress. The SMEI framework, including the definition of targets under the mechanism set in the vigilance mode, and the coordinated release under the Single Market emergency phase, could still apply to critical and strategic raw materials in the event of a crisis or threat; but the objective of approaches 2 and 3 is to act ahead of crisis or threat of crisis, as usually those situations are characterized by high market prices.

9.1.6.2. Approach 3: Enabling the common purchase of strategic raw materials

In addition to approach, this approach would mean that the operational capacity would foster the development of stockpiles of strategic raw materials. Based on the needs expressed by interested companies, the operational capacity (cf. approach 3 of Pillar C) would purchase through a joint procurement mechanism, appropriate quantities of strategic raw materials.

The interested companies would be financing the purchase of the stockpiles, as they are voluntary, albeit at lower costs given the fact that common purchasing would enable marginal saving. In addition, it would have to be assessed whether any financial instrument developed in pillar E.2 would be able to de-risk companies engaged in stockpiling by contributing to this mechanism.

9.1.7. Pillar D – Exploration efforts in the EU

The approaches developed below cover the early stages of the exploration activities related to mineral resources. They aim to enable further exploration activities by ensuring additional coordination or availability and reliability of data. They do not contain provisions to promote feasibility studies that occur later in the exploration process and are usually carried out by economic operators (e.g., junior miners), nor do they contain measures that would allow Member States to override any environmental legislation. However, they also include national reporting of potential

critical raw materials projects according to the United Nations Framework Classification (UNFC) for Mineral and Anthropogenic Resources in Europe. Further support to private explorations projects would rather occur within the context of Strategic Projects (approaches 2 and 3 of pillar E).

9.1.7.1. Approach 1 - Requirement on Member States to report on the mapping and evaluation of the critical raw material resources and extractive waste areas in the EU

With this approach, Member States would have to periodically report on the exploration activities carried by public entities and non-confidential information of exploration activities carried by companies, targeting critical raw materials.

This includes, but not only, existing public exploration programmes of mineral resources, targeting primary deposits (either currently or historically exploited or not) and/or secondary deposits (extractive waste of closed or abandoned facilities). Information on secondary resources should consider the volume, grades, mineralogy, technology feasibility and characteristics of the deposits, when available. The governance structure (cf. Pillar C) would have to ensure regular meetings to discuss progress of these exploration activities.

Member States would also have to periodically report, using the UNFC classification system, on results from public and private exploration activities (when available) that have already estimated mineral resources (measured, indicated or inferred) or reserves (proven or probable) according to existing national or international reporting codes.

On this basis, Member States would have to periodically report to the governance structure the state of knowledge of their critical raw materials resources, under UNFC framework when applicable, and aligned with INSPIRE.

Member States would also be encouraged to:

- Develop and implement public exploration programmes of their mineral resources contributing to the knowledge base of EU mineral resources with a focus, but not only, on critical raw materials;
- Reprocess existing geochemical and geophysical data with new and more accurate and robust algorithms;
- Develop new mineralisation models for critical raw materials;
- Develop predictability maps for critical raw materials and update them on a regular basis;
- Exchange good practices to include critical raw materials in land use policies and land use plans;
- Identify suitable areas for exploration of critical raw materials.

In addition, this approach would also encourage Member States to take due account of the occurrence of mineral resources containing critical raw materials (c.f., pillar A) when taking measures regarded to land use that might affect the exploitability of the deposits, for instance by granting it a statute of public interest, by including it in land use planning, as an information layer, or by ensuring that statutory change in land use determination from non-mining to mining can be implemented in a streamlined and time-considerable manner.

9.1.7.2. Approach 2 – Requirement on Member States to report on, develop and implement national exploration programmes for critical raw material resources and extractive waste.

Under this approach, Member States would be compelled to implement identified actions, even if the extraction or reprocessing of extractive waste is not part of their industrial or economic strategy. The development of the knowledge produced would then be available for future generations and enable the development of the EU critical raw materials value chain.

All actions under this approach would have to be revised on a regular basis in order to target the updated critical and strategic raw materials lists.

- **Develop and implement public exploration programmes**

Member States would have to develop and implement programmes for the public exploration of mineral resources. Programmes must be aligned with the list of critical raw materials but could include more raw materials based on MS specifics objectives.

The public exploration campaign would include geological mapping at a suitable scale, thematic mapping in particular hydrothermal alteration and structural maps, geochemical campaigns of soils, sediments, rocks and extractive waste, aerial geophysical surveys.

It is worth noting that these surveys would not only useful for mineral exploration but also for improving spatial land use and planning, e.g., groundwater knowledge, natural hazards mitigation or mapping natural geochemical background (a key information when dealing with environmental pollution and polluted soils).

The use of earth observation data, in particular hyperspectral and multispectral data could be included as part of the exploration programmes.

The exploration programmes would be designed with the aim of targeting undiscovered deep land deposits but also unexplored shallow deposits of critical raw materials.

The exploration programmes would include the development of new mineralisation models of critical raw materials from the most relevant mineral systems in Europe.

The acquisition and processing of the new data, and the development of new mineral models, could lead to the identification of anomalies and ultimately the discovery of new deposits, to be confirmed by feasibility studies conducted by mining operators.

The results of the implementation of the programmes would be used to estimate the potential of the EU in mineral deposits and to attract investments in private exploration.

Member States would report to the board every year on the status of those exploration programmes.

- **Reporting on critical raw material resources and extractive waste areas in the EU**

With this approach, Member States would have to periodically report on the exploration activities carried by public entities and non-confidential information of exploration activities carried out by companies, targeting critical raw materials. This includes, but not only, public exploration programmes of mineral resources, targeting primary deposits (either currently or historically exploited or not) and/or secondary deposits (extractive waste of closed or abandoned facilities). Information on secondary resources should consider the volume, grades, mineralogy, technology feasibility and characteristics of the deposits, when available.

The governance structure (defined by pillar C) would have to ensure regular meetings to discuss progress of exploration activities in the Member States.

Member States would also have to periodically (yearly) report, using the UNFC classification system, on results from public and private exploration activities (when available) that have already estimated mineral resources (measured, indicated or inferred) or reserves (proven or probable) according to existing national or international reporting codes.

Member States would not have to use the UNFC to report results on early-stage exploration projects that include identification of mineral occurrences or areas with mineral potential.

- **Reprocessing existing geochemical and geophysical data sets**

Member States, in particular Geological Surveys and mining authorities, hold substantial repositories of raw geochemical and geophysical data from past public exploration campaigns or acquired in the context of past exploration permits. This data, together with new data acquired through public exploration programmes, could be reprocessed with new and innovative algorithms and processing methodologies.

Under this approach, Member States would be compelled to develop and implement adequate policies, such as a dedicated a programme, to reprocess existing and newly acquired geochemical and geophysical data, with the aim of defining geochemical and geophysical anomalies, that could lead to discovery of new ore bodies of critical raw materials.

- **Developing predictivity maps**

Member States would be compelled to develop and implement adequate policies, such as a dedicated programme, to produce and update predictivity maps for critical raw materials in order to improve the knowledge of the mineral potential present in the EU.

Predictivity maps are a powerful tool to indicate potential areas containing deposits yet undiscovered. Within one year of entry into force of the regulation, the governance body would define a standardised way to report this mineral assessment. These geological and mineral results would be reported to the governance structure to inform the definition of potential targets for extraction.

- **Publication of data**

The results of the exploration activities promoted by Member States through the actions presented above, would have to be periodically reported to the governance structure by using a predefined template (specifications), following UNFC when applicable, and/or aligned with INSPIRE Directive. This would foster the creation of pan-European data sets or maps as called by stakeholders (e.g. EuroGeosurveys)

After a joint assessment, and in due consultation with the data owners, such data would be made available to economic operators with a guaranteed equal access in view of promoting later stages of economic activities in the value chain, such as feasibility studies.

Finally, this approach would, alike approach 1, encourage Member States to take due account of the occurrence of mineral resources containing critical raw materials (c.f., pillar A) when taking measures regarding land use that might affect the exploitability of the deposits.

9.1.7.3. Approach 3: Obligation to report to the governance structure on the land use decisions applicable to known deposits containing strategic raw materials

In addition to approach 2, approach 3 would require Member States to inform other EU countries and the Commission through the governance structure of their intention to adopt a land use decision that would affect the potential to exploit of a known mineral deposit containing strategic raw materials, allowing for comments and discussion in the relevant fora. This measure would ensure that information on upcoming activities over these deposits are provided to the governance structure if such activities have the potential to affect other actions provided in the CRM act, such as the determination of targets based on an assessment of resources and deposits in Member States. This obligation for Member States to report would be done to the network or the operational capacity (depending on whether option 2 or 3 are chosen).

Discarded approach: It is suggested to discard approach 3 at an early stage. This approach was deemed as not respecting the proportionality principle, given that other reasons of strategic nature or environmental preservations might require the use of the land, despite the presence of a mineral resource of strategic importance, and that it would add unnecessary burden on Member States for the reporting. It is also not in line with subsidiarity principle to the extent that Member States, or local governments, are the most appropriate authorities to judge the relevance of a particular land and its use.

9.1.8. Pillar E – Support to the value chain

9.1.8.1. Approach 1: Requiring Member States to set up strategies to contribute to a stable and secure supply of CRMs

Under this approach, each Member State would be required to create a strategy outlining the ways and timeline how it can contribute towards achieving a more stable and secure supply of CRM in the EU, by identifying and supporting projects that are important across the CRM value chain. These strategies would have to be submitted to the Commission 6 months after entry into force of the legislation. The Commission would then analyse them jointly, evaluate the cumulative impact and based on this give specific recommendations to each Member State 12 months after entry into force.

No specific legal notion of strategic projects would be established under this approach.

9.1.8.2. Approach 2: Identify Strategic Projects, in Europe and partner countries abroad

Under this approach, Strategic Projects would be established with legal consequences regarding permitting and access to finance as outlined in pillars E.1 and E.2.

Companies and investors, would be able to submit their proposals to the Commission. To be eligible, projects would have to fulfil general minimum criteria, among them a meaningful contribution to the targets set under Pillar B, positive spill-over effects beyond the Member State where they are located and a positive outlook regarding long-term economic viability. The governance structure might apply more specific criteria per step of the value chain for each raw material mentioned in the list of targets. To this end, the project promoter's application should include, among other things:

- an assessment of their projects with regard to their contribution to reaching the targets and the applicable criteria;
- a business plan evaluating the financial viability of the project, including an overview about the secured funding and the remaining financing needs and estimated time-to-market.
- an assessment of the level of public acceptance of the project and, where relevant, a plan for ensuring it, including actions (additional to what is already required) such as awareness campaigns to educate and inform the public of the importance of CRMs for the green transition and how these CRMs could be obtained in the EU in a responsible way or setting up mitigation and compensation mechanisms to ensure that the project contributes to the general development of the relevant area.

The Commission would then share the application with the Member State where the project is intended to take place and ask for its general approval within one month for the project to receive the status of Strategic Project. Where it refuses, it would have to present its substantiated reasoning to the Commission who could request the Board to discuss these reasons. Where the Member State accepts, the Commission would check the application for the fulfilment of the minimum criteria. In case of many applications, the Commission would be able to prioritise applications for projects active on specific parts of the value chain in order to work towards a balanced representation of projects along all strategic raw materials along the value chain. The Commission would then assess the projects in consultation with the Board. For projects that fulfil the criteria, the decision to assign them the status of Strategic Project, this would be published as a Commission decision.

Projects outside of the EU could also be labelled as Strategic Projects. To be eligible, those projects would also have to fulfil general minimum criteria, among them high environmental and social performance and contribution to the targets laid out in pillar B. They would also need the support of one or more European companies that have committed to purchase at least e.g. 50% of the production of the respective strategic raw materials for e.g. 180 months for use in Europe. The projects should in principle be located in countries with which the EU has concluded a Free Trade Agreement with a chapter on raw materials or a Strategic Partnership. To ensure compliance with ESG criteria, the project would need to show sufficient evidence that it would qualify for a recognised certification scheme, if recognised. Otherwise, the same process would apply. The respective third country would be closely involved to ensure compliance on the ground. The board might also coordinate with the Global Gateway governance, which could help leverage EU Member States funds for projects outside the EU.

The number and nature of Strategic Projects to be designated would depend on the needs of the European economy, the current level of production as well of supply security per material and step of the value chain, as well as European production potential, next to individual characteristics of projects such as environmental performance Projects of all sizes could become Strategic Projects if they sufficiently help to address gaps in the European CRM value chain. To effectively ensure security of supply, the selection of projects would take into account an analysis of the gaps per material and step of the value chain. Due to its increasing importance over time, recycling projects would be expected to make up an increasing share of Strategic Projects over time. The potential number of projects to be assigned depends also on the size of the available projects. An estimation is made on their number in Annex 4 in order to best assess their potential impacts.

9.1.9. Pillar E.1 – Permitting procedures

Raw materials operations in the EU are subject to a comprehensive legislative framework that is meant to minimise a project's adverse environmental impacts and ensure involvement of all relevant stakeholders in the permit-granting process. This framework is an essential achievement,

which this initiative should build on. However, the unpredictability of permitting procedures in terms of duration and outcome has been shown to discourage much-needed investment into the European raw materials value chain. Against this background, this section sets out different possible approaches to speeding up permitting processes and making them more predictable.

9.1.9.1. Approach 1: CRM projects to be considered in spatial planning

Intervening in an early phase, well-designed spatial planning has the potential to reduce land use conflicts and point project developers to suitable sites, which in turn is likely to accelerate permit-granting procedures. Analogous to Union legislation on the deployment of renewable energies, therefore, Member States' competent national authorities at national, regional and local level would be required to take into consideration and provide for the realisation of CRM projects when developing spatial plans.

Given the potential effects on the environment of CRM projects, Member States should, when developing those spatial plans, apply the Strategic Environmental Assessment (SEA) Directive[11].

Undertaking the SEA procedure encourages a more integrated and efficient approach to spatial planning and early in the project development phase. For example, applying the SEA procedure allows relevant national authorities to plan for the development of CRM projects while factoring in the environmental obligations and identifying the cumulative environmental impacts at an early stage. The outcomes in turn provide a basis for the subsequent project development and permitting procedures. This also translates into fewer conflicts at the individual project level, both in substance and in terms of public acceptance.

9.1.9.2. Approach 2: Mandatory measures to make permitting for Strategic Projects more predictable

This approach includes the measures set out in Approach 1.

In order to ensure a secure investment climate for Strategic Projects (see Pillar G) in particular, a general requirement would be set for Member States to ensure that administrative procedures for their approval are streamlined and expedited at the appropriate administrative level.

In order to put such streamlining into practice, Member States would also be required to take the following concrete measures in relation to Strategic Projects:

- allocating the status of the highest national significance possible under national law to Strategic Projects for the purpose of permit granting processes;
- applying a joint procedure combining all relevant assessments (i.e. those required by the EIA, Habitats, Birds, Water Framework, Seveso and Industrial Emissions Directives) for a given project;
- designating a 'one-stop shop', in the form of a competent authority which should be the sole point of contact for project promoters during the entire process leading to a comprehensive decision for a given project and should coordinate the submission of all relevant documents and information;
- adhering to specific time limits for different stages of the permit granting procedure;
- allowing documents to be submitted digitally;
- making available a manual of procedures for project developers.

In addition, to ensure procedures are more predictable, the scope and the level of detail of information's for the EIA report needed to apply for the relevant permits would have to be clear

from the outset. In order to do so, this approach would make the scoping opinion preceding the submission of an EIA report mandatory for Strategic Projects.

As regards the duration, there would be an overall time-limit set for overall permit granting procedure (covering the period from the date of acceptance of the submitted application file until a comprehensive decision) for Strategic Projects (e.g. 18 months).[153] The following more specific time limits would also be introduced pertaining to specific steps of the permitting process, including:

- period between the request for a scoping opinion for environmental assessment report and the response – *1 month*
- conclusion of the environmental impact assessment (which is bundled with the assessments relevant to the applicable nature protection directives) of a given project - *3 months (with possible 3-month extension)*
- public consultation on the environmental impact assessment report – *2 months*

The time-limits would be shortened for procedures related to exploration, which by its nature has a smaller scope and impacts.

The above-mentioned time limits would be without prejudice to potential delays caused by judicial or non-judicial appeals. However, Member States would be required to, where available under national law, apply urgency procedures for possible litigation related to the permit granting process.

Lastly, this approach would provide direction to Member States on the application of substantial permitting conditions. The nature protection rules that are integral part of the relevant permitting conditions (i.e. the Birds, Habitats and Water Framework Directives) provide that projects considered to be in the overriding public interest can be allowed to go forward even in the case of limited adverse impacts on the environment. Under this approach Member States also would be required to consider Strategic Projects, at least for refining and recycling, as being of public interest for the purposes of that assessment, considering their contribution to the Union's supply security and the green and digital transitions. In addition, the proposal would clearly emphasize that Member States may, when performing their case-by-case assessments to weigh potential environmental concerns with a Strategic Project's public interest, consider a Strategic Project to be of overriding public interest if all the conditions set out in the relevant Directives are fulfilled.

The obligations displayed in this approach take account of the subsidiarity principle by ensuring that Member States may refuse the development of a Strategic Project on their territory in the selection process leading up to them.

9.1.9.3. Approach 3: Require Member States to dedicate sufficient resources to their permitting

This approach includes the measures set out in Approach 1 and 2.

It would also introduce a requirement on Member States to dedicate sufficient resources to permitting procedures for Strategic Projects. Following the example similar provision in the field of competition and consumer protection law, Member States would, more in particular, be required to ensure that responsible authorities have a sufficient number of qualified staff and sufficient

[153] Similar to the time limit included in the TEN-E Regulation for cross-border energy infrastructure projects (18 months) or the RED II Directive for renewable power plants (24 months).

financial, technical and technological resources necessary for the effective performance of their functions.

9.1.10. Pillar E.2 – Access to finance

9.1.10.1. Approach 1: Encourage setting up of Investment Platform, leveraging finance through existing instruments

Under this approach, no new funding instruments outside the possibilities of the current framework would be established, but the Commission would work towards an extended use of the existing possibilities and to tie them as closely as possible to the Strategic Projects. This would include fostering the setting up of an investment platform under InvestEU, which specifically supports CRM projects. This would require an Implementing Partner that has a valid Guarantee Agreement with the Commission (e.g. the Agreement with the EIB that administers 75% of the Commission's guarantee allows to fund raw materials projects), which enables the EU guarantee and helps attracting additional funding from private and public sources. Under InvestEU a wide variety of financial instruments can be provided, for example loans, equity or hybrid products. An InvestEU Advisory Hub on CRM would be set up to support provide technical assistance and advisory services to project promoters (as well as financial intermediaries), including for the creation of the investment platform. Additionally, the use of other existing funds for domestic use (RRF, Innovation Fund, Cohesion Funds, etc.) should be promoted and fostered for these projects. For CRM projects abroad funds aiming at international spending would be used (NDICI, EFSD+, IPA, etc.).

9.1.10.2. Approach 2: Dedicated CRM Fund with Member State contributions and limited EU contribution from existing sources

In addition to approach 1, the Board, with a dedicated standing sub-group consisting of financial experts from the Member State as well as the Commission, would provide support to Strategic Projects in access to finance. It would point to existing sources that could provide funding, including on level of the Member State, international financial institutions, national promotional banks and the Union. Possible sources for support on European and Member State level could be:

- The use of the Recovery and Resilience Fund (RRF) by the Member States to contribute to the needed investments.
- In addition, funds could be used more within existing programmes such as Horizon Europe and/or the Innovation Fund to actions supporting investments in the CRMs field.
- One such example is Horizon Europe which enables funding of pilot demonstrators for industrial application of technologies via proposals for projects.
- The Innovation Fund focuses on highly innovative technologies and big flagship projects within Europe that can bring significant emission reductions. It is about sharing the risk with project promoters to help with the demonstration of first-of-a-kind highly innovative projects. In 2022, a project for battery recycling received a grant of EUR 68 million[154]. The fund could focus even more on CRM projects in the future.
- Regional Development & Cohesion Funds: Under priority 2 – a greener, low carbon transitioning towards a net zero carbon economy – funds could be allocated for raw materials, for example for projects focusing on refining/processing/recycling. The Just Transition Fund could also be used more as has been demonstrated with a grant of

[154] https://climate.ec.europa.eu/system/files/2022-12/if_pf_2022_relieve_en.pdf

EUR 18.7 million to a rare earth magnet manufacturing facility in Estonia[155]. These funds, unlike most other sources of public funding, also allow to finance projects in earlier parts of the CRM value chain, that do not rely on innovative technology.

- Explore providing counter-guarantees to national export credit agencies (ECAs) where such ECAs are involved in the financing of strategic projects in third countries with European off takers and European project promoters;
- The NDICI (and, in particular, EFSD+ guarantee facility and blending facility) and IPA (Instrument for Pre-accession Assistance) funds could be used to support projects in their coverage area (i.e. in third countries) within the existing sectoral windows (e.g. energy or sustainability). Special sectoral windows could be opened for funding CRMs. but this would require additional resources for EFSD+, especially if dedicated guarantee programmes tailored to CRM are envisaged.
- Existing EU funding schemes with loans, equity or grants in the area of energy could be extended to cover also raw materials production for energy applications. They would form a coherent component of such programmes, reflecting the value chain approach. EU added value, in terms of jobs, growth and resilience potential, may be part of the criteria considered when assessing the project proposals.

For the external aspects it is crucial to work with the European Investment Bank and Development Finance Institutions to engage in the raw materials value chain in partner countries. Engagement in the financial and investment ecosystem have so far dominated, but are not sufficient to gauge the full potential. It may also be relevant to leverage existing programmes with other multilateral development banks (MDBs) such as the World Bank Group (including the International Finance Corporation (IFC) and Multilateral Investment Guarantee Agencies (MIGA)), the Inter-American Development Bank (IDB), the EBRD, which have a long standing experience in this domain. As the IFC has submitted a broad proposal to EFSD+, it may be worth exploring including CRM support, i.e. pending resources availability under EFSD+.

Despite these efforts, significant gaps would persist in the funding landscape. For example, cohesion funding provides only limited opportunities for investment in wealthier regions of the EU, where geological resources for extraction, or energy availability for refining may be better; most other relevant funds are directed either at innovative projects or projects directly contributing to positive environmental and climate impacts (without considering the role of CRMs in enabling clean technology). Importantly, current funding conditions do not address strategic autonomy as a goal (even though the Trade Policy Review and other official strategy papers have endorsed this concept) while investments in areas such as CRMs are essential for this objective. An important project about, for example, rare earth extraction in the north of Sweden would therefore still struggle to attract funding.

Therefore, the Commission would work with interested Member States to set up a dedicated CRM Fund to further support CRM projects, including Strategic Projects. This Fund would require Member State contributions and a contribution of existing EU sources to leverage this money with private financing[156].

To ensure the European dimension and to get closer to closing the large investment gap as shown in the access to finance part of the problem section, existing European resources would also be used. The necessary mix of different financial instruments would depend on the project's

[155] https://www.neomaterials.com/neo-performance-materials-to-receive-first-ever-grant-under-europes-just-transition-fund-for-neos-planned-sintered-rare-earth-magnet-manufacturing-plant-in-estonia/

[156] Depending on the design and governance of the upcoming Fund, its support may qualify as State aid, in which case State aid rules will apply.

specificities, notably the stage of the value chain (e.g. risk capital, loans). The Fund's purpose would be to support the CRM value chain in Europe and partner countries abroad, in particular Strategic Projects, and to generate a return on investment. The Fund should be able to provide loans and equity to projects along the entire CRM value chain, focussing on Strategic Projects. Grants should also be considered but depend on the type of financial resources and set up of the Fund.

Where public support qualifies as State Aid, existing State Aid rule would be respected. The support from public sources would be applied to crowd-in private money and increase the leverage. It would focus on filling the remaining gap where the market struggles to finance it due to market failures. Supported projects would also need to show their long-term economic viability under functioning market conditions, the aim would not be to support that permanently require operational support.

9.1.10.3. Approach 3: Dedicated CRM Fund with additional Commission contribution and Member State contribution

In addition to approach 1, the Commission would set up a dedicated CRM Fund that combines new EU money with Member State contributions, leveraging private investments to support CRM projects along the value chain in Europe and abroad, prioritising Strategic Projects. It could be managed by the governance structure (i.e. the board or operational capacity, cf. Pillar C). The CRM Fund would be able to provide loans, equity and grants for investment support, in compliance with State aid rules.

This Fund would provide a common European approach to funding CRM projects. With the appropriate endowment, it would be able to provide more and riskier financing, and could also be less bound by profitability considerations and operate more freely (compared to the fund considered under approach 2) to effectively address proven market failures.

9.1.11. Pillar F – Waste legislation

9.1.11.1. Approach 1: Adoption of a Commission Recommendation targeting small consumer electronics and announcements of future CRM circularity actions

- The Commission would adopt (as part of the CRM Act package) a Recommendation on take-back schemes for small consumer electronics, to improve the return of used and waste mobile phones, tablets and laptops, which contain significant amounts of critical raw materials.
- The Communication accompanying the CRM Act would announce that the upcoming (Q2 2023) joint review of the Directive on end-of life vehicles and the Directive on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability (3R) will include provisions to support recovery of CRMs from end-of-live vehicles and use of recycled CRM content in new vehicles.
- The Communication accompanying the CRM Act would announce (for Q1 2024) upcoming secondary legislation under the current WEEE Directive to amend its Annex VII on selective treatment for materials and components of WEEE to include a list of CRM-rich electrical and electronic equipment and components thereof. It would also announce the launch of a preparatory study for the identification of such CRM-rich EEE and components.

- The Communication accompanying the CRM Act would announce an upcoming review of the WEEE Directive, assessing possibilities of introducing information requirements (on CRMs contained in electrical and electronic equipment), design requirements (for dismantlability of CRM-rich components) – in synergy with Ecodesign provisions – and separate collection and recovery targets for a list of CRM-rich electrical and electronic equipment.
- The Communication accompanying the CRM Act would announce actions to introduce EU end-of-waste criteria for the most important waste streams containing CRMs, notably (based on a JRC scoping exercise[157]): red mud / bauxite residue; phosphorus recovered or produced from waste water treatment and sewage sludge; rubber recovered/recycled from end-of-life tyres; ferro-alloys and silicon slags; and certain categories of waste electrical and electronic equipment that are currently not prepared for re-use.
- The Communication accompanying the CRM Act would announce (for Q2 2024) a proposal to introduce specific waste codes for Lithium-ion batteries and intermediate waste streams ("black masses") under the European List of Waste.
- The Communication accompanying the CRM Act would announce (for Q2 2023) the launch of an Ecodesign preparatory study on potential product-specific requirements on recycled content and on scarce, environmentally relevant and critical raw materials, which would be followed up by implementing measures. It would also note the possibilities to set relevant requirements for CRM-rich products under the proposed Ecodesign for Sustainable Products Regulation.

9.1.11.1.1. Approach 2: Targeted amendment of the Extractive Waste Directive and certain circularity provisions in the CRM Act

- The Commission would adopt (as part of the CRM Act package) an amending Directive to the Extractive Waste Directive, to introduce targeted changes aimed at increasing CRM recovery from extractive waste. The two main measures would be to require:
    1. operators of extractive waste sites to perform an economic pre-feasibility study of the potential to recover CRM from the extractive waste generated (as part of the waste management plans under Article 5), and
    2. Member States to create a database of all closed extractive waste sites, search administrative records and perform geochemical sampling to identify quantities and concentrations of CRMs on these sites, and publish such information in order to encourage CRM recovery projects on those closed waste sites.

The CRM Act would include an obligation for Member States to develop national circularity strategies, addressing areas of national competence, such as waste collection and treatment systems, national R&I programmes for CRM recycling technologies and CRM substitution, and to gather data on the most important product and waste streams and stocks containing CRMs on their territory.

9.1.12. Pillar G - Actions on standards for the critical raw materials value chain

9.1.12.1.1. Approach 1: Increase efforts to have EU rules and principles reflected in international standards

The European Union has had a strong global footprint in international standardisation and European experts and national standardisation bodies are important contributors to the work of ISO. This approach would include several actions to leverage this position specifically in relation to critical raw materials, with the aim of ensuring that the principles and values underlying relevant

[157] JRC Publications Repository - Scoping possible further EU-wide end-of-waste and by-product criteria (europa.eu))

EU legislation are reflected in international technical standards on CRMs, especially standards for ensuring the sustainability of industrial processes involved in the CRM value chain.

This approach would promote a more strategic and coordinated approach to international standardisation activities by helping Member States, EU standardisation bodies and EU industries more effectively coordinate and share resources in support of international standardisation processes.

Following the overall approach set out in the Standardisation Strategy, the Commission would in particular:

- Ensure that the High-Level Forum (HLF), announced in the Standardisation Strategy, includes a specific work stream on CRMs. The HLF will bring together representatives of Member States, European Standardisation Organisations and National Standardisation Bodies, industry, civil society and academia to set priorities, advise on future standardisation needs, and coordinate effective representation of European interests in international standardisation fora.
- Monitor the effective implementation of existing commitments on standardisation in EU trade agreements and use such trade agreements to cooperate on standardisation with like-minded partners and coordinate positions in relevant international technical committees;
- Promote international cooperation on standardisation and EU standards with the Neighbourhood, Development and International Cooperation Instrument – Global Europe (NDICI-GE) and Horizon Europe, also with a view to support stakeholder participation in international standardisation (SMEs, civil society, academics);
- Fund relevant projects in the field of standardisation in selected African countries as part of its development cooperation policy and the Global Gateway. The EU will promote the development of a standardisation infrastructure reflecting the EU principles and values in partner countries with accession perspectives/closer integration with the EU's internal market, starting in the EU's Neighbourhoods.

9.1.12.2. Approach 2: Mandate development of standards regarding relevant industrial processes

In addition to approach 1, this approach would look beyond the EU's contribution to international standardisation efforts by also providing direct support for the development of European standards and standardisation deliverables on the sustainability of CRM-related industrial processes.

Based on the priorities set by the HLF and ERMA working groups, the Commission would request CEN to develop e,g, technical specifications, technical reports, workshop agreements or European standards. The Annual Union Work Programme on Standardisation would thus clearly reflect the growing importance of CRMs. This work would be supported according to the existing rules on financing of European standardisation.

The resulting technical standards will provide solid and coordinated basis for EU participation in international standardisation efforts, and where necessary provide a clear counter-narrative to standardisation efforts by industry or countries with lower environmental standards.

The development of standards following the mandate provided by the Commission to standardisation bodies is likely to take up to three years.

9.1.12.3. Approach 3: Set essential requirements regarding relevant industrial processes and mandate development of related harmonised standards

In addition to approach 1, this approach would include the setting of essential requirements related to the sustainability of CRM-related industrial process, e.g. on the water use and resource efficiency of extraction and recycling processes for lithium. Following a similar approach to the New Legislative Framework, the Commission would issue standardisation mandates for CEN to develop harmonised European standards, providing a presumption of conformity with the requirements to which they are linked.

In addition to operationalising such requirements (allowing responsible economic operators to more easily apply them and competent authorities to more easily enforce them), the creation of harmonised European standards would provide an even stronger basis for European leadership in international standardisation fora.

Discarded approach: Approach 3 was discarded at an early stage. Although this approach would effectively contribute to the objective of having high quality standards available, it would also entail the setting of additional requirements on the EU CRM value chain. In addition, there is a risk that such requirement would overlap or be incoherent with the rules to be developed under the recently proposed revision of the Industrial Emissions Directive, where it is proposed to bring the relevant industrial processes under its scope. As such, approach 3 would risk creating additional barriers to the EU's supply of CRMs, and thereby has the potential to undermine the attainment of the other objectives, including to strengthen the EU value chain for CRMs.

9.1.13. Pillar H – Environmental footprint of critical raw materials

9.1.13.1. Approach 1: Set minimum requirements for certification schemes for sustainable CRMs

This approach focusses on the reliability of general environmental claims (e.g. 'this lithium was produced using sustainable practices') made by operators selling CRMs on the EU market. The availability of specific qualified information on the environmental footprint is addressed in Approach 2 below.

This approach would include setting set of common requirements for voluntary certification158 schemes at EU level related to the sustainability of CRMs. This would be coupled with an empowerment for the Commission to establish which certification schemes meet those common requirements through implementing act. The common requirements to be set should ensure that recognised certification schemes are based on transparent criteria covering all relevant sustainability aspects and are awarded based on reliable and third-party verified information.

In order to prevent unreliable general environmental claims, sellers of CRMs on the EU would only be allowed to make such claims about the sustainability of their materials (e.g. 'this lithium was mined and refined sustainably') based on recognised certification schemes. It would not be allowed to make reference to non-recognised certification schemes.

[158] 'Certification' in this context refers to the voluntary process of providing an operator with an attestation of a status or level of achievement regarding the sustainability of their operations. This is different from the 'declaration' referred to in approach 2, which refers to the making available of specific quantified information on the environmental impacts linked to CRMs placed on the market based on pre-set calculation rules.

9.1.13.2. Approach 2: Require declaration of the environmental footprint of CRMs sold in the EU

In addition to approach 1, this approach would entail requiring economic operators to declare the environmental footprint of CRMs they sell on the EU market, as a market access requirement. This will help bring about transparency on the environmental footprint of CRMs and help shift the Union market towards lower impact CRMs, regardless of where they are produced. It may also enable other policies at Union and national level, such as incentives or green public procurement criteria, fostering the use of CRMs with lower environmental impacts.

This requirement would only apply for CRMs for which there are material-specific calculation rules available. Before mandating the rules for the calculation of the environmental footprint of CRMs, a consultation process with industry and Member States seems necessary to fine-tune those rules and clarify how they will be maintained over time. The material-specific calculation rules would therefore be provided by means of implementing acts prioritising CRMs with relatively higher demand and environmental impacts.

Given the wide variety of environmental profiles of the different CRMs, the Commission would be empowered to, when specifying calculation rules, allow the footprint declaration to be limited to one or a subset of impact categories where this is justified based on the environmental profile of the different materials. For example, the impact category global warming potential or carbon footprint is a significant category for many CRMs (e.g. REEs and lithium) and is an important factor given that CRMs are central to the manufacturing of technologies needed for decarbonisation and could thus be made the focus of specific declarations. In addition, it would allow Member States to set incentives based on the different footprints of CRMs, including potentially in public procurement.

The calculation rules would be based on the Product Environmental Footprint (PEF) method.[1] The PEF method was developed by the Commission to ensure reliable and comparable life-cycle assessment information. As such, it would be ensured that CRM buyers intending to buy relatively more sustainable materials will find reliable information in the market and are enabled to make effective purchasing decisions. A proper enforcement of the regulatory proposal will most likely require putting in place a third-party verification system rather than relying on self-declarations, so that a fair and verifiable mechanism is established. The use of a common calculation tool and harmonised secondary datasets159 could also contribute to this aim.

The requirement would in principle not apply to final products containing relevant CRMs. However, where the footprint of CRMs included in product is specifically referenced in any relevant product documentation, it would be required to justify that claim and refer to the declared footprint of the CRMs used.

9.1.13.3. Approach 3: Putting in place a mechanism for setting performance classes and maximum thresholds for environmental footprint

In addition to approach 1 and 2, this approach would consist in introducing a mechanism to set footprint performance classes to further support market differentiation and the setting of maximum footprint thresholds for specific CRMs placed on the EU internal market. Such measures could have adverse effect on the security of supply for CRMs. Therefore, in light of this risk and in order to avoid any negative effect on supply security, the following measures would be gradual,

[159] The calculation of environmental footprints would require a mix of secondary and company-specific data. For example, for carbon footprints, the calculation rules could allow factoring in information on supplier-specific electricity mixes, which may improve the footprint results compared to the ones obtained with the use of default country residual grid mixes.

progressive and evidence-driven. Indeed, for each maximum footprint threshold, there should be dedicated assessments conducted.

This approach would contain the following gradual steps:

First, as there is not yet sufficiently detailed statistical information on the relative footprints of CRMs, the Commission would gather such information through the declarations proposed in approach 2 through secondary legislation

Second, once sufficient market knowledge is acquired through step 1, relevant CRMs would be categorized in an A-G scale based on their footprint.

Third, a threshold would be identified, which would correspond to correspond to the limit values of the lower or lowest classes in the performance class scale.

The introduction of maximum thresholds the third step would only be possible when accompanied by a proportionate and dedicated assessment, which would take into account the relative distribution of the footprint values for the relevant CRMs placed on the Union market, the extent of progress in the reduction those footprints as a result of the information requirement referred to in approach 2, and the effective and potential contribution of a threshold to the Union's environmental and climate objectives. In addition, this assessment would take close account of the potential effects of thresholds on EU imports of the relevant CRMs, ensuring that the level of the thresholds is set so as to prevent potential bottlenecks for EU supply of CRMs.

This approach would steer relevant economic operators to reduce the environmental footprint associated with their CRMs and would ban from the market those materials with the relative highest footprint. Economic operators should be given sufficient time to adjust their production facilities.

Discarded approach: Approach 1 was discarded at an early stage. Although this approach would help make general claims about the sustainability of CRMs more reliable, it would not affect quantitative claims for which conflicting methods could continue to proliferate. In light of the large support for increasing the availability of reliable environmental footprint information expressed in the OPC, it is expected that this approach alone would therefore not be able to count on sufficient support of stakeholders. In addition, it is expected that without clear quantified information on important impact categories, relying only on increasing the reliability of general claims, it will not be possible to effectively achieve the Union climate and environmental objectives.

ANNEX 6: SME TEST

32 SMEs answered to the public consultation survey, mainly operating in the exploration or extraction of critical raw materials (10 and 11 respectively – often combining both activities), while 14 reporting being active in the use of CRM for manufacturing, 9 in recovery and recycling, 7 in research, etc.

They reported having experienced problems in relation of their supply of critical raw materials, such as shortage or disruption, for most of those which answered.

The initiative is considered as relevant for SMEs.

Step 1/4: Identification of affected businesses

All businesses and SMEs should feel the positive effects of a more stable supply of critical raw materials. Particularly affected by the legislative initiative are businesses and SMEs in sectors along the CRM value chain and those who directly use them as inputs.

The former group includes, for example, junior miners, firms engaged in exploration or in the nascent industry of CRM recycling, that are often SMEs. For them, the easier access to funding as well streamlined permitting provisions are expected to bring large benefits.

For downstream users, the increased availability of their inputs as well as lower risk of severe disruptions is especially beneficial for SMEs as they tend to struggle more with acquiring such goods in a crisis situation.

Step 2/4: Consultation of SME Stakeholders

Of 81 businesses that replied to the Open Public Consultation 32 are SMEs.

Of the policy papers received many explicitly mentioned SMEs calling for financial support due to their particular vulnerabilities. It is also mentioned that it is instrumental for the competitiveness of micro and SMEs to secure reliable sourcing of the input materials needed for the green transition at a competitive price. Social and environmental concerns should be balanced with economic and security interests.

Step 3/4: Assessment of the impact on SMEs

For policy option 2, SMEs would benefit from the enhanced availability of monitoring and information regarding the supply chains of critical and strategic raw materials. Indeed, they usually are less informed about the supply chains risks. In the public consultation, 40% of SMEs agree that companies would benefit from public monitoring programmes with only 6% disagreeing. 44% of SMEs agreed that they would benefit from public monitoring to inform them about risks of supply chains disruption (6% disagreed, the rest being neutral of with no opinion). To this end, 59% of them agree that an EU-wide governance capacity with monitoring tasks could help strengthen the value chain resilience. A slight majority of them agreed that companies lack sufficient information on supply risks to take preventive measures. (28% against 22%), although 72% support measures that would enable them to benefit from such information.

On governance, the board would regularly convene with stakeholder groups, among them some groups explicitly representing SMEs. This would ensure that they could express their opinion.

SMEs are also adamant about the difficulty to access private financing for CRM projects (62% agreeing; 0% disagreeing) and to access public funding (80% agreeing; 3% disagreeing). They converge in saying that the length and complexity of permitting processes are the main reasons for the difficulties in accessing private finance (47%), followed by the lack of support from public financial institutions (34%) and the higher production cost in the EU (31%). For them the funding opportunities are therefore particular valuable. Additionally, the InvestEU guarantee (pillar E.2) contains a specific window for supporting SMEs. Especially, junior miners and exploration projects often struggle to attract adequate funding and using this window would therefore be particularly beneficial for SMEs.

The proposed approach on exploration (pillar D), as suggested by stakeholders (e.g., European Federation of Geologists), would bring positive benefits to SMEs as they are the main actors operating in this early stage of the value chain have less resources and capacities to undertake risk-heavy exploration operations.

A lot of these benefits to SMEs also apply under the other policy options. In option 3 SMEs would additionally benefit a lot from early warning mechanisms of supply chain disruptions provided by the operational capacity. Larger companies are more likely to able to shoulder these tasks on their own than SMEs.

Step 4/4: Minimising negative impacts on SMEs

Although most of the measures discussed in this Impact Assessment have positive impact on SMEs, there are some that could affect them negatively. Therefore, specific exemptions for SMEs are foreseen, such as one from reporting obligations.

Actions of other global actors and organisations

In consideration of the projected supply-demand imbalance and rising concerns with supply security amidst geopolitical tensions, other countries have acted to ensure their supply of CRMs for the future. The following overview includes both countries in a similar situation as the EU such as manufacturing-heavy but CRM-import-reliant Japan, South Korea or the UK but also major mining and refining players such minerals-rich Australia and Canada.

The UK adopted its Critical Minerals Strategy in July 2022[160] which includes three main axes: a) enhancing domestic production; b) collaboration with international partners: using G7, IAE, MSP, and bilateral paths; supporting UK companies abroad including with export finance; c) Enhancing international markets, by promoting the City of London as a hub for responsible mining and trading. The UK established its Critical Minerals Intelligence Centre in July 2022[161], which will provide ongoing intelligence on the supply of and demand for critical minerals. The centre is to be run by the British Geological Survey.

In Japan, a country with a large manufacturing sector and few domestic CRM resources, a dedicated governmental structure on critical raw materials (JOGMEC) is in charge of monitoring, stockpiling (sufficient to meet 60 to 180 days' demand) and investing. It supports exploration and technological development by Japanese companies through equity capital and liability guarantees. Its JOGMEC's mandate was recently expanded to "functions of equity investments for domestic processing and smelting of rare metals". In addition, the Economic Security Promotion Act aims to ensure stable supplies of critical items.

In South Korea, the State-owned Korea Resources Corporation runs a stockpile storage system for rare metals. A dedicated plan to stabilise resources supply in 2021 has developed in 2021 a dedicated plan to stabilise resources supply notably by increasing the stockpile of minerals to 100 days of consumption[162]. The country also has an early warning system in place to monitor 20 key raw materials.

In 2022, the US also adopted the Inflation Reduction Act (IRA), aiming to put the US on a path to around 40% percent emissions reduction by 2030. Numerous financial support programmes in the IRA have domestic or regional content provisions. These include the sourcing, processing and recycling of many critical raw materials. With the American Battery Materials Initiative, USD 2.8 billion in public money will be disbursed to support projects in different stage of the battery value chain, of which USD 1.6 billion are earmarked for projects to separate and process battery raw materials. Critical minerals-related funding is also available under the Infrastructure Investment and Jobs Act.

Australia published in 2022 a Critical Minerals Strategy, which is coordinated by the Critical Minerals Office (founded in 2020). The Office supports research and development, promotes

[160]https://www.gov.uk/government/publications/uk-critical-mineral-strategy/resilience-for-the-future-the-uks-critical-minerals-strategy

[161] UK's first Critical Minerals Intelligence Centre to help build a more resilient economy - GOV.UK (www.gov.uk)

[162] The Ministry of Trade, Industry, and Energy announced on December 28 the Ministry's work report for 2022, titled "Building Korea into an Industrial Power, Overcoming & Rising Together"
http://english.motie.go.kr/common/download.do?fid=bbs&bbs_cd_n=2&bbs_seq_n=903&file_seq_n=1

investment, facilitates strategically important critical minerals projects and improves access to information[163].

On 9 December 2022, Canada released its new Critical Minerals Strategy focusing on the entire value chain of Canada's listed 31 critical minerals and backed by a CAD 5.3 billion (about EUR 3.6 billion) budget allocation. The strategy also aims to accelerate regulatory and permitting processes by enhancing coordination between the federal and the provincial levels. Moreover, the Investment Canada Act subjects foreign investments to review for national security concerns and critical mineral investments receive "enhanced scrutiny." The new guidance states that investments by State-owned enterprises in critical minerals will only be approved on "an exceptional basis" and will apply to investments of any size.

China fully dominates global production of several critical raw materials at different stages of the value chain (e.g., Magnesium, rare earth elements[164]), has consolidated economic activity in China in some of these sectors (e.g. in December 2021, three of the six Chinese state entities producing rare earth merged to create of a State-owner enterprise named China Rare Earth Group Co, which holds nearly 40% of China's rare earth production), and also abroad: in the democratic Republic of Congo, which accounts for half of the world's cobalt reserves, China now controls 70% of the country's cobalt production with 15 out of 19 cobalt mine owned or financed by China (as of 2020). In central Asia, China makes use of its Belt and Road Initiative (BRI) to develop strong ties with mineral corporations[165]. China has made use of export control mechanism for CRMs: for instance, it reduced its export quota of rare earths (to the United States) in 2010, and since January 2022, all rare earth elements are covered by Chinese export control measures. China has also been engaged in economic stockpiling of CRM[166].

At multilateral level, during the G7 2022 Summit in Germany, G7 Leaders agreed to '*promoting market circularity and support diversification by exploring investment in alternative resources, processing capabilities, sustainable practices, and new technologies*'[167].

The 2022 Ministerial Communiqué of the International Energy Agency (IEA) recognised the growing importance of critical minerals and materials to clean energy transitions and agreed to establish a new Working Party on Critical Minerals ("CMWP"). The aim of the Working Party is to provide a forum for IEA member countries to co-operate on critical minerals policy, technology and security.

[163] Critical Minerals Office | Department of Industry, Science and Resources

[164] SWD(2022) 41 final

[165] America's Critical Strategic Vulnerability: Rare Earth Elements - Foreign Policy Research Institute (fpri.org)

[166] Situation and Policies of China's Rare Earth Industry (www.gov.cn)

[167] See the Background for a full quote.

ANNEX 8: INTERPLAY WITH OTHER LEGISLATION AND POLICIES

Environmental legislation

- The Strategic Environmental Assessment Directive (SEA)[168] provides a set of procedural rules to integrate environmental considerations into their preparation, adoption and implementation of public plans and programmes by national authorities, including for land-use. For example, national authorities have to examine reasonable alternatives and take account effects on the environment including biodiversity, soil, water, air, etc.
- The Environmental Impact Assessment Directive (EIA)[169] requires Member States to make projects likely to have significant effects on the environment, because of their nature, size or location, subject to consent and an assessment by a competent national authority (i.e. a permit). To get a permit, the EIA Directive requires e.g. the preparation of an environmental impact assessment report and the carrying out of consultation of the authorities, the public and other Member States affected by the project. Under the EIA Directive a depending on their likely significant impact on the environment, certain projects are subject to a mandatory assessment while for others a determination by a competent authority is required to decide if the project shall be subject to an assessment. In practice, most raw materials related projects, including exploration, extraction, processing and recycling, are subject to the EIA procedure.
- The Industrial Emissions Directive (IED)[170] in turn governs the operation of raw materials related projects. It provides for the integrated prevention and control of pollution originating from relevant installations. Although the current IED only applies to industrial facilities processing raw materials, the recently proposed revision of the IED would widen the scope to also include the extraction and treatment of industrial minerals and metals. The IED requires Member States to make the operation of an installation subject to obtaining a permit containing conditions set in accordance with the principles and provisions of the IED. The permit conditions should take into account the environmental performance of an installation, including emissions to air, water and soil. In that regard, the permit should include emission limit values.
- The Habitats and Birds Directives[171] require Member States to prevent significant negative effects on protected species and habitats in Natura 2000 sites. To that end, raw materials related projects that are likely to have a significant effect on such a site, must be subject to an appropriate assessment. The competent national authorities can, based on the assessment, agree to the project it is does not adversely affect the integrity of the site concerned. In exceptional cases, developments that could have an adverse effect on a protected site can still go ahead under certain conditions and where the procedural safeguards foreseen by the two Directives are respected. The EIA Directive provides for mandatory integration of this assessment with the EIA procedure.
- The Water Framework Directive[172] provides that the deterioration of the ecological status of a body of water is only allowed where justified by overriding public interests or societal benefits, where no feasible environmental alternatives exist, and where mitigation

[168] Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment
[169] Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
[170] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions
[171] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds
[172] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

measures are taken. In light of this requirement, projects potentially affecting bodies of water, including raw materials projects, need to be subject to assessment and permitting procedures (which may be integrated with the EIA procedure set out above).

- The Environmental Liability Directive[173] establishes the obligation for responsible operators, including of raw materials projects, to prevent and, where necessary, remedy environmental damage. It defines environmental damage as damage to protected species and natural habitats, damage to water and damage to soil.
- The Seveso-III-Directive[174] aims at the prevention of major accidents involving dangerous substances. However, as accidents may nevertheless occur, it also aims at limiting the consequences of such accidents not only for human health but also for the environment. The Directive covers establishments where dangerous substances may be present (e.g. during processing or storage) in quantities exceeding certain threshold, which could include CRM projects. Among other things, operators of such establishments are obliged to take all necessary measures to prevent major accidents and to limit their consequences for human health and the environment.
- The above directives also have important links with each other, allowing for or requiring the bundling of assessment required under each. For example, pursuant to Art. 11 (2) of the SEA Directive, Member States may provide for coordinated or joint procedures, fulfilling the requirements of the relevant EU legislation. Likewise, Art. 13 (4) of the Seveso Directive, gives the possibility Member States to provide for coordinated or joint procedures in order to fulfil the requirements about the land use planning in the sense of that directive. The amendment of the EIA Directive (Directive 2014/52/EU) continued the set path for streamlining of the environmental assessments at project level. Under Art. 2(3) of the EIA Directive[175], the one-stop shop approach for assessments deriving from the EIA and the Habitats and Birds Directives[176] is required (with a margin of discretion for Member States). For the other Directives (such as the Water Framework Directive[177] or the Industrial Emissions Directive[178]), it is left up to Member States to decide whether to opt for the one-stop shop or not. To facilitate the transposition in this part of the amended

[173] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage

[174] Directive 2012/18/EU Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances.

[175] Article 2(3) states that Member States shall, where appropriate, ensure that coordinated and/or joint procedures fulfilling the requirements of the EIAD and the Habitats and Birds Directives are provided for

[176] For the Habitats and Birds Directives, several guidance documents have been developed such as the 'Revised methodological guidance on Article 6(3) and (4) of the Habitats Directive', on appropriate assessment of plans and projects on the Natura 2000 sites (EN.pdf (europa.eu)). These guidelines together with sectoral guidelines on wind energy (wind_farms_en.pdf (europa.eu)), energy transmission (guidance_on_energy_transmission_infrastructure_and_eu_nature_legislation_en.pdf (europa.eu)) and hydropower (hydro_final_june_2018_en.pdf (europa.eu)) provide many practical examples for how project approval can be facilitated, among others, by strategic (spatial) planning, use of solid environmental data and suitable mitigation measures without compromising nature protection needs.

[177] For the Water Framework Directive, guidance has been developed on the procedure to be applied for new developments possibly affecting water status. This guidance also highlights the need or advantages of coordinated assessment with assessments under the EIA Directive, where applicable (Guidance Document No. 36 established in the framework of the Common Implementation Strategy under the Water Framework Directive, on Exemptions to the Environmental Objectives according to Article 4(7))

[178] Article 5(2) of the IED obliges Member States to take measures that ensure a coordination of the permitting process when more than one permit/competent authority or more than one operator is involved in the procedure.

Directive, the Commission issued a guidance on the streamlining of the environmental assessments[179].

Waste and circularity legislation

- The Waste Framework Directive (WFD)[180] targets waste in general and obliges Member States to take measures to prevent waste generation, targeting notably products containing critical raw materials (e.g. by instructing Member States to prevent that those materials become waste). The Directive provides that Member States shall establish waste management plans, which are required include, where appropriate, existing major disposal and recovery installations, including any special arrangements for waste containing significant amounts of critical raw materials. In addition, Member States are bound since 2018 to establish waste prevention programmes to define waste prevention measures for products containing critical raw materials. The Waste Framework Directive is complemented by several pieces of sectorial legislation containing obligations for Member States on how to manage specific waste streams, including waste streams containing CRMs.
- The Extractive Waste Directive (EWD)[181] requires any operator responsible for managing extractive waste (i.e. the waste generated by mining operations) to obtain a permit. To do so, the operator has to draw up and submit to the national authorities a waste management plan covering the minimisation, treatment, recovery and disposal of extractive waste. The permit will only be granted if the waste management plan meets the EWD's provisions, which include specific requirements for the prevention of water status deterioration, air and soil pollution, and if the national authorities are convinced that the relevant operator has the means to carry out the commitments laid down in the plan. Moreover, it sets rules for the closure and after closure procedures. The EWD also aims to promote the recovery of extractive waste by means of recycling, reusing or reclaiming such waste, and required that plans to this effect should be included in the waste management plans.
- The Waste Electrical and Electronic Equipment Directive (WEEE)[182] governs the collection and treatment of devices such as computers, fridges and mobile phones at the end of their life. The WEEE Directive lays down rules to, as a first priority, prevent electrical and electronic equipment from becoming waste and, in addition, to promote the re-use, recycling and other forms of recovery of such waste so as to contribute to the efficient use of resources and the retrieval of secondary raw materials including CRMs. To that end, the WEEE Directive sets general treatment requirements and contains general collection targets increasing over time and applicable to all relevant waste equipment combined, as well as recovery targets for each one of the categories of WEEE set out in that Directive (Annex V), that also increase over time.
- The End-of Life Vehicles Directive (ELV)[183] includes rules for the prevention, collection and treatment of waste vehicles and sets targets for the re-use and recycling as well as reuse and recovery of components from such vehicles. The ELV also contains obligations for

[179] Commission notice — Commission guidance document on streamlining environmental assessments conducted under Article 2(3) of the Environmental Impact Assessment Directive (Directive 2011/92/EU of the European Parliament and of the Council, as amended by Directive 2014/52/EU) (europa.eu)

[180] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

[181] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC

[182] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

[183] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles

the provision of information by producers on components and materials used in vehicles, in order to facilitate their identification for reuse and recovery.

Lastly, the European Green Deal sets the goal to protect better human health and the environment as part of an ambitious approach towards a toxic free environment. Substance risk classification and control measures under REACH and the Classification, Labelling and Packaging Regulation[184] serve to ensure the safety of chemicals and products containing chemicals in the EU, highly relevant for base metals and CRM. One recent example is the updated classification of cobalt metal according to EU CLP Regulation (2020), to include carcinogenicity category 1B – presumed human carcinogen (proven in animals), mutagenicity category 2 – suspected of causing genetic defects, and reproductive toxicity category 1B presumed human reproductive toxicant

International instruments

- Critical Raw Material Partnerships taking the form of Memorandum of Understandings (MoUs) have been concluded with Canada, Ukraine, Namibia and Kazakhstan.
- Trade defence instruments[185], such as anti-dumping or anti-subsidy duties, are ways of protecting European production against international trade distortions.
- The objective of the EU's Foreign Direct Investment (FDI) regulation[186]is to make sure that the EU is better equipped to identify, assess and mitigate potential risks for security or public order from FDIs. Foreign investments in the CRM value chain may have security implications.
- WTO obligations cover aspects such as export restrictions in raw materials, subsidies, dumping, trade in services, etc.
- The EU has introduced a comprehensive mix of voluntary and mandatory actions to promote Corporate Social Responsibility / Responsible Business Conduct (CSR/RBC) and implement the UN Guiding Principles on Business and Human Rights (UNGPs) and the UN 2030 Agenda for Sustainable Development.
- The Conflict Minerals Regulation[187], for instance, requires importers of tin, tantalum, tungsten and gold (3TG) to establish and implement due diligence policies in relation to potential environmental and human rights including labour rights impacts along their value chain. Of these, tantalum and tungsten are currently considered critical. This initiative does not include due diligence requirements.
- As an accompanying measure to the EU Conflict Minerals Regulation, the EPRM (European Partnership for Responsible Minerals) targets both upstream and downstream actors of the 3TGs supply chains. At downstream level, it wants to assist EU importers in ensuring that the minerals used in their supply chain are not contributing to financing armed groups, conflict, terrorism, or other violations of human rights. At upstream level, it aims at supporting particularly Artisanal and Small-Scale Miners in sourcing countries to conform to internationally accepted labour and social standards and other basic human rights principles. The EPRM is a multi-stakeholder partnership where Civil Society Organisations, Industry and Governments come together to find mutually beneficial solutions.

[184] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures

[185] https://policy.trade.ec.europa.eu/enforcement-and-protection/trade-defence_en

[186] Regulation (EU) 2019/452 of the European Parliament and of the Council of 19 March 2019 establishing a framework for the screening of foreign direct investments into the Union (OJ L 79 I , 21.3.2019, p. 1).

[187] Regulation (EU) 2017/821 of the European Parliament and of the Council of 17 May 2017 laying down supply chain due diligence obligations for Union importers of tin, tantalum and tungsten, their ores, and gold originating from conflict-affected and high-risk areas

- At bilateral level, all recently concluded trade and investment agreements have an ambitious Trade and Sustainable Development (TSD) chapter. They aim to ensure that that economic growth goes together with the protection of human rights, decent work, the climate and the environment. Those chapters refer to international agreements and standards, and establish a close cooperation amongst others in the field of corporate social responsibility and accountability. The Commission has recently published a Communication setting out how to further enhance the contribution of trade agreements to sustainable development. Some recently concluded Energy and Raw Materials (ERM) chapters of EU Free Trade Agreements contain specific sustainability provisions.
- At the multilateral and plurilateral levels, the EU recognises the importance of and promotes use of internationally agreed standards so as to ensure predictability for businesses. In particular RBC action is included in all TSD chapters via reference to international standards.

Other regulatory interplay

- The Council Regulation 2022/2372 "on a framework of measures for ensuring the supply of crisis-relevant medical countermeasures in the event of public health emergency at Union level" provides for the activation of a mechanism that includes measures such as monitoring, stockpiling or public procurement. Its scope covers "crisis-relevant raw materials", which may include critical raw materials such as bismouth or titanium, which can be used for medical applications and pharmaceuticals.[188]
- In REPowerEU[189], the Commission proposed to increase to 45% the target for the amount of renewable energy in the EU's energy consumption by 2030 in the Renewable Energy Directive.[190]

Interplay with ongoing instruments

- The proposed Single Market Emergency Instrument (SMEI) provides for a set of framework measures for anticipating, mitigating and responding to significant impacts of crises on the functioning of the Single Market. It aims at safeguarding the free movement of goods, services, workers and persons and ensuring the availability of crisis-relevant goods and services during Single Market emergencies. It includes a general vigilance and crisis response mechanism for dealing with unexpected supply disruptions that threaten to severely affect the functioning of the Single Market in the next six months or severely disrupt the functioning of the Single Market, where the supply chains are indispensable for the maintenance of vital societal interests. It is activated for responding to such a threat or emergency once the relevant criteria are fulfilled. If defined through the appropriate procedures as "goods of strategic importance" or as "crisis-relevant goods and services", critical raw materials may be covered by the instrument's set of measures.
- The Chips Act addresses shortages of semiconductors, proposing both short- and long-term measures to reinforce the Union's competitiveness, resilience and innovation capacity; ensure a security of supply; coordinate the monitoring of the semiconductor value chain and respond to disruptions of their supply. The crisis toolbox proposed in the Chips Act may apply to raw materials as well (e.g. in the event a crisis is triggered, common purchasing could take place for raw materials required by semiconductor manufacturing companies).
- The proposed Batteries Regulation and Corporate Sustainability Due Diligence (CSDD) contain measures requiring companies to put in place social and environmental due diligence practices when, *inter alia*, sourcing critical raw materials from both the Single

[188] COUNCIL REGULATION (EU) 2022/2372. of 24 October 2022

[189] (COM/2022/230 final)

[190] Renewable Energy Directive 2018/2001/EU

Market and (especially) the international markets. CSDD is the first proposal of its kind that introduces horizontal due diligence requirements for larger companies in all sectors to identify, prevent, bring to an end, and account for negative human rights and environmental impacts in their own operations, subsidiaries and their value chains. It helps companies understand their value chains and ensure the sourcing is sustainable while contributing to its diversification where necessary. Termination of the business relationship is required when, despite appropriate engagement measures, resolving abuses has no reasonable prospect. The proposed Batteries Regulation, being product-specific, addresses pressing sustainability concerns that are particularly salient as regards the specific product concerned. Both initiatives refer to, *inter alia*, international conventions related to human rights, workers' rights and the environment.

- The recently proposed revision of the Industrial Emissions Directive (IED) [191] widens the scope of the IED to also include the extraction and treatment of industrial minerals and metals. This aims to create a transparent and inclusive permitting process that will accompany the expansion of these activities and allow public authorities to address concerns from the public.
- The Forced Labour proposal, including forced child labour, would complement this approach by banning products produces with force labour from EU market[192]. Producers of critical raw materials are within the scope of the proposal.
- The EU Strategy on Rights of the Child[193] contains commitments to making supply chains of EU companies free of child labour, there is an intersection between critical raw materials supply chains and increased risk of labour abuses, particularly child labour e.g. in artisanal mining settings.
- Ecodesign legislation, including the Ecodesign Directive[194] and the proposal for an Ecodesign for Sustainable Products regulation[195], aims inter alia at extending the lifetime of products, thus contributing to reducing the demand for raw materials, especially critical raw materials in e.g. electronics, batteries etc. In the Ecodesign workplan for 2022-24[196], a horizontal measure on circularity of energy-related products, in particular recycled content, durability, and the use of scarce, environmentally relevant and critical raw materials, is planned.
- The proposal for a CBAM Regulation[197] aims to prevent the risk of carbon leakage for selected energy-intensive sectors by subjecting the import of certain products from third countries to a levy linked to the carbon price paid under the EU ETS. The CBAM will initially cover five industrial sectors: iron and steel, cement, fertilisers, aluminium, and electricity. The Commission has selected these sectors because of their risk of carbon leakage, the magnitude of their carbon emissions, and for administrative feasibility. The proposal does not cover raw materials processing directly. However, current negotiations are considering the possibility to include some precursors materials, meaning basic materials that are used as key inputs in the production of some of the CBAM goods and contribute significantly to the embedded emissions of the latter. Precursors under considerations are the following: coke, iron ore agglomerates, dolime, magnesia, lime, some ferro-alloys and alumina. Their inclusion would be conditional on the relevance of their emissions to the goods that use them and on their tradability. If these precursors are

[191] Directive 2010/75/EU
[192] 2022/0269 (COD)
[193] https://op.europa.eu/en/publication-detail/-/publication/bac6e66a-a3d9-11eb-9585-01aa75ed71a1/language-en
[194] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products
[195] Proposal for a Regulation of the European Parliament and of the Council establishing a framework for setting ecodesign requirements for sustainable products and repealing Directive 2009/125/EC. COM/2022/142 final
[196] EUR-Lex - 52022XC0504(01) - EN - EUR-Lex (europa.eu)
[197] Proposal for a Regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism. COM/2021/564 final

eventually included in the CBAM scope, their imports into the EU will be subject to the CBAM levy.

- The Non-Financial Reporting Directive (NFRD) requires certain large companies to disclose information on the way they operate and manage social and environmental challenges. This helps investors, civil society organisations, consumers, policy makers and other stakeholders to evaluate the non-financial performance of large companies and encourages these companies to develop a responsible approach to business. The Commission's proposal for a Corporate Sustainability Reporting Directive (CSRD) extends the scope of the NFRD and envisages the adoption of EU sustainability reporting standards.

Non-regulatory actions on Critical Raw Materials

To ensure a secure and sustainable supply of critical raw materials, the European Commission has in place a dedicated strategy since 2008[198], which aims to ensure a fair and sustainable supply of raw materials from global markets, within the EU and through resource efficiency and the recycling of secondary raw materials. This initiative also launched the assessment of raw materials' criticality every three years, starting in 2011. Such assessment has helped identify the increasing number of raw materials that are critical due to their economic importance and the supply risk they face.

In line with the European Green Deal's ambition of decoupling the EU's economic growth from resource use, the Commission launched a new Circular Economy Action Plan for a cleaner and more competitive Europe.[199] The new Action Plan builds on the measures adopted by the Commission since 2015, which have contributed to setting the framework conditions, including relevant policies and legislation, for moving towards a circular economy. One of the Plan's goals is to create a well-functioning EU market for high-quality secondary raw materials by proposing several actions that should prevent a mismatch between supply and demand of secondary raw materials and ensure a smooth expansion of the dedicated recycling sector in the EU. By using and consuming in a more circular way, it is possible to not only substantially reduce the impacts of human economic activities on the environment, but also achieve the EU's objective of doubling circular material use rate by 2030.[200]

Considering this assessment and the aforementioned political objectives, the Commission presented a dedicated action plan in the 2020 Communication on Critical Raw Materials[201] to develop resilient value chains for EU industrial ecosystems; reduce dependency on primary critical raw materials through circular use of resources, sustainable products and innovation; strengthen the environmentally and socially sustainable responsible domestic sourcing and processing of critical raw materials in the European Union; and diversify supply with environmentally and socially sustainable responsible sourcing from third countries, strengthening rules-based open trade in raw materials and removing distortions to international trade.

In parallel, the Industrial Strategy Update of 2021 initiated a better mapping of where strategic dependencies lie, their potential development and their effects on the EU's vulnerabilities. It launched two stages of in-depth reviews that provided further analysis on the origins of strategic

198 EUR-Lex - 52008DC0699 - EN - EUR-Lex (europa.eu)

199 Communication A new Circular Economy Action Plan For a cleaner and more competitive Europe COM(2020)98 (europa.eu)

200 COM(2020) 98, p. 2.

201 COM(2020) 474 - Critical Raw Materials Resilience: Charting a Path towards greater Security and Sustainability

dependencies, notably addressing critical raw materials[202] overall before focusing on rare earth elements and magnesium[203]. These reviews also point to the actions and strategies adopted by third countries to secure their access to these resources in a context of growing competition for resources. The Industrial strategy also highlighted the need for supporting the financing of a green recovery and in that context initiatives such as the Directive on corporate sustainability due diligence which helps companies understand their value chains and ensure the sourcing is sustainable while contributing to its diversification where necessary.

Partnerships are one of the actions contributing to security and diversification of supply of raw materials, by mitigating the risks posed by structural external dependencies and concentration of supply. The partnerships are structured around three main pillars: raw materials value chains integration, between the EU and the partner country, the investment and business-oriented pillar; alignment on environmental, social and governance standards, the sustainability and accountability pillar; and cooperation on research and innovation along the raw materials value chain. In the case of developing countries partnerships on raw materials value chains have two additional pillars, with a focus on capacity building, training and skills along the value chain and deployment of infrastructure, in particular renewable energy infrastructure. The partnerships have a roadmap or action plan associated, identifying concrete actions of cooperation under each one of the pillars and the timeframe for implementation, in full alignment with the Team Europe approach. These partnerships are the political umbrella that aggregates existing cooperation actions and new actions at member state and EU levels, mobilizing funding instruments and investment, key investment entities as EIB, EBRD and the national investment banks. The EU industrial alliances also play a key role in the context of the partnerships.

Until now the EU has established bilateral partnerships with Canada (2021), Ukraine (2021), Kazakhstan (2022) and Namibia (2022). The EU will continue to implement this action, establishing partnerships with more resource-rich countries, including Norway, Greenland, Chile and Australia. Further partnerships are considered with countries in the EU neighbourhood, in Africa and Latin America.

The EU is also part of a multilateral partnership – the Minerals Security Partnership (MSP), a US led initiative, launched in spring 2022, aiming to catalysing investment from key partners and the private sector for strategic mining, processing, and recycling opportunities that adhere to the highest environmental, social, and governance (ESG) standards. Under MSP, the partners share information on critical raw material developments in third countries, identify investment opportunities and co-invest in mining, refining and recycling projects covering essential minerals for the clean energy transition such as: lithium, cobalt, nickel, graphite, rare earths, manganese and copper.

In 2020, the Commission announced the creation of the European Raw Materials Alliance (ERMA) as part of its Action Plan on Critical Raw Materials. The aim of the Alliance, which brings together industry, research and technology organisations, civil society, investors and public authorities, is to increase the resilience of critical raw materials value chains, further develop industrial capacities

[202] Chapter 5.1 of SWD(2021) 352, Strategic Dependencies and Capacities (check)

[203] Commission Staff Working Document: EU strategic dependencies and capacities: second stage of in-depth reviews (SWD(2022) 41 final)

and diversify sources of supply. In 2021, ERMA published its action plan that presents a list of specific actions and industrial projects in the area of rare earths and permanent magnets[204].

The Clean Technology Materials Task Force was established in October 2021[205] to mobilise funding and financing for investments in the critical raw materials value chain, to create a joint platform and to implement a structured dialogue between the Commission, industrial alliances and investors (i.e. European Investment Bank, European Bank for Reconstruction and Development, National Promotional Banks and Institutions).

There are also ongoing efforts to increase awareness, acceptance and trust when it comes to EU sourcing. For example, the EU principles for Sustainable Raw Materials were published in September 2021 aimed at aligning Member States' understanding of sustainable EU extraction and processing[206].

In addition, in line with the 2021 Action Plan on Synergies between civil, defence and space industries, the Commission is setting up the Observatory of critical technologies. The Observatory will identify, monitor and assess critical technologies for the space, defence and related civil sectors, their potential application and related value and supply chains. It will also identify, monitor and analyse existing and predictable technology gaps, root causes of strategic dependencies and vulnerabilities.

Finally, EU research and innovation (R&I) is another important avenue to reduce dependencies. EU R&I projects on critical raw materials help to develop domestic technological solutions, academic expertise, skills for students and workers, company know-how and IP. This enables refining, processing and recycling critical raw materials in a more sustainable and efficient way, also as a supplier of these technologies to third countries. The scope of the projects is the full critical raw materials value chain: exploration, extraction, processing, refining, recycling, substitution as well as non-technological projects on capacity building.

There are also two Commission expert groups which cover raw materials:

Raw Materials Supply Group

The creation and functioning of the Raw Materials Supply Group is governed by the horizontal rules published in Commission communication C(2010) 7649 on 10 November 2010.

The mission of the Raw Materials Supply Group is to exchange of views on the competitiveness and sustainable development of the non-energy extractive industry (NEEI). To analyse, discuss and exchange views on the supply of raw materials, with a focus on the sustainable competitiveness of the NEEI sector. Subgroups provide support for the legislator in the development and implementation of EU legislation and policies and develop actions to improve sector sustainability.

EIP Raw Materials

The European Innovation Partnership on Raw Materials was set up by a Communication from the European Commission (COM(2012) 82) to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions.

[204] Rare Earth Magnets and Motors: A European Call for Action. A report by the Rare Earth Magnets and Motors Cluster of the European Raw Materials Alliance. Berlin 2021

[205] ERMA celebrates its first anniversary working towards a more resilient and greener Europe

[206] Commission européenne, Direction générale du marché intérieur, de l'industrie, de l'entrepreneuriat et des PME, EU principles for sustainable raw materials, Publications Office, 2021, https://data.europa.eu/doi/10.2873/27875

The European Innovation Partnership on Raw Materials (henceforth "the EIP") has been instrumental in implementing the EU raw materials policy. It has been the main channel to reach out to high-level representatives from industry, public services, academia and NGOs as well as to wide expert community. Its mission is to provide high-level guidance to the European Commission, EU Member States and private actors on innovative approaches to the challenges related to all non-energy, non-agricultural raw materials (primary and secondary, biotic and abiotic).

ANNEX 9: SCOPE OF MEASURES

TABLE 4: Correspondence table: pillars, actions and scope of the Critical raw materials Act		
Pillars		**Materials scope**
A. Defining critical and strategic raw materials	-	-
B. Setting strategic raw materials targets	Targets for EU capacity	Only strategic raw materials
C.1 Monitoring and risk assessment	Assessment of criticality and strategic dimension	All non-energy, non-agricultural raw materials
	Risk assessment	Only strategic raw materials
C.2 Strategic stocks	EU level coordination and assessment of MS stocks	Only strategic raw materials
C.3 Company risk preparedness	Member States to set incentives to foster companies' resilience	Only strategic raw materials
D. Exploration efforts in the EU	Requirement for MS to develop and implement public exploration programmes	All critical raw materials
E. Support to the value chain	Selection of Strategic Projects, in the EU and abroad	Only strategic raw materials (also as by-products)
	CRM projects to be considered in spatial planning	All critical raw materials
	Mandatory measures to make permitting for Strategic Projects more predictable	Only strategic raw materials
	Access to funding instrument	All critical raw materials
	Privileged access to funding instrument	Only strategic raw materials
F. Waste legislation	Enabling measures and targeted revisions to waste legislation	All critical raw materials
G. Actions on standards for the critical raw materials value chain	Increase efforts to have EU rules and principles reflected in international standards + Mandate development of standards and standardisation deliverables regarding relevant industrial processes	All critical raw materials (but strategic raw materials could be prioritised in the development of methodologies)
H. Environmental footprint of critical raw materials	Set minimum requirements for certification schemes for sustainable CRMs + Require declaration of environmental footprint for CRMs sold in the EU incl. a mechanism for setting performance classes and maximum thresholds	All critical raw materials

9.1.14. Context

9.1.14.1. The green and digital transitions, as well as defence investments, depend on critical raw materials, leading to vastly increased demand in the EU and globally

The shift to a clean energy system, accelerated by the ongoing energy crisis, relies on decarbonised and notably renewable electricity produced from wind turbines and solar panels, transported through electrical grids, stored in batteries and hydrogen and used in electric vehicles and various other end applications, including heavy industry. The technologies that will realise the green and digital transitions require materials with very specific properties. These properties make the products more efficient or performant and cannot, in many cases, easily be replaced by other materials[207]. For instance, rare earth permanent magnets used in wind turbines and electric motors are more compact, resistant and efficient at converting energy; most solar panels are made out of silicon and certain doping elements; batteries that contain manganese, nickel and cobalt can store more energy at less weight compared with other various chemistries, making them ideal for use in electric vehicles; hydrogen electrolysers and fuel cells rely on platinum group metals to catalyse the chemical reactions taking place in them; connecting all of this are electrical wires made of copper and aluminium[208].

As the world shifts its energy systems to clean energy, demand for these raw materials is therefore projected to grow multiple times. At EU level, the JRC foresight report on Critical Raw Materials for Strategic Technologies and Sectors[209] shows that, with the current state of technology, the accomplishment of EU targets for the rollout of batteries, fuel cells, wind turbines and photovoltaics would require multiples of the current demand for lithium, graphite, cobalt, nickel and the rare earth elements dysprosium, neodymium and praseodymium (figure 2).[210]

[207] The Commission's work on the criticality of raw materials assesses price, performance, availability, production and criticality of substitutes per material.

[208] As explained in Textbox 1 and in more detail in section 5.2 and annex 5, copper, nickel and aluminium are not critical raw materials according to the current methodology, but likely candidates for the strategic raw materials list (and by implication of the future critical raw materials list). The other raw materials mentioned here are all currently on the critical raw materials list.

[209] EC, 2020. *Critical materials for strategic technologies and sectors in the EU - a foresight study*. https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf

[210] Note: Of these, only nickel is currently not classified as a critical raw material in the EU, but again likely to enter the proposed future list by virtue of its strategic importance and demand growth.

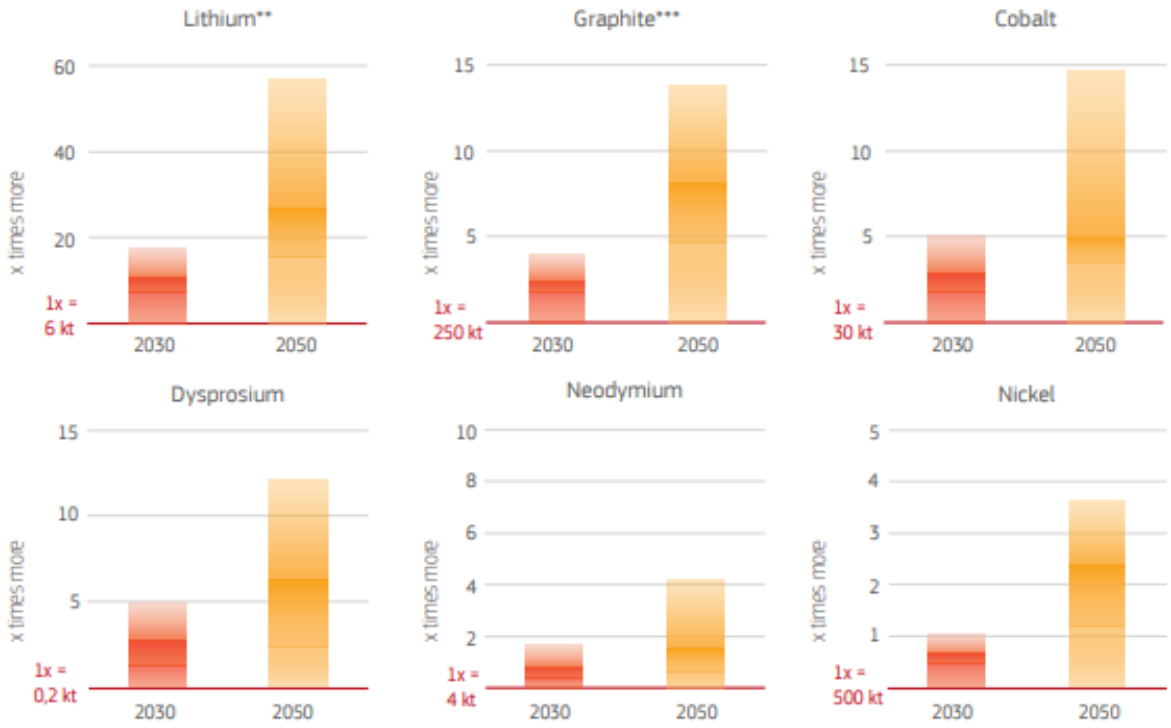


Figure 2: Material consumption for batteries, fuel cells, wind turbines and photovoltaics in 2030 and 2050 as a multiple of current (2020) EU consumption of the material in all applications[211]

At the global level, the International Energy Agency (IEA)'s 2021 Clean Energy Minerals report[212] predicts that total mineral demand[213] will increase by a multiple of between 2 and 4 times between 2020 and 2040,[214] and demand for battery-related materials such as lithium up to 42 times. Clean energy technologies are set to emerge as a major force in driving demand growth for critical minerals and the market value of energy transition minerals could overtake that of the global coal business sometime in the 2030s.[215]

For the digital transition, there has been less attention so far to the implications of the exponential growth of digital technologies to the demand for critical raw materials. However, the aforementioned JRC foresight study[216] identifies important dependencies of digital technologies including robotics, drones, 3D-printing, semiconductors and hard drives on critical raw materials. The exponentially growing number of chips and devices produced each year suggest that the digital sector could become a driving force for some critical raw materials: For tantalum, electronics is currently the main application and the growth of demand from this one sector could soon outpace

[211] EC, 2020. *Critical materials for strategic technologies and sectors in the EU - a foresight study*. https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf. Note: The different shadings refer to the low, medium and high-demand scenarios included in the report. The full height of the bars thus refers to the high-demand scenario. ** of refined supply (Stage II) instead of ore supply (Stage I) *** increase in demand of all graphite in relation to natural graphite

[212] IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*, IEA, Paris https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

[213] Including chromium, copper, lithium, nickel, cobalt, manganese, graphite, molybdenum, platinum group metals, zinc and rare earth elements.

[214] Page 46 of IEA (2021): Clean Energy Minerals.

[215] Page 47-48 of IEA (2021): Clean Energy Minerals.

[216] EC, 2020. *Critical materials for strategic technologies and sectors in the EU - a foresight study*. https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf

its current use in all applications. Similarly, indium, used in electronic displays and touch screens, has experienced a more than fivefold growth in primary production between 1993 and 2013.[217] At the same time, it is of growing concern due to the lack of substitutes, its extraction as a by-product from carrier metal ores, low recovery efficiency of processing and non-existent recycling at end of life.[218]

In addition, the intensifying geopolitical instability has increased the focus on ensuring EU's security and resilience. This has translated into increased defence budgets and defence procurement plans[219] and a need for industrial ramp up[220] but also heightened attention to ensure EU's autonomous access to space, including concerning the protection and development of the EU space assets, which constitute EU critical infrastructure. Against this background, the JRC foresight report provides an assessment of the raw materials dependencies of the defence and aerospace sector: "As with many other economic sectors, the EU defence industry relies on the use of a wide range of materials with unique properties that make them essential for the manufacture of components used in military applications because the use of substitutes does not always guarantee the same performance. For example, REE [rare earth elements] are indispensable in remotely piloted aircraft systems, precision guide munitions, targeting lasers and satellite communications. […] High-performing alloys that are used, for instance, in fuselages of combat aircraft, require specific raw materials such as niobium, vanadium or molybdenum. Other alloys are based on titanium, which provides high specific strength and corrosion resistance, at just half the weight of steel and nickel-based super-alloys." Regarding space applications, rare gas (e.g. high purity helium) are used for propulsion and lasers and show significant import reliance. Further investigations might be also needed for germanium substrates combined with gallium arsenide semiconductors, which enter in the composition of highly efficient solar cells used for satellite PV panels.[221] This being said, the demand for raw materials used in the production of defence applications is relatively a very small share of total raw materials consumption but important due to the considerable global rise in defence and security investment after the Russian aggression against Ukraine.

Textbox 3: Can material demand mitigation measures offset the need for more critical raw materials?

The projections discussed in this chapter rely on certain assumptions regarding economic growth, technological development and consumption patterns. Many stakeholders (in the context of the open public consultation and the call for evidence) have emphasised the need to critically assess these assumptions to identify whether the EU's increasing demand for critical raw materials could be offset by putting greater attention on demand mitigation and behaviour change.

Indeed, technological innovation has led to higher material efficiency also for critical raw materials: Over the past 15 years, the amount of platinum used per kW fuel cell capacity has declined by 80-90% in the automotive sector and there are plans to decrease this amount

[217] Tercero, L., Report on the Future Use of Critical Raw Materials. SCRREEN Project D.2.3, 2019. Quoted following EC, 2020. Critical materials for strategic technologies and sectors in the EU - a foresight study.

[218] Ciacci, L., T.T. Werner, I. Vassura, and F. Passarini, 'Backlighting the European Indium Recycling Potentials', Journal of Industrial Ecology, Vol. 23, No. 2, 2019, pp. 426–437. Quoted following EC, 2020. Critical materials for strategic technologies and sectors in the EU - a foresight study.

[219] In particular, according to the European Defence Agency's data, defence spending within the EU grew in 2021 to €214 billion. This is a **6% increase compared to 2020.**

[220] Joint Communication on the defence investment gaps analysis and way forward of 18 May 2022, JOIN(2022) 24 final

[221] Joint foresight report of JRC and GROW (update in preparation).

further.[222] In the case of batteries, a clear trend to reducing the quantity of cobalt due to price and sustainability concerns is visible,[223] though this goes hand in hand with a higher consumption of nickel, which while not currently on the EU's list of critical raw materials is among the materials considered at risk of future short supply.[224] There are also efforts by wind turbine and electric vehicle motor manufacturers to reduce the quantity of rare earths in permanent magnets, though these show trade-offs between compactness, reliability and CRM content.[225]

In terms of behavioural changes, the two most relevant scenarios would be decreased electricity demand and a shift in mobility patterns, potentially including greater use of public transport, shared mobility services and autonomous vehicles – as electricity generation and mobility are the dominant sectors driving increasing demand for critical raw materials. As regards electricity consumption, projections aligned with the EU's 2030 and 2050 climate and energy goals assume that total electricity demand in the EU will increase, from 2900 TWh in 2018 to 3100 TWh by 2030 and to 6900 TWh by 2050.[226] This is despite significant energy efficiency increases being assumed in the scenario, and mainly due to the significant increase in electricity demand for electric mobility, heat pumps and the production of hydrogen and e-fuels. Since political targets for the expansion of renewable energy have been set, it can additionally be assumed that a reduced electricity demand would lead to a faster phase-out of fossil fuel-based electricity generation rather than a decreased demand for renewable energy technologies and the critical raw materials embedded in them.

As for changes in transport patterns, the JRC's Future of Road transport reviews different studies and scenarios on the impact of car sharing, automated vehicles and societal attitudes to transport systems.[227] It concludes that "Both a decline or increase in travel activity are possible, depending on the new opportunities enabled by disruptive technologies and services, although the evidence until now suggests that increases in vehicle travel activity are likely to occur for both passenger and freight transport." It also highlights the existence of rebound effects and induced demand from cheaper travel in connected and autonomous vehicles, and the potential for new business models to extending the lifetime of electric vehicle batteries through remanufacturing and repurposing.

While both the IEA and JRC studies cited in this chapter do not explicitly account for uncertainties related to behaviour change,[228] they do take into account and provide different scenarios regarding technological developments, including substitution of critical raw materials, and speed of uptake of clean energy technologies. Figure 3 (left), for example, shows the size of the electric vehicle/plug-in hybrid electric vehicle fleets assumed in the low-, medium- and high-demand scenarios of the JRC foresight study.[229] Figure 3 (right) shows the impact of different technological assumptions for renewables- and network-related technologies on demand for copper, silicon and rare earth elements in the IEA study.

[222] These numbers refer to the case of the Toyota Mirai, for which the use of platinum declined by three quarters and then by another third from the prototype in 2008 to the second generation in 2020. Source: Page 113-115 of IEA (2021): Report on Clean Energy Minerals/James et al., 2018.

[223] Page 90-92 of IEA (2021): Report on Clean Energy Minerals

[224] Page 118 of IEA (2021): Report on Clean Energy Minerals; KU Leuven/Eurometaux (2022): Clean Energy Metals.

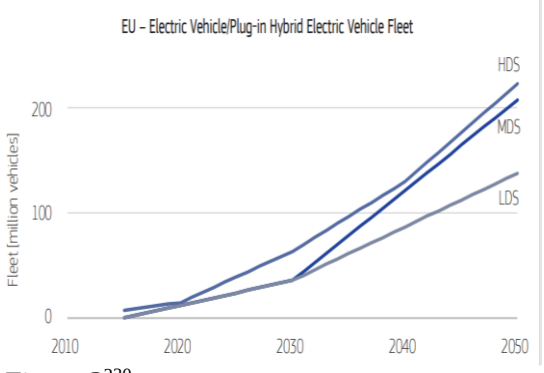
[225] JRC (2020): The role of rare earth elements in wind energy and electric mobility

[226] Source: Impact Assessment accompanying the Communication "Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people", SWD(2020) 176 final.

[227] JRC, 2019. The future of road transport - Implications of automated, connected, low-carbon and shared mobility, doi: 10.2760/668964, JRC116644.

[228] Source: Page 86 of IEA (2021): Clean Energy Minerals; information provided by JRC.

[229] JRC (2020): Critical materials for strategic technologies and sectors in the EU - a foresight study.



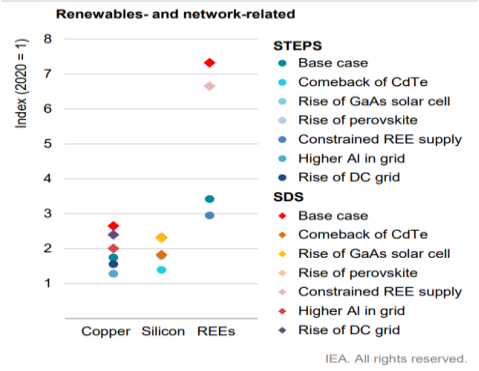


Figure 3[230]

In conclusion, there is much scope for material efficiency improvements, substitution and behaviour change to reduce the demand for critical raw materials. Such efforts can be supported not only through research funding but also through business model innovation and greater societal awareness. While such developments would somewhat alleviate the pressure, the scenarios considered in the aforementioned studies show that, while the exact level varies, a significant and challenging growth, adding to the already high supply concentration today, is certain. A different question is from which sources (primary or secondary raw materials production) this demand is met. This is discussed in the following section.

9.1.14.2. Significant supply-demand gaps for critical raw materials are projected in the medium term

While global demand is set to increase significantly for a wide range of raw materials used in clean energy and digital technologies, and more dramatically for a smaller set of raw materials used in batteries and permanent magnets, global supply is currently not projected to grow sufficiently to meet this demand without substantial price increases.[231] According to the IEA Report on Clean Energy Minerals, the required level of supply growth for most minerals under the Sustainable Development Scenario (SDS) is well above the levels seen in the past decade. For example, between 2020 and 2040, annual average demand growth for nickel and cobalt is projected to be two and five times higher, respectively, than the levels seen between 2010 and 2020.[232]

As explained in textbox 3, the raw materials value chain consists of different steps, each of which require significant time and investments to build up or expand. Supply and investment plans analysed by the IEA show a gradual increase in production over the next years, but these are far from sufficient to support accelerated energy transitions (e.g. for lithium, mines currently operating or under construction are set to produce around 1 000 kt of lithium carbonate equivalent but the primary demand under the SDS will be around 2 600 kt).[233] Several factors, including project development lead times, declining ore quality, increased ESG scrutiny and climate risks, are likely to hinder or delay the supply expansion necessary to meet demand.[234] Additionally, the fact that many critical raw materials are produced as a by-product of other raw materials (e.g. gallium and

[230] Left: Page 21 of JRC foresight report; right: Page 52 of IEA (2021): Clean Energy Minerals.
[231] It should be noted that this perspective, because it focuses on project pipelines, does not take into account economic incentives for expanded production (for the supply side) or reducing consumption (for the demand side). However, several factors mentioned in this section (notably the long lead times, and the by-product relationships) make it likely that the current pipeline.
[232] Page 120 of IEA (2021): Clean Energy Minerals.
[233] Page 119 of IEA (2021): Clean Energy Minerals.
[234] Pages 122-131 of IEA (2021): Clean Energy Minerals.

germanium as a by-product of copper production), makes their supply inflexible, as their supply depends on the economic incentives to produce their higher-volume carrier metals.

Textbox 4: Stages of the critical raw materials value chain

Most critical raw materials are metals and follow a typical value chain, shown in Figure 4. The first stage, **exploration**, consists in identifying a deposit of a certain mineral or metal and ascertaining that it is technically and economically recoverable. Based on general exploration by public authorities (geological surveys) and research institutions, exploration companies conduct targeted exploration through geological mapping, geophysical surveys, geochemical surveys and drilling. While not the most capital-intensive, this stage is characterised by high risk, as only a fraction of exploration ventures lead to successful mining projects.[235] Companies are categorised into junior (which are often founded for one specific exploration project, usually have no operating revenue and rely on equity financing) and major, or senior, companies (who are already active in the mining business, finance themselves mainly from operating cash flow and often buy projects from junior companies once their viability has been demonstrated).

The following stage is **mining**, or more generally **extraction**,[236] i.e. the development of the actual mine and of the surrounding infrastructure, as well as its operation. The development of mining projects can take a long time – according to the IEA on average over 16 years from discovery to first production but with strong variation by country and raw material[237] – and is capital-intensive and risky, as uncertainties surrounding the ore quality, cost increases, market swings and problems with permitting or social resistance can still lead projects to fail. In this time, the site has to be planned, its environmental impacts assessed, feasibility studies conducted (in multiple rounds, from an initial economic assessment to a bankable feasibility study, reflecting greater knowledge of the orebody, the design of the operation and the project's financing structure of the project) and permits requested.

In the **processing** stage, which may be located on the same site as the mine or elsewhere, depending on the mineral and the site's specificities, the ore that has been extracted at the mining stage is **beneficiated**, i.e. separated from economically worthless material, through crushing, roasting, magnetic separation, flotation or leaching, to get an ore concentrate (this is the "mineral processing" stage shown in figure 4). A second step in getting from ore to metal, sometimes included under the heading of processing, is the **smelting or refining** step. Operations here are metallurgical, and can be classified into hydrometallurgy (involving aqueous solutions), pyrometallurgy (high-temperature processes) and electrometallurgy (involving electrical energy). The result of this process is a purified metal or metal compound, with the level of purity achieved depending on the required grade. This stage, especially the smelting/refining part, requires significant amounts of energy. While generally not as impactful on the environment, also this stage requires substantial investment into specialised industrial plants, which also require permits. The level of risk, and the margins for producers, are generally smaller than at the processing stages, though also affected by fluctuations in material prices, and in particular of energy prices.

While the manufacturing step depends very much on the application (from steel and alloying plants to chemical operations, battery manufacturing and many more), the **recycling** stage again revolves around raw materials and has some typical features: After collection and, depending on the waste stream, sorting and removal of hazardous waste, material recycling is done in smelting plants, sometimes in specialised recycling smelting plants, sometimes through mixing of

[235] Several studies have estimated that the success rate of mineral exploration varies from 0.03% to less than 1%. This means that only 1 exploration target will get to the development phase out of a variable amount of exploration targets (3000 to 100). Source: Regueiro y González-Barros, Manuel & Espi, Jose. (2019). The returns on mining exploration investments. BOLETÍN GEOLÓGICO Y MINERO. 130. 161-180. 10.21701/bolgeomin.130.1.010. Also: Minerals Intelligence Capacity Analysis : Fact Sheet exploration stages, 163b11a7-d944-494e-a21e-a8f81ce8b175 (geus.dk)

[236] For lithium, for example, liquid brine extraction is a common extraction method. However, it is similar to mining in most of the described characteristics.

[237] Page 12 of IEA (2021): Clean Energy Minerals

primary and secondary inputs (which, depending on the composition of the inputs, can often meet the same quality requirements as the primary production). This means that the recycling stage is in many respects identical to the smelting stage, exposed to high energy costs and relying on specialised installations. The main added difficulty relates to the proper and separate collection that has to precede any recycling, as well as the complexity of the manufactured goods to be recycled where 1) the metal to be recycled is too low in concentration (by design) to be economically retrieved and 2) the metal compounds or alloys artificially created during manufacturing process can be much more complicated to dissemble than naturally occurring ones.[238]

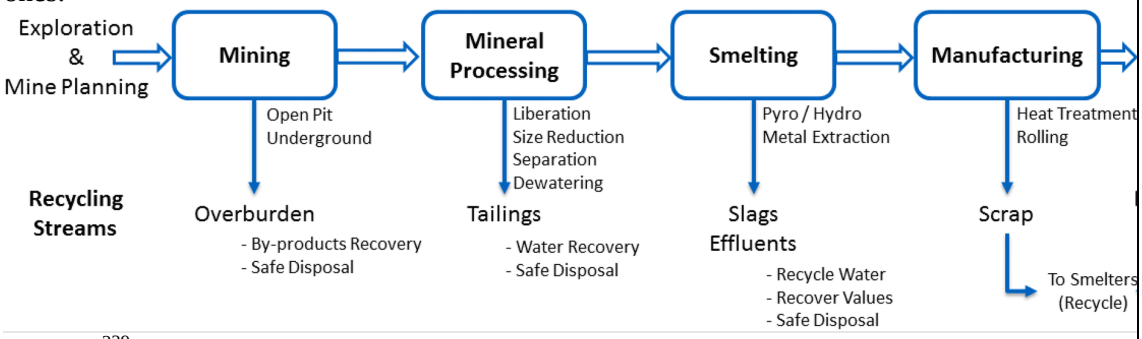


Figure 4[239]

Description based on: The stages of mining: 5 lifecycle processes explained - Crux Investor; Canada's critical minerals strategy: Discussion paper - Canada.ca; Exploration Methods: Common Ground (nsw.gov.au); Canadian Mineral Exploration Information Bulletin (nrcan.gc.ca); Materials processing | Definition, Examples, Types, & Facts | Britannica

A study by KU Leuven/Eurometaux on "Metals for Clean Energy" (2022)[240] provides detailed projections on both supply (operating, base case and best case) and demand (based on the IEA scenarios and different assumptions regarding the EU's role in the different steps of clean energy value chains) for aluminium, copper, nickel, zinc, silicon, lithium, cobalt, and the rare earth elements dysprosium, neodymium and praseodymium.[241] On this basis, it identifies that for copper, lithium, nickel, cobalt and the three rare earth elements, even the current best case supply scenario would not allow to meet demand under the IEA's Sustainable Development Scenario during the decade 2020-2030[242], such that supply bottlenecks could lead to commodity price fly ups, or will need further increased innovation and substitution efforts and consumption changes. In the worst case, this could lead to a delay of technology updates.

The study takes into account the contribution of secondary raw materials supply, based on available supply from products coming to their end-of-life and assumed average recycling rates. It projects that secondary raw materials supply could satisfy a growing share of demand by the 2030s, achieve peak primary metals demand in Europe around 2040, and, by 2050, provide more than half of the demand for most analysed metals, and over 75% for lithium and rare earths. In the short to medium term, however, secondary raw materials production will not be able to make a significant difference, as the strong growth of renewable energy and electric mobility has only begun recently,

[238] Ferrous and non-ferrous recycling: Challenges and potential technology solutions. Leslie Brooks Gabrielle Gaustad Adam Gesing Teija Mortvedt and Felipe Freire. https://doi.org/10.1016/j.wasman.2018.12.043

[239] Future of Mining, Mineral Processing and Metal Extraction Industry | SpringerLink

[240] KU Leuven/Eurometaux (2022): Metals for Clean Energy. Metals Clean Energy (eurometaux.eu)

[241] Of these, silicon, lithium, cobalt, and the rare earth elements are currently on the EU's List of critical raw materials, while aluminium, copper, nickel, zinc are not.

[242] Note: For aluminium, the best case supply would be sufficient, but not the base case, such that further investment is required. For zinc and silicon, no issues are expected.

and therefore the amounts that can be recovered in the next years would not grow as fast as demand.[243]

Focusing on the EU's ambitions for renewable energy, the demand for rare earth permanent magnets will increase five-fold compared to present levels to meet REPowerEU's objectives of tripling wind power capacities by 2030.[244] This comes in addition to a projected increase of EU demand from e-mobility as rare earth permanent magnets are used in the traction motors of electric vehicles. However, the global supply, determined by reserves and presently planned projects, would only double by 2030, which is likely to be insufficient to meet the global and EU demand.[245] This potential gap extends to other critical raw materials, notably to battery raw materials. Based on current projections and planned capacities, demand would not be met by corresponding supply for lithium, cobalt, manganese and nickel.[246]

All projections therefore underline the need to expand primary production, and to ensure EU access to it. Furthermore, the need to develop domestic circular supply chains is crucial as well as the development and deployment increasingly of new technologies that need less of these critical materials and or allow for larger amounts of reuse and recycling.

9.1.14.3. Supply of critical raw materials at both the extraction and processing stage is highly concentrated

Figure 5 shows the supply concentration, along with the level of governance of producing countries,

[243] KU Leuven/Eurometaux: Metals for Clean Energy.

[244] "Supply chain challenges: Wind Turbines and magnets" Science for Policy Brief, 1 July 2022, Joint Research Center, European Commission" Note: The over-proportional increase in demand for rare earth elements stems from the fact that in particular the offshore and large-scale wind turbines contain large amounts of rare earth elements.

[245] Idem.

[246] "Supply chain challenges: batteries" Science for Policy Brief, 1 July 2022, Joint Research Center, European Commission". Note that nickel is currently not on the EU List of critical raw materials.

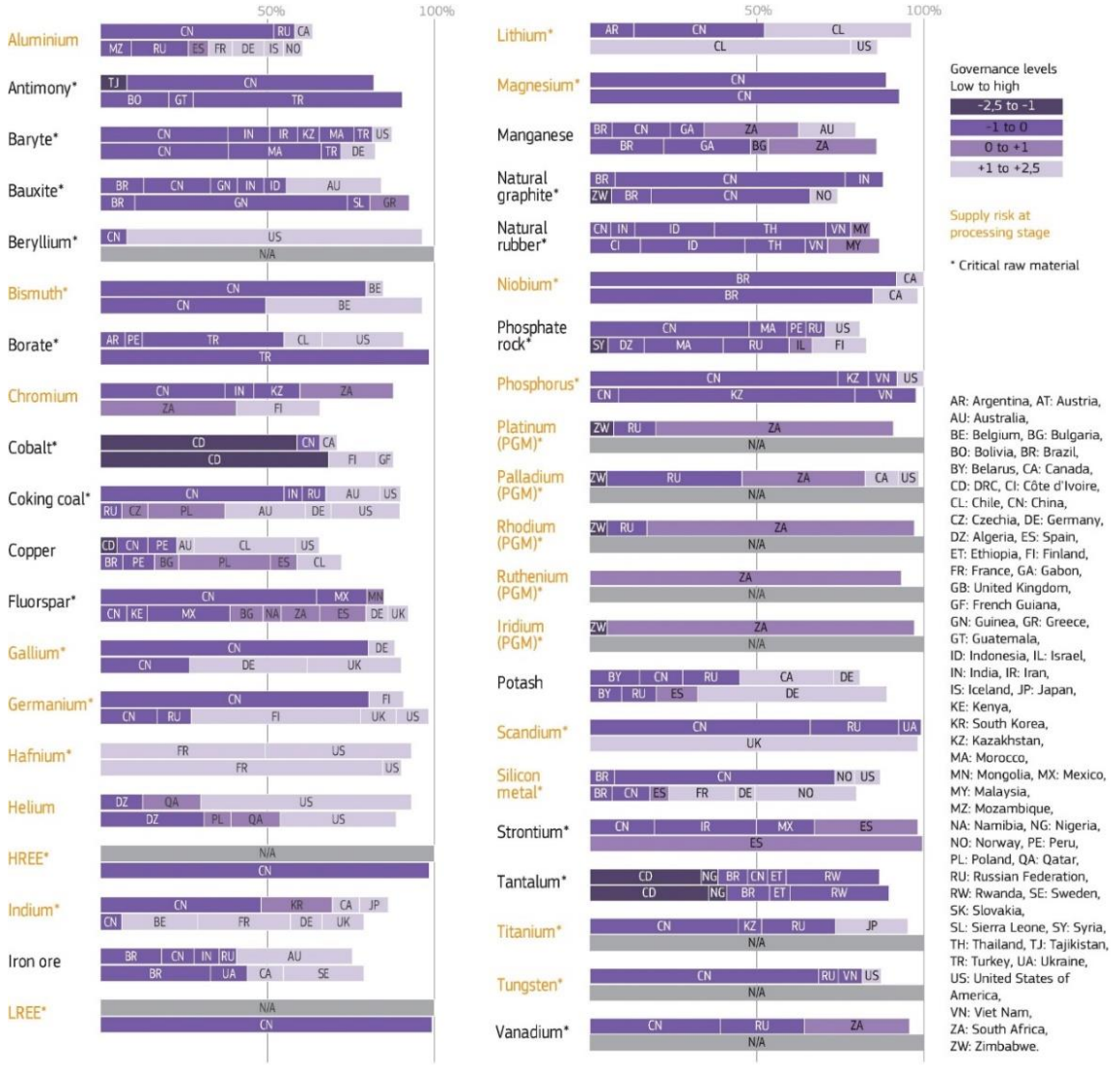


Figure 5: Geographical concentration of global production (upper bar for each material) and supply to the EU-27 (lower bars) (average 2012-2016) and the corresponding governance level in producing countries (2016).[247]

It is important to note that in addition to a concentration of the share of supply in certain countries, risks may also exist due to supply-side concentration where certain companies represent a large share of supply to the EU of a given critical raw material. This may be the case where companies own mining and/or refining assets across multiple countries. Similarly, problematic supply concentration may occur where a certain third country (for example via state-owned enterprises) controls mining and/or refining assets not just in the country itself, but also across other countries.

Figure 6 from the IEA Clean Energy Minerals report shows this more vividly for a smaller set of raw materials[248]: At both the extraction and the processing stage, there is a higher level of concentration than for the main fossil fuels. Also noteworthy is that while different countries

[247] Source: JRC Raw Materials Scoreboard 2021, Indicator 9: Geographical concentration and governance
[248] IEA (2021): Clean Energy Minerals. Note again that Copper and nickel are not currently on the EU List of critical raw materials but at risk of short supply in the future.

dominate the extraction stage, China has gained a dominant position at the processing stage for all of them.[249]

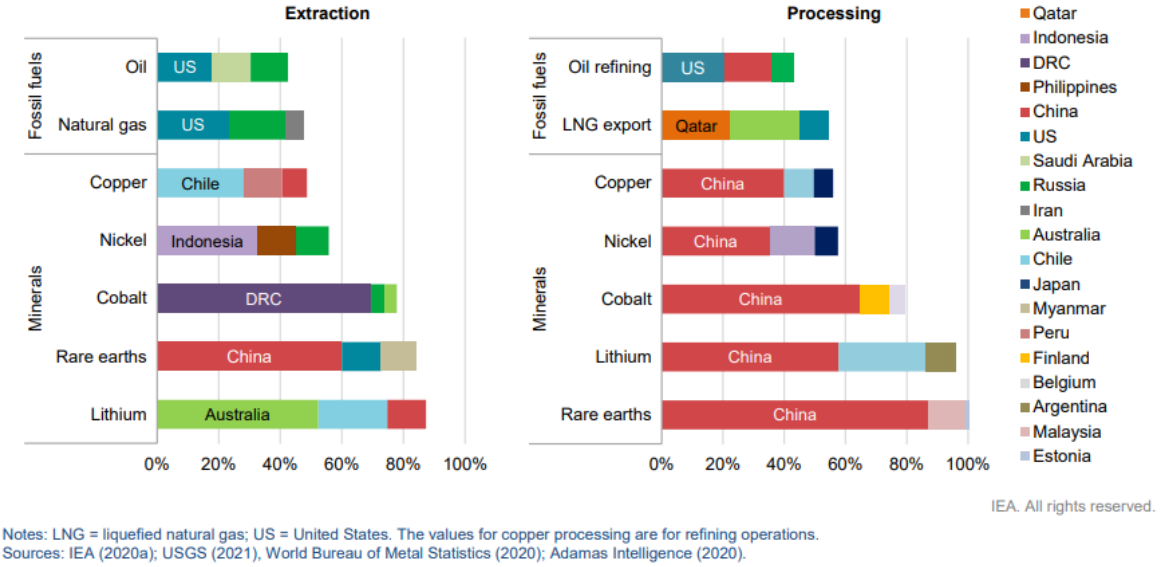


Figure 6: Share of top three producing countries in production of selected minerals and fossil fuels (IEA)[250]

Overall, the context suggests that critical raw materials markets, which are already highly concentrated, are likely to be put under strain by significantly increased demand, to which supply, especially in the EU, is expected to only be able to react gradually. This will likely lead to a sustained period of economic and geopolitical competition as well as high and volatile prices for critical raw materials – putting the EU's secure and sustainable access to critical raw materials at risk.

9.1.15. Consequences of the problem

If the EU does not contribute to the need of ramping up CRM globally by developing alternative European sourcing of CRMs, the EU's reliance on highly concentrated imports might continue with the corresponding identified risk for the EU economy:

9.1.15.1. Risk of future geopolitical vulnerability

A new geopolitics of resources is emerging, where critical raw materials such as lithium or rare earths could take the role that oil and gas held in the fossil fuel economy.[251] While their direct economic value is currently significantly smaller, it is projected that the market size for a set of raw materials used in energy applications could overtake the global coal business in the 2030s[252]. They are also significantly more concentrated in their sourcing and/or processing than fossil fuels (see figure 6 above).

[249] See also: Castillo, Purdy (2022): China's Role in Supplying Critical Minerals for the Global Energy Transition. What Could the Future Hold? LTRC_ChinaSupplyChain.pdf (brookings.edu)
[250] IEA (2021): Clean Energy Minerals. The Role of Critical Minerals in Clean Energy Transitions – Analysis - IEA
[251] Cf. 2022 State of the European Union speech
[252] Cf. page 10 of IEA (2021): Clean Energy Minerals. Note that this figure includes copper, nickel and manganese, which are currently not listed on the EU's List of critical raw materials.

In case of future geopolitical tensions, exports of critical raw materials to the EU could be curtailed, where the resulting shortage and price spike could lead to economic disruptions. The clearest example of this occurred in September 2010, when China, in the context of a territorial dispute with Japan over the Senkaku islands, halted all exports of rare earth elements to Japan. While only temporary and subsequently settled through WTO dispute settlement, this disrupted industrial production in Japan, triggered a significant price spike on global markets and led to global efforts to find alternatives to the Chinese-dominated rare earths value chain.[253] Another example of this dynamic is the ongoing energy price crisis resulting from Russia's military aggression in Ukraine: Prior to the war, Russia supplied 40% of the EU's natural gas consumption.[254] The ongoing crisis and recession are a demonstration of how costly and politically challenging the replacement of one dominant supplier in a vital input to our economy is. Russia, importantly, is also a major exporter of some critical raw materials, notably of palladium and nickel,[255] imports of which to the EU have not been covered by sanctions. Geopolitically relevant supply risks are also evident in the area of defence and aerospace, where the EU is currently highly dependent on imports of certain critical raw materials that are used in military and aerospace equipment. For example, the import dependence for titanium metal (with a majority of aerospace-grade titanium coming from Russia in 2022) and beryllium, used in air- and spacecraft, is 100%, and for tungsten, used in weapons and ammunition, 59%, and supply for both is also highly concentrated[256]. These metals are also important for other sectors of the EU economy.

9.1.15.2. Risk of adverse environmental and social adverse effects

If not properly managed, extraction, processing and waste treatment operations of critical raw materials, can have negative impacts on the environment and on populations living close to them.[257]The EU's import dependency means that these impacts mostly happen in third countries, often with relatively low levels of governance[258], and that CRM use is associated with high transport emissions. The negative impacts associated with producing CRMs have to be seen in perspective with the positive environmental effects of their applications (clean energy, reduced fossil fuel extraction, digitally enabled services, etc.). However, if left unmitigated, the potential impacts (e.g. water use, loss of ecosystems and biodiversity) associated with an exponential increase in the use of critical raw materials, notably in these third countries, would still risk undermining the achievement of EU and international objectives to transition to a climate neutral economy with low environmental impacts overall.

[253] Guillame Pitron (2022) The Geopolitics of the Rare-Metals Race, The Washington Quarterly, 45:1, 135-150, DOI: 10.1080/0163660X.2022.2059146 (p.140)

254 In focus: Reducing the EU's dependence on imported fossil fuels | European Commission (europa.eu)

[255] The supply of critical raw materials endangered by Russia's war on Ukraine (oecd.org); Securing EU critical raw material supplies after Russia's war | Comment | Encompass (encompass-europe.com). Note that nickel is not currently on the EU's list of critical raw material but a candidate to enter it as described in textbox 1.

[256] For further information, please refer to: C.C. Pavel, E. Tzimas, Raw materials in the European defence industry, JRC Science for Policy Report, 2016. https://setis.ec.europa.eu/system/files/2021-02/raw_materials_in_the_european_defence_industry.pdf

[257] Mononen, Kivinen, Kotilainen, Leino (2022): Social and environmental impacts of mining activities in the EU. Study requested by the PETI Committee of the European Parliament. Social and environmental impacts of mining activities in the EU (europa.eu)

[258] JRC (2019), Mapping the Role of Raw Materials in Sustainable Development Goals. A preliminary analysis of links, monitoring indicators, and related policy initiatives. EUR 29595 EN, Publications Office of the European Union, Luxembourg, 2019 ISBN 978-92-76-08385-6, doi:10.2760/026725, JRC112892.

9.1.15.3. Risk of unforeseen disruptions to industrial supply chains

In a context of structural supply challenges, short-term shortages or supply challenges are more likely to materialise and to severely affect the industrial base, as evidenced by e.g. the semiconductor shortage. In the 2020-present chips shortage, unavailability of an early stage input led to production curtailment of major downstream sectors (especially automotive) and economy-wide damages. The insurer Allianz estimates that the lack of chips in 2020 and 2021 cost EU-based carmakers around EUR 100 billion.[259,260] Similar scenarios may concern critical raw materials. Given the significant investments and lead times (see textbox 4 in Annex 10), supply for critical raw materials is particularly inflexible in the short term, and with their currently high supply concentration, political instability, trade dispute or natural disasters could lead to simultaneous disruptions in the major producing sites, thus producing a shortage that could only be addressed by price spikes shedding demand and thereby affecting large downstream industries from steel and alloy manufacturing to electric vehicles and renewable energy. However, if price spikes can be partly handled by industry, the fact that some CRMs are indispensable (with no known substitute and sometimes in very low concentrations) to some key components of the industry (e.g. heavy rare earth elements in magnets), a lack of access to CRM could lead to a major disruption of entire value chains in the EU (from electric mobility to defence and renewable energy production).

Evidence that such unforeseen disruptions can occur (though so far with limited downstream effects) include the magnesium shortage in the fall of 2021 (caused by China's energy prioritisation[261]) during which the import price in EU jumped from EUR 2 000 to over EUR 10 000 per metric tonne in less than a month (The EU is 100% dependant from third countries for raw magnesium metal imports). A second example is nickel whose prices spiked following the Russian invasion of Ukraine before going back to pre-war level in the following months, leading the London Metals Exchange to put a momentary halt to nickel trading in the early days of the invasion.[262]

9.1.15.4. Risk of high and volatile prices delaying the green transition

Besides the risk of unforeseen disruptions occurring, a structural shortage of critical raw materials and rising uncertainty would lead to increased and volatile prices. The price of lithium for instance has risen more than 10-fold between 2020 and 2022.[263] Such increases could derail clean energy projects in planning and make the achievement of the EU's climate and renewable energy targets more difficult to reach and costly. These possible disruptions or a structural undersupply of critical raw materials are difficult to take into account for projections for the expansion of renewable energy, hydrogen, electric mobility, etc...

The IEA Report on Clean Energy Minerals for example discusses the case of lithium-ion batteries, whose price had fallen dramatically over the 2010-2020 decade, reaching USD 137/kWh in 2020.[264] Further reductions along this learning curve and stable prices are assumed in the model that achieves the IEA's Sustainable Development Scenario, but given the rising share of costs that

[259] https://www.allianz.com/en/economic_research/publications/specials_fmo/Europe-automotives.html

[260] Ref. EU Chips Act Staff Working document – to complete

[261] For further details, refer to the publication of the in-depth review on strategic dependencies published in 2022.

[262] https://www.ft.com/content/e691a6fd-b4a8-4002-ae04-d58c46ae9a40. FT: "Nickel dogged by liquidity concerns and price volatility"

[263] https://tradingeconomics.com/commodity/lithium. In late 2017 the price of lithium carbonate in CNY per tonne was trading around 160,000, in late 2020 it was around 40,000 (minus 75% in two years) and as of December 2022 at close to 600,000 (plus 1400% in three years).

[264] Page 107 of IEA (2021): Clean Energy Minerals.

raw materials now account for, this development is becoming uncertain.[265] For example, according to IEA, a doubling of lithium or nickel prices would induce a 6% increase in battery costs. If these events happen at the same time, the cost increase would eat up the anticipated learning effects associated with a doubling of capacity.[266] According to BloombergNEF, this development has led to the first price rise for electric vehicles (EV) batteries in 2022 up to USD 151/kWh, further away from the price of USD 100/kwH usually assumed to be needed for cost competitiveness with combustion cars[267]. There is also evidence that surging materials prices, along with more expensive transportation and financing, have driven the costs of wind turbines and solar panels up between 10 and 20 per cent in 2022 and thus potentially undermining the competitiveness of the European renewables industry.[268] Similar considerations may apply to elevated critical raw materials prices delaying investment into the digital transition and into defence and security, but such analysis has so far not been published.

9.1.15.5. Risk of dominant critical raw materials suppliers leveraging market power in downstream industries

The high concentration of critical raw materials supply gives critical raw materials producers substantial market power (whether they are companies or states), impacting the pricing mechanism and price-competitiveness for important industries such as clean energy and high tech. Such market power is due to a combination of natural favourable occurrences, active industrial policies, including acquisitions by state-owned companies of mines in third countries[269][270], and outright dumping[271]. More recently, considerations by some countries of creating a supply cartel for certain critical raw materials to maintain elevated raw material prices have been made public[272].

Through such coordination but also on their own, critical raw materials-producing countries are explicitly aiming to move up the value chain and leverage their dominance at the extraction stage to move into processing and refining and ultimately, into manufacturing of end products, such as magnets, batteries, electric vehicles or wind turbines.[273,274,275] While aspirations to increase value addition is a legitimate policy objective, supported under strategic partnerships, for third countries just as for the EU, it should not be achieved through distortive practices such as dual pricing, export taxes or export bans. As of 2018, 20.5% of platinum, 22.0% of copper, 73.3% of rare earth minerals, 77.9% of cobalt and 92.1% of tungsten supply globally was subject to some form of

[265] Page 107 of IEA (2021): Clean Energy Minerals. See also: E-Mobilität: Preise für E-Autobatterien sinken langsamer als angenommen (handelsblatt.com)
[266] Page 107 of IEA (2021): Clean Energy Minerals.
[267] FT: Electric car battery prices rise for first time in more than a decade
[268] Rising prices and supply chain risks threaten Europe's renewable aims | Financial Times (ft.com)
[269] A Power Struggle Over Cobalt Rattles the Clean Energy Revolution - The New York Times (nytimes.com); Studies Reveal China's Dominant Position in High-Tech Minerals (voanews.com)
[270] Such acquisitions by state-owned companies of mines in third countries mean that a simply country-by-country comparison of supply rates to the EU may not show the full picture of supply concentration (e.g. in a case where a certain country has significant domestic mining assets and controls further such assets in other third countries via state-owned companies).
271 See e.g. EU takes action on dumped calcium silicon from China (europa.eu)
[272] Indonesia considers Opec-style cartel for battery metals | Financial Times (ft.com), Métaux stratégiques : et si les pays producteurs se regroupaient en cartel du type OPEP ? (theconversation.com)
[273] On China: China Is Moving Rapidly Up the Rare Earth Value Chain – BRINK – Conversations and Insights on Global Business (brinknews.com); How long will China's dominance of rare earths last? Investment Monitor (mining-technology.com)
[274] On Indonesia: Indonesia bans mineral exports to move up value chain – Asia Times; Indonesia's Nickel Industrial Strategy | Center for Strategic and International Studies (csis.org)
[275] General overview: Export taxes and other restrictions on raw materials and their limitation through free trade agreements: Impact on developing countries (europa.eu), table 5

export restriction.[276] This could be a threat for large European manufacturing industries such as the wind and automotive sectors.

In addition, concentration at the supply level by non-EU producers (countries or companies) may also result in increased prices for downstream industries reliant on these input materials.

9.1.16. What are the sub-problems and their drivers?

9.1.17. Sub-problem 1: Insufficient anticipation and mitigation of supply risks

9.1.17.1. Driver 1.1: Lack of systematic monitoring and risk preparedness

Given the increasing risk of CRMs shortages, both structural and acute, as well as recent experiences of Covid-19-related supply chain disruptions, there is rising awareness among EU companies that there is a need to develop risk management tools. Companies in the open public consultation reported having suffered from the price volatility (34%), supply disruptions (29%) and supply shortages (22%) in their supply of CRM in the last 5 years, while only 4% reported not having experienced any supply problems. Their supply of CRMs is deemed for at risk than their supply of other inputs by 26% of companies, with only 3% disagreeing[277].

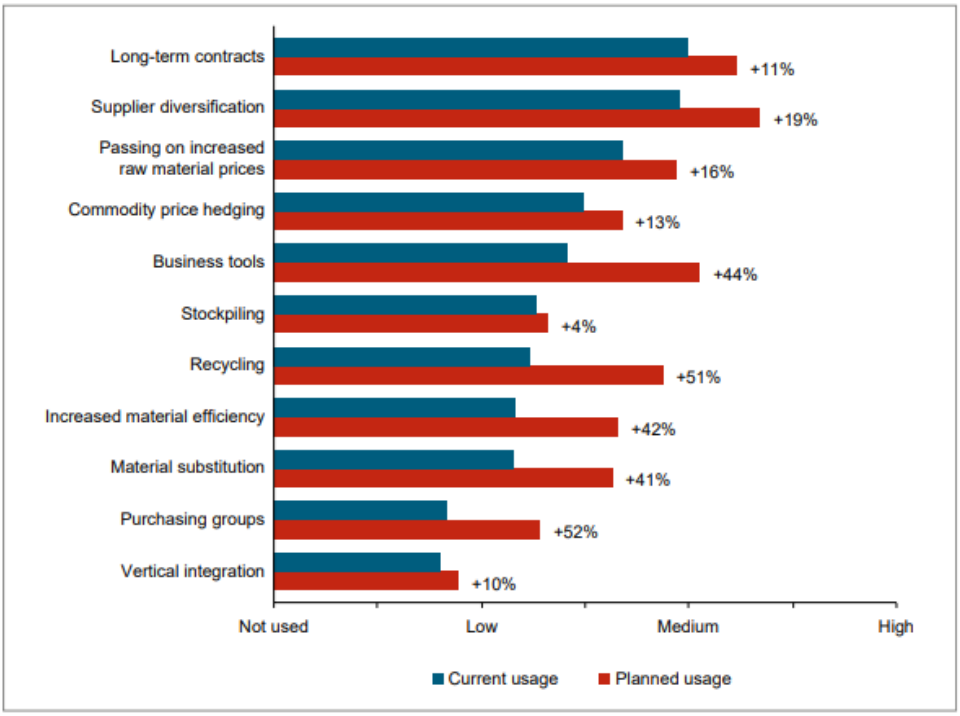


Figure 2: Usage of strategies for securing raw material supplies in the companies surveyed

Figure 7: Usage of strategies for securing raw materials supplies in the companies surveyed by PWC/DERA (2022)[278]

[276] JRC Raw Materials Scoreboard 2021, Indicator 10: Export restrictions, based on OECD and World Mining Data.
[277] The other companies did not express an opinion on this question.
[278] KÖSTER, H., NEUBERT, F. P., DIERKSMEIER, K., ADELMANN, L., LENTGE, H., SCHMIDT, P. (2022): Securing raw material supply: Benchmarking of measures of foreign manufacturing companies and recommendations for action. – DERA 5RKVWRI¿QIRUPDWLRQHQ, 52: 172 p., Berlin.

A study by PWC, commissioned by the German Resource Agency DERA[279], investigated which strategies leading international companies use to ensure their supply security. The results, presented in Figure 7, show the variety of approaches, from business tools over supplier diversification and stockpiling to material substitution and recycling. It also evidences the fact that many companies are not yet using these approaches but planning to use them in the future.

This study provides an indication of what large companies with experience and sophistication in managing critical raw materials supply risks consider effective strategies. There is evidence, in particular for the case of stockpiling/increasing inventories (the most easily quantifiable of the measures), that these strategies have been made use of in the context of recent supply chain shortages such as the chips shortage.[280] A survey conducted by the German Chamber of Industry and Commerce (DIHK) among its member firms in the summer of 2021 finds that 57% of companies across all sectors intend to increase their stockpiling in order to secure their own production capacity. 17% of companies reported the use of recycling and substitution.[281]

However, risk management by companies might not be sufficient to address the growing challenges since there is a geopolitical dimension to the problem and the often complex and opaque value chains for critical raw materials markets require a level of sophistication that most companies do not possess.

In the open public consultation, the views on this issue are nuanced: Only 29% of respondents agree or strongly agree that companies currently lack sufficient information on supply risks to take preventing measures, and 34% agree or strongly agree that companies do not have contingency plans in place to deal with supply disruptions. However, 56% agree or strongly agree that companies would benefit from public monitoring programmes, with only 3 % of respondents disagreeing on this statement. This could be interpreted as meaning that while companies do already collect information and develop their own contingency plans, they see potential to go further with the help of a public monitoring capacity.

At Member State level, only two governments have established institutions to monitor critical raw materials supply for their industry. In Germany, the German Mineral Resources Agency (DERA), a part of the Federal Institute for Geosciences and Natural Resources, has been developing a strong monitoring capacity, publishing studies on the implications of the energy transition and further technology developments for raw materials market, providing consulting services to companies and advising the federal governments in its policy development and international engagement. Albeit still at testing stage, DERA's toolbox monitors daily risk events of selected major global production facilities for around 60 materials, using a commercial AI based software.[282] The French Government is currently setting up a similar structure, namely the French Observatory of Mineral Resources for Industries (OFREMI) to provide a strategic and economic monitoring for public bodies and industries. Hosted and managed by BRGM, the French Geological Survey, OFREMI is

[279] KÖSTER, H., NEUBERT, F. P., DIERKSMEIER, K., ADELMANN, L., LENTGE, H., SCHMIDT, P. (2022): Securing raw material supply: Benchmarking of measures of foreign manufacturing companies and recommendations for action.
[280] Anecdotal: Chip Makers Stockpiled Key Materials Ahead of Russian Invasion of Ukraine - WSJ; Nintendo Appears To Be Stockpiling Raw Materials, Doubles Its 2019 Spending On Supplies | Nintendo Life; Comprehensive: New PMI Comment Tracker dataset reveals key insights into the global supply chain | S&P Global (spglobal.com)
[281] DIHK-Umfrage zu Lieferengpässen und Rohstoffknappheit
[282] Buchholz et al., Mineral Economics, 2022.

a public-private partnership building on the expertise of other public bodies[283]. In other Member States, however, such high-quality analysis and up-to-date market monitoring is not available.[284]

In some Member States, independent research organisation can provide similar services to companies and authorities. This is the case of the TNO in the Netherlands, which is notably active in the reuse of raw materials and provides policy-makers with support and advise on policy options concerning critical raw materials.

There are other Member States with similar capabilities, such as the Austrian government, which publishes yearly one of the most complete datasets on extraction globally and free of charge[285], or the Finnish geological survey GTK, which provides advisory services both to the government and business sector.

At European level, the European Commission has developed the triannual criticality assessment, establishing the EU's List of critical raw materials. This exercise serves to identify the raw materials with the greatest economic importance and supply risk and is used to prioritise research and innovation efforts and focus international engagement. It has also been well taken up by the research community and by industry. However, it relies on validated past data and thus does not serve to monitor current developments and give early warnings that would help companies prepared for an imminent supply crunch or longer-term structural shortages.[286] A sub-list of the most strategic raw materials, based on a filter of the critical raw materials list for strategic applications, and the highest expected supply-demand gap, would help focus efforts. 70% of all respondents in the open public consultation said such a sub-list would be useful to guide investment decisions of companies and financial institutions and also 70% said it should be used to target public support at EU and national level.

The critical raw materials assessment included in 2020 a foresight analysis for strategic sectors and technologies[287]. A 2023 update is expected to expand the list of technologies. This provides forecast insights into the associated demands for raw materials. Such studies are complemented at EU-level by supply chain analyses, as e.g. conducted in the context of the Russian invasion of Ukraine[288]. More in-depth supply and demand analyses, accounting also for technology developments as well as foreseen extraction/processing planning, are available for specific sectors such as e-mobility and batteries[289]. These EU-level analyses could be improved by expanding their scope.

In 2015, the Circular Economy Action Plan included the mandate to establish the EC's Raw Materials Information System (RMIS)[290]. RMIS facilitates EU-level coordination, coherence, and quality assurance of knowledge on raw materials value chains from EC services, member states, as well as e.g. Horizon projects. Profiles includes recent information on e.g. the import reliance of extracted and processed raw materials as well as on the current levels of recycling, as well as trade

[283] Launching of OFREMI - French Observatory of Mineral Resources for Industrial Sectors | BRGM; géosciences n°26, métaux critiques, concilier éthique et souveraineté?, Juin 2022

[284] Note that each Member State has a geological survey, but this is concerned with geological knowledge, mine production and environmental aspects, rather than price developments in global markets, disruptions in third countries and risk management strategies for raw material buyers.

[285] World Mining Data: https://www.world-mining-data.info/

[286] Note that the JRC foresight study on critical raw materials in strategic sectors and technologies provides demand forecasts but no analysis of supply developments.

[287] Raw Materials Information System (europa.eu)

[288] Raw Materials Information System (europa.eu)

[289] see e.g. Raw Materials Information System (europa.eu)

[290] Raw Materials Information System (europa.eu)

analyses and forecast information for various sectors/technologies. The system was further reinforced by the 2020 CRM Action Plan. However, such a system cannot provide regularly updated monitoring analyses in the contexts of security-of-supply and sustainability. Associated networks also need to be reinforced.

The Commission also maintains several expert groups and networks to advise on its policymaking and to enable an exchange of information and best practices: which bring together from technical level to high level Member States, international organisations, industry, R&D organisations, civil society, NGOs. However, none of these groups have operational capabilities to monitor markets or support companies in their risk management efforts, or powers to mandate information exchanges, harmonise reporting or build an effective strategic preparedness system.[291] In the open public consultation, 53% of respondents agree or strongly agree that Member State authorities do not have in place sufficient monitoring mechanisms allowing them to assess supply risks and anticipate problems. 58% agree or strongly agree that Member State authorities do not sufficiently cooperate and coordinate in monitoring critical raw materials supply chains.

In contrast, there are energy goods for which a systematic preparedness system exists. The EU's Oil Stocks Directive obliges Member States to hold emergency stocks of crude oil and/or petroleum products equal to at least 90 days of net imports or 61 days of consumption, whichever is higher.[292] For natural gas, Regulation (EU) 2017/1938 on measures to safeguard the security of gas supply lays down a framework for EU emergency preparedness and resilience to gas disruptions. The recently adopted Regulation on Gas Storage (EU) 2022/1032 amends this regulation and imposes minimum storage levels for natural gas.

In addition, while the proposed Single Market Emergency Instrument (SMEI) comprises measures related to the monitoring of supply chains of goods of strategic importance (article 11), those are only triggered after the activation of the vigilance mode (following a threat/incident with potential to significantly disrupt the supply chain), and such tasks would be carried out by Member States based on voluntary information requests.

Regarding stockpiling, SMEI provides for the possibility for the Commission to identify goods of strategic importance for which it might be necessary to build strategic reserves (art. 12) after the activation by implementing act of the vigilance mode (art. 9). Through implementing acts, the Commission may require to Member States information on such reserves (current stock, potential for further purchase, alternative supply option, etc). As necessary, the Commission may determine individual targets for the strategic reserves, taking into account the probability of shortages, the level of stock, the costs for building them, etc, and the Member States shall inform the Commission about their status. Only if the Member States fall continuously significantly short of its target, may the Commission make the individual targets for strategic reserves mandatory. If a Single Market emergency has been activated (art. 32), the SMEI mechanism also enables the Commission to recommend to Member States the targeted distribution of strategic reserves with a view to not further aggravate the disruptions in the single market (art. 32). Therefore, the SMEI mechanism does not provide for a permanent assessment and coordination of the stockpiles of critical raw materials outside of its vigilance mode.

[291] The Single Market Emergency Instrument partially covers such tasks, but only enters the field when a significant disruption is expected and does not provide expertise on critical raw materials markets. (see section _)
[292] EU's Oil Stocks Directive (2009/119/EC)

9.1.18. Sub-problem 2: The EU is currently not making full use of its domestic critical raw materials potential and lacks capacity in key stages of the value chain

As discussed in the introduction and context, the EU relies almost exclusively on imports for many critical raw materials (this is in part what makes them critical). In a globally integrated economy, different regions specialise in the goods in which they have a competitive advantage and this can be to the benefit of all involved; however, where inputs used in strategic applications are concerned, and when they are as concentrated as discussed above, such import reliance poses a significant risk. Besides pursuing diversification – the potential for which is limited at least in the short term due to the high concentration of global markets – it is in the European interest to reduce some of these dependencies and maintain or develop at least a certain degree of domestic capacities. Most respondents in the Open Public Consultation either agree or strongly agree with statements that refer to underexploited opportunities of critical raw materials (CRM) within the EU. 66% of respondents agree or strongly agree that the potential to extract CRM from primary sources within the EU is currently underexploited. 72% agree or strongly agree that EU's processing and refining capacities for CRM are currently underexploited. 84 % agree or strongly agree that the re-use and recycling opportunities within the EU are currently underexploited and only 2 respondents (out of 259) disagree or strongly disagree with the statement.

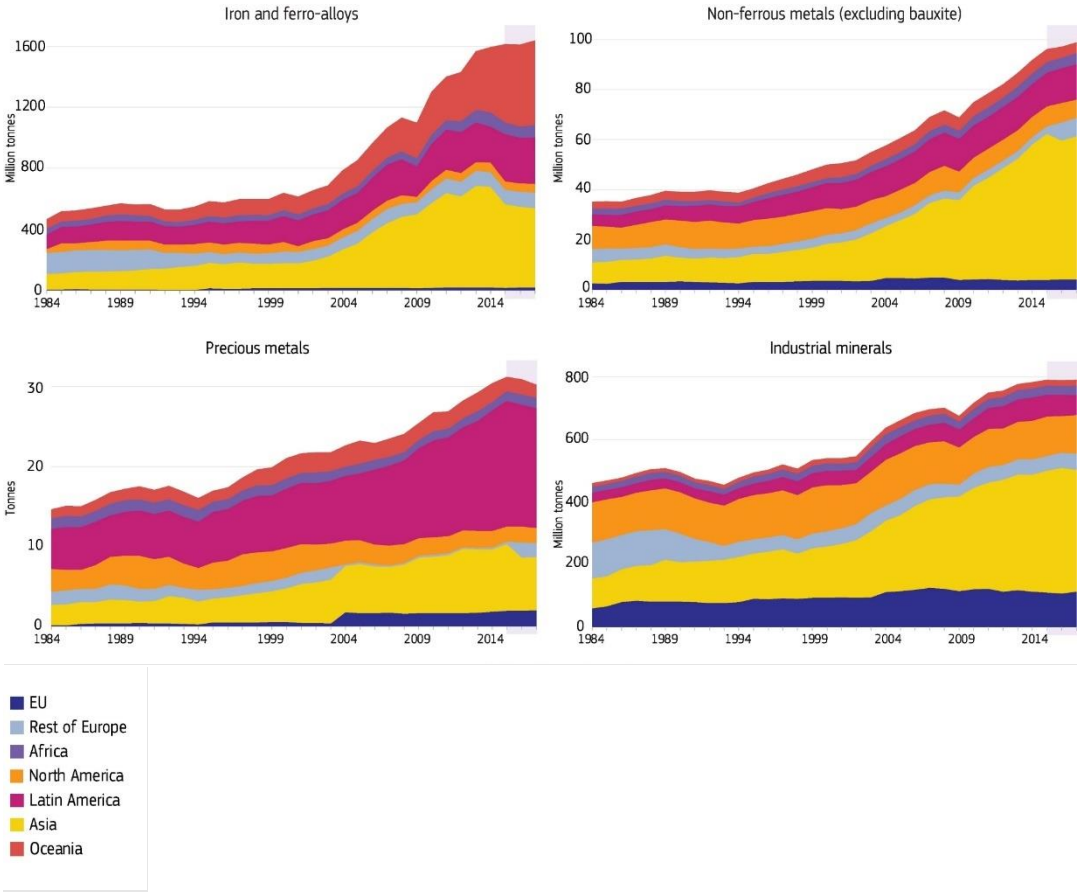


Figure 8: World regions' share in global production for different material categories (EU, 1984-2017). For data on mining production the UK is excluded (EU-27) only since 2015.[293]

[293] Raw Materials Scoreboard 2021, Indicator 7.

On the global stage, the EU is a minor player in terms of mineral production, including in the categories within which critical raw materials fall.[294] As shown in figure 8 the EU is one of the smallest producers of iron and ferro-alloys, non-ferrous metals and precious metals, while it does have a significant production (third largest globally) in the category of industrial minerals. On the institutional side, the major international mining companies are headquartered outside of the EU.[295] The major trading hubs and stock exchanges for raising capital for raw materials projects are located in Canada[296] and the UK[297]. The EU has a significant metals processing and manufacturing industry,[298] but the currently very high energy prices have led to temporary and in some cases indefinite closures or relocations at the refining stage.[299]

However, even if Europe does have mineral potential for most critical raw materials, they could only be confirmed and turned into mineral resources and reserves (economically recoverable deposits) through increased exploration (see figure 9). The SCRREEN2 project reports a summary of known deposits in EU Member States, with for instance cobalt deposits in Finland, Germany, Norway, Sweden but only extracted in Finland[300]. The EU also possesses significant potential for extraction of phosphate rock, lithium and natural graphite[301].

[294] There are critical raw materials among each of these four categories, though they are generally not the drivers of the trends seen above due to their low volumes. However, since the value chains are similar and interlinked, the low production share of the EU in these broad categories does show the focus of industrial and knowledge ecosystems.
[295] Global leading mining companies by revenue 2022 ranking | Statista
[296] Toronto: The world's mining investment capital - BNN Bloomberg
[297] About | London Metal Exchange (lme.com)
[298] The EU non-ferrous metals sector (which includes the processing, refining and downstream metal treatment activities for all metals except iron and steel, including most critical raw materials) generates €120bn in annual turnover and employs 500,000 people directly. Source: Key Industry Data (eurometaux.eu)
[299] non-ferrous-metals-ceo-letter-on-energy-crisis-06-09-2022.pdf (eurometaux.eu); Metal Plants Feeding Europe's Factories Are in Existential Crisis - Bloomberg
[300] SCRREEN project, Challenges of locating, mining and extracting CRM resources, 2018. Table 5: Geological settings, known deposits and mine production of CRM D3.3: Challenges of locating, mining and extracting CRM resources)
[301] The Geological Surveys of Europe: https://www.europe-geology.eu/mineral-resources/mineral-resources-map/critical-raw-materials-map/

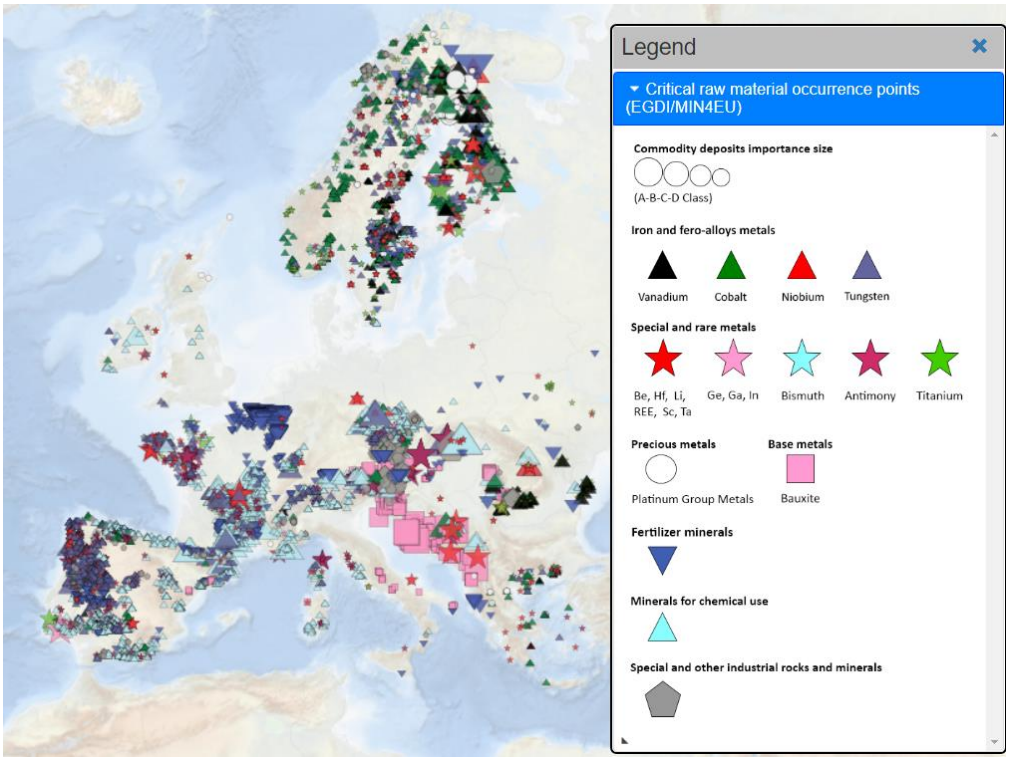


Figure 9: Mineral occurrences of critical raw materials in Europe[302]

It is important that, while exploration and extraction depend only on the location of mineral occurrences, this is only one determinant of location for processing/refining and not relevant to the recycling stages. Due to the high energy intensity of smelting and processing operations, the main determinant of competitiveness for these stages of the value chain are energy costs.

Apart from natural competitive advantages, other jurisdictions are moving more and more towards using subsidies to support their green and digital technologies and to promote their strategic autonomy.

There are also potential pipelines of projects that, if materialised, could turn those geological occurrences into concrete operations that would help achieve a higher self-sufficiency and secure a foothold in important industries and competences. For the rare earth magnets value chains, ERMA identified that investments of EUR 1.7 billion would be capable of building projects along the value chain that would allow the EU to produce 20% of its demand by 2030.[303] Only a small part of these potential pipelines, however, are planned to go ahead under current conditions.[304] More developed and likely to go ahead are investments in the lithium and batteries manufacturing value chain: The EU database of critical raw material projects[305] shows that if all the projects under

[302] Screenshot from EGDI (geus.dk) (04.12.2022). Note that incomplete reporting by Member States geological surveys affects these results.
[277] 32 Rare Earth Magnets and Motors: A European Call for Action. A report by the Rare Earth Magnets and Motors Cluster of the European Raw Materials Alliance. Berlin 2021
[304] Based on confidential information from ERMA.
[305] EU database of Critical Raw Materials projects: 2022 update. Internal Report prepared by the European Commission in collaboration with the Member States.

development in the EU as of 2022 would materialise, they could be sufficient to cover 38% of the EU's rapidly growing lithium demand by 2030 and at least 15% of EU demand by 2050.[306]

While the quality and accessibility (given high population density and environmental protection areas in the EU) of geological occurrences certainly plays a role in explaining the low investment into critical raw materials projects, the case of China, which is dominant in processing for many critical raw materials without being the dominant country at the extraction stage (see figure 6 above), demonstrates that this is not the main factor for investment and capacities at the later stages of the raw materials value chain. As discussed in textbox 4, at the processing/refining stage energy costs, reported by many stakeholders are the determining factor for location, while for recycling operations both energy costs and the availability of waste streams play a role. After lengthy permitting and a lack of support from public financial institutions, higher production costs are overall reported as the 3rd most important reasons impeding CRM's project difficulties in accessing private finance, alongside unfair competition from third countries. It should also be noted that, while certain highly economical geological endowments exist that justify investment even in a challenging regulatory and business environment, many projects are on the margin and could be made economical through price swings on global markets, customers' willingness to pay a premium for transparent and sustainable sourcing, and accelerated permitting timelines.

9.1.18.1. Driver 2.1: Insufficient exploration of European mineral resources

Exploration is a precondition for any extraction project. As noted in textbox 4, exploration is a high-risk business and therefore structured in stages of increasing cost and certainty on the mineralogical and economical properties of the project.

At global level, exploration spending (public and private) for non-ferrous metals[307] is growing (after a slump in the early 2010s) and was estimated at USD 9.8 billion in 2019, while the share of EU was less than EUR 300 million. Within this sum, three Member States – Finland, Sweden and Spain – accounted for 50% of the total spending.[308] While the EU's exploration budget is increasing (nearly doubling between 2016 and 2022), it remains very low compared to other world regions in the world, accounting for about 2% to 3% of global exploration expenditure in 2010-2022 (Figure 10) while the European continent represents around 7% of the Earth's landmass.

[306] European Commission internal database, 2022. NB: This includes only projects that are under development or operational today. Additional EU projects could be developed, making the estimation of EU demand covered by EU projects potential in 2050 a low estimate.
The 2022 EU database of Critical Raw Materials projects, initiated as Actions 4 and 5 of the Action Plan on Critical Raw materials, provides for the mapping of CRM projects at different value chain stages.
[307] A class of metals that includes most critical raw materials, as well as the precious metals gold, silver etc., and the base metals aluminium, copper, zinc etc.
[308] S&P Global Market Intelligence, 2019

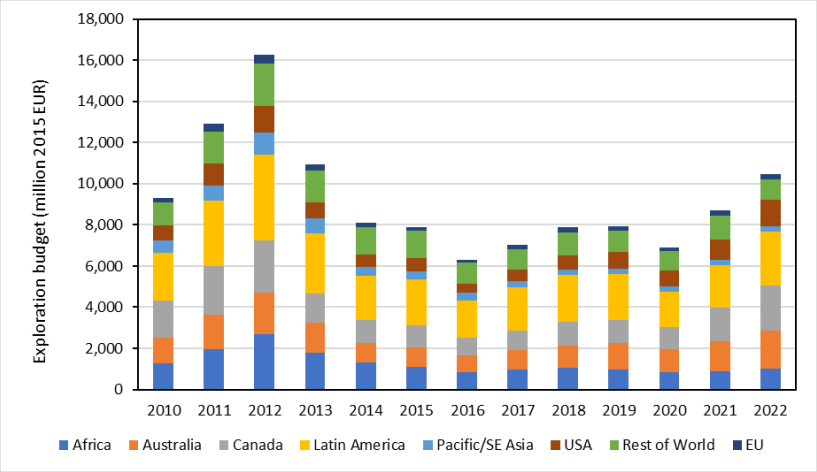


Figure 10: Global exploration expenditure. Note: 2022 refers to Jan-Oct 2022. Data include spending for gold, silver, base metals (copper, nickel, zinc and lead), cobalt, lithium, molybdenum, platinum group metals, diamonds, U_3O_8, rare earths, potash and phosphate.[309]

Since mining companies generally focus their exploration budget on a well-defined, small area covered by an exploration permit, public/general exploration is needed at regional level to define areas of mining interests for each specific mineral.

Member States' spending for these regional (or national, sometimes) surveys existed until the end of 1980's and significantly decreased in the 90s onwards.[310] In addition, these surveys were focused on materials of economic interest at that time and not on the critical raw materials needed today for the green and digital transition or for resilience and security purposes. Previous regional exploration surveys were also limited to the first few meters of the underground for technological and budgetary reasons. Advances in technological tools for raw material exploration at the end of the 1990s (mainly geophysical methods) have permitted to significantly enhance the knowledge on material resources potential, up to several hundred meters deep. The generalised lack of investments during the past decades on geological exploration by Member States (specifically on the critical raw materials and with the most advanced technology tools) has led to a general lack of knowledge regarding the true potential of critical raw materials in the EU to the present day. This impedes the further exploration by private companies on specific sites of mining interest and further exploitation.

Despite a current scarce mining industry, Europe has a long history of mining industry that resulted in the creation of a large amount of mining tailings[311] across the continent, mostly in relation with closed mines. Since mining companies generally focused on one specific substance only (mostly a base metal), some of these mining tailings have been recently recognised has major potential sources of critical raw materials across the EU. However, to which extent and for which elements the reprocessing of these mining tailings could be an economically viable source of critical raw materials remains mostly unknown due to a lack of proper exploration of mining tailings in the EU. Several Member States map the tailings, for instance the Polish Geological Survey has a dedicated

[309] Source: JRC, based on S&P Global, USD/EUR exchange rate from OECD, HICP from ESTAT. Note that the minerals shown here include not only non-ferrous metals, as the data in the preceding paragraph.

[310] Regueiro y González-Barros, Manuel & Espi, Jose. (2019). The returns on mining exploration investments.. BOLETÍN GEOLÓGICO Y MINERO. 130. 161-180. 10.21701/bolgeomin.130.1.010.

[311] Tailings are the waste materials left after the target mineral is extracted from ore.

web-tool showing identified sites.[312] The challenge is then to identify the critical raw materials in each of these tailings and develop a technology and business model to extract them. Several pilot projects of reprocessing mining tailings from selected sites to produce critical raw materials are currently underway in the EU (notably under the EIT Raw Materials NEMO project[313]), but delivering the full potential of this source of critical raw materials would require a proper evaluation of the resources through specific exploration across Member States.

9.1.18.2. Driver 2.2: Unpredictable and fragmented permitting procedures

Industrial activities along the raw materials value chains, including exploration, mining, processing, refining and recycling, make use of energy-intensive processes with potentially significant impacts on the environment and local communities. Therefore, various areas of legislation, including on land use planning and nature conservation, apply to their planning and operation. Compliance with these rules is ensured through the obligation to obtain several permits before starting operations.

EU legislation determining the process and substance of permitting procedures related to CRM projects includes the Strategic Environmental Assessment (SEA) Directive, the Environmental Impact Assessment (EIA), Birds, Habitats[314], Water Framework, Industrial Emission Directives and the Seveso Directive (an overview of permitting-related EU legislation is included in Annex 8). This legislation seeks to mitigate the risk of causing significant adverse environmental effects, such as generation of contaminants deposited on land, in the air and water, with the development of exploration, mining, refining and recycling activities. Member State legislation on the process and criteria for issuing permits reflects such EU rules and adds rules in areas of national competence.

The costs and time associated with permitting procedures and the likelihood of obtaining a permit are key considerations underlying investment decisions in the CRM sector. Currently, the unpredictability of the length of national permitting processes and of the criteria for the assessments and documentation required are often reported as barriers to investment in new CRM projects.[315] Consultations with stakeholders in the context of this initiative have further underlined the degree to which this unpredictability is perceived as a barrier to building an EU CRM value chain.[316]

For raw materials extraction projects, the MINLEX study showed that times to obtain a permit (related to all relevant rules, not only environmental) can vary between procedures from 3 months

[312] https://cbdgportal.pgi.gov.pl/haldy/

[313] Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy (h2020-nemo.eu)

[314] Interaction with nature protection, and notably the Birds and Habitats Directives, is important: A total of 375 out of 943 critical raw materials projects under development in the EU (40% of the total) are located within or closer than 1000m to 180 areas identified as Natura 2000 (0.6% of the total). Source: Internal analysis by DG GROW.

[315] For example, the European Federation of Geologists also identified long permitting timelines as a 'major obstacle in sourcing finance' for CRM extraction projects - Microsoft Word - 2022_EFG_Letter_Top10_Mining_Opportunities_20221021.docx (eurogeologists.eu).

[316] For example, the length and complexity of permitting procedures was the main reason for the lack of private investment in CRM projects identified by respondents to the OPC. As one company respondent put it: 'Projects along the value chain – such as mining or secondary production installations – might face delays and uncertainty, eroding viability of the investment and competitiveness of operations in the EU.'

to 3 years.[317] More problematically, outliers can be found with timelines up to 9 years.[318] Current examples of CRM projects where permitting procedures are, for different reasons, lasting longer than was initially expected include:

- the Sakatti project in Finland, aimed at producing platinum group metals (as well as nickel and copper), where the permitting process started in February of 2018 and where, as per December 2022, there was no decision yet (approx. 4 years later)[319];
- the Mina do Barroso project in Portugal, aimed at producing lithium, where the permitting process started in 2018 with a decision initially expected within 140 working days - in line with the guidelines of the responsible authorities - and where currently the decision is expected in April 2023 (approx. 4 years later)[320];
- the Talga project in Sweden, aimed at the production of natural graphite, where the EIA report was submitted in May 2020 and where, as per December 2022, there was no decision yet (approx. 2,5 years later)[321].

One reason for unpredictable timelines is that the procedure for performing the necessary environmental assessments is not consistently implemented, within and across Member States, especially with regard to the timing. The average duration of the procedure provided for in the EIA Directive (for all projects in scope, including CRM projects), for example, was, according to the most recent data, approximately 11.6 months, but with figures ranging from 5 to 27 months.[322]

Similarly, differences can be observed in the structure of the procedure, with various levels of authorities (local, regional, national) involved in this process. The "one-stop shop" concept allows applicants to interact with a single authority and facilitates efficient coordination among authorities, which is especially relevant when dealing with interdisciplinary projects. EU law also facilitates the development of a "one-stop shop" for permitting by allowing to streamline the environmental assessment procedures at planning level and project level323. However, the MINLEX study assessed that, as of 2017, only some jurisdictions have a one-stop-shop regime in place and that, without distinguishing per type of mineral, an average of 3.03 authorities were involved for exploration projects and an average of 4.02 authorities for extraction projects.[324]

Environmental assessment procedures are organised differently across Member States also in terms of content. First, the number of different environmental assessments required differs between Member States. Although the EIA Directive explicitly provides that the environmental impact assessment of projects can be integrated with other required assessments (i.e. those under the

[317] MinPol/European Commission (2017): Legal framework for mineral extraction and permitting procedures for exploration and exploitation in the EU. Final report. https://op.europa.eu/en/publication-detail/-/publication/18c19395-6dbf-11e7-b2f2-01aa75ed71a1/language-en "Minpol (2017)" in the following.

[318] E.g. For the Kallak iron ore project in Sweden, the developer submitted request for exploitation concession in 2013. In 2022, 9 years later, authorities approved to issue the concession to the developer, after which the preparations for the EIA have been initiated. Source: https://www.sgu.se/om-sgu/nyheter/2022/mars/regeringen-beviljar-koncession-for-kallak/

[319] Environment.fi (joint website of Finland's environmental administration): https://www.ymparisto.fi/fi-fi/Asiointi_luvat_ja_ymparistovaikutusten_arviointi/Ymparistovaikutusten_arviointi/YVAhankkeet/Sakatin_monimetalliesiintyman_kaivoshanke_Sodankyla

[320] See Agência Portuguesa do Ambiente (apambiente.pt)

[321] Registered by the Swedish Land- and environment court (Mark- och miljödomstolen) in Umeå in June 2020. Case number: M 1573-20.

[322] GHK (2010), Collection of information and data to support the IA study of the review of the EIA Directive. The average duration of an EIA ranges from 7 months or less (4.75 in Estonia, 5 in Slovakia, 6.5 in Latvia, 7 in Greece) to more than 20 months (21 in Denmark, 27 in Spain). New figures are expected in 2024.

[323] See Annex 10 for the different possibilities and relevant provisions.

[324] Minpol (2017)

Habitats, Birds, Water Framework and Industrial Emission Directives), offering significant potential for simplifying procedures where multiple assessments are required and several authorities are involved, this option is not consistently applied.325 Second, a lack of clarity about the scope and level of detail of the information required in the environmental assessment report can lead to multiple exchanges and new requests between the developer and the competent authorities leading to delays. The EIA Directive provides that project developers may request a scoping opinion from the competent authority identifying the content and the extent of the assessment and specifying the information to be included in the EIA report, to provide clarity from the outset. However, only in a number of Member States[326] such scoping applied consistently.

Such different time schedules and approaches applied by the authorities can generate significant uncertainty and delays for the developers, with associated additional costs. This is particularly challenging for projects along the critical raw materials chain, where large capital investments are needed to develop a plant and start production. At the same time investors need to be able to perform long-term planning of operational costs and revenues to create a profitable business model against the background of volatile commodity and energy markets. The unpredictability of permitting procedure therefore discourages private investment.[327]

An additional point made many by stakeholders is that public authorities responsible for issuing permits sometimes lack sufficient expertise and resources, such that investing into skills and the budget of permitting authorities could speed up procedures.[328] It should also be noted that, in addition to the permitting procedure as such, judicial appeals can also lead to delays. MINLEX' court cases database indicated that a majority (53 %) of the appellants are companies, followed by NGOs (14 %).[329] Appeals were reported to be a concern in the mining sector because, even though they ensure the right of access to justice, they often cause increased unpredictability for potential investors and other concerned stakeholders.

9.1.18.3. Driver 2.3: Difficulty in accessing financing

Quantification of Investment Needs (see annex 12 for methodological details)

The soaring demand for many raw materials needed for the green and digital transition and for strategic sectors relevant for security and resilience translates into massive investment needs, both globally and in Europe.

The JRC estimates that the capital investment required to refine all the battery raw materials needed for batteries placed on the European market by 2030, would amount to EUR 20 billion.[330] Of this, EUR 6.9 billion account for lithium, EUR 6.2 billion for nickel, EUR 5.5 billion for graphite, EUR 0.9 billion for manganese, EUR 0.7 billion for cobalt. These figures already take into account that

[325] 18 Member States have established a joint procedure for the Habitats Directive, but only in some cases this joint procedure also covers assessments under the other Directives.
[326] I.e. Bulgaria, Czech Republic, Denmark, Estonia, Finland, Luxembourg, and Romania.
[327] As one company respondent (Aurubis AG) to the OPC put it: 'Projects along the value chain – such as mining or secondary production installations – might face delays and uncertainty, eroding viability of the investment and competitiveness of operations in the EU.'
[328] This point was made in the position papers submitted by Junta de Andalucia, Aurubis AG, Vulcan Energy Resources and EIT Raw Materials in response to the Call for Evidence. Vulcan Energy Resources specifically calls for "hiring and training personnel not just for the direct administrative responsibilities but also for project management of the permitting process", improving the technical equipment (hardware, software, and training); and standardising application and permits.
[329] MinPol (2017).
[330] Internal calculations by JRC, see annex 12.

by 2030 a small but non-negligible share of battery raw materials demand will be covered by recycling. For 2040, the headline figure reaches EUR 33.4 billion.

The investments required to fully meet the EU's domestic needs for battery raw materials recycling amount to EUR 3 billion by 2030 and EUR 10.1 billion by 2040. This reflects the growing importance of recycling over time. These figures also take into account the different levels of recyclability, which is high for cobalt and nickel but very low for graphite. The calculation of these figures assumes similar investment costs for recycling as for refining per tonne of material.

When assessing the investment needs for the extraction projects, one has to take into consideration the mineral potential of Europe. An example, where Europe is well endowed is lithium. Calculations by DG GROW based on the JRC figures and public data indicate that required capital expenditure of EUR 4.9 billion by 2030 and EUR 8.7 billion by 2040 will be needed to extract 100% of the lithium needed for batteries domestically.

In total, the investment needs for the refining and recycling of battery raw materials as well as lithium extraction to supply the entire European battery market with fully domestically produced raw materials amounts to EUR 27.9 billion by 2030 and EUR 52.2 billion by 2040. If the EU set the goal of 25% domestic production of raw materials (primary and secondary) this would mean investment needs of EUR 7 billion by 2030 and EUR 13.1 billion for 2040.

The level of public support needed is difficult to estimate as it is very sector-dependent. A more detailed breakdown can be found for the projects receiving public funding from the American Battery Materials Initiative[331], which is part of the Bipartisan Infrastructure Law and was announced in October 2022. The initiative disburses USD 2.8 billion for several steps of the battery value chain. USD 1.6 billion are earmarked for projects to separate and process battery raw materials, for which the recipients are expected to contribute USD 3.4 billion. This represents a share of public money of 32%. Among the projects supported, there is only one project on battery materials recycling, which receives funding indicating a public share of 41%.

Assuming a similar aid intensity as well as compatibility with EU State aid rules, for comparable projects in the EU, this could result in public support needs of EUR 2.2 and 4.2 billion by 2030 and 2040 respectively, for one quarter of European needs for the refining and recycling of battery raw materials as well as for lithium extraction.

Only for battery raw materials and rare earth permanent magnets, the investment needs to ensure the supply of 20% or 25% of the European demand from domestic sources amount to EUR 8.7 billion by 2030 and 14.8 billion by 2040. Assuming a share of public spending to realise these projects comparable to the American Battery Materials Initiative, public support of EUR 2.7 billion by 2030 and 4.7 billion by 2040 would be required.[332]

Other strategic raw materials are also likely to require large investments in light of the green transition; e.g. copper for electrifying infrastructure, silicon for solar panels, platinum group metals for hydrogen electrolysis. The European Raw Materials Alliance[333] has identified potential investments of EUR 1.7 billion for rare earths extraction, refining and recycling as well as magnet production, which would ensure a supply of 20% of European demand along the value chain by

[331] https://www.energy.gov/sites/default/files/2022-11/DOE%20BIL%20Battery%20FOA-2678%20Selectee%20Fact%20Sheets.pdf
[332] The calculations can be found in the description of the driver in section 5.2 and annex 5 and further methodological details in Annex 12
[333] https://eitrawmaterials.eu/wp-content/uploads/2021/09/ERMA-Action-Plan-2021-A-European-Call-for-Action.pdf

2030. For other CRM, their potential investment cases amount to EUR 3.1 billion, fulfilling between 20 and 60% of projected EU demand in 2030 for different relevant raw materials.[334]

Difficulties in Access to Finance

Several CRM market-specific factors complicate access to (public and private) finance. The volatility of prices for CRMs makes it hard for investors in projects at all stages of the value chain to predict earnings, especially in the medium to long term. Meanwhile, given the long lead times and potential permitting delays (see previous chapter), significant investment decisions have to be taken years before a project starts gaining operational revenue. In addition, global markets for many critical raw materials are small, highly concentrated and opaque[335], increasing the risk premium that needs to be paid compared to other markets. To provide financing, the financial institutions need to possess in-depth knowledge about mining project development and global raw materials markets to be able to assess CRM projects. Maintaining this expertise in-house is difficult considering the small size of the European raw materials sector. While all such factors are not unique to the CRM market and investors routinely deal with such risks (ultimately, high returns on such projects should compensate for the risk taken and the resources invested), their aggregation does make the financing of CRM projects very costly and, given the limited overall size of the EU's mining, processing and refining industries, it can be hard to find any partners willing or able to provide the type of financing required.

Based on discussions Commission services had with various European public and private financial institutions, the following observations can be made on the state of financing for the different stages of the critical raw materials value chain:

- Exploration: Most exploration companies active in Europe are either based outside of the EU, notably in Australia and Canada, or financed by actors in these third countries. Dedicated private investment funds exist in North America (US and Canada), Australia, UK[336]. In general, the interviewed private and public financial institutions have not been involved in financing exploration projects and stated that this was due to the high risk involved. The European Bank for Reconstruction and Development (EBRD) is the only notable exception, with a team dedicated to this area and the ability to support such projects. Exploration financing mostly comes in the form of equity or quasi-equity to project companies set up *ad hoc*. To address this market gap, the Commission and the EBRD are negotiating to establish a financial instrument to invest equity or quasi-equity in companies performing innovative sustainable exploration in Europe.
- Extraction: While public institutions have limited capabilities to engage, some private financial organisations have dedicated metals and minerals investment teams. They generally require the project to be financed by a large corporation through their balance sheet rather than through project finance. Financing of junior miners is generally considered very risky and the private financial sector is not willing to engage. Furthermore, for mining projects in third countries, the involvement of an Export Credit Agency for risk sharing is key. All interviewed institutions indicated that financing of investment projects would be usually done on a syndicated basis. MS started to implement some measures to

[334] Source: Overview of the current state of the investment pipeline provided by ERMA to Commission services (not public).
[335] https://www.ft.com/content/46e5c98e-f9cd-4e88-8cd5-23427522c093: Financial Times: Tesla supplier warns of graphite supply risk in "opaque" market. Syrah Resources says lack of transparency over pricing in China-dominated market poses challenge for financing.
[336] Examples of investments funds in the mining industry Resource Capital Funds (offices in US, Canada, UK, Chile); Taurus Funds Management (based in Australia, with two satellite offices in UK and Paris); Denham Capital (offices in US, UK, Australia); The Pallinghurst Group (based in London); Waterton Global Resource Management (based in Canada).

promote investments in the CRM field in third countries (including extraction)[337]. Investing in extractive industries in EMDEs have faced increasing complex challenges in meeting environmental, social and governance standards, implying the mobilisation of significant resources in technical assistance. Furthermore, the cost and risks of litigation after investments, i.e. during implementation, have increased considerably. Given the challenges, most DFIs, including MDBs, have cancelled or significantly reduced their programme in extractive industries, including the EIB. EFSD+ guarantees investment windows have not included mining investments explicitly.

- Processing/refining: Banks indicate that in order to finance processing/refining projects, a stable and secure supply of critical raw materials would have to be ensured, which is currently not the case for a number of critical raw materials. New green field facilities could be set up next to mines outside EU, but financing of integrated projects (mining + refining/processing) is considered high-risk. Private financial institutions are willing to engage if a large established client with strong credit rating sponsors and finances the project through its balance sheet (corporate finance). The role of energy prices and the price volatility of the relevant critical raw materials has also been mentioned as important in determining the viability of European refining projects.[338]
- Recycling: The interviewed banks have little experience so far on this but generally are willing to engage. One of the main issues for the viability of this type of investment is the steady supply of material for recycling.

Overall, the results from the open public consultation and the targeted consultations of banks show that access to finance is considered a major barrier to investment in specific stages of the critical raw materials value chain in Europe[339]. While the need for financial support for projects will likely vary from case to case, many stakeholders underlined the importance of de-risking, notably through guarantees, including for projects outside the EU, of signalling through participation of public financial institutions, and of reducing the exposure of processing/refining operations to high and volatile energy and critical raw materials prices.

In addition, under the Taxonomy Regulation[340], the Platform on Sustainable Finance has started the work on Taxonomy criteria for pollution prevention and control in mining and delivered a criteria for climate change mitigation in manufacture of copper (smelting, roasting and refining operations) activities. The work on mining could resume under the new Platform 2.0.

9.1.18.4. Driver 2.5: Lack of high-quality technical standards to ensure sustainability of critical raw materials-related industrial processes

The availability of high-quality technical standards is essential to ensure a level-playing field in the single market for businesses and to underpin consumer confidence. Standards can help facilitate

337 Examples in this respect are the German UFK programme, which provides a government guarantee for privately financed projects in third countries provided that a long-term off taker agreement exists with a German client; and the French Bpifrance's Strategic Project Insurance, introduced in 2018, which provides an 80% insurance for projects located in France or involving a French business partner.

338 See also the results of the public consultation.

339 51% of respondents to the open public consultation agree or strongly agree that accessing private financing for CRM projects in the EU is difficult and a challenge for the expansion of the EU's critical raw materials capacities; many respondents are neutral on this question; 9 % disagree or strongly disagree. 56% of respondents agree or strongly agree that there is a difficulty to access public funding in the EU; 4 % disagree or strongly disagree. 64% of the 259 respondents to the open public consultation agree or strongly agree that the price volatility or unpredictability poses a challenge to the roll-out of CRM projects in Europe. Some stakeholders make the point that the absence of mining activities in the EU taxonomy would make funding and investment unattractive (see Annex II).

340 Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (Text with EEA relevance), *OJ L 198, 22.6.2020, p. 13–43*

the creation of a transparent global market for critical raw materials. Currently, European and international standards only partially cover critical raw materials-related industrial processes, including processes involved in their extraction, processing and recycling.

At the level of the relevant European Standardisation Organisation CEN, a number of technical committees exist in charge of the standardisation of metals (aluminium, copper, nickel and steel) but new committees have not been created for several decades, and critical raw materials are not covered by the work of these committees. What concerns the international aspect, as highlighted in the recent EU Standardisation Strategy, other actors follow a more assertive approach to international standardisation than the EU. This has led to a situation whereby in some sensitive areas non-EU actors are taking the lead at the international level promoting their technological solutions, which may be inconsistent with the EU's policies and regulatory framework.

At the level of the International Standardisation Organisation (ISO), standardisation efforts related to critical raw materials have been mainly instigated by non-EU countries. The Chinese standardisation body has initiated standardisation on rare earths (2015) and lithium (2020) within ISO, covering the whole value chain including upstream extraction and sustainability. On rare earths, the results so far point at slow progress as concerns sustainability aspects, and ambition level is not at par with what is spelled out in the EU principles for sustainable raw materials.[341] Similarly, at the end of 2021, Standards Australia was allocated the leadership of an ISO Strategic Group on Critical Minerals. The mandate of this group was to identify which minerals/metals could be standardised in ISO. [342] [1]

There currently does not exist a common European strategy to ensure that standardisation efforts for critical raw materials sufficiently reflect the sustainability principles underlying EU legislation relevant for the critical raw materials value chain. As international standards are an important point of reference for the global market, and in the absence of alternative European standards, this risks undermining consumer confidence and making it more difficult for EU buyers of critical raw materials to choose sustainable options.

9.1.18.5.

9.1.18.6. Driver 2.6: EU waste legislation does not sufficiently target critical raw materials recovery

Circularity is in many ways the optimal avenue to pursue in the area of critical raw materials. The reduction in critical raw materials use (material efficiency and substitution), the lifetime extension, reuse and remanufacturing of products containing critical raw materials, and their recovery and recycling at the end of life can all contribute to lowering demand for primary raw materials and thereby contribute to reducing dependencies. Secondary raw materials also generally have a significantly lower energy and environmental footprint[343] compared to primary raw materials.

[341] For REEs, actions focus on the whole value chain including rare earth mining, concentration, extraction, separation and conversion to useful rare earth compounds/materials (including oxides, salts, metals, master alloys, etc.), covering also sustainability of different processes.

[342] Although work is not yet finalised, several minerals or metals have been identified as being of a particularly strategic nature: cobalt, indium, vanadium, graphite, gallium, tungsten. Their mandate was extended by 12 months to summer 2023.

[343] For example, the production of secondary aluminium can save up to 95% of the carbon emissions of primary aluminium (European Aluminium Association, 2018. Environmental Profile Report https://www.european-aluminium.eu/media/2052/european-aluminiumenvironmental-profile-report-2018-executive-summary.pdf

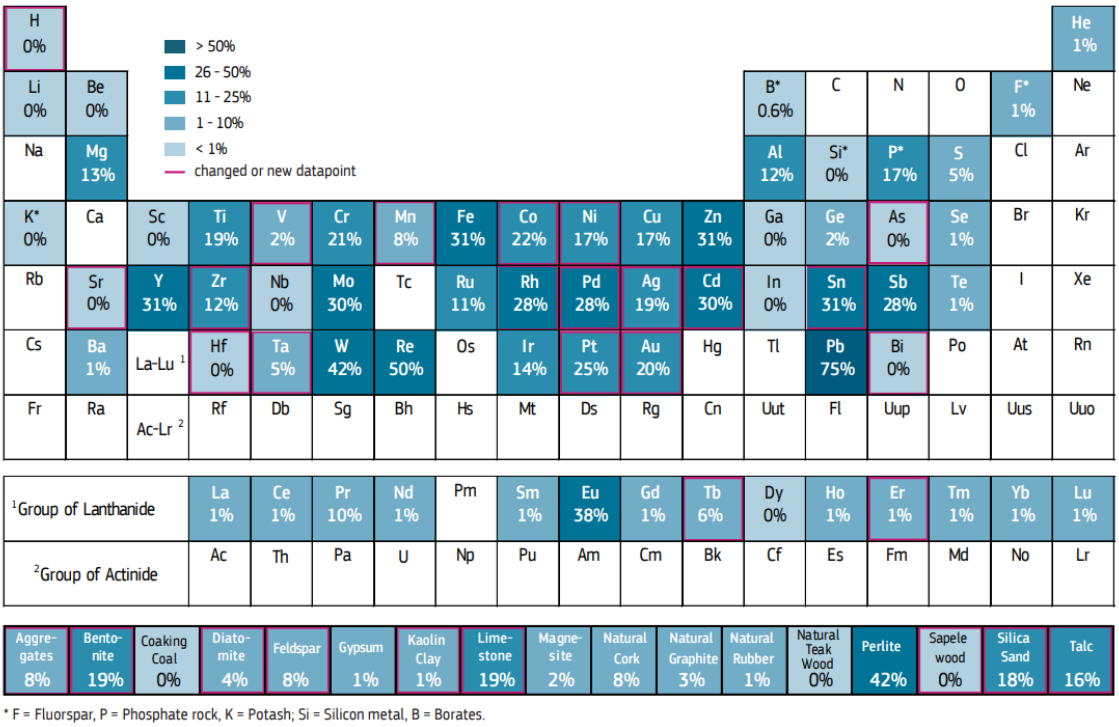


Figure 11: End-of-life recycling input rate for the EU[344]

As most critical raw materials are metals, they are in theory highly recyclable. Currently, however, the share of recycled critical raw materials that are used by clean tech industry in Europe is very low. This is the case e.g. for rare earths neodymium and dysprosium in permanent magnets in wind turbines and for gallium in integrated circuits and lighting in EVs (see figure 11). This is due to the fact that collection and sorting systems prevent end-of-life metals from reaching recyclers, a number of CRMs are locked in products that have not yet reached their end-of life, most critical raw materials are used in low quantities and/or concentrations and are scattered which make the recovery processes from end-of-life products technically and economically complex and difficult. As a result, CRMs are often disposed of at the end of a product's lifetime, or non-functionally recycled (i.e. recycled in a way that does not make use of the special properties of the raw material), leading to a significant loss of value. Moreover, current recycling practices and waste legislation often focus, to a large extent, on waste collection and de-pollution, and on mass recovery but too little on the recovery of trace metals such as CRMs, even though many of these may have a significant intrinsic economic value.

According to Horizon 2020-funded studies (ProSUM[345], SCRREEN[346]), the most important waste streams for CRM recovery are: Extractive waste ; Waste batteries; Waste electrical and electronic equipment (WEEE); End-of-life vehicles; Renewable energy: wind turbines, solar photovoltaics (PV) waste.

Most of these have dedicated sectoral waste legislation (Extractive Waste Directive, Batteries Directive/proposed Batteries Regulation, WEEE Directive, End-of-life vehicles Directive), specifying extended producer responsibility, specific treatment requirements, collection and recovery targets etc.; renewables are only partially covered (solar PV under the WEEE Directive, for wind turbines, only the electrical and electronic products that are parts of the wind turbines are covered so far). In addition, the Waste Framework Directive covers all waste streams horizontally,

[344] Source: EU Raw Materials Scoreboard 2020
[345] ProSUM | Prospecting Secondary raw materials in the Urban mine and Mining wastes (prosumproject.eu)
[346] RESULTS - SCRREEN2

setting targets for preparation for reuse and recycling, notably for household and construction waste, requiring Member States to define waste criteria, draw up waste prevention and waste management plans, and defining minimum requirements for extended producer responsibility schemes.

Apart from the proposed Batteries Regulation, these legislations do not specifically target the recycling of critical raw materials, and therefore do not give sufficient incentives to separately collect waste streams rich in critical raw materials, and to recover them. This leads to a low availability of secondary critical raw materials and an even lower take up of recyclates by European industry, as shown in figure 11.

Existing recycling targets, such as in the **WEEE Directive**, apply to overall weight ratios rather than individual raw materials, which provides an incentive to recover the bulk materials first, as this is less expensive, rather than the dispersed critical raw materials. The WEEE Directive in its Annex VII also lists proper treatment requirements that could help to remove from the WEEE collected components rich in CRM and apply targeted recovery operations; however, these are currently targeted to hazardous waste components rather than to recovery of CRMs.[347]

The **Waste Framework Directive** already requires Member States' waste prevention plans and waste management plans to target products containing critical raw materials and installations treating them, but no guidance on specific measures to be taken has been given nor have targets for the collection or recovery of critical raw materials been set.

In countries with an active mining industry or a history of mining activity, mining wastes often constitute the largest part of society's total waste flow and stock. Since historically most mining operations were targeted at high-volume commodities such as base metals iron and copper and precious metals, rather than critical raw materials, which are often a by-product of the aforementioned, extractive waste may contain significant amounts of critical raw materials. Studies have estimated significant amounts of critical raw materials such as phosphate rock, silicon, tungsten or cobalt in mining waste (see figure 12),[348] and recent industrial projects in Spain[349] and in Sweden[350] show that this can be valorised profitably. In most cases, it is unlikely that a recovery process will be economical if it regards a specific critical raw material alone, especially if present in low concentration, but by jointly recovering and valorising base metals, critical raw materials, and the rock matrix as industrial minerals and/or aggregates, the process can be realised[351]. A significant advantage lies in the fact that such operations take place on brownfield sites, thus reducing the risk of additional environmental impacts and conflicting land-use interests. In some cases, re-mining of extractive waste can even be an opportunity for rehabilitation of abandoned mining sites.[352]

A barrier to the full use of this potential, however, lies in the lack of knowledge concerning the critical raw materials potentially recoverable from closed and abandoned mines, as well as the risk and liability assumed by a company re-mining a site with potentially unknown legacy. The **Extractive Waste Directive** currently regulates primarily how to minimise and manage waste generation and it requires Member States to draw up an inventory of closed and abandoned facilities, but it does not provide incentives or targets to recover critical raw materials from the

[347] Note that at the component level annex VII also includes removal of printed circuit boards and batteries.
[348] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills; pg. 93-98 of SCRREEN-D3.2-Identification-and-quantification-of-secondary-CRM-resources-in-Europe.pdf
[349] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills , chapter 7.1:"Recovery of Tantalum and Niobium from tailings at the old Penouta mine
[350] Critical minerals extracted from mining waste - LKAB
[351] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills
[352] JRC (2019): Recovery of critical and other raw materials from mining waste and landfills , chapter 7.1:"Recovery of Tantalum and Niobium from tailings at the old Penouta mine.

extractive waste, nor does it oblige Member States or operators to gather information or report on the critical raw materials content of the generated waste.

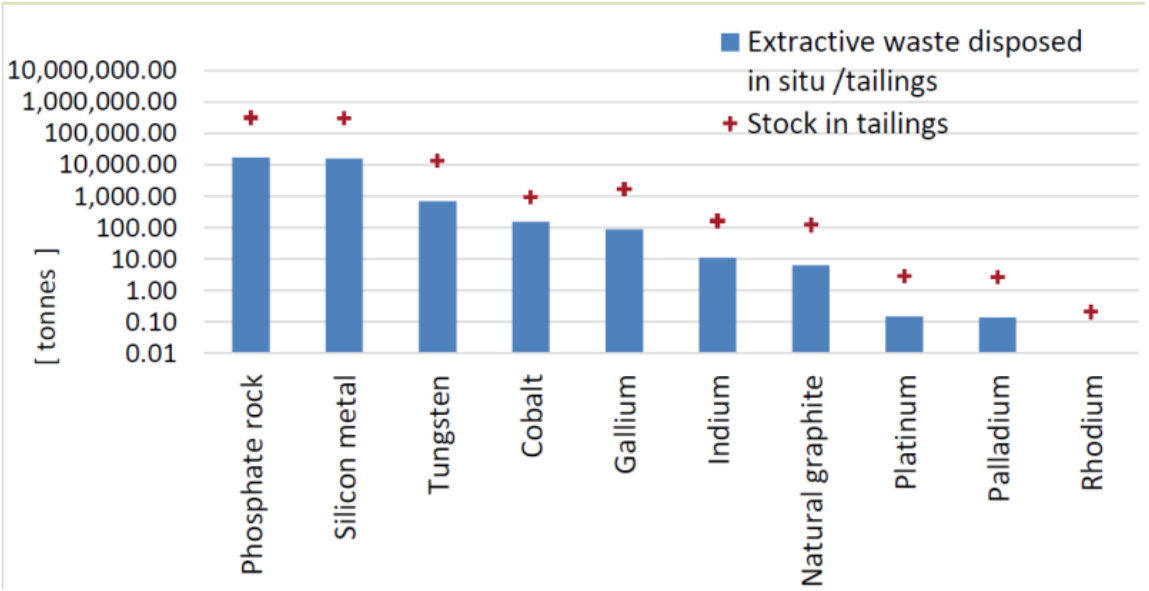


Figure 12: Estimated amounts of various CRMs in the EU-18 in 'Extractive waste deposed in situ/tailing' and 'Stock in tailing'. Source: JRC estimations based on the 2015 MSA study [353]

The Horizon 2020-funded "Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy" (NEMO) project found that sulfidic mining waste residues, from mining and processing sulfidic ores to produce copper (Cu), zinc (Zn), lead (Pb), nickel (Ni) and critical metals, represent the largest extractive waste in Europe. Approximately 600 Mt are produced per year and there is a historic stockpile of 28 000 Mt deposited in either tailings storage facilities, dry stacked or back-filled in mines. When poorly managed, this waste can become an environmental hazard, causing problems such as acid-mine drainage or the outflow of acidic water from mine waste. At the same time, this waste represents a new stock of critical metals and minerals needed to move to a green circular society.

NEMO focused on three cases: 1) Sotkamo Ni-Cu-Zn-REE/Sc (rare earth element scandium) mine in Finland, 2) Luikonlahti processing facility in Finland (cobalt), 3) Tara Zn-Pb mine in Ireland,

In addition, four pilots using NEMO technologies to demonstrate cutting-edge bioleaching processes to recover additional metals from sulfidic ores/residues and to boost the conversion of sulfides to sulfates – helping to eliminate the risk of acid-mine drainage. It also aimed at 'cleaning' the residual matrix allowing its use in cement and construction applications. The results from NEMO will provide the EU with a number of benefits: new resources for the metal and agricultural sectors, a reduction in CO2 levels in the metal recovery process, and the replacement of ordinary Portland cement, addressing acid-mine drainage and other environmental problems. Further steps include replicating the technologies and concepts in other mines within the EU and beyond.

In the open public consultation, 66% of respondents agree or strongly agree with the statement that "EU waste legislation does not sufficiently incentivise the recovery and recycling of raw materials". 53% agree or strongly agree with the statement that "shipments of waste containing

[353] Recovery of critical and other raw materials from mining waste and landfills - Publications Office of the EU (europa.eu)

critical raw materials between Member States are difficult, which limits possibilities for viable recycling project".

9.1.19. Sub-problem 3: EU sourcing of critical raw materials is not sufficiently sustainable

The extraction, processing and refining, as well as the potential recycling, of CRMs is associated with a wide range of environmental impacts. For example, the production of rare earth elements (REEs), used e.g. in electric motors and wind turbines, is associated with significant material and energy consumption and generates large amounts of air and water emissions and solid waste.[354] Similarly, the use of platinum group metals in electrolyte membrane fuel cells is the main determinant of the fuel cells' environmental footprint, considering e.g. the acidification impacts associated with the extraction of these metals.[355] The production of cobalt and lithium, essential for battery production, is amongst other things associated with significant greenhouse gas emissions.[356]

It was estimated that greenhouse gas emissions associated with overall primary metal and mineral production accounted for approximately 10% of total global energy-related emissions in 2018.[357] In addition, the overall environmental impacts of extraction and processing of key minerals are projected to double by 2060, as a result of both the increased scale of extraction and production and of declining ore grades.[358] Given the expected massive increase in demand, CRMs (which are currently all metals and minerals) will likely contribute an increasing share of these impacts. If left unaddressed, therefore, the environmental footprint of CRMs may cancel out, to an extent, the environmental benefits of their use in green technologies and could mean that decarbonisation comes at the cost of an increase in other environmental impacts.

9.1.19.1. Driver 3.1: The market does not take sufficient account of the environmental footprint of critical raw materials

Given the speed of developments in the critical raw materials sector, it is unlikely that the market, left to its own devices, will ensure that all costs associated to the critical raw materials value chain are properly identified and internalised. Steering the market toward more sustainable critical raw materials, however, has the potential to drive down impacts given the differences in the environmental footprint of critical raw materials available to EU buyers. This is evidenced, for example, by the difference in carbon and environmental footprints observable between critical raw materials produced using different production methods,[359] It is also clear that the varying carbon intensity of the energy used in the extraction and refining of CRMs leads to varying environmental footprints (see for example figure 13 below, showing different grid emissions factors in cobalt and

[354] Navarro, Julio, and Fu Zhao. "Life-cycle assessment of the production of rare-earth elements for energy applications: a review." Frontiers in Energy Research 2 (2014): 45.

[355] Stropnik, Rok, et al. "Critical materials in PEMFC systems and a LCA analysis for the potential reduction of environmental impacts with EoL strategies." Energy Science & Engineering 7.6 (2019): 2519-2539.

356 Gregoir, L., and K. Van Acker. "Metals for clean energy: pathways to solving Europe's raw materials challenge." Eurometaux, KU Leuven (2022).

357 Azadi et al. (2020). Transparency on greenhouse gas emissions from mining to enable climate change mitigation.

358 OECD (2019). Global Material Resources Outlook to 2060.

[359]On difference between brine and hard rock based lithium, see "Metals for clean energy'' report (Gregoir and Van Acker)'. On magnesium, see Ehrenberger, Simone. "Carbon Footprint of Magnesium Production and its Use in Transport Applications." (2020). For scandium, see Kaya, Şerif, et al. "Scandium recovery from an ammonium fluoride strip liquor by anti-solvent crystallization." Metals 8.10 (2018): 767. For titanium, see Pal, Uday B. "A lower carbon footprint process for production of metals from their oxide sources." JOM 60.2 (2008): 43-47.

REE producing countries[360]). In addition, it is clear that recycled CRMs will have generally a lower environmental footprint than primary materials, given for example the absence of the extraction phase.

Even though stakeholders, including downstream users, state that they are willing to take into consideration the relative sustainability performance when procuring materials[361], the market response so far has resulted in the creation of different methods and initiatives, with a varied level of reliability and coverage.[362] The European Commission developed the Product Environmental Footprint (PEF) with the aim to provide a common and robust method to underpin claims made about the relative footprint of different materials sold on the EU market, which could support to distinguish between environmental performances of materials.[363.] However, uptake of the PEF method for the assessment of CRM is still limited.

In addition, for critical raw materials, different public and private certification systems with different scopes and coverage are currently available to show the sustainability of raw materials sold on the EU market (e.g. the Initiative for Responsible Mining Assurance (IRMA), CERA 4in1 certification, World Bank Climate Smart Mining Initiative).[364] Having different overlapping schemes to show sustainability of critical raw materials placed on the EU market can lead to potential confusion and undermine their effectiveness. Stakeholders have underlined the need to assess the suitability of different certification schemes.[365] This incomplete information hampers fair and transparent competition for critical raw materials producers in terms of sustainability claims. Likewise, it hampers sustainable choices to underpin the green transition.

In addition, even where information is available, there is currently nothing preventing users of critical raw materials from procuring the most impactful materials. It can reasonably be assumed that, so long as the negative externalities of CRMs are not accounted for, at least some users will continue to be mainly driven by cost considerations and will continue to procure the most polluting CRMs.

[360] Source: "Metals for clean energy'' report (Gregoir and Van Acker)

[361] For example, 186 (72 %) out of 259 respondents to the PC agreed or strongly agreed that CRMs should be accompanied by information on their environmental footprint. Business interest is also driven by changing consumer preferences: based on a recent EU survey (Consumer conditions survey, European Commission, 2021.), the majority of EU consumers being "occasional" consumers of environmentally-friendly products (56%) and more than a quarter paying attention to the environmental impact of all or most goods and services (23%), and 67% EU citizens buy products that are better for the environment even if they cost more.

[362] There are currently 457 voluntary environmental labels worldwide and over a 100 in the EU (Ecolabel index 2020, http://www.ecolabelindex.com/), underpinned by non-comparable methods.

[363] Commission Recommendation of 16.12.2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations.

[364] See also the overview of different schemes provided in IEA, I. (2021). The role of critical minerals in clean energy transitions. World Energy Outlook Special Report, p. 240.

[365] See for example the Call for Evidence submission of the European Automobile Manufacturers' Association.

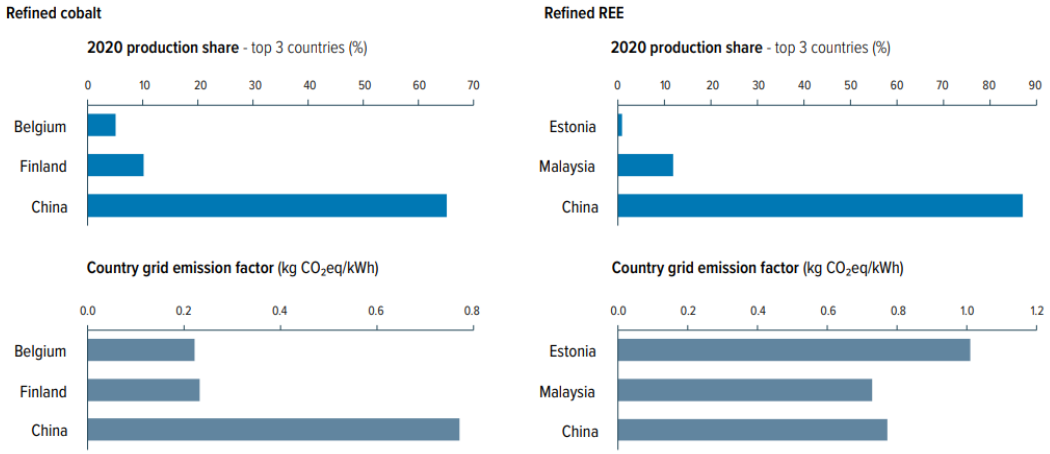


Figure 13[366]

[366] KU Leuven/Eurometaux (2022): Metals for Clean Energy.

9.1.20. Policy Option 1 – additional information on impacts

9.1.20.1. Impact on Member States

Regarding the **governance structure** (pillar C), Member States' participation to the board and the network's meetings through their representatives is expected to require 2 FTEs per year. Member States which do not have a dedicated supply and intelligence capacity yet would be encouraged to develop such structure (whether a task force in the ministry responsible or a dedicated body), whose size would vary depending on the Member State's resources. Since this is not an obligation, it would not add burden on Member States. In the public consultation, national authorities or agencies, notably in Sweden, Estonia or France, express support for the development of this type of network.

On **monitoring** (pillar C.1), rather than relying on national efforts, this option would lead to a division of tasks between Member States and enable where possible the pooling of resources to jointly create missing capacities. It is deemed more efficient than the baseline to improve monitoring and risk assessment.

On **the coordination of strategic stocks** (pillar C.2), this option would require Member States to report to the Commission on the state of their strategic stockpiles for strategic sectors, under strict confidentiality requirements, which would require 1/4 FTE for each Member States as it would add additional workload in the relevant national authority or agency in charge of stocks. It is also likely to bring benefits, as the Commission could assess the overall state of stocks in the EU for strategic raw materials and could point out, with the agreement of the concerned Member States, to potential areas of convergence. Member States have also indicated their preference for this type of coordination compared to more stringent obligations forcing them to build additional stocks.

Regarding **exploration** (pillar D), since most of the actions are voluntary, Member States would implement only those that are part of their core and regular activities. The only obligation would be the regular classification of potential projects with the UNFC classification framework and reporting to the commission. This is a task that requires minimum investment (1/2 FTE) by national Geological Surveys or other national competent authorities.

The requirement to set up strategies to **support the value chain** (pillar E) to increase access to stable and secure supply of CRMs would result in some additional costs for Member States, which would amount to 2 FTE per Member State for half a year to develop the strategies on a one-off basis and then on average 1 FTE to follow-up and implement the strategies.

Regarding **permitting** (pillar E.1), this option is expected to result in additional costs for Member State authorities. Structural integration of CRM projects in spatial plans and the application of the SEA Directive to those plans would imply an additional cost to responsible planning authorities. However, this cost will depend on the actual potential for CRM project in the area under consideration for the spatial plan, and the related amount of potential impact to be assessed, as well as the extent to which Member States already voluntarily apply the procedure. As also concluded in a recent evaluation of the SEA Directive, there are currently not enough comparable quantitative

information available on the costs of the SEA procedure.[367] However, it is clear that costs would be involved stemming from e.g. additional man-hours invested and external consulting services.

On **waste legislation** (pillar F), this option would not add additional work to Member States' policy development.

Regarding **environmental footprint** (pillar H), this option would entail additional burden for Member States, who would have to devote resources for the enforcement of a new obligation of a very technical nature. The market surveillance authorities of Member States will have to invest in developing the necessary skills to ensure that the footprint declarations, as well as the third-party verifications, are performed properly. They would also have to regularly check whether CRM sold on their market are not sold with reference to non-recognized certification schemes. This may entail training and/or hiring costs. The amount of FTEs needed for this task would depend on the amount of CRMs sold on a specific national market as well as the amount of relevant economic operator active on that market.

9.1.20.2. Impacts on the Commission

Regarding the **governance structure** (pillar C), the costs accounted for are those pertaining to supporting the organisation of the board and network, notably through a common secretariat. In terms of direct costs, this can be estimated at EUR 75.000 per year, given the standard budget for a meeting with 27 Member States experts of EUR 15.000 , and given that on average 5 meetings would be required per year, either by the board or the operational capacity, on tasks pertaining to pillars A and B (once every 2/3 years), pillar C1 (2/3 times per year), pillar C2 (once per year), pillar D (once every 2/3 years), pillar E (once every 2/3 years). In terms of human resources, the secretariat and coordination provided by the Commission would consist of 2 FTEs.

Regarding **monitoring, data gathering and risks assessment (**pillar C.1): additional capacity would be needed in the Commission to implement the tasks developed. The costs would relate to 17 FTEs for data gathering, monitoring and analysis (similar to HERA.2 Intelligence Gathering, Analysis and Innovation Unit), which in detail would mean 10 FTEs for market monitoring, drawing on expertise from JRC including links to the RMIS and existing agencies, so as to concentrate on mineral and metal raw materials, with 1 FTE dedicated to the management of studies and contracts, 1 FTE dedicated to access to data and building up the relevant dataset of information and 5 FTEs to ensure the coordination of information gathering from Member States and support the governance structure.

The coordination of **strategic stocks** (pillar C.2) would also require additional resources to analyse the state of strategic stocks as provided by Member States, coordinate actions (e.g. in the IEA working group) and provide guidance, when possible, which would be assessed at 3 FTEs and could be detached from national authorities in charge of stocks.

Regarding **exploration** (pillar D), the impact relates to coordination of Member States' submissions, which corresponds to 1 FTE per year.

On **waste legislation** (pillar F), this option would consist in business-as-usual policy development within the Commission.

The measures on **standards for the critical raw materials value chain** (pillar G) would have budgetary implications for the Commission. Coordination and planning of efforts to have for EU

[367] See Study concerning the preparation of the report on the application and effectiveness of the SEA Directive (Directive 2001/42/EC) - Publications Office of the EU (europa.eu), p. 14.

rules and principles to be reflected in international standards would require 1 FTE on a continuous basis.

Regarding **environmental footprint** (pillar H), this option would entail additional burden for the Commission, which would be responsible for assessing the suitability of different certification schemes and check them against the criteria, as well as monitor their continued compliance. This is expected to require 1 FTE per year.

In addition, the Commission would be responsible for coordinating the development and adopting the relevant calculation methods. This is expected to require 2 FTEs per year as well as costs associated with external studies to develop methods, procuring secondary datasets and consulting stakeholders.

9.1.21. Policy Option 2 – additional information on impacts

9.1.21.1. Impact on Member States

The mechanism set to determine **targets** for EU capacity and the dialogue and reporting that Member States would have to commit to can be considered as having no budgetary consequence on Member States, since they would only have to comply to it in the event that such targets are not met. Member States would however have to report on the state of CRM projects in general on their territories, which would amount to a regular cost of 1/4 FTE.

Regarding the **governance structure** (pillar C) and the sub-pillars on **monitoring, stockpiling and company risk preparedness**, the costs and benefits would be the same as in option 1.

On **exploration** (pillar D), the costs on Member States are more substantial as the option commits them to undergo further exploration programmes with a view to reinforce the knowledge and mapping of the EU's mineral resources. Since all Member States already have a body or team in charge of geological mapping, additional geological mapping should not incur extra costs. However, the development and implementation of wider mineral exploration programmes would require additional one-off costs, which would depend on the ambition of each MS. In total for all Member States, such cost could amount to EUR 82 million for aerial geophysical survey and EUR 80 million for geochemistry mapping survey, in addition to side costs (e.g., interpretation)[368].

Regarding **permitting** (pillar E.1), this option is expected to, in addition to option 1, result in limited additional costs for Member State authorities.[369]

Better coordination or integration of different types of assessments and permits can result in reduced burden. However, a reorganisation of the administration in some Member States may be

[368] Aerial geophysical survey (Mag. + Spec) for EU, assuming the coverage of half the EU (excluding the sedimentary basins) at 250 m spacing (and 10 €/kml) :EUR 82 M + 10% for designing, tendering, and managing the campaigns and sub-contractants + 10% for interpretation. (EUR 98,4 M)
The geochemistry mapping survey for EU assuming a 10 km2 sampling (covering half of the EU, including the analysis of metals and interpretation of the data) would need an investment of EUR 80 M +5% for tendering and managing the campaigns and sub-contractants. (EUR 84M)
FTE per MS: 1 unit of 10 FTEs for aerial geophysics (already operative in some MS) 1 unit of 10 FTEs for geochemical survey (also already operative in some MS) Data reprocessing and predictivity maps: 1 unit of 5 FTEs. Classification and reporting to the Commision: 1/2 FTE

[369] The assessment below is based on the assessment of similar measures in the impact assessment accompanying the 2012 proposal for revision of the EIA Directive – see footnote 93.

required and, in the short term, this may be costly. However, as this measure will avoid duplication of efforts at the various stages of the EIA process, it is expected to reduce administrative burden in the medium to long term.

Changes related to time-frames will shorten procedures but are not expected to increase administrative burden. The time-frame for public consultation on the environmental report does not entail any direct costs for public authorities. The proposed time limits for decision-making are based on time-frames that are often already achieved and aim mainly to prevent outliers and increase predictability of the process. In addition, time limits can in some cases provide incentives to public authorities to consolidate internal processes.

Mandatory scoping for Strategic Projects is expected to have no net effect on the burden for authorities. Although there are extra costs involved for MSs where scoping is not currently mandatory, those costs are likely to be offset by the fact that resulting reports would be of better quality and more focused. Thus, authorities would spend less time requesting further information to developers, reviewing lengthy reports and asking for successive modifications of these reports.

Efforts to allow documents to be submitted digitally and to make available a manual of procedures for developers of Strategic Projects will imply additional costs, especially in the short term, the amount of which will depend on the extent to which a Member State already takes these measures generally.

Regarding the **selection of strategic projects** (pillar E), Member States would participate in board meetings with the Commission to designate Strategic Projects. These meetings could occur bi-monthly and would need ½ FTE. This option however enables Member States to support projects in their territory with a European strategic dimension and access to the appropriate funding instrument, thereby creating added value on their territory.

The management expenses of the **fund** (pillar E.2) would be paid directly from the capital under management (usually, 1 to 2% are standard practice[370]). This would slightly reduce the effectiveness of the fund but would not require additional financial resources from the Member States, the Commission or the fund manager. The same holds for the costs of setting up the fund, which would directly be paid out from the fund's capital.

On **waste legislation** (pillar F), in addition to the effects described under option 1, this option would require Member States to transpose the amendments to the Extractive Waste Directive into national law, creating minor administrative costs that could be included in other ongoing revision processes. It would also require them to develop a national circularity strategy, which likely Requires 1 FTE per Member State to develop and implement.

The greatest additional burden for Member States consists in the obligations created under the Extractive Waste Directive. They would be required to create a database of all closed and abandoned waste sites, screen their available data on such sites and perform a geochemical campaign to complement this information. It is estimated that 3-4 FTE experts per Member State would be required to fulfil this obligation.

In the open public consultation, 68% of respondents agree or strongly agree that the Critical Raw Materials Act should require Member State to design waste management plans including specific measures to promote the recovery of critical raw materials, from historical mining waste. 78%

[370]https://www.investopedia.com/articles/investing/072115/private-equity-management-fees-regulation.asp#:~:text=Private%20equity%20funds%20have%20a,committed%20capital%20of%20the%20fund

agree or strongly agree that it should strengthen exploration and documentation of critical raw materials in secondary deposits and waste streams.

Regarding **environmental footprint** (pillar H), this option would entail roughly similar impacts as in option 1, with the only additional task being the need to check whether the declared footprints meet the thresholds where they are set.

9.1.21.2. Impacts on the Commission

Regarding the **governance structure** (pillar C), and the following sub-pillars on stockpiling and company risk preparedness, the costs are the same as in option 1. The monitoring and intelligence gathering and forecasting to support the assessment of critical and strategic raw materials will require additional 20 FTEs.

However, it is assessed that the new missions enabled by the **exploration** (pillar D) would require 1 additional FTE (comprised in the governance) to ensure the coordination of the new data compiled under this option.

Regarding the selection of **Strategic Projects** (pillar E), the Commission would need to send a representative to the board to determine the selection of Strategic Projects. Preserving the European angle would require more resources than the Member States, this would amount to 1 FTE (comprised in the governance). The assessment for projects would also fall on the Commission. However, it should be noted that the Commission is currently already assessing the usefulness of projects abroad, for example in its work on the Mineral Security Partnership. Hence, this obligation should not result in additional resource requirements

On **waste legislation** (pillar F), this option would require increased enforcement of the obligations under the Extractive Waste Directive (notably the database of closed extractive waste sites), performed by1 AD FTE continuously.

Regarding **standards for the critical raw materials value chain** (pillar G), this option would, in addition to option 1, have budgetary implications for the Commission. Promoting the development of technical standards regarding relevant industrial processes would require substantial additional resources, the estimation would be 1 FTE to prepare approximately 3 standardisation requests per year.

Regarding **environmental footprint** (pillar H), this option would, in addition to option 1, entail additional burden for the Commission to prepare performance classes and minimum thresholds.

9.1.22. Policy Option 3 – additional information on impacts

9.1.22.1. Impact on Member States

On **targets** (pillar B.) and on **exploration** (pillar D), the costs are the same as for option 2.

Regarding the **governance** aspects (pillar C) and the corresponding actions under sub-pillars C.1, C.2 and C.3, the indirect costs for Member States relate to their contribution to the EU budget to enable the creation of this operational structure.

Regarding **permitting** (pillar E.1), this option has the same impact as under option 2.

On **waste legislation** (pillar F), this option has the same impact as under option 2.

On **environmental footprint** (pillar H), this option would have the same impact as option 2.

9.1.22.2. Impacts on the Commission

The detailed costs of an operational capacity are already explained in chapter 6, with around 100 FTEs. In comparison, Japan's CRM agency JOGMEC has around 600 staff (2 groups on metals and minerals, 3 groups on oil, gas and geothermal energy and a horizontal stockpiling unit. The German Mineral Resources Agency (DERA) has 30 staff conducting market surveillance for raw materials. The International Energy Agency has around 6 FTEs working for its new Working Party on Critical Minerals (CMWP) and is in the process of expanding its staff numbers.

On **waste legislation** (pillar F), this option has the same impact as under option 2.

For **standards for the critical raw materials value chain** (pillar G), this option would have the same impact as option 1 and 2 combined.

For **environmental footprint** (pillar H), this option would have the same impact as option 2.

ANNEX 12: ESTIMATION OF INVESTMENT NEEDS

The estimation of investment needs in the context of the problem section is based largely on the Total Investment requirement for battery grade raw materials for batteries sold in the EU over the period 2022-2040 calculated by JRC. The JRC's calculation approach is set out here:

Methodology:

- The demand of refined **battery-grade raw** materials (i.e. products for use by cathode/anode makers) is computed on the end-use demand for batteries (sold batteries in the EU, **placed-on-the-market**) after considering production yields in the midstream stages of cell manufacturing and cathode/anode production. The supply deficit is derived after subtracting supply from the existing/operating installations in 2021.
- From the supply **deficits** calculated above, an **investment requirement** is calculated for new capacity of battery-grade raw materials. The cumulative investment requirement in a given year is defined as the sum between the previous years' requirement and the additional capacity units needed to be constructed in the current year. 2022 is set as the first year.
- Considering that the investment requirement for battery-grade raw materials can be mitigated by **EOL battery recycling**, the results also present the investment requirements after taking into account the expected supply of secondary raw materials.
- The 'investment requirement' could be interpreted as the **total investment needed for additional new supply to achieve self-sufficiency of battery-grade raw materials for end-use demand in the EU**. If investment requirement is plotted versus investments already in the pipeline, the difference will highlight the annual cost of new capacity required to be brought online to bring the market back into balance. Should the development of additional capacity be lagging, the reliance on primary supply of battery-grade raw materials will remain. The overall downstream self-sufficiency requires that cathode/anode capacity will be developed on time to treat refinery output, and that cell manufacturing capacity will be able to satisfy end-use market demand (so that all demand for battery sales could be satisfied by the EU cell producers).
- Only the **refining step** is considered in the analysis. Refineries are considered to have a greater potential for investing in additional capacity compared to the upstream supply segment of mining. Mining is excluded from the analysis; if it is included, it could be reflected by the CAPEX of the projects in the pipeline, as developing new projects and/or expanding existing mining capacity within the next years in the EU is constrained. As primary metal production capacity exceeds mining capacity, imports of mineral concentrates and intermediates would be needed to feed this additional refining capacity. Finally, investment requirements for battery cell manufacturing and anode/cathode production are excluded from the results.

Data on investments are coming from various sources:

  - Company announcements and feasibility studies
  - S&P database
  - Other sources, e.g. Roskill study for JRC (Ni)

Data on supply and demand are based on JRC internal forecast analysis, mostly from the battery model developed in 2021 for DG GROW. Table 5 displays data for demand

Table 5: Forecast of demand for battery-grade raw materials, latest update September 2021

	2020	**2021(f)**	**2025(f)**	**2030(f)**	**2035(f)**	**2040(f)**

Cobalt	32,000	37,000	69,500	92,500	116,000	124,500
Nickel	44,500	60,000	183,500	378,000	541,000	645,000
Graphite	63,500	85,500	233,000	489,000	743,000	930,500
Manganese	18,000	23,000	51,000	70,000	95,000	111,000
Lithium (LCE)	73,000	92,500	222,500	449,000	679,500	865,000

LCE = Lithium Carbonate Equivalent, NB: rounded values, Source: JRC

The initial CAPEX used in the calculations is defined as the median of the data sample collected (except for Ni, for which Roskill data are used). Table 6 shows the figures applied in the calculations:

Table 6: Initial CAPEX used for calculating investment needs

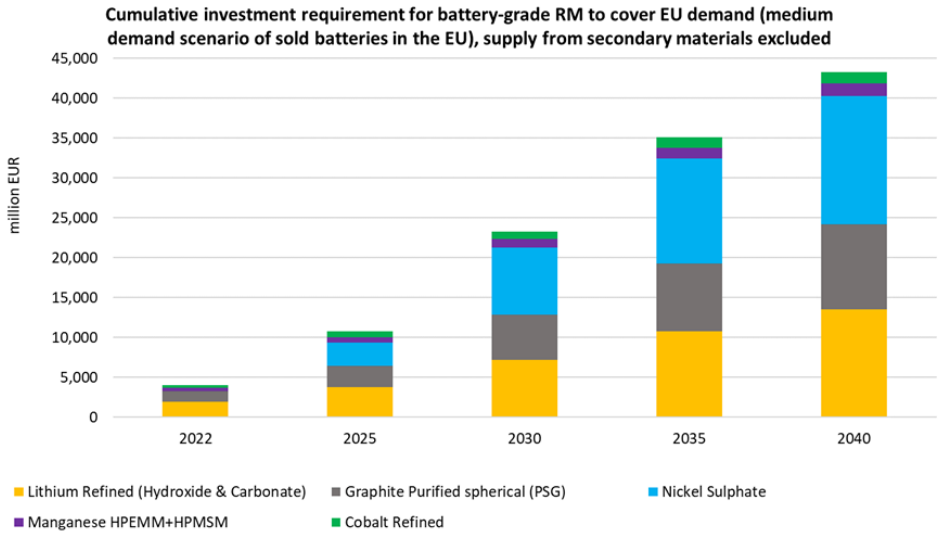
Material	**Product**	**Capital intensity (initial capital cost)**	**Unit**	**Plant type**	**Source**
Nickel	Ni Sulphate	28,500	EUR/t Ni	Greenfield	Roskill Ni study for JRC (2021)
Cobalt	Refined Co	13,000	EUR/t Co	Brownfield and Greenfield	JRC data compilation
Graphite	Purified spherical graphite (PSG)[371][1]	12,500	EUR/t PSG	Greenfield	JRC data compilation
Manganese	HP MSP[372][2]	15,000	EUR/t Mn	Greenfield	JRC data compilation
Lithium	Li carbonate and Li hydroxide	15,500-17,000[373][3]	EUR/t LCE[374][4]	Greenfield	JRC data compilation

Source: JRC

[371] Purified spherical graphite refined from natural graphite; data for spherical graphite not available
[372] HP EMM: High-Purity Electrolytic Manganese Metal; HP MSP: High-Purity Manganese Sulphate Monohydrate. Data for EMM (High Purity Electrolytic Manganese Metal) not available
[373] Production demand for Carbonate and Hydroxide is estimated in each year according to the battery chemistry forecast until 2040. The initial CAPEX is calculated accordingly, taking also into account the different feedstock material i.e. Li carbonate plants (processing Li concentrates): EUR 13,000/t LCE; Li hydroxide plants (processing Li concentrates):
[374] LCE = Lithium Carbonate Equivalent

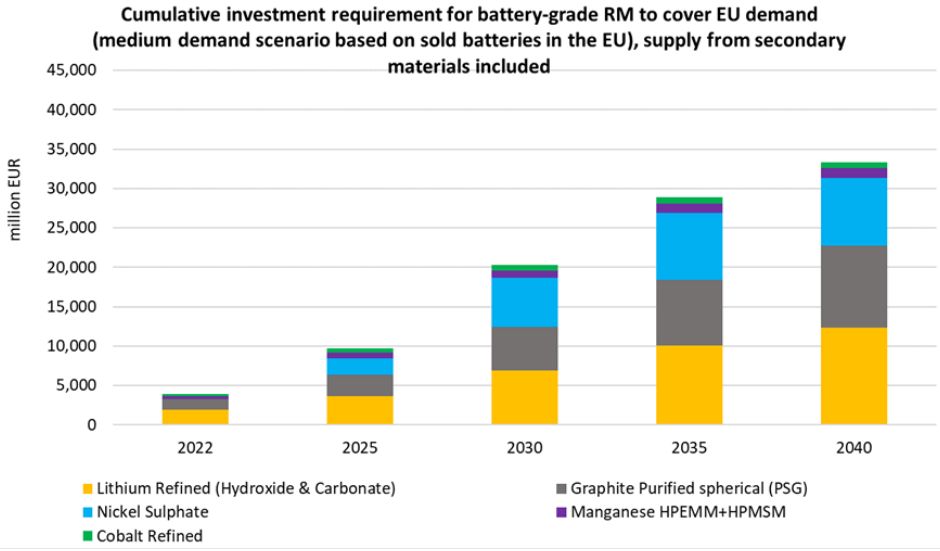
Results visible in the following figures:

Figure 14: Cumulative investment requirement for battery-grade raw materials from primary sources (supply from secondary raw materials excluded) for batteries sold in the EU



Source: JRC

Figure 15: Cumulative investment requirement for battery-grade raw materials from primary sources (supply from secondary raw materials considered) for batteries sold in the EU



Source: JRC

Notes

- the demand for production is derived from the consumption of batteries. Last data update in September 2021;
- the demand for production includes all other uses (not only batteries), while recycling is considered only for the battery sector;
- only the refining stage is represented in the graph, not the upstream investment for mining/exploration, nor investment for recycling capacity;

- for manganese: only Li-ion batteries are considered; LMO and primary batteries are excluded;
- for graphite: the demand considers the overall demand of graphite (i.e. natural and synthetic). The capital investment refers only to refined battery-grade graphite produced from natural graphite feedstock;
- for lithium: the initial capex considers a split between the future needs for lithium carbonate and lithium hydroxide (based on anticipated battery chemistries of batteries placed on the EU market);
- for nickel: existing supply in 2021 includes Class I Ni and Ni sulphate. It is noted that Class I supply is considered to be directed for conversion to sulphate. Availability is dependent on demand from other Class I consuming industries.

Final remarks

1. The investment requirements for lithium, nickel and graphite are much higher compared to cobalt and manganese until 2040.
2. Investment needs amount to almost EUR 10 billion already in 2025 (Figure 15), mainly on lithium, nickel and graphite. The most intense investment requirement for refined capacity of battery-grade RM from primary sources is in 2025-2030 (primarily for nickel, followed by lithium and graphite).

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Abstract

This report examines the strategic importance of titanium metal for the European Union (EU) economy and explores the potential for increased circularity in its value chain. Recognised as both a critical and strategic raw material under the EU Critical Raw Materials Act, titanium is essential for key sectors such as civil aviation, defence, space, and advanced manufacturing. The supply chain faces significant challenges due to geopolitical tensions, resource dependency, and sustainability demands, with a notable gap between global supply and projected demand. Chapter 2 analyses the titanium supply chain, highlighting the EU's reliance on imports and the need for diversification and enhanced domestic capabilities. Chapter 3 focuses on the demand side, detailing the EU's strategic industries that depend on titanium. Chapter 4 delves into the geopolitical dynamics, assessing the EU's position relative to major global players and the impact of Russia's unprovoked full-scale invasion of Ukraine on the supply chain. Chapter 5 addresses the opportunities and challenges in terms of increasing circularity in the titanium supply chain by identifying drivers and barriers, measuring research and innovation intensity through academic publications and patents, and evaluating enhanced circularity scenarios using macroeconomic modelling. The report concludes, in Chapter 6, with potential policy interventions aimed at strengthening the EU's titanium supply chain, reducing external dependencies, and promoting a transition to a circular economy.

Acknowledgements

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Executive summary

A companion website to this Report is available at the JRC Raw Materials Information System (RMIS)

Policy context

Titanium metal is critical for the European Union (EU) due to its relevance in industries such as aerospace and defence, and in several technologies key to the Green and Digital transitions. The EU currently faces significant challenges due to its heavy reliance on imports for titanium metal products. This dependency exposes the EU to risks of supply chain disruption, particularly as the global landscape is dominated by a limited number of suppliers, including China, Russia, Japan and Kazakhstan, and in light of current global tensions such as the Russian aggression on Ukraine and rising protectionism.

This report suggests several policy options based on the current priorities of the European Union in the context of decarbonisation, derisking, reshoring and critical raw materials scarcity, as they are laid down in recent and upcoming policies and guidelines, such as the CRM Act, the Net Zero Industry Act, the Green Deal Industrial Plan, the envisaged Clean Industrial Deal and the Draghi Report.

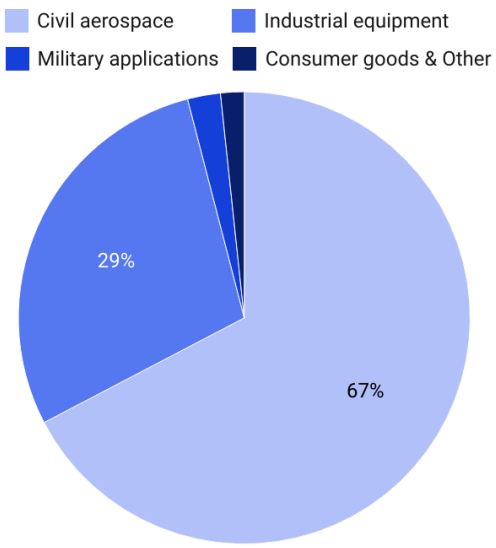
Main findings

The titanium metal supply chain

- Titanium is an energy-intensive material, and this feature has significant implications for policy recommendations. Secondary material flows play a crucial role in this value chain.
- In **sponge**, China's dominant position has increased significantly over the past decade, accounting for roughly two thirds of global output by 2023. However, the majority of Chinese titanium sponge is not suitable for critical aerospace applications. High-quality sponge required for aerospace is produced in Japan, Russia, and Kazakhstan.
- In **melted and wrought products**, China also maintains a strong leadership. The EU has some capacity, but remains significantly behind other major players. As a result, the EU must import substantial quantities of sponge and semi-finished products to meet domestic demand.

Titanium in EU strategic industries and applications

- **Aerospace** is the largest consumer in the EU (67% of total demand), particularly for aircraft structures; as a result, titanium demand remains heavily linked to aerospace activity. The **defence** sector relies on titanium for aircraft, armoured vehicles, submarines and missile systems. **Industrial** use of titanium spans from chemical processing to marine environments. Emerging applications in **additive manufacturing** (AM) present significant opportunities to enhance material efficiency, mitigate supply risks, and improve titanium's circularity.

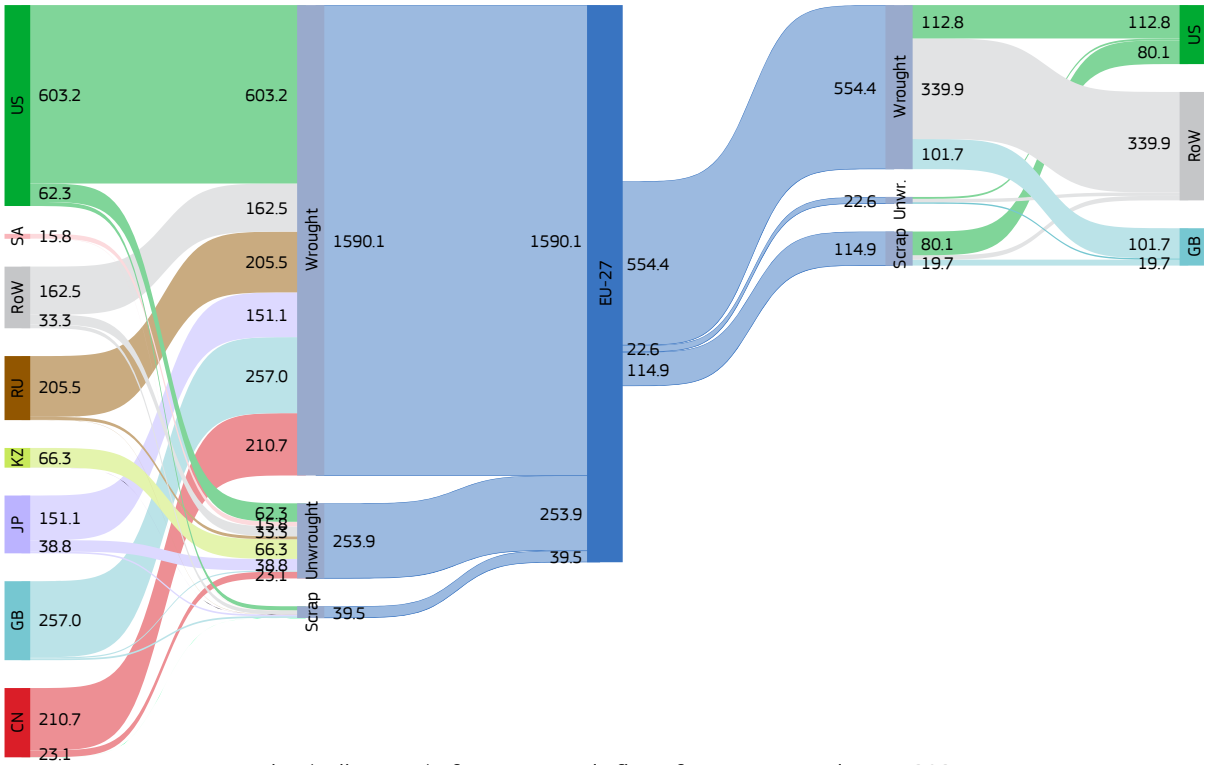


Titanium metal consumption in Europe by application, 2019

The EU position

— **The EU is a net importer of titanium metal**, with an overall import-to-export ratio of 10:1 for unwrought products and 6:1 (3:1 by value) for wrought products. Wrought products represent the largest share of the EU's imports.

— **Buyback agreements constitute a significant obstacle to circularity in the EU**. Titanium producers in third countries offer discounted primary titanium in exchange for returning the scrap after manufacturing parts in the EU. Besides, the lack of titanium production capacity makes recycling scrap within the EU less economically viable.



Value (million EUR) of extra-EU trade flows for titanium products in 2023

The geopolitics of titanium metal

— The **United States** have been the EU's most important trading partner for wrought titanium products and scrap. Due to the current geopolitical pressures linked to the Russian war in Ukraine, the US is likely to remain the most important source of wrought titanium imports to Europe.

— **China** has the largest titanium ore resources in the world. It is also the biggest producer of titanium metal outputs globally. The high costs and subprime quality of Chinese titanium remain major obstacles for expanding the supply chain for aeronautical applications to China.

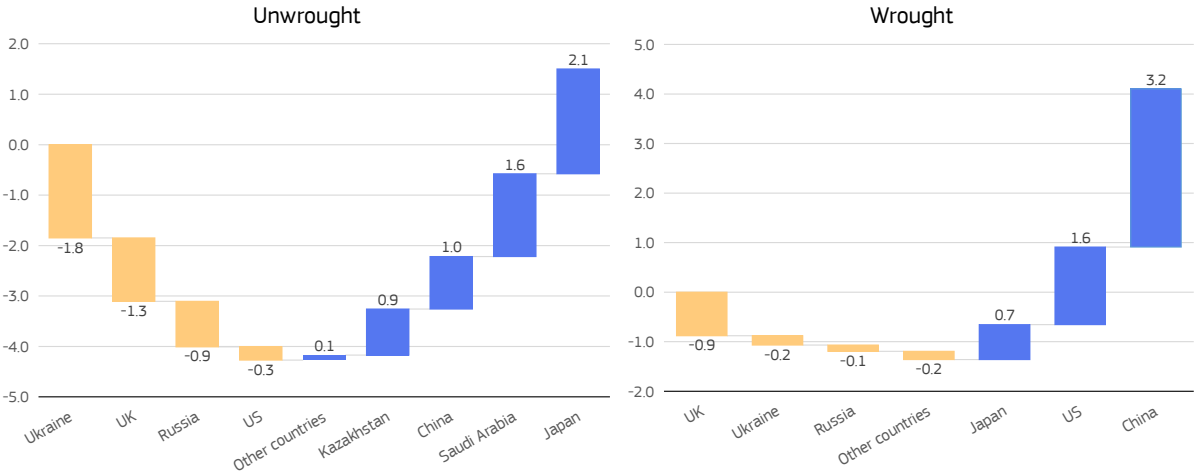
— **Russia** has become a major supplier of titanium for the aeronautical sector, while also heavily reliant on imported titanium sponge.

— **Kazakhstan** has partnered with consumers in Europe and Asia, boosting sponge production and sustaining it effectively. The Russian aggression on Ukraine conflict has redirected most Kazakh exports to the EU, the US, and South Korea.

— **Ukraine** has worked to regain control over the titanium industry after an extended period of Russian control. The EU stands as the primary partner for Ukrainian titanium exports. Export volumes have drastically declined following the Russian invasion.

— High inventories and lower demand have mitigated impacts of the **Russian aggression on Ukraine**. In addition, spare capacity in Japan, Kazakhstan and the US, as well as the expanding capacity in China and Saudi Arabia, has filled supply gaps for sponge and ingots. However, Russia's influence in the global aerospace industry is substantial. The risk of a global titanium supply chain crisis is further aggravated by the expected rise in demand from the aerospace and defence industry in the coming years, and the few producers worldwide.

— **The EU has completely made up for the losses of Russian and Ukrainian supply of unwrought titanium products** (sponge, ingots and powders), as well as managed the additional demand for imports. Regarding wrought products, increased imports from China, the United States and Japan have met the higher domestic needs in the EU.

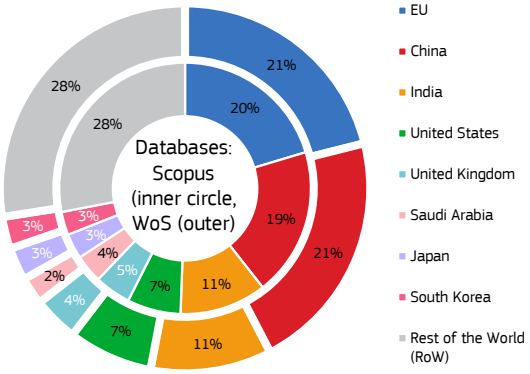


Variation (kt) in annualised EU imports of titanium metal (unwrought/wrought products) after Russia's invasion of Ukraine

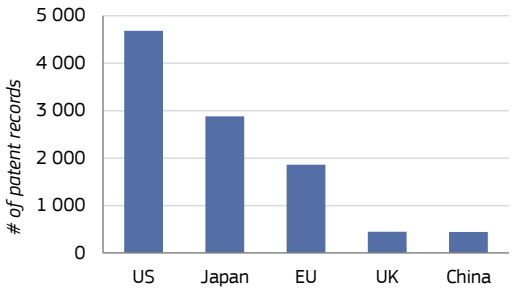
R&I in titanium circularity

— The geographical distribution of **academic publications** on titanium metal circularity reveals that Europe and China are leading regions. Western Europe and Central Asia exhibit the strongest collaboration with the EU, which also maintains a notable presence in Central and South America.

— **Patents** present a different structure: the US leads by a significant margin, followed by Japan and the EU; despite its lack of titanium production capacity, the EU shows substantial patenting activity, reflecting efforts to establish circularity solutions and reducing import dependencies.



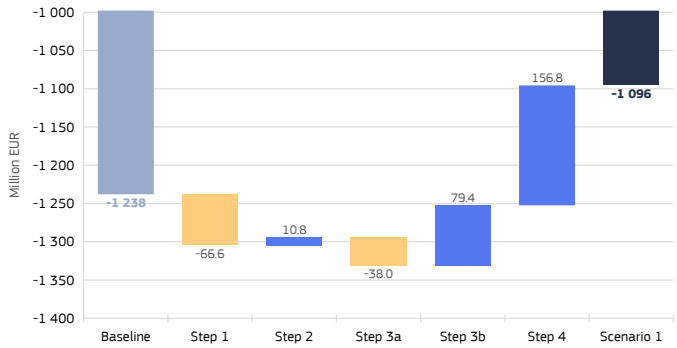
Academic papers on titanium circularity by country, 2014-24



Patents on titanium circularity by country, 2014-24

Circularity scenario modelling

- Disaggregating trade flows using customs data**, two enhanced circularity scenarios for the EU are constructed**, and their macroeconomic and environmental effects are assessed.
- **In the first scenario, the EU retains aeronautical manufacturing scrap that is currently returned under buyback agreements**, which will be used to produce new aeronautical ingot and finished titanium products domestically. The EU economy could gain 377 jobs within the titanium supply chain, and EUR 20 million in total output. This is equivalent to doubling employment in the EU titanium sector, and increasing value added by the equivalent to the total assets of a medium-sized titanium factory.



Construction of EU circularity scenario 1: Effects on the EU trade balance for titanium products (m EUR). After all steps are taken into account, the net effect is positive, as the deficit with extra-EU countries is reduced

- **In the second scenario, we estimate the amount of scrap that could be recovered from decommissioned commercial aircraft at their end of life**, and remelted into ingots. This scenario indicates only a marginal sectoral gain, with the current infrastructure sufficient to manage the increased flow.

Key policy conclusions

- **Reshoring the midstream titanium industry in the EU, together with fostering recycling capabilities, is critical for strategic autonomy.** However, high energy costs, the lack of access to scrap, and competition from vertically integrated foreign firms constitute major challenges. Policies to lower energy costs, incentivize public-private investments, and adopt emerging technologies could reduce energy use and emissions. Transitioning to a cleaner energy mix and leveraging circularity could align reshoring with decarbonization goals, enhancing competitiveness and supporting EU industrial and environmental priorities.
- **To enable domestic titanium recycling, the EU must secure high-quality production scrap, which is hindered by buyback agreements with the US.** Phasing out such agreements requires simultaneous development of the EU titanium industry and collaborative trade talks to avoid trade tensions. Partnering with US firms on EU recycling infrastructure and accessing advanced American technologies could foster mutual benefits and strengthen the EU's titanium supply chain resilience.
- **Ukraine's high-quality titanium deposits present opportunities for EU value chain integration, but the ongoing war has disrupted production facilities and created uncertainty**. Past efforts, including strategic EU-Ukraine partnerships, suggest potential for collaboration post-conflict. Revamping Ukraine's processing facilities, aligning them with EU environmental standards, and navigating internal debates on privatisation versus state control will be key. Post-war reconstruction provides an opportunity for the EU to support Ukraine's titanium industry, ensuring strategic supply while countering geopolitical risks.

— **The EU must diversify titanium sponge sourcing by expanding partnerships with countries like Kazakhstan, Japan, and Saudi Arabia.** Collaborations under the Global Gateway and Mineral Security Partnership Forum could secure resilient supplies while greening global value chains. Investing in sustainable technologies in extraction countries can reduce environmental impacts. Joint ventures for technological upgrading can enhance resource efficiency and competitiveness, supporting EU industrial decarbonization goals.

— **End-of-life recycling of titanium in the aeronautical sector is hindered by profitability issues, technical challenges, and stringent regulatory requirements.** Policies promoting eco-design could encourage easier recovery of titanium from airframes and engines. Greater transparency in material composition and revised recertification systems could unlock greater circularity. Incentives to retain end-of-life (EoL) scrap domestically could ensure economic, environmental, and strategic benefits for the EU titanium industry.

Related and future JRC work

This report gathers information from several JRC publications in the form of policy documents or academic articles. It aims to consolidate the existing in-house knowledge into a more comprehensive reference, while also complementing the existing material with new insights and updated information. The main publicly available sources for the report are the following:

— Baldassarre, B., Buesa, A., Albizzati, P., Jakimów, M., Saveyn, H. and Carrara, S. (2023). "*Analysis of Circular Economy Research and Innovation (R&I) intensity for critical products in the supply chains of strategic technologies*", JRC Science for Policy Report, JRC134253.

— Baldassarre, B. (2024). *"Circular economy for resource security in the European Union (EU): Case study, research framework, and future directions"*. *Ecological Economics* 227: p. 108345.

— Buesa, A., P. Albizzati, E. Garbarino, H. Saveyn and Baldassarre, B. (2023). *"Circular economy in EU critical value chains: The case of titanium metal in defence and civil aviation"*. In K. Niinimäki, K. Cura (Eds.), *Product Lifetimes and the Environment 2023*, Aalto University Publication Series, pp. 149-154.

— Buesa, A., Pedauga, L., Piñero, P., Rueda-Cantuche, J.M., and Baldassarre, B. (under review, 2024). "*The benefits of enhanced circularity for strategic autonomy: Titanium metal in the EU*". Submitted to *Resources Policy.*

[Earlier version published as "*Can circularity in titanium metal improve EU strategic autonomy? Scenario modelling with heterogeneous data*", JRC Working Papers in Economics and Finance 2024/06, JRC139576.]

— Carrara, S., Bobba, S., Blagoeva, D., Alves Dias, P., Cavalli, A., Georgitzikis, K., Grohol, M., Itul, A., Kuzov, T., Latunussa, C., Lyons, L., Malano, G., Maury, T., Prior Arce, A., Somers, J., Telsnig, T., Veeh, C., Wittmer, D., Black, C., Pennington, D. and Christou, M. (2023). "*Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study*", JRC132889.

— Georgitzikis, K., D'Elia, E. and Eynard, U. (2022). "*Titanium metal: Impact assessment for supply security*", JRC129594.

— Jakimów, M., Samokhvalov, V. and Baldassarre, B. (2023). "*Achieving European Union strategic autonomy: circularity in critical raw materials value chains*". *International Affairs* 100 (4): pp. 1735-1748.

1 Introduction

Titanium metal plays a critical role in the global economy, particularly in the European Union (EU). Its unique combination of strength, lightness and corrosion resistance makes it indispensable for several key sectors, including civil aviation, defence and space, healthcare and medical equipment, and advanced manufacturing. However, the titanium supply chain faces significant challenges driven by geopolitical tensions, resource dependency and an evolving landscape of sustainability demands.

With the recent adoption of the EU Critical Raw Materials Act (European Union, 2024), titanium metal has been identified as both a critical and a strategic raw material for the EU economy. Critical raw materials (CRMs) are defined by their high import reliance and concentrated supply from third countries, often characterised by poor governance. Strategic raw materials, on the other hand, are those crucial to technologies underpinning the green and digital transitions, as well as defence and space applications. These materials face a significant gap between global supply and projected demand, with the upscaling of production proving particularly difficult (European Commission, 2021b; European Commission, 2023).

As the EU seeks to secure its strategic autonomy and support its industrial base to maintain a sustainable competitiveness as recommended by the Draghi report (Draghi, 2024), it becomes essential to evaluate both the supply dynamics and the prospects of titanium from a circular economy standpoint. This report offers a comprehensive assessment of titanium's strategic relevance for the EU and explores the intra-EU potential for greater circularity in its value chain.

Chapter 2 introduces the titanium metal supply chain, from the extraction of titanium sponge to the production of melted and wrought products, providing insights into global sourcing and the processing stages that make titanium suitable for high-performance applications. The EU's reliance on imports and exposure to international market fluctuations are highlighted in particular, revealing a need for diversification and stronger domestic capabilities.

Subsequently, in **Chapter 3**, the report explores the demand side by delving into the various strategic industries within the EU that depend on titanium metal, including civil aviation, defence and space, and the emerging fields of advanced materials and additive manufacturing. These industries not only drive demand for titanium metal but also anchor the EU's global competitiveness. Understanding the distribution of titanium demand and its projected growth is vital to ensuring the stability of these sectors, particularly in light of global supply chain disruptions.

The geopolitical dimension of the titanium metal supply chain is also a focal point of the analysis. **Chapter 4** explores international trade dynamics and the EU's position vis-à-vis major global players such as the United States, China and post-Soviet economies. Recent or ongoing events, ranging from the Covid-19 crisis to the unprovoked full-scale invasion of Ukraine, have underscored vulnerabilities in the EU's titanium supply chain (Georgitzikis et al., 2022), with significant implications for import dependency, trade flows, and long-term resilience. These developments necessitate a re-examination of the EU's strategic relationships and its capacity to manage external shocks. The chapter includes an assessment of the impact of Russia's war of aggression against Ukraine on titanium metal from a global and an EU perspective.

Considering the EU's Green Deal and associated Circular Economy Action Plan (European Commission, 2020) as well as the announced Circular Economy Act (Von der Leyen, 2024), increased circularity in the titanium supply chain presents both a challenge and an opportunity. Research and innovation (R&I) in titanium metal circularity is ongoing, aiming to reduce resource dependency and environmental impacts through recycling and reuse. **Chapter 5** of this report conducts an analysis of drivers and barriers to titanium circularity using the PEST (Political, Economic, Social, Technological)

approach. Subsequently, it measures R&I intensity in circularity through academic publications and patenting trends. Finally, it describes how to use disaggregated economic data to construct enhanced circularity scenarios, then evaluates them through a macroeconomic modelling framework. The findings highlight the importance of targeted policy interventions to enable a more sustainable, autonomous and resilient titanium ecosystem.

Finally, **Chapter 6** comes up with several potential policy interventions: (1) Reshoring the midstream segment of the titanium supply chain together with the further development of recycling capacities in the EU; (2) negotiating withdrawal from the buyback agreements to ensure access to manufacturing titanium scrap; (3) integrating Ukrainian Tier-3 operations into the EU titanium value chain; (4) widening international partnerships to ensure a steady supply of titanium sponge; and (5) encouraging end-of-life (EoL) circularity.

Through this detailed examination, the report provides a roadmap for policymakers to strengthen the EU's titanium supply chain, reduce external dependencies, and promote the transition to a circular economy.

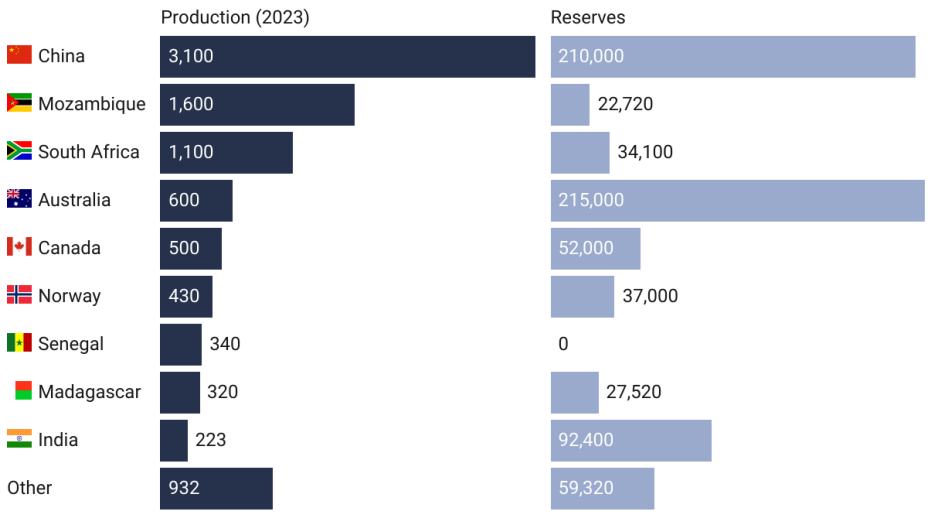
2 The titanium metal supply chain

This chapter gives a brief overview of titanium and describes how titanium metal is produced from ores and concentrates, and who the main actors in the global supply chain are. Our overview draws mainly on insights from Buesa et al. (2023), Georgitzikis et al. (2022) and Takeda et al. (2020).

2.1 Overview

Titanium (Ti), atomic number Z=22, is a transition metal with properties similar to elements like zirconium (Zr), hafnium (Hf), and vanadium (V). Like these elements, titanium is known for its high melting point, strength and resistance to corrosion; it also shares its characteristic reactivity with oxygen and other non-metals, forming stable oxides and nitrides. Titanium is the ninth-most abundant element in the Earth's crust. It is present as oxides in igneous rocks and their sediments, in fauna and flora, and in natural bodies of water. Primary titanium minerals are ilmenite ($FeTiO_3$) and rutile (TiO_2). The countries with the highest production are China (34%), Mozambique (17.5%) and South Africa (12%), while the most abundant reserves are found in Australia, China and India (**Figure 1**).

Figure 1. Production and reserves (kt) of ilmenite and rutile minerals (in TiO_2 content)



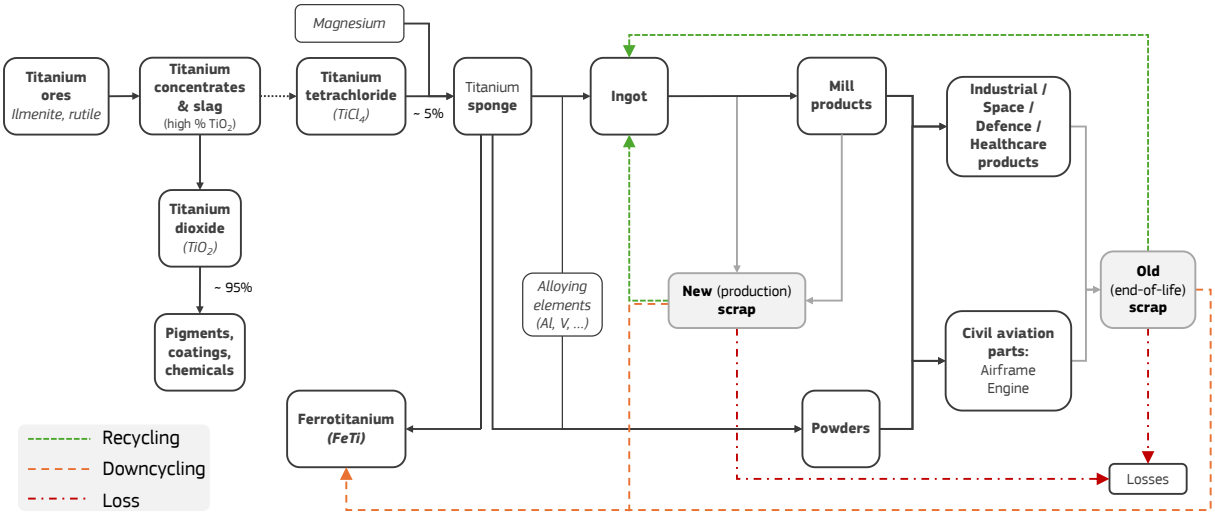
Source: USGS MCS (2024). Image created with Datawrapper.

Figure 2 shows a simplified diagram of the titanium metal supply chain. The first stage of the titanium metal supply chain is mining, where titanium-containing minerals are extracted and processed to remove impurities, separating titanium dioxide (TiO_2) from other elements. Approximately 95% of TiO_2 is used in the manufacturing of whitening pigments, while only around 5% is allocated to titanium metal manufacturing (USGS MCS, 2024). The process of converting titanium dioxide into titanium metal begins with the Kroll process, where TiO_2 is chlorinated to produce titanium tetrachloride ($TiCl_4$), which is then purified and reduced with magnesium under a vacuum or inert atmosphere. This yields titanium sponge, a porous form of pure titanium. While the Kroll process remains dominant, alternatives such as the *direct reduction of slag with magnesium hydride (DRTS)* or the *Fray–Farthing–Chen (FFC) Cambridge process*, are being explored for greater efficiency and energy saving.

A small portion of titanium sponge is used to make ferrotitanium, an alloy applied as a cleansing agent in steelmaking, while the rest is processed into titanium metal. In the next stage, titanium

sponge and scrap feedstock, predominantly new scrap, are melted along with alloying elements such as vanadium and aluminium to form cast shapes, commonly referred to as ingots or slabs, or turned into titanium alloy powder for use in additive manufacturing. These are then fabricated into generic mill products, including blooms, billets, bars, tubes, wires, plates, sheets and strips, through forging and rolling processes. These mill products or titanium powders are later converted into downstream titanium articles like forgings, castings and finished components.

Figure 2. Simplified supply chain for titanium metal



Source: Adapted from Buesa et al. (2024).

Secondary material flows play a crucial role in this value chain. Titanium scrap is generated at various production stages: new scrap, composed of machining waste and turnings, is produced during manufacturing, while old scrap arises from end-of-life products such as decommissioned aircraft parts. This scrap can be remelted with titanium sponge for ingot production, thereby reducing the need for primary materials (Takeda et al., 2020). The percentage of scrap that can be reused in this process—known as the scrap ratio—depends on two key factors:

- *Furnace technology*: Conventional ingot production allows for a maximum scrap ratio of about 30%, while newer technologies can accommodate up to 75% (Louvigné, 2021).
- *Scrap quality*: Scrap containing impurities is unsuitable for high-end applications unless contamination can be removed; otherwise, it is either discarded as waste or downcycled into ferrotitanium production.

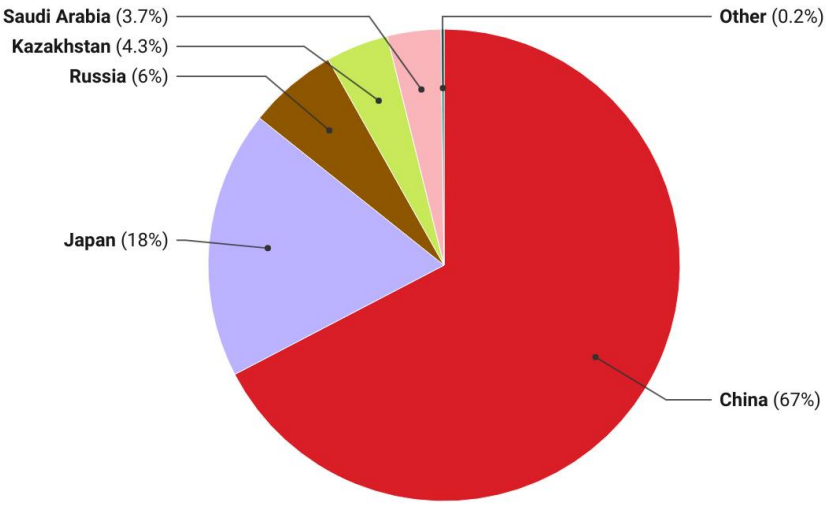
Titanium is an energy-intensive material, and this trait has significant implications for policy recommendations, as outlined in Chapter 6. Producing one kilogram of titanium sponge via the Kroll process requires an estimated 250 to 360 megajoules (MJ) of energy (Xia et al., 2020; Bowden and Peter, 2012), far exceeding the energy required for other metals such as aluminium (210 MJ/kg) or steel (20 MJ/kg) (Norgate et al., 2007). Emerging production techniques offer promising reductions in energy consumption; moreover, substituting virgin sponge with recycled scrap during ingot fabrication significantly lowers both energy use and CO_2 emissions.

This report focuses on titanium sponge, titanium melted products (ingots), and wrought titanium, including mill products and downstream articles. It excludes titanium minerals and slag, titanium oxide for pigments, titanium powders, and ferrotitanium used in steel production.

2.2 Titanium sponge

Few countries worldwide have the capacity to metallurgically process titanium minerals into primary titanium (sponge). The production of titanium sponge was mainly located in five countries in 2023, in order of output, China, Japan, Russia, Kazakhstan and Saudi Arabia ([1]) (**Figure 3**). The global production volume of titanium was estimated to be approximately 327 kt in 2023 (USGS MCS, 2024), surging by over 60% compared to 2018 (**Figure 4**). The EU does not produce titanium sponge and is 100% reliant on imports.

Figure 3. Distribution of global production of titanium sponge by country, 2023



Source: USGS MCS (2024). Image created with Datawrapper.

China has come to dominate the global titanium sponge industry through a remarkable expansion of its production capacity since 2018. The Chinese output increased nearly threefold between 2018 and 2023, from a 37% share of global output in 2018 to two thirds in 2023. Among other significant developments in the titanium sponge industry in recent years, the halt of Ukraine's production after Russia's invasion in February 2022 is noteworthy, according to data from USGS MCS (2024). Additionally, the closure in August 2020 (Argus Media, 2020) of the last sponge plant in the US (Timet Henderson) capable of producing titanium sponge suitable for aerospace and industrial applications marked the end of sponge production in the US ([2]) and a significant shift in the industry's landscape. Moreover, the commencement of commercial production in September 2019 of a new plant in Yanbu, Saudi Arabia, has had a significant impact on the dynamics of global sponge supply. The new Saudi plant, operated by a joint venture (ATTM) of Advanced Metal Industries Cluster Company (AMIC) from Saudi Arabia and the Japanese producer Toho Titanium ([3]), has largely offset the loss of non-Chinese production from Ukraine and the US and aims to become a supplier of aeronautical titanium sponge (Abduljalayel and Martin, 2024).

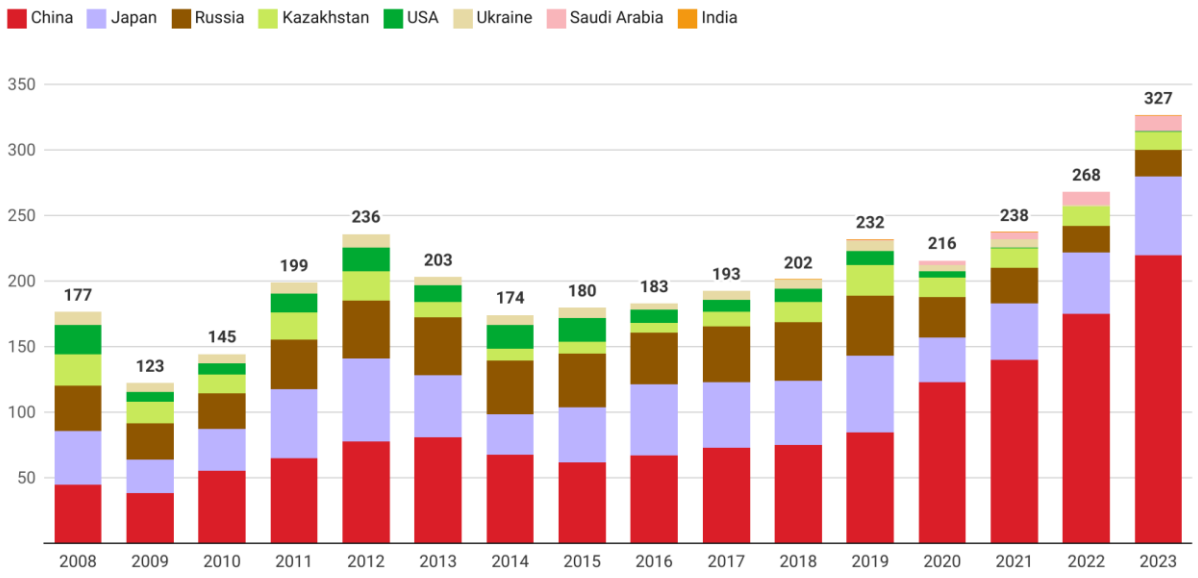
[1] Minor quantities were also produced in the US and India.

[2] A small production capacity is still operating in the US for the electronics market.

[3] https://www.toho-titanium.co.jp/en/business/timetal/

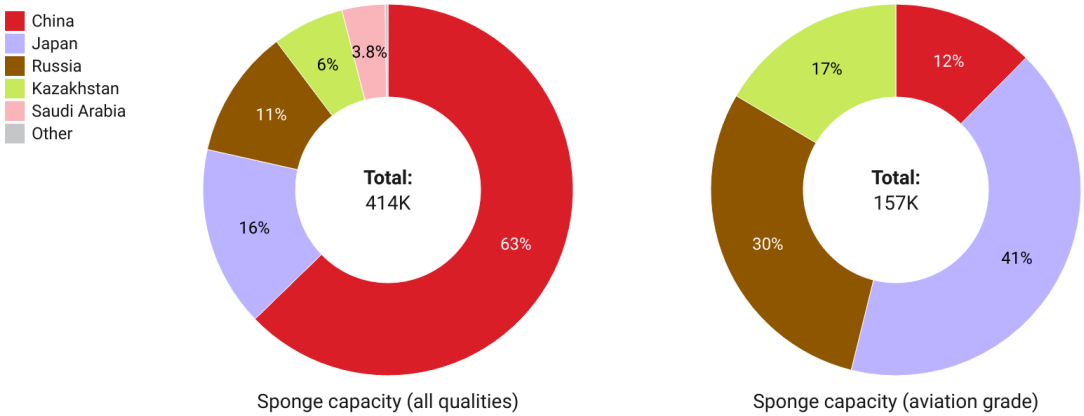
China's dominance in operating capacity is also indisputable (**Figure 5**). However, Chinese titanium sponge is qualified mostly for common applications (standard quality) and not for aerospace. China's high-quality sponge production capacity represents a small share in comparison with major producers elsewhere (Qiu and Guo, 2022; Hui et al., 2023).

Figure 4. Global production of titanium sponge by country, 2008-2023, in kt



Sources: Data collection from USGS MCS (2024), ITA (2022), ITA (2021), Wang (2023), Zhongsheng et al. (2023), USITC (2017), Gehler (2019), Gehler (2013), Venger et al. (2024), Elsner (2021), and Louvigné (2021). See Annex for details. Image created with Datawrapper.

Figure 5. Operating capacity for titanium sponge by quality, 2023

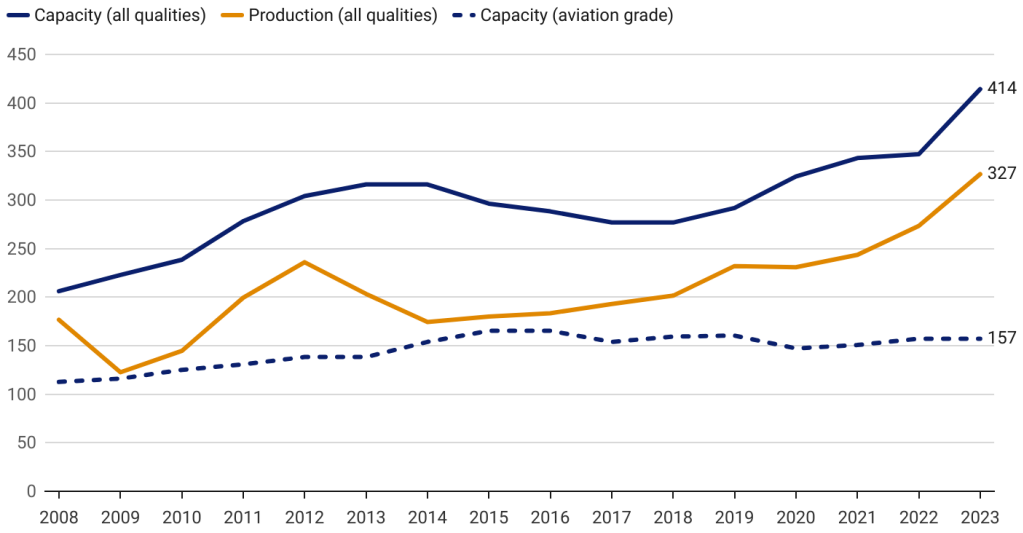


Source: USGS MCS (2024) and own assessment for aviation-grade capacity. See Annex for details. Image created with Datawrapper.

Sources of supply for titanium sponge suitable for critical aircraft equipment are limited. After the closure of the US plant, qualified producers for aviation-grade sponge are Japanese, Russian and Kazakh; some Chinese producers also provide sponge to the domestic market for aerospace applications (Wang, 2023; Hu et al., 2022). In 2023, the production capacity for aviation-quality

sponge is estimated at between 35% and 40% of global capacity (**Figure 6**). However, the qualification and traceability of aeronautical-grade titanium faces significant challenges, as highlighted by recent concerns over falsely certified aeronautical-grade titanium sold by a Chinese supplier (Bushey and Pfeifer, 2024).

Figure 6. Evolution of global capacity and production of titanium sponge, 2008-23, in kt



Source: Capacity data from USGS MCS (2024), Wang (2023), Elsner (2021), Louvigné (2021), Mansfeldt (2020), and USITC (2017). Own assessment for aviation-grade. For production data see Figure 4. See Annex for details. Image created with Datawrapper.

Box 1. Titanium sponge qualities

The purity and grade of titanium sponge considerably influence its downstream applications. The minimum titanium content of standard-quality (SQ) titanium sponge is 98.5% (or more often 99.2%) (Elsner, 2021). The end uses for SQ sponge include the production of airframes, non-rotating parts of jet engines, industrial applications, and other non-aerospace end uses.

Premium-quality (PQ) sponge — commonly referred to as "rotor-grade" — has a chemical composition of over 99.7% Ti achieved by strict control of impurities and trace elements (Elsner, 2021). PQ sponge is suited for critical rotating parts of aircraft engines. Some end users in the aerospace industry require a lengthy certification process for producers of premium-grade titanium sponge to ensure that their product complies with the highest quality standards (e.g. manufacturers of rotating engine parts and aircraft engines, OEMs – *original equipment manufacturers*) (USITC, 2017) (Timet, 2018). PQ titanium sponge can be used in SQ applications across different industries, whereas SQ titanium sponge cannot be used in PQ applications (USITC, 2017).

Ultra-high-purity titanium sponge is reserved for the semiconductor industry and is not used in the production of titanium mill products (USITC, 2017).

"Off-grade" sponge does not meet the purity standards required for high-quality titanium products but is suitable for the production of ferrotitanium or titanium ingots for other industrial applications where purity is not essential (Wang and Wu, 2023) (Timet, 2018).

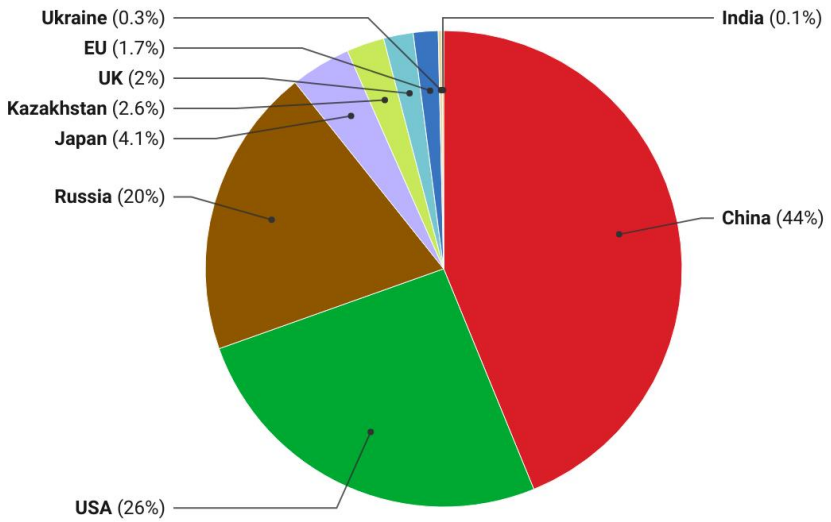
A similar quality classification also exists for titanium ingot products. Premium quality (PQ) titanium ingots for critical rotating aircraft engine applications must meet stringent requirements for chemical segregation and melt-related inclusions (Woodfield and Lemaitre, 2020).

2.3 Titanium melted products

Similarly to titanium sponge, the regional production hubs for melted products are limited to a small number. China is the world's largest producer of titanium metal ingots and other melted products, accounting for 44% of global output in 2020 (**Figure 7**). It is noted that China's production of titanium melted products has risen rapidly beyond 2020 as is shown in **Figure 8**, reaching 145 kt in 2022 (An et al., 2023). This marks a substantial expansion of over 90%, compared to the 75 kt produced in 2018. The US ranks second globally, accounting for about 26% of global output in 2020, followed by Russia, which represents nearly 20% of global output. The US consumes the majority of scrap from remelting operations around the world, and scrap is estimated to correspond to about 60% of melted feedstock (Coggins, 2019). Melting furnaces ([4]) capable of recycling titanium scrap into titanium ingots are currently operating in all producing countries. These capacities are expected to develop further, especially in places with an established downstream industry, such as China, Japan and Europe (Louvigné, 2021).

Other operators of melting capacity are located in Japan, Kazakhstan, Ukraine, the United Kingdom and the EU (**Figure 9**). The global melting capacity was estimated to be around 510 kt/year in 2020 (**Figure 10**). According to Louvigné (2021), the melting capacity bound for aerospace alloys accounted for about half of the world's capacity in 2020 (i.e. about 260 kt/year), which corresponds to approximately 100 kt/year of solid products ([5]). According to other estimates, the melting capacity for aerospace alloys was about 150 kt/year in 2018 (data from Roskill in Elsner, 2021).

Figure 7. Estimate of production distribution of melted products (ingots) by country, 2020

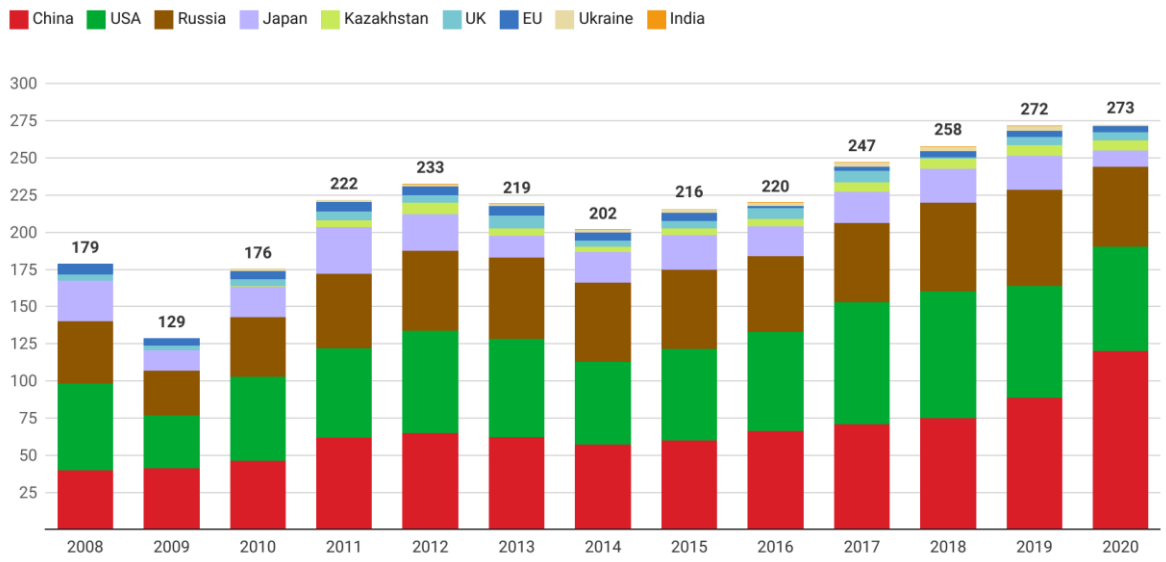


Sources: ITA (2022), Wang (2023), and own estimates (see Figure 8). Image created with Datawrapper.

[4] Commonly applied processes: Vacuum arc remelting (VAR), Electron beam melting (EBM), Plasma arc melting (PAM).

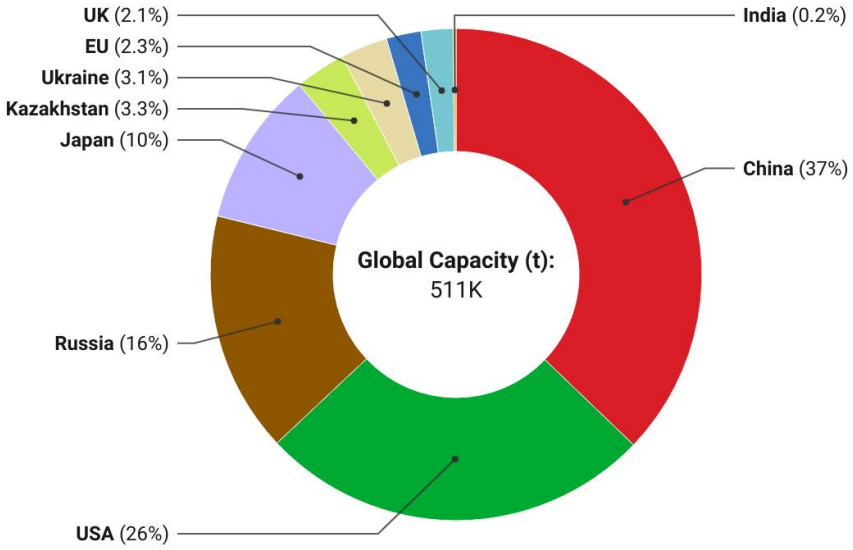
[5] The melting capacity is used in double and triple melting to reduce impurities in titanium metal, so actual available capacity is much lower.

Figure 8. Global production of melted products (ingots), 2008-2020, in kt



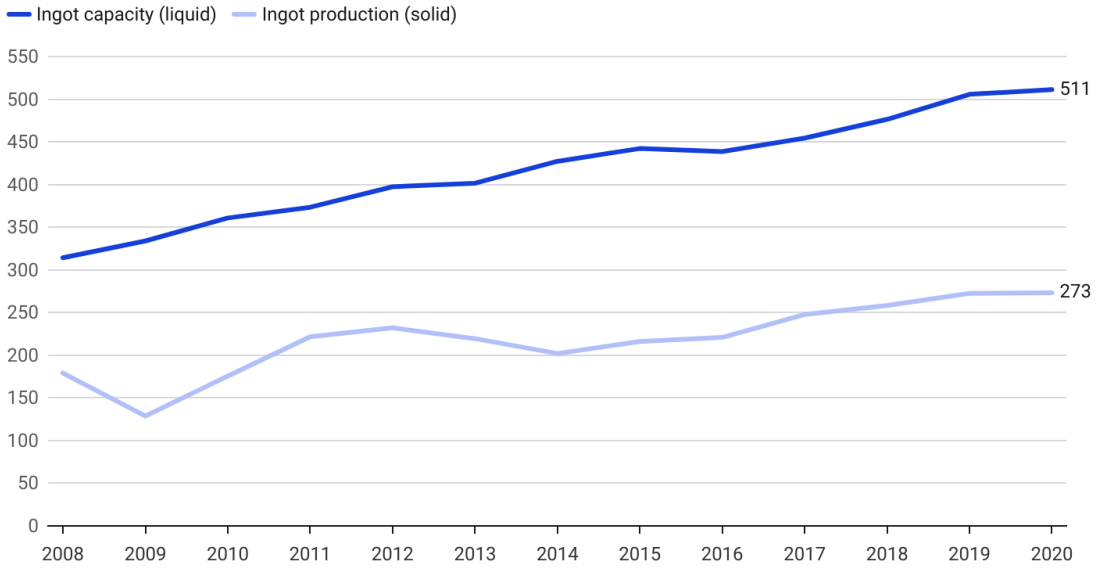
Sources: Data compilation based on ITA (2022), ITA (2021), Elsner (2021), Wang (2023), USITC (2017), Mansfeldt (2020), USGS MYB-Ti (2023), and Jefferies (2018). See Annex for details. Image created with Datawrapper.

Figure 9. Production capacity for melted products (ingots), in 2020



Source: Data compiled from Elsner (2021), Wang (2023), Louvigné (2021), Mansfeldt (2020), and USGS MYB-Ti (2023). Image created with Datawrapper.

Figure 10. Evolution of global melting capacity (liquid) and production (solid), in kt

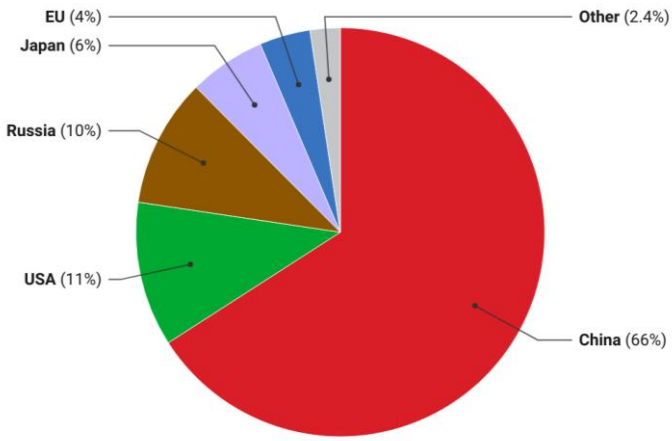


Source: See Figure 8 and Figure 9 for production and capacity data sources, respectively. See Annex for details. Image created with Datawrapper.

2.4 Wrought titanium products

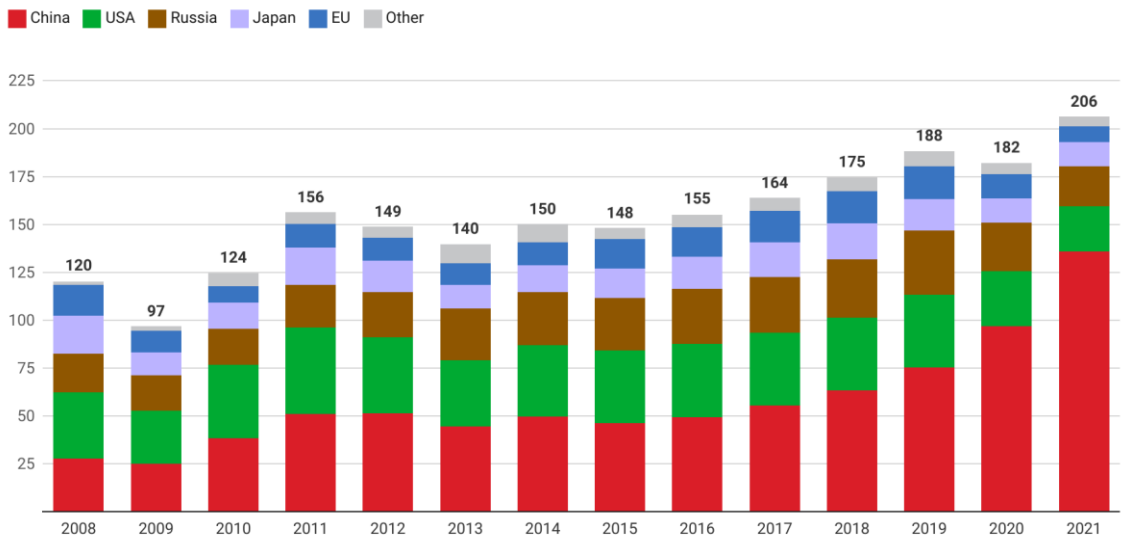
China has become the leading producer of wrought titanium products (mill products), having a significant share of two thirds of global production in 2021 (**Figure 11**). China has greatly increased its wrought titanium production in recent years, with output reaching an all-time high of 151 kt in 2022 (An *et al.*, 2023), doubling since 2019 (75 kt). Elsewhere in the world, the demand for titanium mill products is satisfied by a supply base primarily located in the US, Russia, Japan and the EU. The global mill product supply reached a record high in 2021, despite the impact of Covid-19 and the downturn in the aerospace sector due to China's massive increase in output (**Figure 12**).

Figure 11. Global production of titanium mill products by country, 2021



Source: ITA (2022), Zhongsheng et al. (2023), Eurostat Prodcom (2024), and own estimates (see Figure 12). Image created with Datawrapper.

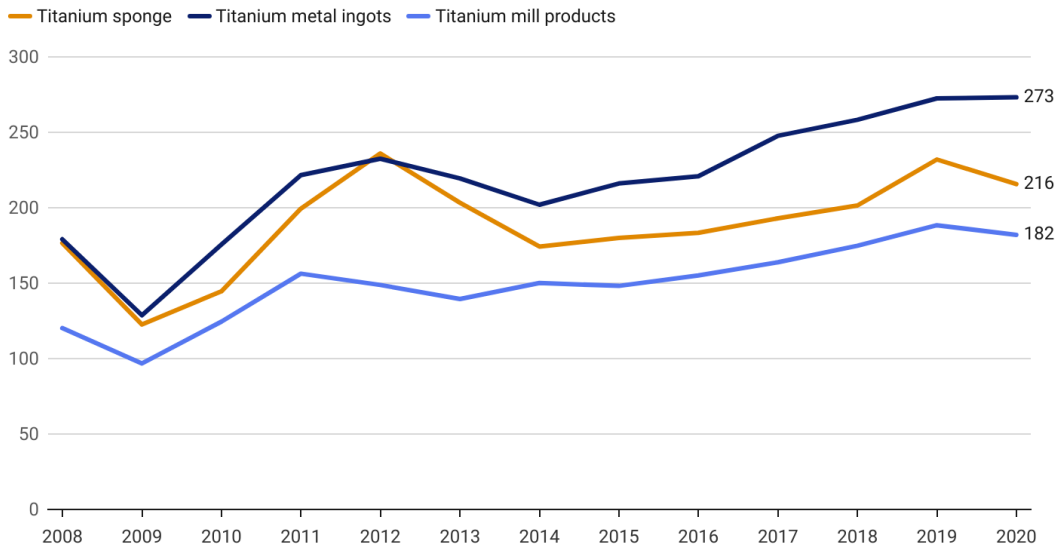
Figure 12. Global production of titanium mill products, 2008-2021, in kt



Sources: Data compilation from various sources, including Wang (2023), Timet (2018), ITA (2022), ITA (2021), Ashraf Imam (2016), USGS MYB-Ti (2023), Zhongsheng et al. (2023), and Eurostat Prodcom (2024). See Annex for details. Image created with Datawrapper.

Figure 13 provides an overview of total production trends across the supply chain from 2008 to 2020. The widening gap between ingot and sponge production since 2012 indicates a rising proportion of scrap being utilised in titanium metal production. It is highlighted that the largest suppliers of titanium bound for the aerospace market (VSMPO-AVISMA, Allegheny Technologies Inc. (ATI), Timet and Howmet) supply about 80% of total global aerospace titanium demand (structural or rotor grades). Even though most of their production facilities for mill products for the aerospace market are located in North America or Europe, VSMPO-AVISMA's facilities in Russia have been a major source of supply to the global aerospace industry (Zimm, 2023).

Figure 13. Evolution of titanium sponge, ingot and mill products production, 2008-2020, in kt



Source: Own elaboration based on data presented in Figure 4, Figure 8, and Figure 12. Image created with Datawrapper.

2.5 Summary

The EU finds itself in a particularly vulnerable position regarding titanium metal as it lacks domestic production capacity for primary titanium sponge, rendering it entirely dependent on imports. This dependency exposes the EU to risks of supply chain disruption, particularly as the global landscape is dominated by a limited number of suppliers, including China, Russia, Japan and Kazakhstan.

China's dominant position in the production of titanium sponge has increased significantly over the past decade, accounting for roughly two thirds of global output by 2023. However, it is important to note that the majority of Chinese titanium sponge produced is of standard quality, which is not suitable for critical aerospace applications. High-quality titanium sponge, required for aerospace and other specialised uses, is primarily produced in Japan, Russia, and Kazakhstan. This concentration of supply also poses a significant risk for the EU, especially in light of geopolitical tensions that could further jeopardise access to reliable sources of aviation-grade titanium.

Another challenge for the EU concerns the downstream production of titanium melted products and wrought products, where China also maintains a strong leadership position. The EU currently has some capacity for processing titanium metal, including for melted and wrought products, but remains significantly behind other major players in terms of overall production volume. As a result, the EU must import substantial quantities of both titanium sponge and semi-finished titanium products to meet domestic industrial demand.

Despite these challenges, the EU's established industrial base and the presence of key downstream processing facilities provide a potential foundation for future growth in titanium metal production and processing.

3 Titanium in strategic EU industries and applications

3.1 Overview

Titanium is an excellent material for a wide range of applications across various industries due to its exceptional properties. It has the highest strength-to-weight ratio of any metal, excellent corrosion resistance and a high melting temperature. Some of the key applications of titanium metal are strategic (ITA ,2011; Elsner, 2021; Britannica, 2024; Froes et al., 2019; or Veiga et al., 2012):

1. *Aerospace & Defence:* Titanium is a critical material in the aerospace and defence industries due to its outstanding strength-to-weight ratio (density of about 60% that of steel and strength that exceeds carbon steel), thermal stability and superior corrosion resistance. It is extensively used in aircraft structures, engines, and military applications where components must withstand extreme temperatures, high stresses, and comply with rigorous safety standards.

    (a) Aircraft structures and components. Due to its strength and lightweight properties, titanium is used in elements of the airframe, landing gear and fasteners, to reduce weight and increase fuel efficiency. In addition, titanium alloys are highly compatible with carbon-fibre composite structures and resist galvanic corrosion when coupled with carbon fibre-reinforced plastics (CFRP) used extensively in modern aircraft.

    (b) Engine parts. Titanium alloys are used in jet engines for compressor blades, discs and casings, as they can withstand high temperatures and resist corrosion.

    (c) Military applications. Because of its lightness and durability, titanium is a metal of choice for many military applications, such as vehicles, armour plating and missiles.

    According to estimates reported by Zimm (2023), engines, which comprise about 40% of the titanium demand in aircraft, equipment systems (25%) and aerostructures (30%) consumed the most.

2. *Industrial applications:* Titanium is increasingly used in critical components of various industrial applications, such as equipment used in chemical processing, marine applications, power generation, desalination plants and the automotive industry. It is used in heat exchangers and condensers, tanks, reactors, piping systems, shipbuilding (hulls, propeller shafts, pumps, valves and other components), offshore equipment, nuclear power plants (e.g. waste storage), geothermal energy, automotive components (e.g. engine valves and exhaust systems), and desalination plants due to its excellent resistance to corrosion in harsh environments.

3. *Medical and healthcare.* Titanium's excellent biocompatibility characteristics and durability make it ideal for medical applications, including implants and prosthetics (such as hip and knee replacements, dental implants), surgical instruments and medical devices (e.g. pacemakers, defibrillators).

4. *Architectural applications.* Titanium is used in the field of construction for building facades (cladding and roofing materials) and structural elements in buildings and bridges due to its durability, corrosion resistance and aesthetic appeal.

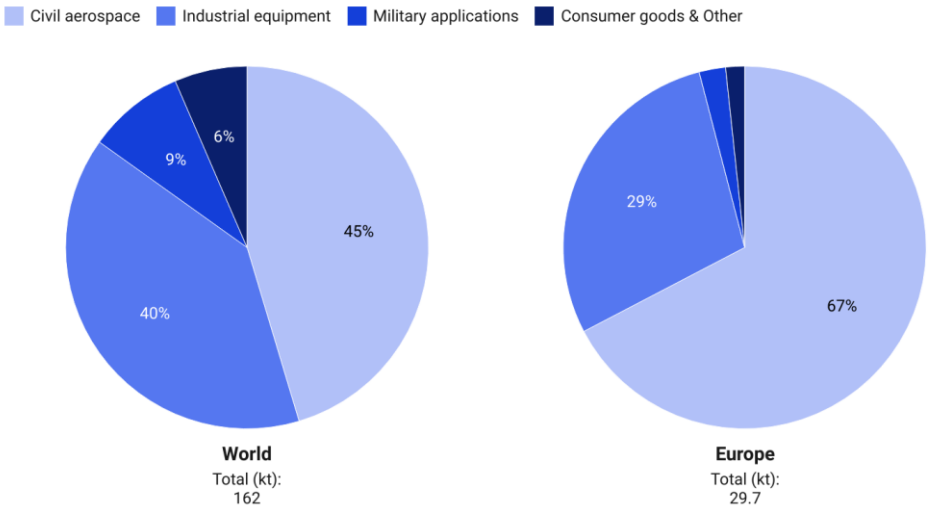
5. *Consumer goods.* Titanium is also used in consumer electronics (casings and components of smartphones, laptops and tablets), jewellery including watches and glasses frames, and high-end sports equipment (professional-level golf clubs or bicycle frames).

3.2 Demand distribution and outlook

On the demand side, the two major market segments are commercial aircraft production (airframe structures, engine parts, and specific components) and industrial applications (chemical industry, oil & gas, nuclear plants, etc.), making up 85% of all titanium demand on a global basis (**Figure 14**). The segments of defence and consumer goods contribute less to global titanium consumption (9% and 6%, respectively). However, there are significant regional variations. For instance, in Europe, the civil aerospace sector accounts for two thirds of titanium metal consumption, while industrial applications account for 29% (**Figure 14**). Conversely, in China, industrial applications dominate, comprising 70% of the total demand, with the aerospace sector accounting for 18% (Qiu and Guo, 2022).

Titanium is used in the form of alloys in high-performance applications and components in aeronautics and defence, and in its commercially pure or low-alloy form in airframes, industrial applications and consumer products (Louvigné, 2021).

Figure 14. Titanium metal consumption by application in 2019 (World and Europe)



Source: Data from Louvigné (2021). Image created with Datawrapper.

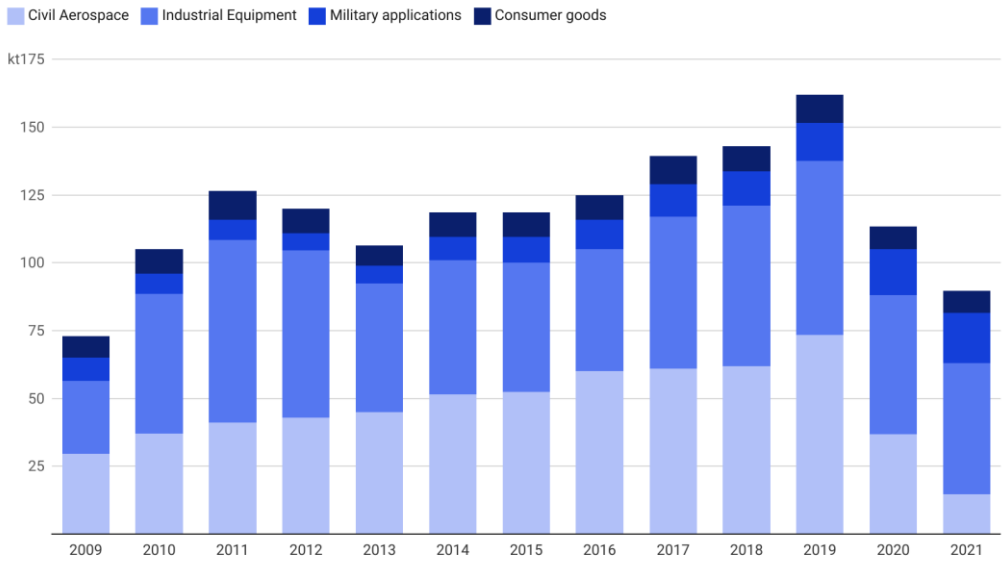
Titanium demand is heavily dependent on industrial activity, and demand for the higher grades of sponge and ingot is directly linked to the aerospace industry. The titanium market grew strongly from 2009 to 2019 at a compound annual growth rate of 8%, primarily driven by the aerospace sector (**Figure 15**). Prior to the Covid-19 crisis, titanium demand reached a record high in 2019, with more than 160 kt of titanium consumed globally. European consumption amounted to approximately 30 kt in 2019 (18% of the global total), with two thirds destined for high-end aerospace applications.

Covid-19 substantially impacted the titanium industry. The decrease in titanium demand in 2020 reflects this impact, mainly due to the collapse of aviation activity. Lockdowns and travel bans in 2020 forced most airlines around the world to scale back or cancel orders. The immediate effects of

the pandemic's strike were somewhat mitigated by long supply chains ([6]) and the building up of "white-tail" inventories ([7]) (Roskill, 2020). Titanium consumption worldwide is estimated to have plummeted by 30% to 113 kt in 2020 and, further, to 90 kt in 2021, i.e. a 45% drop in 2021 compared to 2019, reflecting an almost 80% decline in civil aerospace applications (Louvigné, 2021).

In a report by Louvigné (2021), it was anticipated that the annual growth rate of demand would be about 12% until 2026. A return to 2019 levels of consumption was expected no earlier than 2027. However, the growth in production and global exports worldwide in 2022-2023 indicates that demand recovery is accelerating. The outlook for titanium demand appears robust, supported by its essential applications in key industries, and it is expected to grow in the coming years. The major factors that contribute to the speeding up of demand's recovery are outlined below.

Figure 15. Trends in global titanium consumption, 2009-2021, in kt



Source: Data from Louvigné (2021). Image created with Datawrapper.

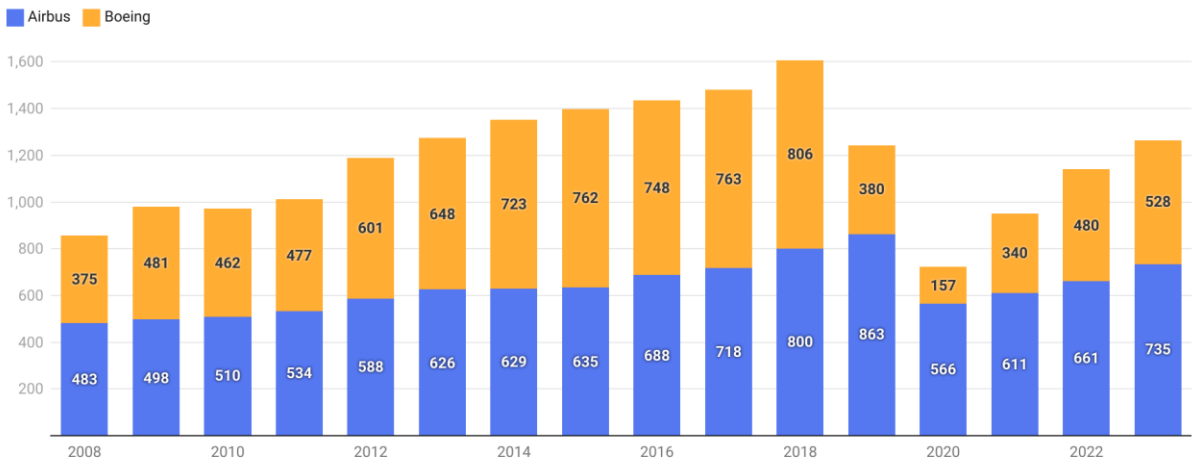
The ongoing production of commercial aircraft, particularly the renewal of the fleet with lightweight and more fuel-efficient models, will continue to drive demand from the aerospace industry. According to data shown in **Figure 16**, global deliveries of commercial passenger aircraft in 2023 are close to reaching the pre-pandemic level of 2019 (which was a year impacted by the grounding of Boeing's 737 MAX). Major aircraft manufacturers like Boeing and Airbus have robust order backlogs, with the global order backlog of passenger aircraft reaching a record year-end level in 2023 of almost 16 000 aircraft from Airbus and Boeing (Centre for Aviation, 2024), supporting sustained demand for titanium. Aircraft production is expected to grow at 8.8% CAGR over 2022-2027, the total demand for aerospace raw materials is forecast to grow by 5.9 % CAGR from 620 kt in 2022 to 830 kt in 2027, and the titanium mill products for aerospace are projected to increase by 7.7% CAGR from 71 kt to 103 kt in 2022-2027 (Zimm, 2023).

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[6] Due to the lengthy assembly of aircraft, titanium purchased today may serve aircraft production 2-3 years in the future.

[7] A 'white-tail' refers to a plane built but not delivered to a buyer.

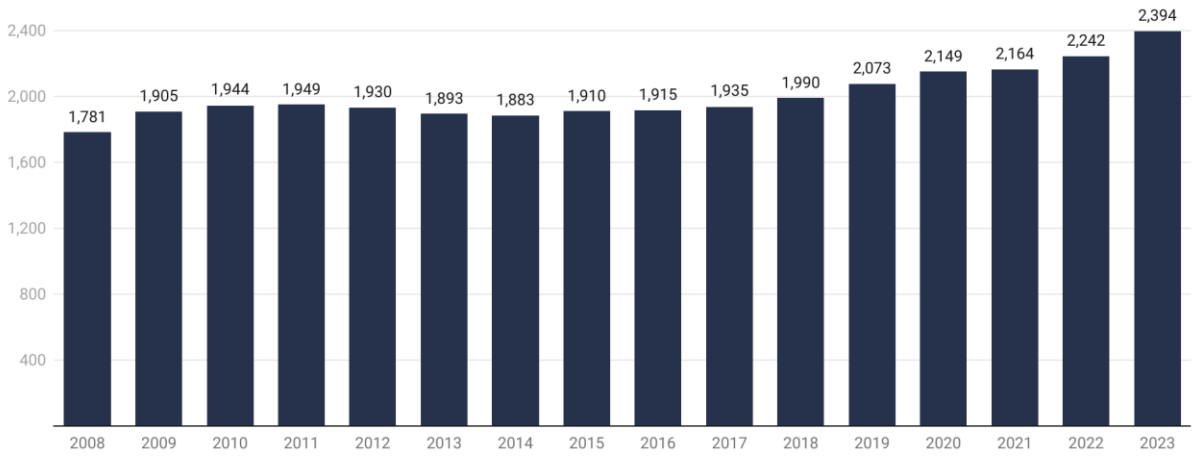
Figure 16. Trend of aircraft deliveries by Airbus and Boeing, 2008-2023, in units



Source: Data from Statista (2024) and Statista (2024b). See Annex for details. Image created with Datawrapper.

Increased defence budgets over the coming years in the aftermath of Russia's unprovoked full-scale invasion of Ukraine may boost titanium demand. In 2023, military spending worldwide reached its highest level during the period considered (**Figure 17**). Undoubtedly, these events have significantly contributed to the strong rise in military spending in 2022-2023.

Figure 17. Military expenditure worldwide, 2008-23, in billion USD



Source: Data from SIPRI (2024). Constant 2022 prices and exchange rates. Image created with Datawrapper.

Industrial demand for titanium is foreseen to expand in the near to medium term. Main drivers are the chemical (chlorine and PTA production), power generation (nuclear, renewables) and LNG transport sectors using titanium (Coggins, 2019; Bruneau, 2020). Growth is also expected for titanium-based medical products due to population growth and ageing (Coggins, 2019).

3.3 Strategic segments for the EU economy

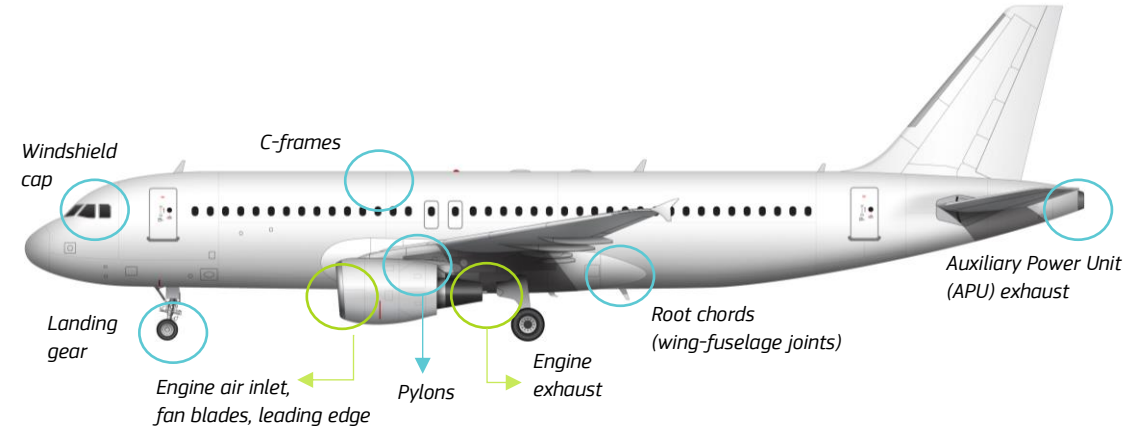
This section presents an overview of titanium's relevance in strategic sectors and technologies for the EU economy, in the spirit of existing work by Carrara et al. (2023).

3.3.1 Civil aviation

Titanium is widely used in civilian aeronautical products, especially jetliners. While legacy models used titanium mostly in the hydraulic system, in more recent models it is found in airframe components such as pylons, in the landing gear, and in engine parts (e.g. blades), as illustrated by **Figure 18**. In general, titanium is suitable for parts subject to intense thermal fatigue. The spectrum of parts where titanium alloys are found has also evolved in line with the increasing use of composite materials, such as carbon fibre-reinforced plastic (CFRP), with which titanium is highly compatible, leading to a steady rise in the proportion of titanium by weight in these parts over recent decades (**Table 1**).

Several aircraft components containing titanium, such as pylons or landing gear elements, are *rotables*, i.e. parts that wear over time but can be overhauled and subsequently reused. In contrast, several components (e.g. any rotating part of the engine) are considered *life-limited parts (LLPs)*, which have a known degradation profile and are safety-critical and will be discarded after a certain number of flight hours or cycles. Aviation regulations often require LLPs to be destroyed or rendered unusable after their removal.

Figure 18. Titanium alloys in commercial aircraft: engine (green) and other assemblies (blue)



Source: EFESO (2024) and own elaboration. Aircraft image from Norebbo represents an Airbus A320.

The most common titanium alloy used in aerospace is Ti-6Al-4V (also known as Ti-6-4 or TA6V), composed of around 90% titanium, 6% aluminium and 4% vanadium. This alloy constitutes roughly 90% of the titanium content in the airframe. Engine parts often use other alloys such as Titanium 6-2-4-2, which includes 6% aluminium, 2% tin, 4% zirconium and 2% molybdenum, although their precise physical properties and composition are sometimes unknown.

Due to the precise shape requirements of many components to minimise weight, titanium alloy parts frequently have a *buy-to-fly* ratio of 9:1 or higher, meaning that producing one tonne of components results in eight tonnes of new scrap (Inagaki et al., 2014). When possible, this new scrap is purified and remelted. For old (end-of-life) scrap, titanium engine parts often re-enter a dedicated reuse loop for such assemblies. In contrast, airframe scrap is treated differently: large pieces can be cut and

downcycled into ferro-titanium, but only a minimal amount of airframe scrap is remelted, as the high costs or technical challenges make it unfeasible in many cases.

Table 1. Titanium content in selected civilian aircraft

Aircraft model	Year	Type	Titanium content	Aircraft model	Year	Type	Titanium content
MD-80	1980	NB	5%	767	1982	WB	5%
757	1983	NB	5%	747-400	1989	WB	5%
737Classic	1984	NB	5%	A340-200/300	1993	WB	6%
A320CEO	1988	NB	5%	A330	1994	WB	5%
737NewGen	1997	NB	10%	777-200/300	1995	WB	10%
A320neo	2016	NB	12%	787	2011	WB	15%
A220	2016	NB	8%	A350	2015	WB	13%
737max	2017	NB	12%	A330neo	2018	WB	10%
				777X	(2025)	WB	13%

NB: Narrow-body, WB: Wide-body. Table assumes 85% of aircraft weight in airframe.

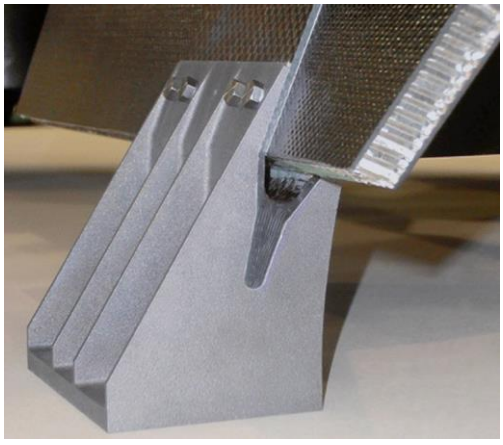
Source: Buesa et al. (2024) from various sources.

3.3.2 Space

Titanium's properties make it an essential material in the space industry. In the harsh environment of space, where components are exposed to extreme temperatures, radiation and vacuum, titanium's resilience and lightweight characteristics are vital. In space launchers, titanium is used in components that must be both strong and lightweight to maximise payload efficiency and ensure the structural integrity of the vehicle during launch, such as cryogenic propellant tanks.

For satellites, titanium durability is crucial for maintaining functionality over extended periods in space. The nitinol (nickel-titanium) alloy family is extensively used in the construction of satellite antennas and serves as a key material for the deployment structures of solar panels, which provide a continuous energy supply to satellites. Nitinol alloys are widely recognised for their shape memory properties, allowing them to return to their original form when subjected to specific temperatures or external forces. On a different note, high-pressure gas cylinders made of titanium alloy provide kinetic energy for altitude adjustment and mechanism drives. Finally, structural parts such as mountings and brackets are also manufactured using titanium alloy (**Figure 19**).

Figure 19. Titanium bracket for satellites created through additive manufacturing



Source: EOS (2015).

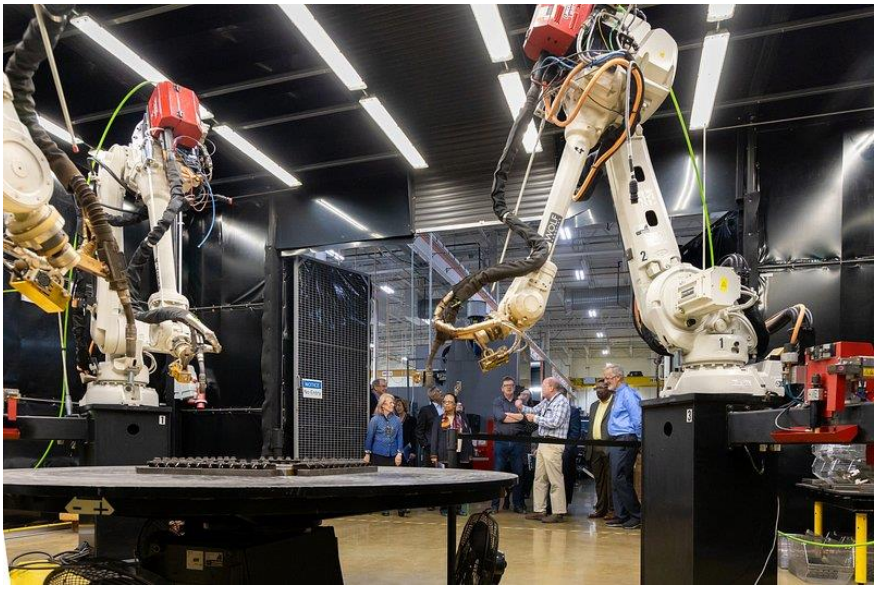
Metal structures for European space systems are produced in EU territory: titanium parts of propellant tanks are manufactured by MT Aerospace (an OHB subsidiary) in Germany. Additionally, titanium-based components produced through additive layer manufacturing have been created in Europe by leading industrial players for over a decade, primarily using Ti-6Al-4V alloys and Electron Beam Melting technology.

3.3.3 Robotics and drones

Robotics

In robotics, titanium is a preferred material for robotic arms, joints and frames, where durability and the ability to handle significant loads without adding unnecessary weight are crucial (**Figure 20**). As robotics technology advances, especially in sectors such as healthcare, manufacturing and defence, the demand for titanium is projected to rise. The material's biocompatibility also makes it suitable for robotic systems used in medical applications, where precision and safety are paramount.

Figure 20. Multi-axis Laser cutting robotic arm



Source: Baison Laser and Rawpixel.com. Free CCO U.S. Government image.

Drones

Drones, or unmanned aerial vehicles (UAVs), rely on materials that provide the necessary balance between strength and weight to ensure long flight times and robust performance. Titanium's application in drone technology is primarily in the construction of airframes and critical components that must withstand high stress while maintaining a low weight (Yan and Ebel, 2019). In military and commercial drones, titanium is crucial for improving endurance, maneuverability and payload capacity.

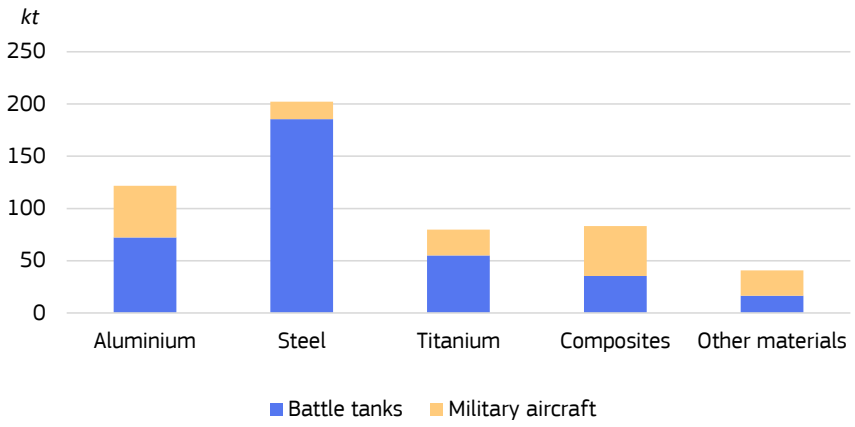
Similarly to aviation, the combination of titanium with composite materials, such as carbon fibre-reinforced plastics, is an emerging trend that leverages the strengths of both materials to enhance performance while reducing weight. Additive manufacturing is optimising the use of titanium in drone applications, offering advantages such as reductions in cost and the amount of manufacturing scrap generated.

As the use of drones expands into other areas such as logistics and environmental monitoring, the demand for titanium is expected to increase correspondingly.

3.3.4 Defence

As of 2022, over 80 kt of titanium metal are currently embedded in aircraft and battle tanks of NATO countries (**Figure 21**). Beyond these two applications, titanium also finds a niche in other weapons systems such as missiles or sea-based elements.

Figure 21. Structural materials demand in NATO aircraft and battle tanks (in kt), 2022



Source: Reproduction from Carrara et al. (2023).

Military aerospace applications

The use of titanium in military aircraft and helicopters, which are subject to intense stress and must operate reliably under harsh conditions, enhances durability and performance. In comparison to civilian aerospace, the use of titanium alloy in defence began much earlier in the 20th century; a paradigmatic example is the SR-71 Blackbird fighter dating back to the mid-1960s, of which over 85% of the total weight was titanium alloy ([8]). In mass terms, the titanium content of military aircraft has historically been considerably higher (**Table 2**). On average, NATO aircraft fleets contain 30% aluminium, 10% steel, 15% titanium and 29% composites in their mass (Carrara et al., 2023).

Naval applications

Titanium is also vital in naval defence, particularly in the construction of submarines and surface vessels. Its resistance to seawater corrosion, combined with its strength, makes it ideal for use in critical components such as hulls, propeller shafts and other structural elements of naval ships. The material's use extends to both offensive and defensive systems, including underwater weapons. Regarding submarines, titanium is also used in ball valves, heat exchangers and fire pumps.

[8] The United States lacked the resources to produce titanium metal in the quantities needed for the development of the SR-71 and had to import most of it from the USSR; this entailed circumventing export controls at the epitome of the Cold War through shield companies and third countries. For more information, refer to BBC (2013).

Table 2. Titanium content in selected military aircraft

Category	Model	Year of introduction	Titanium content (% total weight)	Main users
Transport	C-5 Galaxy	1968	6%	USA
	Il-76 *Candid*	1974	15%	Russia, China, India
	C-17 Globemaster III	1993	10%	USA, UK, India, Australia
Reconnaissance	SR-71 Blackbird	1966	>85%	USA
Bomber / Attack	F-117 Nighthawk	1983	25%	USA
	Tu-160 *Blackjack*	1987	38%	Russia
	B-1 Lancer	1986	18%	USA
	B-2 Spirit	1997	26%	USA
Fighter	F-4 Phantom II	1960	8%	USA, Germany, Japan
	F-15 Eagle	1976	27%	USA, Japan, Saudi Arabia
	F-16 Fighting Falcon	1978	7%	USA, Turkey, Israel
	F/A-18 Hornet	1983	13%	USA, Canada, Spain
	Eurofighter Typhoon	2003	7%	UK, Germany, Italy, Spain
	F-22 Raptor	2005	42%	USA
	F-35 Lightning II	2015	20%	USA, UK, Israel
	MiG-25 *Foxbat*	1970	9%	Russia, India, Iraq
	MiG-31 *Foxhound*	1981	16%	Russia, Kazakhstan
	J-8 *Finback*	1980	4%	China
	MiG-29 *Fulcrum*	1983	3%	Russia, India, Iran
	Su-27 *Flanker*	1985	18%	Russia, China
	J-11 *Flanker-L*	1998	18%	China
	J-10 *Firebird*	2005	3%	China, Pakistan
	J-20 *Fagin*	2017	20%	China
	Su-57 *Felon*	2020	19%	Russia

Models in purple represent aircraft from non-NATO countries. Italics used for NATO reporting names.

Sources: See Annex for details.

Ground-based and strategic weapons systems

Titanium's application in ground-based defence systems, particularly in armoured vehicles, is another area of critical importance: as of 2020, the main battle tank models deployed in NATO fleets are estimated to contain 15% of their weight in titanium, versus 20% aluminium and 50% steel. The material is used to enhance the protection of these vehicles while keeping them lightweight, which is crucial for mobility and fuel efficiency in the field. Titanium alloys are employed in the construction of armour plating, providing protection against ballistic threats without significantly increasing the vehicle's weight. Moreover, titanium alloy is used in gun mounts, hatches and turret sides (Montgomery and Wells, 2001). Another application of titanium in land systems is found in structural elements for howitzers, such as mounts and support arms (Herman, 2005).

Initially, titanium for combat vehicles was subject to aerospace requirements; subsequently, testing requirements and material quality standards were simplified, likely to speed up the development of new technologies (e.g. in-the-field parts repair through additive manufacturing).

Titanium use is also prominent in the production of rocket casings, missile airframes, and other critical components of strategic weapons systems, capable of withstanding high temperatures and extreme mechanical stresses. Although there is limited information on these products due to security concerns, it is reasonable to assume that missile systems will embed similar components and be subject to similar requirements to space applications.

3.3.5 Advanced materials and additive manufacturing

Brief description of the technology

Additive manufacturing (AM), also known as 3D printing, is a technology that turns digital 3D models into physical objects by building them up in layers. AM offers advantages such as providing design freedom for customisation and prototyping, lowering the cost of producing low volumes of geometrically complex and materially simple objects (Carrara et al., 2023). Thus, AM processes are generally suitable for unitary or small series, making them well-suited for specific high-end applications but often not ideal for mass production (EPMA, 2015).

Applications

AM technology finds applications in relevant sectors such as automotive, aerospace, health, consumer goods, electronics, energy, industrial equipment, tooling, and construction, with varying degrees of maturity (EC - EISMEA, 2021). The automotive and aerospace sectors originally led AM technological development. AM technology is well-suited to the space industry, since it combines low production rates with complex geometric design for the spacecraft pieces and mass-saving requirements (Carrara, S. et al., 2023). AM encompasses high-strength and lightweight applications in aerospace (SCRREEN, 2023). Especially in industries like the aerospace and medical industries, parts need to meet stringent regulatory standards, requiring extensive testing and certification.

While still in their initial phase, AM technologies are also expected to enhance defence capabilities (EDA, 2024). Titanium offers high ballistic protection for applications ranging from body armour and helmets to tanks and aircraft. Currently, with conventional production process, this sector still faces high production costs when it comes to components of a more complex shape.

Titanium powder manufacturing and supply chain considerations

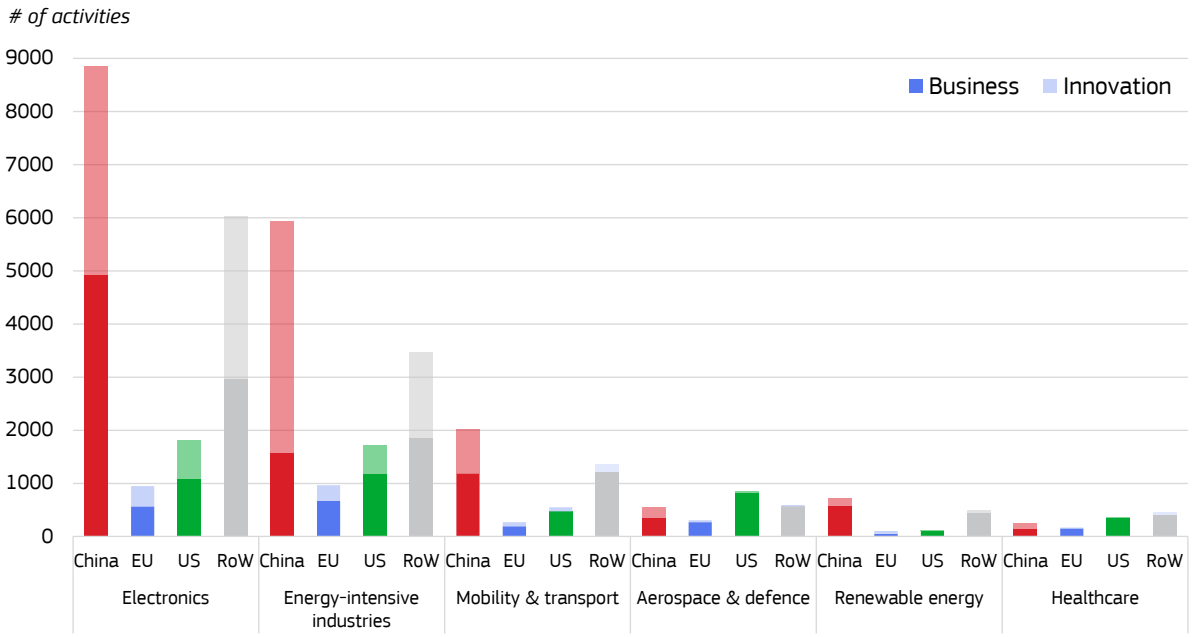
Titanium powders for additive manufacturing can be produced using several methods depending on the powder morphology and properties requested, such as particle size and distribution, sphericity and purity grade. Based on the chosen applications, several production routes can be selected such as gas or plasma atomisation, plasma rotating electrode process or hydride-dehydride process using hydrogen.

Europe is well positioned in AM system manufacturing with 27% of global sales in 2020, second only to the United States (38%) (Wohlers et al., 2021). At the processed materials stage, while the supply risk for most AM alloys is moderate, this is not the case of the titanium alloys, as stated in Carrara et al. (2023). This is also the case of the upstream titanium not being produced in the EU, as highlighted in Section **2.2**. All in all, since the EU is highly dependent on third countries, additive manufacturing could be a game changer in the field by limiting the quantity needed to manufacture final products.

Advanced Manufacturing and EU competitiveness

AM is one of the most dominant Advanced Manufacturing technologies. The contribution of AM activities relative to all advanced manufacturing activities varies in different sectors in the EU. According to Fabiani et al. (2024), with the highest contribution in energy-intensive industries (40.2%), followed by aerospace and defence (28.3%), healthcare (18.1%) and mobility and transport (17.1%). However, the EU is less competitive compared to China in terms of the number of activities dedicated to advanced manufacturing, especially in energy-intensive industries and mobility and transport (see **Figure 22**). The US leads in aerospace and defence and healthcare, two sectors where titanium is mostly deployed.

Figure 22. Number of AM activities in manufacturing-oriented industrial ecosystems, by main geographical area: Business (dark bars) and innovation (light bars)



Source: Reproduced from Fabiani et al. (2024).

Conclusion

AM technology has been gaining in importance especially in sectors like the aerospace, medical and defence sectors. In the aerospace industry, the application of AM is shifting from the production of smaller, non-structural components like brackets and housings to structural ones such as airframe and wing structures (AMFG, 2019). Given the high supply risk of titanium metal along the supply chain, an increasing trend of recycling titanium powder from sectors like the aerospace, defence and medical sectors is expected. As specifically detailed in **Box 6**, AM technology presents an opportunity for improving resource efficiency and providing better circularity of titanium in the supply chain.

3.3.6 Summary

Titanium is a versatile metal with applications across strategic industries, including aerospace, defence, industrial manufacturing, healthcare, architecture, consumer goods and advanced technologies. Aerospace is the largest consumer, particularly for aircraft structures, where titanium's compatibility with carbon composites enhances fuel efficiency and performance, and engine parts. The defence sector relies on titanium for aircraft, armoured vehicles, submarines and missile systems, all of which benefit from its durability and reduced weight. Industrial use of titanium spans from chemical processing to marine environments, driven by its resistance to harsh conditions. Titanium demand remains heavily linked to aerospace activity, with anticipated growth driven by renewed aircraft production and increased defence spending. Industrial and medical sectors are also expected to expand titanium use, fuelled by developments in power generation, desalination and healthcare.

Emerging applications in additive manufacturing (AM) present significant opportunities, especially in aerospace, defence, and healthcare, where titanium is used to create complex components that are lightweight yet strong. The EU's adoption of AM technologies could enhance material efficiency, mitigate supply risks, and improve titanium's circularity.

4 The geopolitics of titanium metal

This chapter outlines global trade trends in titanium metal (unwrought, wrought and scrap) and how they have evolved in recent years. It then examines the EU's position in terms of trade exposure, production capacity and key companies. This is followed by an analysis of the major players in the titanium supply chain, including the US, China and post-Soviet economies. The last section is dedicated to the impact of the Russia's war of aggression against Ukraine on the EU and global markets.

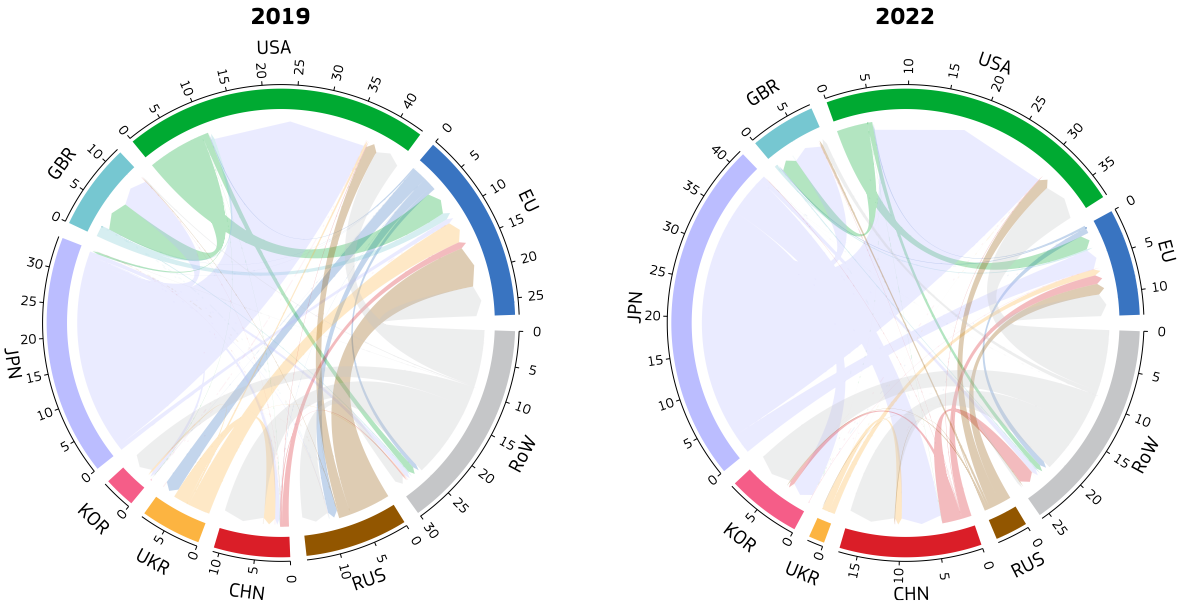
4.1 Overview and main dependencies

This section depicts global trade flows for titanium products, reflecting the 'pre-crisis' situation of 2019 and the situation in 2022, already distorted by the Russian aggression against Ukraine ([9]).

Unwrought titanium (sponge, melted and powder)

Japan dominates the global picture due to its dominance in sponge production (see below). The EU is a net importer, yet it exports powders for the additive manufacturing market (see Section **3.3.5**). The Rest of the World (RoW) block, driven by Kazakhstan and Saudi Arabia, ships sponge to the EU, the US, South Korea and China. With respect to 2019, three effects are visible: the shrinkage of Ukraine's flows due to the Russian aggression; the US and EU attempts to decouple from Russia; and the fall in flows from Russia and Ukraine being offset by larger flows from Japan and South Korea (**Figure 23**). Finally, despite the visible increase between 2019 and 2022, Chinese exports are negligible compared to its massive sponge production as most Chinese output is consumed domestically.

Figure 23. Global trade trends in unwrought titanium (HS code 8108.20), in mass terms (kt)

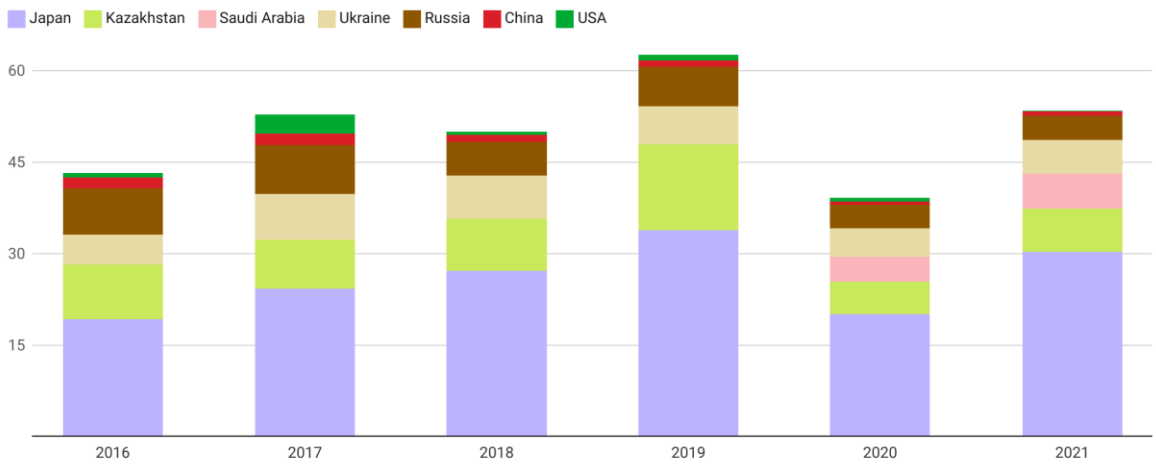


Source: UN Comtrade. USA = United States; GBR = United Kingdom; JPN = Japan; KOR = Republic of Korea; UKR = Ukraine; CHN = China; RUS = Russia; RoW = Rest of the World. See Annex for details.

[9] These figures display export flows data for 2019 and mirror imports data for 2022, as UN Comtrade does not include export data reported by Russia in that year. See Annex.

Concentrating on *sponge*, only a handful of countries supply the international market as most of the sponge-producing companies have downstream operations producing titanium ingot and mill products. Japan, renowned for producing high-quality titanium sponge (see **Figure 5**), has been the top exporter of sponge for several years, accounting for over half of worldwide export volumes since 2018 (**Figure 24**). The US is the main destination for Japanese exports accounting for 58% to 80% of the total in 2017-2021. The EU is Japan's second larger export partner, with a share ranging from 11% to 17% during the same period (ITA, 2022). Kazakhstan has been the second most significant supplier to international markets in recent years. Additionally, Saudi Arabia has emerged as an important global supplier as the output from its plant is ramping up.

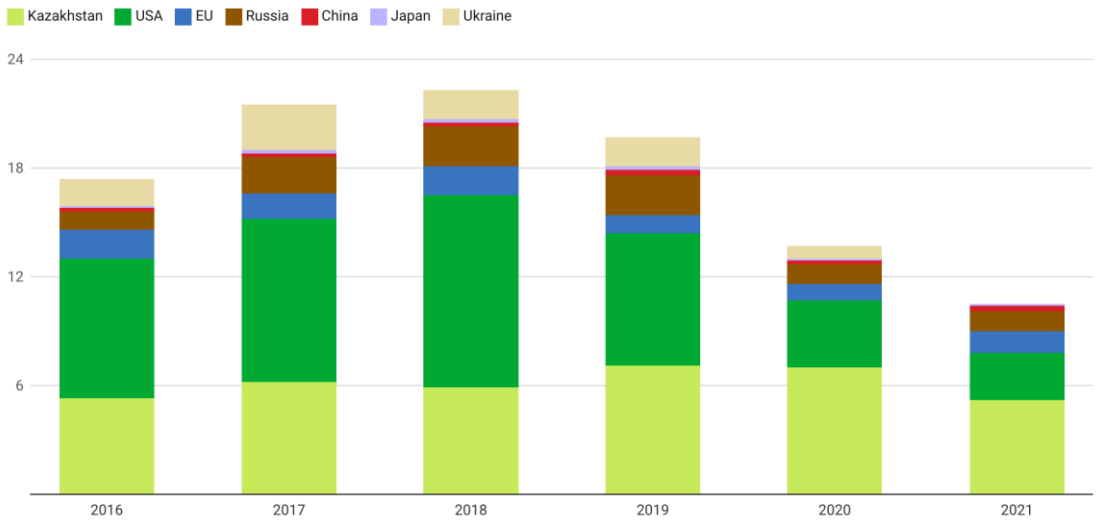
Figure 24. Global exports of titanium sponge by quantity and countries, 2016-2021, in kt



Sources: Data compiled from ITA (2022), ITA (2021), USGS MYB-Ti (2023), USGS MIS-Ti (2024), UN Comtrade (2024), Venger et al. (2024), GACC, (2024). See Annex for details. Image created with Datawrapper.

For *melted products,* Kazakhstan and the US are the most significant suppliers of titanium metal feedstock to international mill product manufacturers, accounting for about three quarters of the total ingots exported annually (**Figure 25**). Similarly to sponge, Chinese exports of titanium melted products are negligible relative to domestically consumed output for mill products. The traded quantities of titanium ingots are lower by volume compared to other titanium product categories. For example, in 2021, exports of titanium ingots amounted to about 10 kt. In contrast, in the same year, exports of titanium sponge were approximately 53 kt, and exports of mill products were around 67 kt.

Figure 25. Global exports of titanium ingots by quantity and country, 2016-2021, in kt

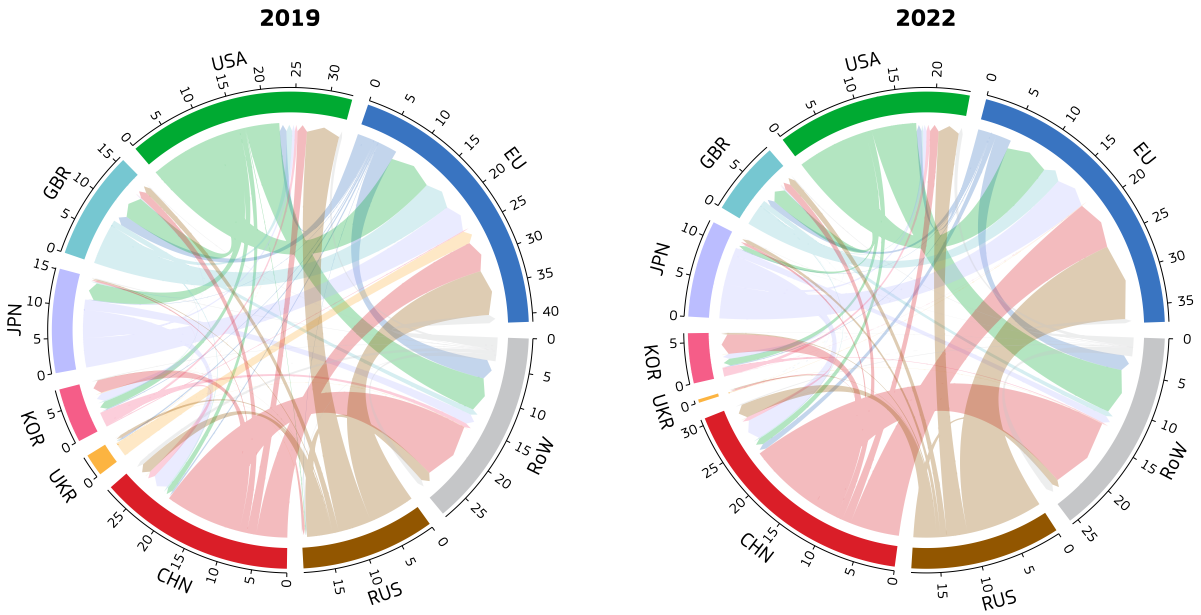


Sources: Data compiled from ITA (2022), ITA (2021), USGS MYB-Ti (2023), USGS MIS-Ti (2024), UN Comtrade (2024), Eurostat Comext (2024), and GACC (2024). See Annex for details. Image created with Datawrapper.

Other titanium products (wrought and articles)

The trade in other titanium products, which include more specialised or processed forms of titanium (wrought and titanium articles), shows the EU, South Korea and the Rest of the World block as net importers, with notable shifts having occurred between 2019 and 2022 (**Figure 26**). Besides Ukraine's flows vanishing due to the Russian invasion, China's role as a major importer and exporter grew significantly, reflecting its increasing production and processing capacity. Finally, note that Russia's share and flow composition remains constant despite the war, probably highlighting the EU and US dependency on Russian titanium in aerospace (see **Box 5**).

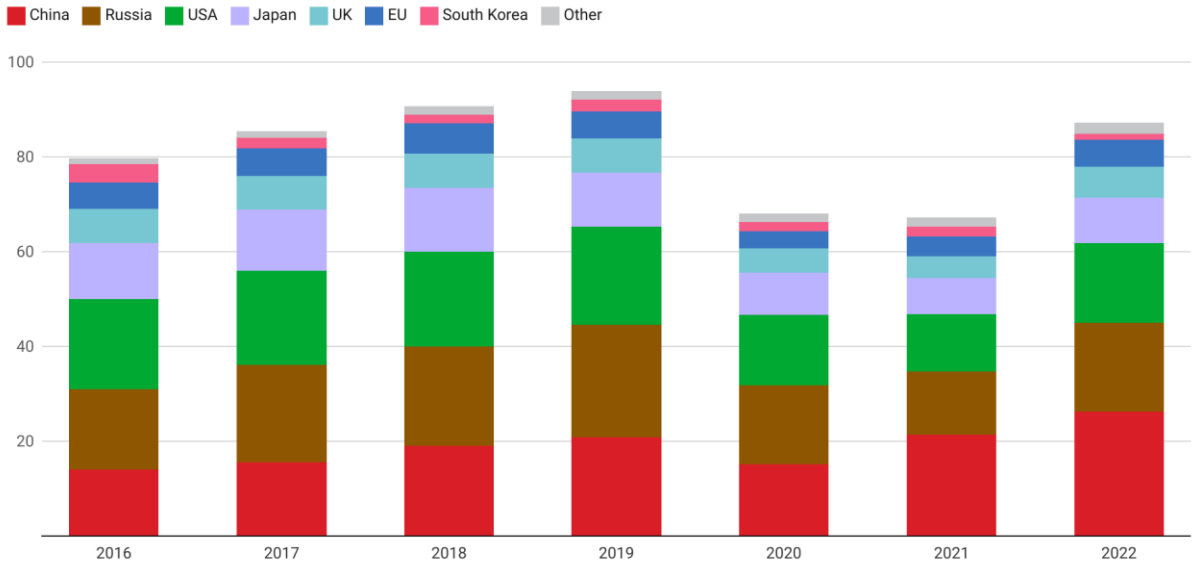
Figure 26. Global trade trends in other titanium products (HS code 8108.90), in mass terms (kt)



Source: UN Comtrade. See caption in Figure 23 and Annex for details.

For *wrought* products, global exports in 2022 were led by China (30%), Russia (21%) and the US (19%) (**Figure 27**). Exporters of mill products are more diversified than those of sponge and melted products, and flows are directed to a wider range of countries.

Figure 27. Global exports of wrought titanium by country, 2016-22, in kt

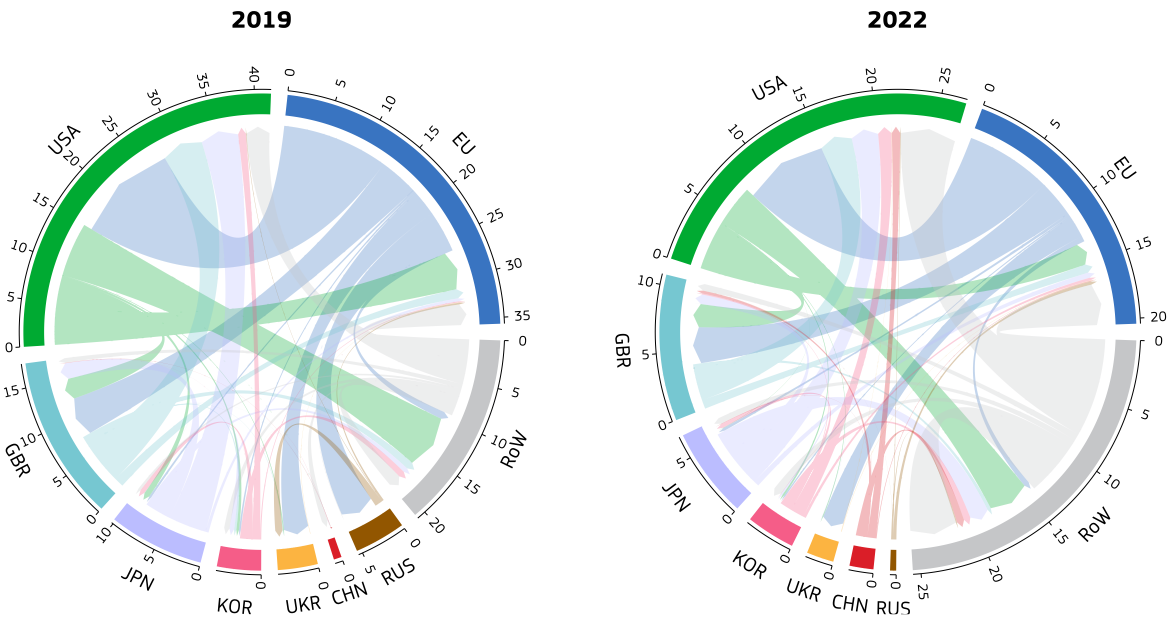


*Sources: See Figure **25** and Annex for details. Image created with Datawrapper.*

Titanium waste and scrap

The most notable feature is how the US receives scrap from the rest of the world. The EU is a net exporter of scrap (see Section **4.2**), shipping most of it to the US and the UK. In temporal terms, the picture has not varied significantly since 2019 (**Figure 28**).

Figure 28. Global trade trends in titanium waste & scrap (HS code 8108.30), in mass terms (kt)



Source: UN Comtrade. See caption in Figure 23 and Annex for details.

4.2 The EU position

Overview

The titanium metal value chain is a classic example of how former free-trade-orientated policies led to the offshoring of major parts of the titanium value chains away from the EU. It is also a relevant case in the context of the need to both promote strategic autonomy and resilience and increase circularity. This section first discusses the EU perspective on trade in titanium metal.

The EU's position in the titanium metal value chain needs to be framed within the wider geopolitical context, which has been significantly altered in the last decade. First, the international landscape has been marked by the increasing global rivalry over key technologies for the green and digital transitions, which have driven the competition for critical raw materials (CRMs). Another interlinked trend has been that of economic decoupling, which started in the 2010s and has been primarily driven by the severing of the US' trade links with China during the 2017 Trade War. It has been further strengthened in the US with policies such as the 2022 *CHIPs Act*, which aims at reshoring and friendshoring the production of semiconductors, and the 2022 *Inflation Reduction Act*, which seeks to reshore green technologies and product supply chains to the United States. In the meantime, China itself has long maintained its dual strategy (now dubbed *Dual Circulation*) of preserving strategic autonomy and protectionism of its own domestic market on the one hand, and promoting the opening of international markets to its products and services (via strategies such as the *Belt and Road Initiative*) on the other (Gehrke, 2022). These geopolitical transformations have been compounded by the Covid-19 pandemic and the Russian war of aggression against Ukraine.

All these global developments have spurred the EU's own derisking strategy, leading to the transformation of the EU's legislative landscape concerning CRMs and strategic value chains. The new strategy is being built on the legislative turn, marking an important adjustment from earlier unfettered championing of free trade and abstention from state interventionism in domestic industries (Smitz and Seidl, 2022). This renewed emphasis given to the idea of Open Strategic Autonomy (OSA), which prioritises mitigation of strategic dependencies while upholding the idea of free trade, epitomises this shift in the EU's current policies (Damen, 2022).

Among those, the 2023 CRM Act is particularly relevant to the CRM value chains. The Act postulates the need to increase intra-EU extraction and processing of strategic raw materials, increase their recycling, and diversify the sources of imports to mitigate the risk of industrial dependency on a small set of third countries. The changing geopolitical context and the EU's legislative responses underscore the importance of reshoring and circularity within critical value chains.

Against this backdrop, the EU's position in the titanium metal value chain is weak in terms of strategic autonomy, as it lacks domestic reserves of titanium ore and does not have any infrastructure for sponge production. Moreover, the EU's ingot production represents less than 5% of the global capacity. Due to these vulnerabilities, titanium metal was added to the EU's Critical Raw Materials list in 2020 and continues to be listed in the 2023 update (EC – DG GROW, 2023) ([10]).

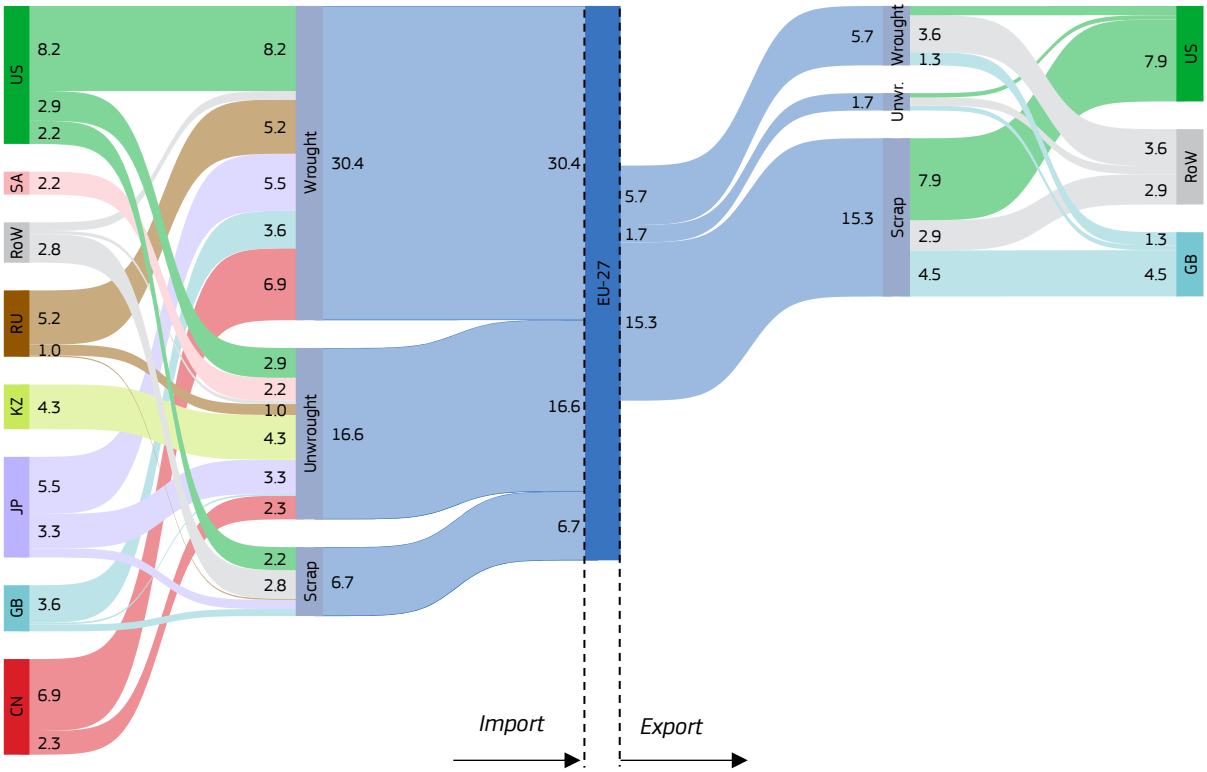
[10] The EU employs a systematic methodology to identify CRMs, focusing on two key dimensions. Firstly, the *Economic Importance (EI)* of a material is calculated based on its role in the EU's economy. EI is typically expressed as the material's contribution to Gross Value Added (GVA) in its end-use sectors. The EU assigns higher weight to materials used in economically significant sectors, especially those that support the Green Deal and digital transformation. The *Supply Risk (SR)* dimension assesses the potential for disruptions in supply. It considers the concentration of production, trade policies, political stability of producing countries, and recycling potential within the EU. See EC – GROW (2017).

Trade linkages

Several key observations emerge from an analysis of the EU's import and export structures for titanium products, as illustrated in **Figure 29** and **Figure 30**, which provide an EU-focused perspective on the trade trends and stylised facts discussed in Section **4.1**. First, the EU's import structure is geographically diverse across all three product categories. Second, wrought products represent the largest share of the EU's imports from non-EU countries. Third, the EU is a net importer of titanium metal products, with an overall import-to-export ratio exceeding 2:1 in both mass and value; more specifically, the ratio is 10:1 for unwrought products and 6:1 (3:1 by value) for wrought products. Fourth, the UK and the US are the EU's most significant export partners at country level ([11]).

This last point highlights a marked imbalance between import and export composition: scrap accounts for 12.5% of the EU's import mass (2% by value) compared to 67% of its exports (17% by value). Why does the EU export such a large volume of scrap overseas? On one hand, the lack of sponge and ingot production capacity makes recycling scrap within the EU less economically viable. On the other hand, high-quality EU-generated scrap is often tied to *buyback* agreements, where titanium producers in third countries offer discounted primary titanium in exchange for returning the scrap after manufacturing parts in the EU. In some cases, these producers retain ownership of the material, merely "leasing" its use for EU production, with the scrap being exported after manufacturing. This creates a significant obstacle to circularity in the EU, a challenge explored further in Section **5.3**.

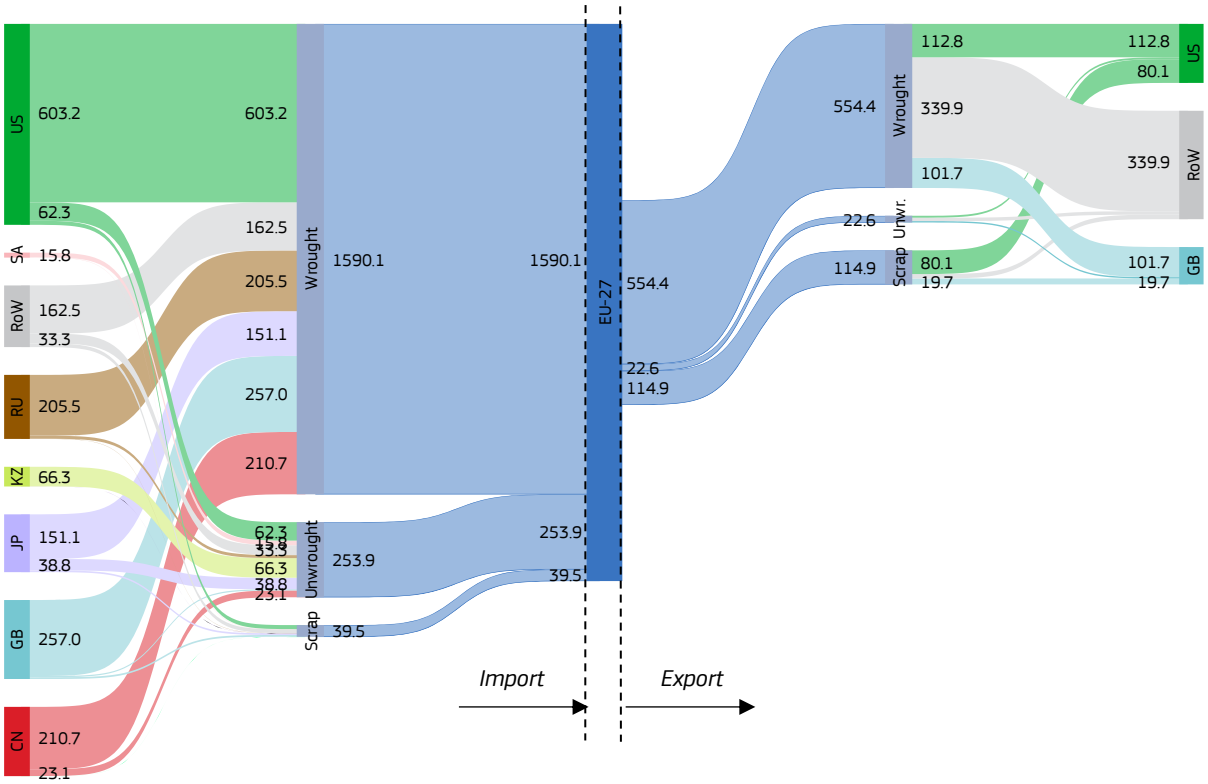
Figure 29. Overview of extra-EU international trade volumes (kt) of titanium products in 2023



Source: Adapted from Buesa et al. (2024). Country codes: US = United States, SA = Saudi Arabia, RU = Russian Federation, KZ = Kazakhstan, JP = Japan, GB = United Kingdom, CN = China.

[11] Note that in Figures 29 and 30 the "Rest of the World" (RoW) block represents a different aggregate for imports and exports; in the latter case, they include all extra-EU export partners except for the US and the UK.

Figure 30. Value (million EUR) of extra-EU trade flows for titanium products in 2023



Source: Adapted from Buesa et al. (2024). See Figure 29 for country codes.

Box 2. Assessing the strategic dependence risk of titanium imports for Europe

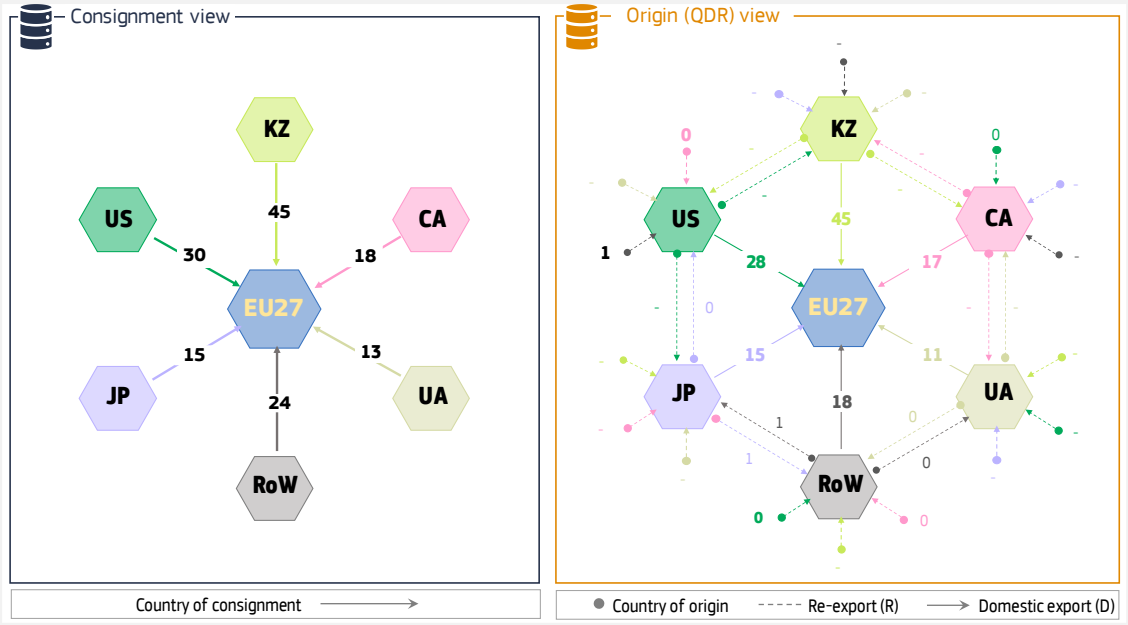
The European Commission's efforts to secure the supply of critical raw materials and ensure the EU's resilience and competitiveness in various sectors led to the publication of the EU Critical Raw Materials Action Plan in September 2020 (EC – DG GROW, 2020). This strategy aimed to address the challenges posed by the growing demand for critical raw materials and the EU's dependence on imports. Building upon this Action Plan, the Commission conducted a comprehensive review of the EU's strategic dependencies and capacities in May 2021 focusing on six strategic areas, including raw materials.

The EU dependence review (EC – DG GROW, 2021) introduced a methodology with three criteria for foreign dependency: first, the majority of non-EU imports of that product must come from fewer than three foreign countries; second, extra-EU imports of the good must account for at least 50% of its total EU imports; and third, non-EU imports must exceed total EU exports. By classifying goods as foreign-dependent, it is possible to assess strategic dependencies by identifying excessive concentration on foreign sources, significant scarcity within the EU and low domestic substitution possibilities.

In line with this analysis, Rueda-Cantuche et al. (2022) underscore the importance of accounting for re-exports when determining foreign strategic dependencies in the context of the EU's critical raw materials. Re-exports, which involve goods being traded between countries without domestic production, can significantly skew the measurement of foreign import concentration and the potential for domestic substitution. To mitigate the potential bias from re-exports, FIGARO (*Full International and Global Accounts for Research in input-Output analysis; s*ee Eurostat, 2019) estimates domestic trade by incorporating data on the consignment process (the movement of goods from one location to another) and the country of origin (where products are produced or manufactured), as reported by partner countries (see Ferreira, 2018 for more details). Consequently, it is crucial to emphasise that re-exports play a remarkable role in assessing foreign import concentration and production capacity substitution, particularly in strategic dependency analyses.

According to FIGARO's balanced view of trade, the EU import structure of *unwrought titanium and titanium powders* is depicted in Figure B2.1, revealing a moderate degree of concentration. The analysis reveals that Kazakhstan accounts for about 31% of the total value of EU imports, followed by the US (20%) and Canada (12%), with other countries such as Japan and Ukraine contributing to the remaining supply.

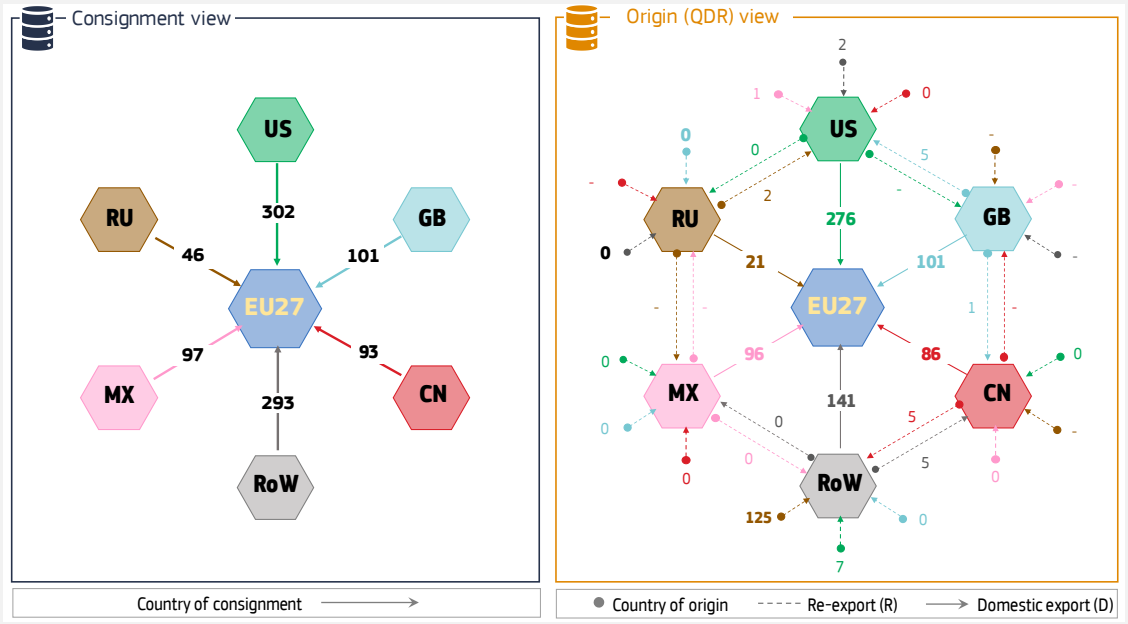
Figure B2.1. Extra-EU imports (million EUR) of HS6 code 8108.20: Unwrought titanium; titanium powders



Source: Own calculations from the FIGARO/ITGS 2021 database.

Regarding *Other articles of titanium,* Europe is a significant importer, with countries such as the United States, the United Kingdom, China and Mexico accounting for around 65% of the imports from a consignment point of view, and underscoring the level of concentration in the titanium market; this effect is further intensified when considering adjustments for re-exports. While Russia initially appears to supply 5% of the European market, recognising the passage of its products through the Rest of the World reveals a high dependence. Adjusted figures show that Russia's share of this market is close to 18%.

Figure B2.2. Extra-EU imports (million EUR) of HS6 code 810890: Articles of titanium



Source: Own calculations from the FIGARO/ITGS 2021 database.

Manufacturing of melted products

In the EU, EcoTitanium, a joint venture between UKAD ([12]), the French State (ADEME) and Crédit Agricole, has operated in France since September 2017. It produces aerospace-grade titanium ingots, mostly from recycled materials (80% of titanium scrap in the feedstock). The facility produces titanium alloy ingots by recycling new scrap from aircraft makers and subcontractors, most of which was previously exported to the US. The titanium ingots are processed downstream by UKAD to semi-milled products, and final products are produced at Aubert & Duval.

In France, titanium ingots are also produced by Timet Savoie, a US Titanium Metal Corp. subsidiary, mostly for aerospace. In other Member States, Tifast Titanium in Italy produces titanium alloy ingots from scrap and sponge, which are subsequently fabricated into wrought titanium products (billets, bars and wire). Zirom Titanium also produces titanium alloy ingots (and wrought products) from sponge and scrap in Romania. Titanium alloy ingot producer VDM Metals GmbH closed its facility in Germany in 2016. **Table 3** shows the installations in EU Member States with industrial capacities to produce titanium ingots from imported titanium sponge and/or scrap feedstock. **Figure 31** shows the evolution of melting capacity in the EU in previous years.

Table 3. Operating producers of titanium ingots in the EU

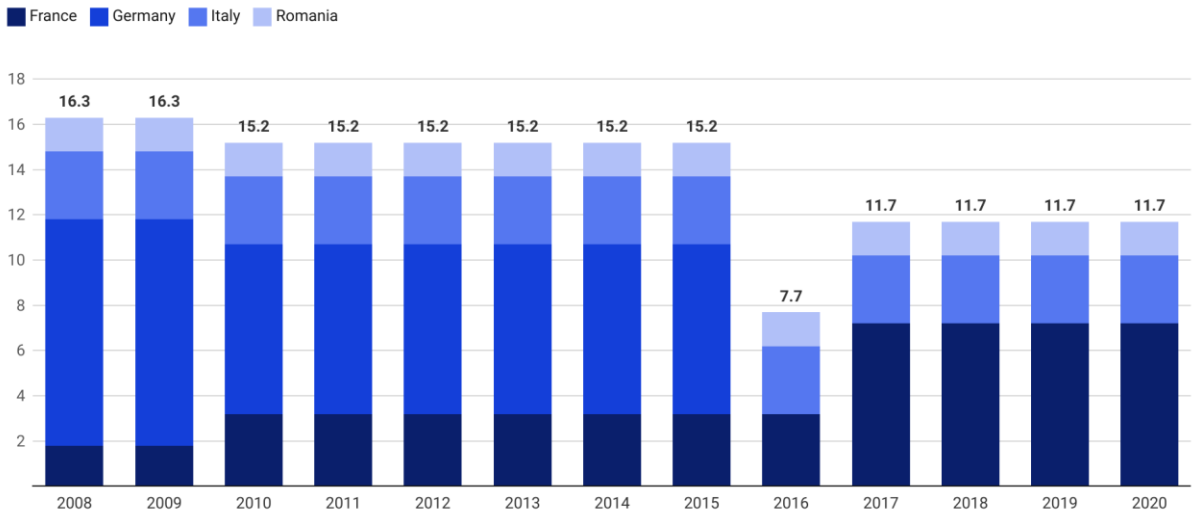
Company name	Location	Total assets (m EUR)	# of employees	Melting capacity (kt/year)	Shareholders		%	Shareholder ownership	
Timet Savoie	Ugine, FR	122.0	114	3.2	Timet Europe Ltd.	*GB*	70.0	Berkshire Hathaway Inc. 100%	*US*
					Framatome	*FR*	30.0	Électricité de France 80.5%	*EU*
								Mitsubishi Heavy Industries 19.5%	*JP*
TiFast S.R.L.	Narni, IT	48.0	43	3.0	Smartora Trading Ltd.	*CY*	64.5	Mr. Dmytro Firtash 100% ([13])	*UA-RU*
					BC Titanium S.r.l.	*IT*	29.4		
					Other shareholders	*IT*	6.2		
Zirom SA	Giurgiu, RO	12.2	11	1.5	S.C. Fondul Proprietatea SA	*RO*	100		
EcoTitanium	Saint-Georges-de-Mons, FR	30.9	29	4.0	UKAD (Aubert & Duval)	*FR*	44.8	Airbus 33.3%	*EU*
								Safran 33.3%	*EU*
								Tikehau Capital Advisors 33.3%	*EU*
					Agence de la transition écologique (Ademe)	*FR*	42.6	Govt of France 100%	*EU*
					Crédit Agricole (CACF développement)	*FR*	12.6		

Source: [Firm information] Orbis. Data for 2024 (Timet Savoie, Framatome, Zirom, EcoTitanium), and 2023 (Timet Europe, TiFast, UKAD). Green indicates a State participation; [melting capacity] Carrara et al. (2023), Elsner (2021), Timet (2011).

[12] UKAD was created in 2011, initially a joint venture between the French Aubert & Duval and the Kazakh UKTMP, producing semi-finished forged titanium and titanium alloy products (billets and bars). The company became 100% French after UKTMP divested its share in January 2022 and Aubert & Duval took over.

[13] For details on Dmytro Firtash and his ties with Russia, see Section 4.3.3.3 of this report.

Figure 31. EU melting capacity (ingots), 2008-2020, in kt

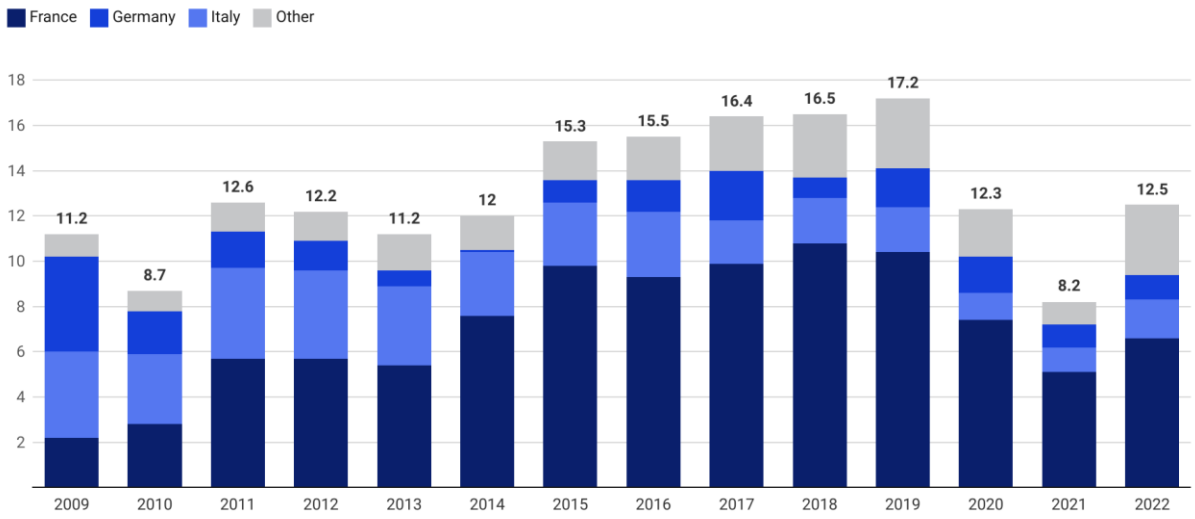


Source: Own elaboration based on various sources. Image created with Datawrapper.

Manufacturing of wrought products

In 2022, France accounted for more than half (53%) of the EU's shipments of wrought titanium products, making it the largest producer in the EU. Germany followed with a 14% share, and Italy with a 9% share. The EU production of mill products was severely impacted in 2020-2022 by the Covid-19 crisis and its aftermath in the aerospace sector The EU's production of all titanium products is estimated to have decreased to about 8 kt in 2021, down from the record level of 17 kt in 2019 (**Figure 32**). All in all, EU capacities in this segment remain limited to date, with France hosting the only coherent titanium metal industry cluster. (**Box 3**).

Figure 32. EU production of wrought titanium by country, 2009-22, in kt



Source: Own elaboration based on Eurostat Prodcom (2024). See Annex for details.

Box 3. The titanium metal ecosystem in France.

In France, numerous aerospace giants like Airbus and Safran, as well as industrial defence companies such as Dassault, Naval Group and MBDA rely on titanium components in the production of aircraft, helicopters, missiles and other critical equipment.

There are several specialised companies dedicated to titanium processing in France, particularly from the ingot-making stage onward. While the raw materials, such as titanium sponge, are typically imported from abroad (e.g. Kazakhstan), they are processed into ingots by two key players: Timet Savoie, situated in Ugine (Savoie), and EcoTitanium, based in Saint-Georges-de-Mons (Puy-de-Dôme) (see section above). Beyond these primary entities, numerous other facilities are engaged in the production of intermediate and finished titanium products, serving downstream segments of the aerospace and defence value chain.

Several initiatives are currently in progress to strengthen the titanium industry in France. For instance, last year, IMET Alloys established its presence in Eyrein (Corrèze) to secure the access of titanium scrap. This involves cleaning the scrap within France prior to its transformation into ingots, as opposed to exporting it and it being used as a raw material by another country. Additionally, in January 2024, the Aubert & Duval group unveiled its acquisition of a new forging press for its Pamiers facility (Ariège), a pivotal asset for the precision machining of specific aircraft components.

The French industrial sector also includes many manufacturers capable of processing titanium parts to produce flat products, rolled products, round products, tubes, wires, treated products, etc. Furthermore, Eramet, operating through its subsidiary Grande Côte Opérations (GCO), extracts heavy mineral sands abundant in titanium ore (ilmenite) in Senegal. Similarly, the titanium dioxide production plant currently managed by Tronox in Thann (Alsace) not only produces titanium dioxide but also titanium tetrachloride.

4.3 Major players in titanium metal and their evolution

This section discusses the evolution and traits of the titanium metal industry in those countries with a prominent role in the global supply chain: the US, China and three post-Soviet economies (Russia, Kazakhstan and Ukraine). The relevance of these actors surfaced in Section **4.1** with the presentation of major trade flows; below we focus on their historical background and structure.

4.3.1 United States

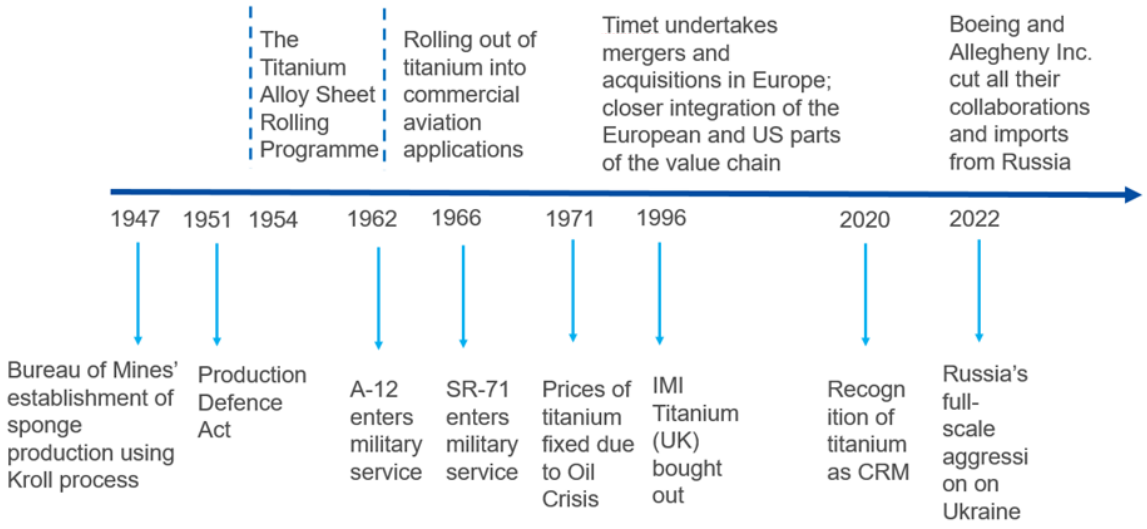
The US has been the EU's most important trading partner for wrought titanium products and scrap. The symbiosis between the two titanium metal industries – in the US and Europe (in this case referring to the EU and the UK) – has dates back to the 1990s, with the mutual dependencies tightening ever more closely since. Due to the current geopolitical pressures linked to the Russian war in Ukraine, and EU companies' subsequent attempts to decrease their reliance on Russia-imported titanium metal products, the US is likely to remain the most important source of wrought titanium imports to Europe.

In terms of exports, the mutual dependencies in the titanium industry are linked to two overlapping reasons. First, the US is the largest market for the EU's titanium virgin scrap – the by-product of fabrication of ingots into titanium products – scrap which is valuable, but which cannot be processed in the EU due to the absence of the relevant industry. Second, the business model of companies in the American midstream value chain relies on reimports of that virgin scrap in order to decrease costs of producing new ingots (by mixing roughly 50% scrap with sponge). This creates a situation in which EU companies are disincentivised from creating a home midstream value chain industry for titanium scrap processing linked to ingot production, as they are bound by the multiannual contracts which guarantee imports of titanium metal ingots from the US at an attractive price. That dependence is crucial to understand, as it is linked to inhibiting both the strategic autonomy and circularity of EU industry.

In order to understand the circumstances which have led to this state of affairs, it is useful to first trace the historical evolution of the titanium metal industry in the US. The titanium industry emerged under the auspices of the Cold War competition with Soviet industry, which pioneered titanium manufacturing. The first attempts at producing commercially viable titanium metal in the US were undertaken at the end of the 2nd World War, when the US Bureau of Mines produced commercially viable titanium sponge using the Kroll process in 1947. The subsequent attempts were also heavily state-subsidised and continued via the Production Defence Act (PDA), which aimed at ensuring US industrial independence, and an increase in defence spending spurred by the Korean War. At the time, concerted scientific, commercial and state efforts led to the formation of one of the most applauded metallurgical projects in US history dubbed The Titanium Alloy Sheet Rolling Programme (1954-1962). This programme sponsored lab-level and pilot projects, allowing the best cases to be selected for industry applications and building the economies of scale through multi-million-dollar state subsidies (NMAB, 1983).

The rollout of the titanium metal industry programme had been especially awaited among the aerospace and defence sectors. After the failure of several commercial programmes in early 1950s, government actors such as the Bureau of Mines and the Army invested in designing materials applicable for aerospace applications. It was the Army, for instance, that funded the programme which developed the Ti-6Al-4V alloy still used commonly in the production of engine parts today. The first use of titanium in military jets dates to the late 1950s with the development of the A-12 and later, in the early 1960s, the SR-71 (**Figure 33**).

Figure 33. The evolution of the US titanium industry for aerospace (1947-2024)



Source: Own elaboration from various sources.

It was not until the 1990s, however, that the European value chain was more tightly integrated with the American one. Up to the 1980s, there was still a robust titanium metal producing industry in Europe – indeed some countries, such as France, were still producing sponge well into the 1980s. This industry was successively dismantled as the production costs in Europe became unsustainable in the face of international competition. In the 1990s, the American competitor, Timet, successively took over the smelting plants, such as IMI Titanium in the UK and Cezus in France. Nowadays, Timet owns various subsidiaries across Europe, including Timet Savoie (a French part) and Timet UK (**Table 4**). Allegedly, Timet supplies 50% of the semi-finished wrought titanium (such as plates, sheets or bars) from which European companies then fabricate parts.

Taking over the European part of the industry facilitated exports of titanium scrap back to the US and created transatlantic circularity of titanium metal processing. The US sources titanium scrap from various countries, of which European sources tend to constitute nearly half of the imports, according to data from various years over the last 20-year period. More precisely, in 2004, 43% of titanium metal scrap was imported from European countries (18% from Germany, 14% from the UK and 11% from France) (Goonan, 2010), while in 2021 a total of 45% was imported from the same countries (20% from Germany, 15% from the UK and 10% from France) (USGS MCS, 2024).

Table 4. US companies in the titanium for aerospace ecosystem, by value chain tier

	Examples of companies	Basic information	Specialisation
OEM/Tier-1 (secondary fabrication, design of parts and assembly)	Boeing	Est. 1916, HQ: Chicago, IL; 156 000 employees (2022)	- Boeing Commercial Airplanes: commercial aircraft (e.g. 737, 767, 777, 787), freighters and business jets - Boeing Defence, Space and Security: military aeroplanes, missiles etc. - Boeing Global Services
Tier-1 (downstream) (secondary fabrication, supply of parts to OEMs)	Spirit Aerosystems; Wyman-Gordon; S. Letvin & Son Inc.; Collins Aerospace (subsidiary of RTX)	Suppliers of parts (other than engines)	- Spirit Aerosystems: aerostructures (world's largest manufacturer) - S. Letvin & Son Inc.: produces fasteners (bolts, nuts and screws) - Collins Aerospace: systems and component for commercial aviation and defence
	General Electric (GE) Aviation; Pratt & Whitney (*since 2023 a subsidiary of RTX)*	Suppliers of engines	- GE: supplies engines to Boeing - P&W: supplies engines to Raytheon - Also other non-US companies supply engines to Boeing (e.g. Rolls-Royce)
Tier-2 (midstream) (ingot production and primary fabrication of parts)	Timet - Titanium Metals Corp. *(incl. Timet UK and Timet Savoie)*	Est. 1950, HQ: Warrensville Heights, OH; ~1 000 employees (2024)	Most important US titanium manufacturer, focus on aerospace Semi-fabricated Ti products: more than 20 000 t/year
	ATI Inc. (*formerly Allegheny Technologies Inc.)*	Est. 1950, HQ: Dallas, TX; 6 300 employees (2021)	Semi-fabricated Ti products: 15 000 t/year
	Arconic Corporation; Howmet Aerospace Inc. (*Both Arconic Inc. prior to 2009*)	Est. 2019, HQ: Pittsburgh, PA; 13 400 employees (2020)	Semi-fabricated Ti products: 10 000 t/ year
EoL (end-of-life)	Keywell LLC Metals; Grandis Titanium (also Tier-2); AmeriTi & Reading Alloy (part of Kymera Int.; also Tier-2)	Scrap processing companies, some also Tier-2	- Keywell: Worldwide purchaser, processor and seller of titanium scrap metal for ingot production - Grandis Titanium: major global supplier of Ti products; prepares and supplies TI scrap

Source: Own elaboration from various sources.

This process of building midstream value chain industry in the US has progressively led to the decrease of the energy-heavy, costly and polluting Tier-3 (upstream) extraction and sponge production in the US. Eventually, the last sponge production plant, that of Timet (located in Henderson, Nevada) closed in August 2020. The plant struggled due to the 80% decrease in demand following the pandemic, which came on the back of being unable to compete with the lower prices of imported titanium sponge (especially Japanese) for years (Ng, 2020). Coincidently, in February 2020 the Trump

administration recognised titanium as a CRM; however, this did not stop the cessation of sponge production in the US.

Currently, the US relies on two main sources for its production input materials: the sponge imported almost entirely from Japan and virgin scrap imported from the EU (plus the UK), Canada and Japan, as well as inputs from the home market ([14]). While in the trade statistics (see p. 35) large parts of scrap are exported from the EU to the UK, our research indicates that most of it is then re-exported as scrap to the US, and that this is done through the Timet subsidiary (see Sections 4.2 and 5.3.1).

In recent years, and particularly since the Russian annexation of Crimea in 2014, the largest importers of titanium metal products in the US, such as Boeing or Allegheny Technologies, have been limiting their reliance on titanium metal sponge and products from Russia. Following the US government's advice, Boeing started a diversification process away from its joint venture with VSMPO-Avisma in 2014 and completely stopped imports of titanium metal after Russia's invasion of Ukraine (Allegheny Technologies, 2022).

While the EU's largest OEM, Airbus, is the main competitor of Boeing, the industries on both sides of the Atlantic are strongly interconnected. However, in order to make progress in increasing strategic autonomy for the supply of CRMs in strategic value chains, as outlined in the CRM Act, it is necessary to rethink this reliance and to progressively design ways in which the midstream value chain and particularly recycling capacities can be created in the EU in the near future ([15]). While this will require the concerted efforts of commercial and state actors on both sides (and especially in the EU), the reshoring of such capabilities would benefit European industry given the current geopolitical circumstances and a possible upcoming Republican presidency in the US which would be likely to break with the current government's pro-Atlanticist stand.

4.3.2 China

China has the largest titanium ore resources in the world (see **Figure 1**). It is also the biggest producer of titanium metal outputs globally. As of 2022, 36% of the world's ore extraction took place in China, compared to 13% in Mozambique, 10.5% in South Africa, and 9% in Australia, among others (USGS MCS, 2024). In terms of sponge production, China, once again, leads with 52% of global output, ahead of Japan (19%), Russia (14%), Kazakhstan (8%), Ukraine, Saudi Arabia and India (USGS MCS, 2024). However, despite leading production worldwide, China is not a key country in the global titanium value chain for aerospace applications. Indeed, China is unlikely to be a suitable substitution for Russia-sourced titanium imports to the EU. There are several reasons for this. First, China itself imports high-grade titanium from overseas, as it does not produce enough of it to meet its domestic needs. Second, even though China has abundant deposits of titanium, 90% of which are concentrated in the Panxi region of Sichuan province, these are of low quality, and even with additional processing they only generate 60-70% purity sponge, which is insufficient for EU and US aeronautical standards (Qiu and Guo, 2022). Third, to prevent overt exporting of the valuable metal, the Chinese state imposes 13% VAT on titanium exports[16], which makes their prices uncompetitive on international markets. The high

[14] In 2018, the US consumed 70% of global titanium scrap suitable for remelting, and scrap made up 58% of the feedstock (with 42% being sponge) for the ingot production stage. See Elsner (2021).

[15] For policy recommendations, see Jakimów et al. (2024) and Section 6 of this report.

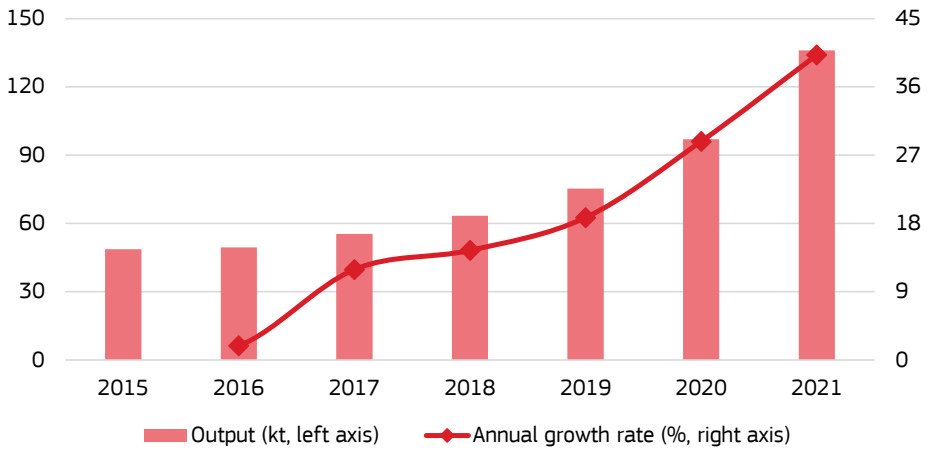
[16] Normally, goods for exports are exempted from VAT in China.

costs and subprime quality of Chinese titanium remain major obstacles for expanding the supply chain for aeronautical applications to China.

However, given the size of the Chinese titanium industry and its increasing output in recent years (see Section **2**), it is important to observe current developments in the Chinese industry. China is experiencing a growing demand for high-quality titanium products due to the current rapid development of a globally competitive aviation industry, making it a major market for high-quality titanium imports. Aviation remains the last unconquered bastion in China's global dominance of the transportation industries. Commercial aircraft are the only transport-related activity (as compared to high-speed rail, shipbuilding and passenger vehicles) where China still depends considerably on imports of finished products, and where the EU industry holds over 50% of the global market share, while China has just 5% (Zenglein and Sebastian, 2023). However, China is rapidly transforming its domestic aviation industry to become more competitive; while it still relies on EU imports, with Airbus holding a substantial market share in China, it aims to eventually upend western companies, similarly to what it has done in the automotive, solar PV and wind industries.

The upgrading of the industry is reflected in the steady rise in the industrial output and demand for titanium metal sponge and products in China in the last decade. The production of titanium sponge increased 15.85% year-on-year on average in the years 2016-2021, and the production of titanium metal products (processed outputs) has been rising steadily since 2016, increasing rapidly (40.2%) in 2021, **Figure 34**). Moreover, in 2020, aviation applications constituted 18%, aeronautics 3%, and marine engineering 8% of all titanium applications in 2020, which is a considerable percentage, likely to grow further given the sector's expansion plans (Zhiyan, 2024).

Figure 34. Production of titanium metal processed outputs in China, 2015-21 (in 10 000 tonnes)



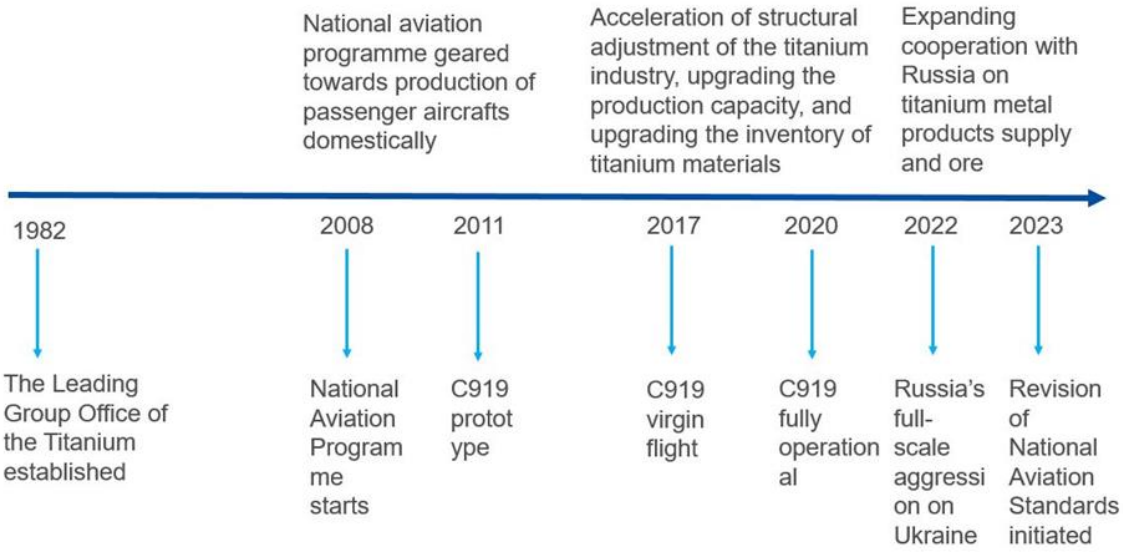
Source: China Non-ferrous metals Industry Association, Zhiyan (2023).

In terms of policies driving the developments in the sector (**Figure 35**), China recognised the importance of the titanium metal industry as early as 1982, with the establishment of the Leading Group Office of Titanium. It started its mission to climb up the value chain in the late 2000s with the initiation of the national aviation programme, aiming to produce its own passenger aircraft (see below). Since 2016, in particular, China has accelerated structural adjustment of the titanium industry, upgraded its production capacity, and cleared its inventory of inferior titanium materials (Qiu and Guo, 2022). Concomitantly, the governments of the two key provinces for the production of titanium, Shaanxi and Sichuan, have upgraded and restructured the industry, consolidating its leading importance globally. Sizeable subsidies have been injected into the industry, as most recently

demonstrated by the inclusion of titanium metal in the 2019 Industrial Structure Adjustment Catalogue, which positioned titanium metal and its alloys as key materials supported by the state funding, and the inclusion of titanium metal (among other crucial non-ferrous metals) in the 2021 key new materials applications catalogue eligible for state subsidies (MIIT, 2021).

Recent years have seen an increase in industry-related standards. In 2020 a new standard for titanium-processing factories was introduced (MoHURD, 2018). In 2023, the Civil Aviation Administration of China (CAAC) called for revisions in national aviation standards, including civil aviation and engineering standards among overall improvements in national security and passenger safety, signifying rapid transformation of China's aviation to meet (and potentially) exceed global standards (CAAC, 2023). In addition, China has also been investing in overseas deposits, exploring in particular the potential of Russia-based deposits in the Arctic, which are of higher quality ([17]). It has also partnered with VSMPO for the purpose of its national aviation programme, and has also increased imports of Russian titanium, especially since the start of the war in Ukraine in 2022 (North Steel, 2017).

Figure 35. Evolution of the Chinese titanium industry for aerospace (1982-2024)



Source: Own elaboration from various sources.

As for the industry actors and industry initiatives (**Table 5**), much of the innovation, driven by state policies and subsidies, has been taking place over the last decade or so. With regards to Tier-2 (midstream) and Tier-3 (upstream) industry, the production of titanium metal in China is geographically split between two main provinces: Shaanxi (Baoji and Xi'an) for Tier-2 industry and Sichuan (Panxi region) for Tier-3 extraction. While Panxi in Sichuan province is the largest extraction site for titanium ore, the most important centre of titanium processing is located in Baoji, China's northern Shaanxi province. Baoji, sometimes dubbed 'China' s titanium valley', is the biggest titanium-processing centre in the world (SCIO, 2024), hosting an array of Tier-2 companies, processing sponge to ingots and fabricated parts. Among those, Baoji Titanium Industry Co. Ltd. is the largest titanium and titanium alloy producer in China, with a steady year-on-year increase in revenue, reaching around

[17] Robert Fife and Steven Chase, ''China gains major Arctic foothold as Russia turns to Beijing".

EUR 598 million in 2021, and a profit margin of over 21% in the years 2018-2021 (Zhiyan, 2024). Shaanxi province is also home to a national cluster of the aviation industry, owing to its robust Tier-2 processing capacities.

Table 5. Chinese companies in the titanium for aerospace ecosystem, by value chain tier

	Examples of companies	Basic info	Specialisation
OEM/Tier-1 (secondary fabrication, design of parts and assembly)	COMAC (Commercial Aircraft Corporation of China) (中国商用飞机有限责任公司)	Est. 2008, HQ: Shanghai, State-Owned (SOE)	Commercial aircraft, large passenger aircraft (ARJ21, C919)
	AVIC (Aviation Industry Corporation of China) (中国航空工业集团公司)	Est. 1951, HQ: Beijing, State-Owned (SOE)	- Military aircraft (ex. Chengdu J-20, Shenyang FC-31), UAVs, and helicopters - Civilian aircraft (ex. Xian MA60/600/700, AS700), other aviation products
Tier-2 (ingot production and primary fabrication of parts)	Baoji Titanium Industry (宝鸡钛业股份有限公司)	Est. 1999, HQ: Baoji, Shaanxi, State-Owned (SOE)	- Largest titanium alloy production and scientific research base in China. - Produces bars, ingots, blocks, forgings, rings, plates, wires, foil, pipes, tubes and standard parts, etc.
	- TC AEROSPACE (Shaanxi Tian Cheng Aerospace); - Shaanxi Lasting titanium Industry	Ti metal processing companies	
	- Baoji Xingsheng Titanium Industry; - North Steel; - Iron & Steel Holding; - Yunnan Titanium Industry; - Pangang Group Vanadium Titanium & Resources	Steel-Ti metal processing companies	- Some specialise in large forgings and a wide heavy-plate low-cost production process - Pangang Group promotes steel-titanium joint production to improve output and quality of titanium materials
Tier-3 (extraction and refining, sponge production)	- Jinzhou titanium Industry - Chongqing Iron and Steel Mining	Extraction and sponge producing companies	Jinzhou Titanium Industry is the main company which extracts Ti metal via the use of chlorination process in China
EoL (end-of-life)	Majority of Tier 2 companies also deal with scrap, so participate in the EoL stage.		

Source: Own elaboration from various sources.

Regarding Tier-1 and OEMs, China's two most important aerospace OEMs which use aviation-grade titanium metal are COMAC (specialising in civil aviation) and AVIC (specialising in military applications). Both companies are state-owned enterprises (SOEs) and therefore benefit from generous state support. COMAC was established in 2008 as part of the National Aviation Programme. The company produced Advanced Regional Jets (for example ARJ21 Xiangfeng – certified in 2016) and released the first prototype of Comac C919 in 2011, which made its maiden flight in 2017 and became operational in 2020. Russia-imported forgings have been important in the production of the C919, but it has been the native 3D-printing additive technologies that have made C919 truly unique. Chinese aerospace manufacturers have invested in laser additive manufacturing (LAM) technologies since 1995, and started applying it to plane parts production in 2001, using it in military jets earlier than in civil aviation. These research projects allowed COMAC to successfully 3D-print key parts of the plane, such as load-bearing wing spars, windshield frames and landing gears. This is not only

innovative on a global scale, but also lowers the price of aircraft production significantly (the cost of 3D-printed parts stands at 5% of the cost of the traditionally manufactured parts) (North Steel, 2017).

For the production of its plane, COMAC follows the Chinese standards (some mentioned earlier), which are set by the CAAC. However, the possibility of these planes entering the global market is currently unclear. For instance, it is questionable whether EU aerospace manufacturers would be willing or able to use Chinese standards, which allow a lower titanium grade and 3D-printing of important parts, as in the case of the C919. Indeed, key EU and US clientele have been suspicious of Chinese sponge and milled titanium products' quality, suspecting counterfeit certification processes, and have not established longstanding reliance on Chinese providers. The main aerospace companies also concur that Chinese titanium is too costly, and that problems with the quality remain a major obstacle for diversifying the supply chain to include China ([18]).

To sum up, China is currently in the process of creating a competitive aviation industry; upgrading its titanium ore processing technologies to achieve higher-grade titanium from its domestic deposits; improving its access to high-grade ore and titanium products from Russia; and prioritising the subsidisation of its titanium metal value chain. All these developments are positioning China as a potential future key player in the field of aeronautical-grade titanium production and aerospace applications. This is important to bear in mind for the EU's strategy in maintaining a dominant global position in the aviation industry.

4.3.3 Post-Soviet economies

Russia, Ukraine and Kazakhstan are the three post-Soviet states that make the most noticeable contribution to the global titanium metal value chain. The titanium ecosystem in these economies is shaped by two factors: on the one hand, Soviet legacy – metal production in the three countries was created as part of the Soviet military industrial complex; on the other hand, the countries of the region and their titanium ecosystems have evolved in divergent ways, although some degree of collaboration has continued. This Section will outline the main actors and policies and assess the interplay between both factors.

Titanium was discovered on the territory of the Russian Empire by Adolph Theodor Kupffer in 1827. A Russian professor of German origin, Kupffer discovered deposits of titanoferrite mineral ($FeTiO_3$) in the Ilmensky mountains in the South Urals region. Named after its location, ilmenite deposits became subject to serious exploration only about a century later. The first systematic efforts to identify, map and use titanium compounds in the region were undertaken during World War I. Acknowledging its technological inferiority, the Russian Imperial government in 1915 created the Committee of Military Technical Assistance (CMTA) with a special titanium subcommittee which was mandated to identify titanium mineral reserves, and to conduct research on their processing. In September 1925, the expedition of Professor L.I. Preobrazhensky discovered the first large reserves of magnesium raw materials in the Urals, in the region of Solikamsk (Zapariy, 2012). By the end of the 1920s, the Solikamsk deposit under exploration covered an area of >1 500 km^2. Stocks of chloride magnesium in the local salts amounted to about 7 billion tonnes, more than in all European layers combined.

With the rapid industrialisation and militarisation, the Soviet government could not secure the necessary volumes of exports of light metals and intensified efforts to create an independent light

[18] Tom Gentile, CEO of Spirit Aerosystems (major US Tier-1 and OEM company), quoted in Hamilton and Scott (2022).

metal industry ([19]). Industrial production of light metals in the USSR started in 1929-30 with the launch of an experimental aluminium-magnesium factory in Leningrad. In 1931 the Head Research Institute of the light metal industry, the plant and the institute prepared the data for the design of factories, and trained the workforce in parallel. In 1931, the construction of a magnesium plant and carnallite mine and potash plant began near Solikamsk. In 1935, on the territory of today's Ukraine the second magnesium plant was put into operation – Dneprovskiy Magnesium Plant (ZTMC) ([20]). In 1939, the USSR Economic Council decided to design a third magnesium plant in Berezniki (Urals region). To provide raw materials for the production of 11 000 tonnes of magnesium at Berezniki, it was planned to expand the Solikamsk carnallite factory (SCF) and construct a new carnallite mine and processing plant. In 1938, Russia produced 500 tonnes of magnesium per year, making it the sixth largest producer in the world together with Switzerland (Ball, 1957).

With the growing use of titanium in the aviation industry, the Soviet magnesium plants were directed to apply their capacities to the production of titanium. In 1951, following an experiment, the team produced smelted tonnes of titanium slag that contained 77-84% titanium at the Experimental Aluminium-Magnesium Plant in Berezniki. Following this success, the USSR started its own titanium production. The construction of the first plants was headed by P. Lomako, with the raw materials supplied from Ukrainian SSR. In 1954, the Berezniki Magnesium Plant (BMP) received the first batch of raw magnesium. Drawing on this success, the Council of Ministers of the USSR issued "On Measures for the Development of Titanium Production" in March 1954 aimed at consolidating efforts to develop the titanium industry. It envisaged the construction of a titanium-magnesium plant with an annual capacity of 8 000 tonnes of titanium for ingots. The first stage of the complex was scheduled to be operational in 2.5 years with a capacity of 2 000 tonnes. Besides, BTMK was to include a workshop for processing titanium and its alloys, renamed the Berezniki Titanium-Magnesium Combine (BTMK).

Similarly, in Soviet Ukraine, after rich deposits of ilmenite and magnesium ores were discovered in the central region, in 1956 the Dneprovskiy Magnesium Plant was reprofiled into a Titan-Magnesium plant and renamed the Zaporizhzhia Titanium-Magnesium Combine (ZTMC). In 1960, the extraction and processing of ilmenite ores started in central Ukraine (Irshansk deposits in Zhitomyr region) to supply the Irshansk Mining Processing Plant (IMPP) (UMCC-Titanium). In 1961, a mining and smelting plant in Vilnohirsk (VMSP – Dnipro region, East Ukraine) was launched. In 1971, a new plant 'Krymski Titan' (Crimean Titanium) was opened in Crimea to produce titanium pigment. Additionally, production of titanium alloys, slabs and other products began at the Alchevsk Metallurgy Plant (East Ukraine). With the discovery of numerous deposits of titanium ores, exploitation of Ukrainian sites rocketed and by the late 1980s Ukraine accounted for about 90% of extracted ilmenite.

In the context of the geographical distribution of industrial production and industrialisation of underdeveloped rural areas of Central Asia, the Soviet government also ordered to start the construction of a Titanium-Magnesium Plant in Ust-Kamenogorsk (UTMK) in the eastern part of Kazakhstan; the first production line was launched in 1965. According to the principle trans-territorial production chains, the UTMK received its raw material from Ukrainian deposits. **Figure 36** shows the scattered titanium industry present in Russia, Ukraine and Kazakhstan.

[19] In 1929 global production of magnesium already amounted to about 2 000 tonnes. It was expensive: more than 3 000 roubles per tonne. The light metals were imported into the USSR, and, in a quantity of about 100 tonnes per year, which was far from sufficient. This significantly hampered the development of Soviet aviation.

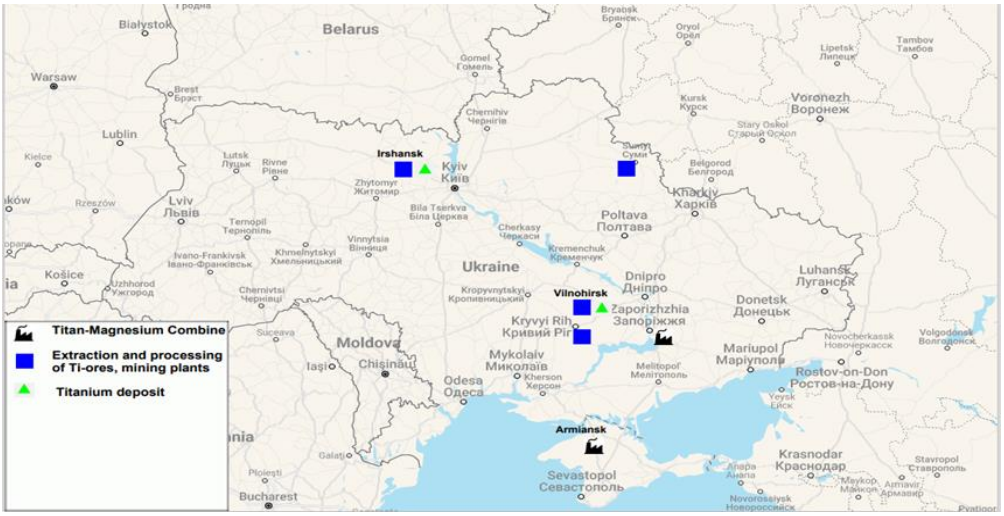
[20] Dneprovskiy Magnesium Plant was built in the city of Zaporizhzhia. It was officially renamed the Zaporizhzhia Titanium-Magnesium Combine (ZTMC). In this report we use the abbreviation ZTMC throughout.

Figure 36. Post-Soviet countries' titanium ecosystems: extraction and production

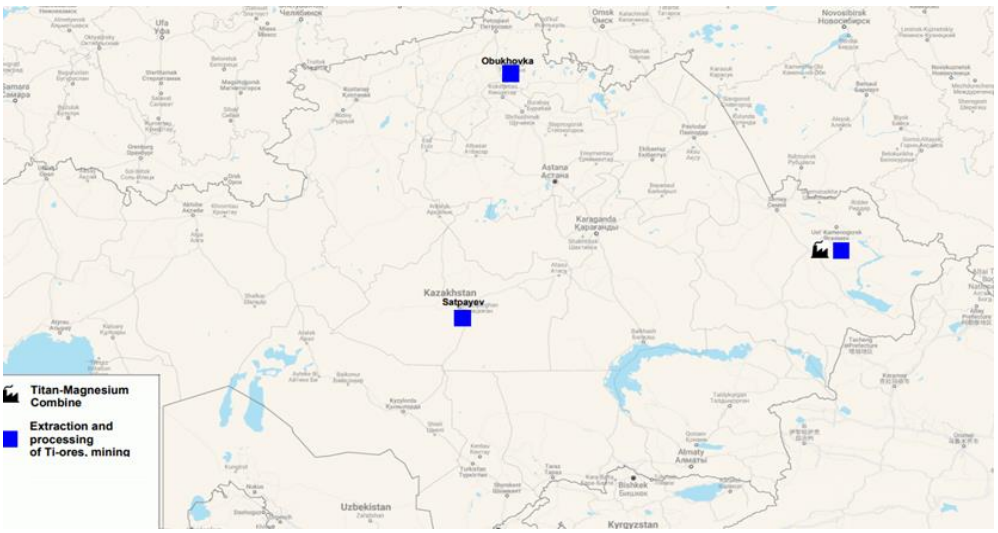
(a) Russian Federation



(b) Ukraine



(c) Kazakhstan



Source: Own elaboration from various sources.

In the period of post-Soviet transition, the titanium industries of all three countries were shaped by different political trajectories and national constellations of power. In Russia, during the early 1990s the publicly owned titanium industry was broken up and sold to private owners. In 1992, BTMK was registered as AVISMA ([21]). After several acquisitions, AVISMA was purchased by aviation part producer VSMPO, led by its charismatic owner Vladislav Tetyukhin. The new company VSMPO-AVISMA evolved into a vertically integrated holding which controlled the full production cycle of titanium, from ilmenite extraction in the Urals to production of advanced titanium elements. Throughout the 1990s, the company built a strong reputation and secured long-term contracts with major titanium producers and consumers, such as US-based Allegheny Technologies (ATI), Boeing, and Airbus (Starkov, 2022).

The growing volume of production and export prompted the company to seal deals for outsourcing of ilmenite ores and titanium sponge from Ukraine, Kazakhstan and more distant international markets. After the rise of Putin to power, the Russian government took over the company and transferred ownership to the state-owned defence industry holding RosOboronTechProm. One of Putin's longstanding associates with a KGB background, Sergey Chemezov, became the chairman of the VSMPO-AVISMA board. Over time, the ownership was transferred to offshore companies; however, there are clear indications that the Russian military-industrial complex is effectively in control of the company. RosTech, a state corporation, retains a blocking minority stake. Furthermore, the offshore companies that own the remaining stakes are linked to Chemezov's close associates. In total, VSMPO-AVISMA claimed to produce 20-25% of global titanium output or 100% of titanium and titanium composites domestic output.

In Kazakhstan, from the first days of independence, the government and President Nazarbayev personally attached great importance to the preservation of heavy industries and modernisation of the Kazakh titanium sector. The Director of the Kazakhstan titanium producer UTMK B. Shayakhmetov belonged to the generation of Soviet directors who had privileged access to political leadership and lobbied for strong government support of internationalisation of titanium production. As a result, UKTMP was turned into a joint stock company and open for privatisation. The Kazakh government allocated seed-funding, and the managing company Specialty Metals Ltd. was entrusted with the implementation of the programme and raising investment in exchange for 29%. Several investors from Singapore soon became stakeholders and the property ownership has not change significantly since the mid-1990s ([22]). While the ownership of the company is non-transparent, the management is linked to the ruling political elite, i.e. the AMANAT Party of the President (Turkestanova, 2021).

In Ukraine, the mixed record between democratic and authoritarian rule and the absence of a stable industrial development programme resulted in volatile development of the titanium metal industry. After several years of disruptions in the early 1990s, it started to slowly recover driven by the technocratic governments of President Kuchma. ZTMK, the main domestic titanium producer, resumed production. While Ukraine exported sponge to Russia, Kazakhstan and other markets, there was no serious government ambition to upgrade production for high-added-value product for international markets. The most advanced industrial samples covered the needs of the national aviation industry (Antonov) and space industry (Yuzhmash).

[21] According to some industry historians, AVISMA comes from the abbreviation avis-light, ma-materials. The organisation was later registered with industrial profile 'aviation materials' (Ezhov, 2018).

[22] Most of the companies in the property structure, including Belgian Specialty Metal Company (front company for another Swiss shell company) and Singapore company suggest that privatization was conducted in the interests of insiders or political elite. (Postanovlenie, 1996).

The situation deteriorated further in the late 1990s, when rising Ukrainian oligarch Dmytro Firtash gained access to secondary capacities of titanium dioxide production in the Krymsky Titan plant in Crimea (KT). Later, in the time of President Yanukovych, the Firtash-owned DFGroup 2012 with the support of President Yanykovych received privileged access to deposits, mining and processing plants, either through direct acquisition or purchasing stakes and imposing his own management on various plants, including ZTMK. In essence, until 2014, DFGroup controlled the full production chain – from licences to deposit fields to production of sponge and ingots. Most of the plants work on outdated equipment, old technologies and low energy efficiency (Grigorenko, 2019). Also, Firtash management managed to secure the supply of sponge to VSMPO-AVISMA and titanium pigment to Crimean Titan (KT).

Effectively, Russia managed to lock Ukraine in the lower part of titanium value chain for almost two decades. The above-mentioned difference in state- and industrial-building programmes resulted in growing divergences in the development of titanium ecosystems in the three countries. Russia sought to assertively climb up the value chain and create its own titanium industry hub. Kazakhstan tried to internationalise in a more balanced way and increase its presence through integration with more advanced partners abroad. Ukraine's ecosystem did not change significantly; the country is still looking for acceptable industry arrangements, which would include the flexibility of private ownership while remaining under the control of the state.

4.3.3.1 Russia

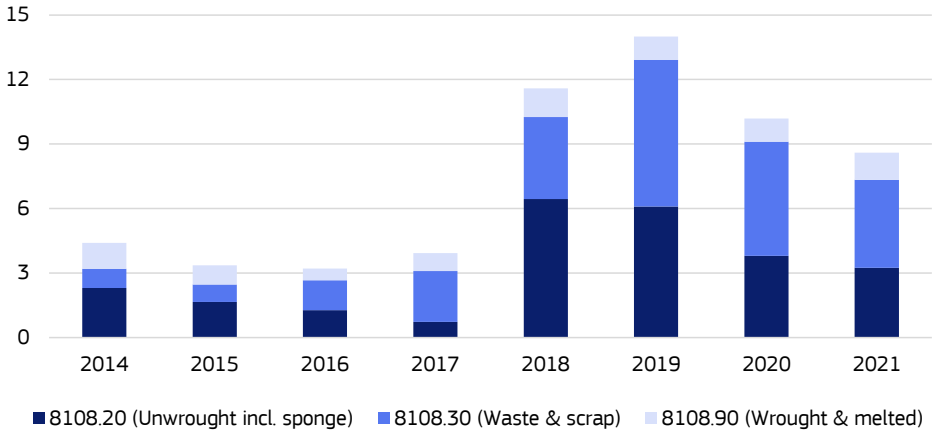
Overview of the sector

With the adoption of policies aimed at positioning Russia as a global titanium champion, VSMPO-AVISMA continued aggressive internationalisation by clinching deals with major titanium consumers. In 2002-03, it became a major supplier of titanium for Boeing (35% of titanium), Airbus (70%) and Embraer (100%) (Starkov, 2022). Drawing on this success, it sealed long-term deals and joint ventures with several aviation producers: in 2007, VSPMO-AVISMA and Boeing created a joint venture (Ural Boeing Manufacturing). The companies signed a 7-year contract for deliveries of titanium products. Boeing planned to invest USD 27 billion in the production of titanium parts to meet its own needs (VSMPO-AVISMA, 2007).

At the same time, VSMPO-AVISMA was also heavily reliant on imported titanium sponge. In 2019, Russia imported USD 53 million in unwrought titanium - 39% of titanium imports - primarily from Kazakhstan (70%) and Ukraine. In addition, imports of scrap -which can feed into primary material production- are also sizeable: USD 50 million (36% of the total), mainly from Switzerland (68%) and Germany (26%). In mass terms, owing to the high buy-to-fly ratio of titanium parts (especially so in aerospace), the import composition shows the absolute preponderance of sponge and scrap as main items (**Figure 37**).

Table 6 shows an overview of some relevant actors in the Russian titanium ecosystem.

Figure 37. Evolution of the composition of Russian titanium imports (volume, kt)



Source: Own elaboration from UN Comtrade data.

Table 6. Ecosystem of Russia's titanium industry (production/extraction facilities only)

Name of the company	Ownership structure	Place in value chain (mining / sponge production / component manufacturing)	Deposits/capacity of deposits
VSMPO-AVISMA *(for holding structure check **Box 4** below)*	*Industrial Investments* (main owner: Mikhail Shelkov) owns 65.3% (formal owner). Rostec State Corp. owns blocking 25%+1 share([23]).	As of February 2022, VSMPO produced 90% of titanium in Russia and exported it to 50 countries.	Previously imported ilmenite ore. Currently, African countries and Vietnam. In Tambov region, the company currently seeks access to use Tsentralny Zirconium Titanium.
TGOK Ilmenit (Tuganskii Gorno-Obogatitelnyi Kombinat Ilmenit AO) ([24])	No publicly available information. Company created by the State in 2002. In 2021, 25% of shares were purchased by a company under Rosatom (Glushenkova 2022).	Extraction of ilmenite for the needs of high-tech enterprises: - Manufacturer of zirconium claddings for nuclear fuel JSC ChMP (part of the control loop of TVEL JSC, the fuel division of the Rosatom State Corp.) - Manufacturer of metallic titanium and titanium alloys - VSMPO-AVISMA.	Perm region. Pilot on extraction of mineral sands was launched with a capacity of 125 000 t/year. Currently, Large-Scale Development Project is being implemented by involving the resources of the Kuskovsko-Shiryaevsky licensed area in the extraction and increasing production capacity to 6.9 m tonnes of ore sands per year.
Solikamskii Magnesium Plant (AO "СМК")	Unknown, private. From 2002 to 2021 one of the owners was JSC NPO AVIATECHNOLOGIA (liquidated in Dec 2019).	Produces titanium for aircraft manufacturing.	n/a
Russian Rare Metals or RusRedMet (*ООО "НПО "РУСРЕДМЕТ"*)	100% of shares owned by Ananin Valerii Mihailovich.	Supplies titanium products for aircraft manufacturing and other high-tech industries: Missiles, space, etc.	n/a

ООО: Private limited firm (*общества с ограниченной ответственностью*); АО: Joint stock (*акционерное общество*).

Source: Own elaboration from various sources.

[23] Information as of 2022. *Industrial Investments* LLC are mentioned as a majority shareholder in the 2017 Annual Report. Previously, Shelkov was mentioned as a direct shareholder, but there might have been a requirement to publish the names of individuals owning over 5%. This might have prompted the transition (VSMPO-AVISMA, 2018).

[24] The enterprise was created in 2002, and the production was supposed to start in 2021. There is no certainty as to the actual production capacity today.

Box 4. The ecosystem of Russian titanium production centred around VSMPO-AVISMA

Almost all of the company's production is located on the territory of the Russian Federation. The company is owned by two Cypriot companies who are linked to the Deputy Chairperson of the Board of Directors of VSMPO-AVISMA. The Cyprus-based companies Cador Enterprises Limited and Jivanta Ventures are owned by Industrial Investments LLC, through which they are controlled by CJSC Business Alliance Company. The main shareholder of the Business Alliance Company is Mikhail Shelkov, Deputy Chairperson of the Board of Directors of VSMPO-AVISMA. A small percentage of free float shares were offered to minority owners for acquisition. According to the latest information available, Industrial investments, owned by Mr Shelkov, controls 65.27% of VSMPO-AVISMA shares and Rostec State Corporation owns 25% plus 1 share (Interfax, 2022).

The structure of the company includes the following subsidiaries:

— *AVISMA branch* - titanium sponge production. The technological chain starts from the AVISMA branch. Titanium sponge is produced here at the chemical and metallurgical enterprise in the city of Berezniki, Perm Territory. There is also production of metallic magnesium and alloys based on it, and chemicals.

— *Joint Stock Company Ural Boeing Manufacturing*. It is a joint venture focused on machining of titanium forgings with one of the two largest aircraft manufacturers, Boeing. The company is located in the Sverdlovsk region for the purpose of machining stampings for aircraft. As a result of the activity, Boeing receives blanks that are close in size to the final part.

— *JSC ATI Forge*. The company produces processed products from titanium and aluminium alloys. In October 2013, an agreement was signed with the global aluminium giant Arconic to establish a joint venture, AlTi Forge, to produce semi-finished products from aluminium and titanium alloys, large forgings, including landing gear parts and wing mounts. Production is organised on the basis of the Alcoa SMZ forging and pressing shop (Samara Metallurgical Plant), which is part of the Arconic structure. This workshop has high-performance equipment, including a vertical press with a force of 75 000 tonnes.

— *Private Joint Stock Company Corporation VSMPO-AVISMA* - production of titanium products. The last in the chain is PJSC VSMPO-AVISMA Corporation, a full-cycle enterprise for the production of semi-finished products and titanium alloys. It has the world's largest melting and casting complex, as well as sheet-rolling, forging and stamping, pipe-profile production, shops for machining stampings and non-standard equipment.

Despite the presence of the entire production base in Russia, the corporation is focused on selling products abroad. The following production and marketing divisions are located abroad:

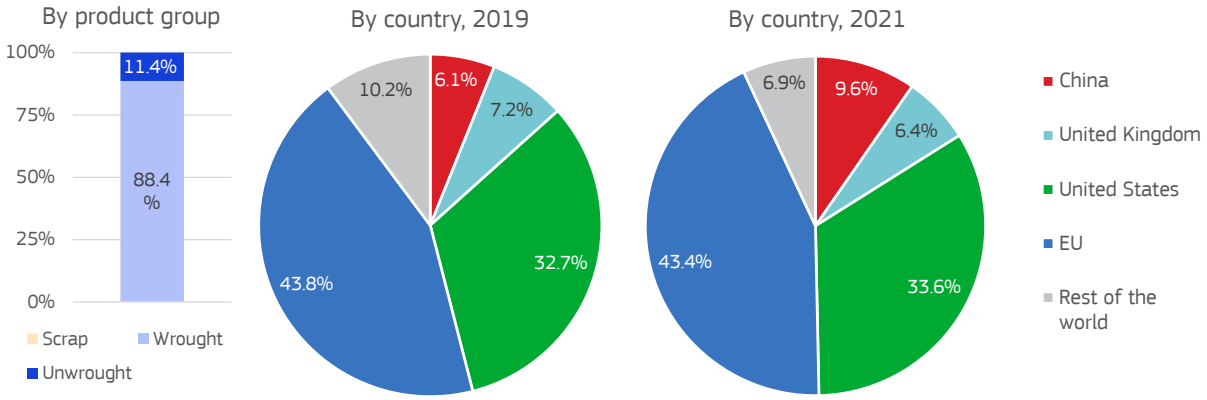
— *NF&M International*. NF&M is a key company in the production of small assortment products. It was acquired by the company in 2003 in order to expand the range and focus on one of the main markets - the United States. It manufactures titanium billets and bar stock for the aircraft engine and structural, medical and consumer markets, as well as small-diameter, tight-tolerance bars and coiled wire for aviation, medical and automotive applications.

— *VSMPO Tirus*. VSMPO-Tirus handles distribution and sales in Europe and North America. The divisions are distributed in the USA, England, Germany, Switzerland and China. They house warehouses for the sale of products manufactured in Russia, and sales specialists.

— *Joint venture with Allegheny Technologies Incorporated* (ATI) UniTi with an office in Pittsburgh, USA. It was established in 2003 to manufacture and market a wide range of products in industries such as electricity, chemicals and oil refining, automotive and transport, electronics and more.

In this vein, the composition of Russian titanium exports shows how wrought, finished products make up nearly 88% of the total (**Figure 38**). Geographically, the export structure is diversified between the EU, the US and the UK, which altogether constitute 84% of the total. The other partners are relatively much smaller, although China has increased its share from 2019 to 2021.

Figure 38. Export composition of titanium products from Russia



Source: Own elaboration from UN Comtrade data.

Titanium-related policies

With President Putin's rise to power, Russia adopted several important initiatives for the titanium industry. In 2008, the government released the long-term development strategy "*Strategia-2020*" which envisaged extensive support to the high-technology industries, including the establishment of territorial clusters in various regions. One of them was "Titanium Valley", a high-technology cluster created to facilitate the development of the space and rocket industries, located in the Sverdlovsk region with its core in the city of Yekaterinburg. Titanium Valley was centred around VSMPO-AVISMA, but other state companies were invited to participate. In 2018, Russia established the special economic zone (ESZ) "Titanium Valley" aimed at creating favourable conditions for stimulating titanium companies in the aircraft, automotive, shipbuilding and medical industries (**Figure 39**).

Figure 39. Titanium Valley entrance



Source: Wikipedia.

Titanium Valley is expected to host at least 20 enterprises and stimulate titanium processing in collaboration with global companies. The planned expenditure associated with this economic zone is at the level of 40 billion roubles (USD 1.29 billion) from the Russian budget. The Special Economic

Zone enjoys special legal status, customs and tax preferences: income tax is set at 2% for the first 2 years, and companies are exempt from land tax, corporate taxes and import tariffs. **Table 7** presents a summary of the main companies involved.

Table 7. Firms present in Titanium Valley

Name (Transliteration)	Main activity	Jobs	Status
Zavod "Zibus"	Medical instruments, implants		Operational
Zavod "Ural Boeing Manufacturing"	Titanium processing for Boeing aircraft (Joint w/ VSMPO)	204	Operational
OOO "Instrumentalnoe proizvodstvo Minikat"	Metal cutting tools		Operational
OOO "Allegro"	Steel rolling for railway wheels	425	Planned
OOO "Silarus"	Production of technical silicon	320	Planned (2027)
OOO "Zavod pressovannykh profiley"	Aluminium extrusion	199	Planned (2024)
AO "IKMZ"	Production of titanium billets	115	Planned (2025)
OOO "Ametist-SPG"	LNG	17	Planned (2024)
OOO "RP1"	Automotive parts (brakes)	509	Planned (2026)
OOO "Keramax-Verkhnyaya Salda"	Welding electrodes, Metal wire	69	Planned (2025)
OOO "VSMPO - novye tekhnologii"	Production of Ti-based products	300	Planned (2027)
OOO "EkoTekh"	Graphite electrode production		Planned
AO «Uralskiy zavod grazhdanskoy aviatsii»	Aviation components	1060	Operational
OOO «Rusmed»	Medical equipment	144	Operational
OOO «MO «Otdel meditsinskoy tekhniki»	Medical equipment	165	Under construction (2024)
OOO «Ob'edinyonnaya Neft'egazovaya Gruppa»	Gas processing equipment	150	Planned (2024)
OOO «Zavod trotuarnoy plitki «Porevit Yekaterinburg»	Pavement and tiles	80	Planned (2025)
OOO «KMZ Air»	Aircraft equipment	25	Planned (2025)
OOO «GIG-Yekaterinburg»	Glass insulators		Planned
OOO «ZKO «Gornyak»	Mining and metallurgy equipment		Planned
OOO «Aspekt Medikal»	Medical instruments		Planned

OOO: Private limited firm (*общества с ограниченной ответственностью*); AO: Joint stock (*акционерное общество*).

Source: Own elaboration from Titanium Valley website (Russian version).

Another essential element of Russian industrial policies was the development of a national raw material base. In January 2007 the State Balance of Mineral Resource Reserves listed 25 titanium deposits, of which 4 are classified as promising for industrial development: Iareg, Kuranakh, Gremekha-Vyrmes, and Central. However, one distinctive feature of the titanium mineral raw material base is the limited share of ilmenite placers and the complete absence of rutile deposits. The deposits mined in Russia have very a specific composition (loparite ores, leucoxene sandstones, phosphate-titanium placers, etc.): to acquire its own raw material base for the titanium industry means developing and using new technologies that can make it profitable to mine the ores from existing deposits (Sokolov, 2011). Thus, as long as the ilmenite mining processing plants have not reached their envisaged capacity to cover the needs of VSMPO-AVISMA holding (120 000 tonnes of ilmenite concentrate) Russia remains dependent on imported materials.

4.3.3.2 Kazakhstan

Overview

Over the past 30 years, Kazakhstan has adopted several internationalisation policies and been active in developing its own mineral base, extracting ilmenite ores in several deposits in the East Kazakhstan region.

The Kazakh champion in global titanium supply is UKTMP (**Table 8**). The firm has sought to engage in international titanium value chains by partnering with a number of consumers in Europe and Asia. Several notable examples are joint ventures with France, South Korea and India. Two joint ventures between UKTMP and the French Aubert & Duval allowed the construction of two plants (UKAD and EcoTitanium) for the production of bars, forgings, other products for the aerospace industry as well as ingots and slabs in France (Chelekbay, 2013), although UKTMP divested its share in 2022. In 2015, POSUK (a joint venture with South Korean POSCO) was put into operation for production of ingots and slabs (Mal'ko, 2015). Finally, in 2020, UKTMP and the Indian company IREL Limited created a Kazakh-Indian joint venture for the production of titanium slag. The company also has a trade arm, UKTMP International Ltd, which was registered in the UK in 2014. The branch is engaged in the sales of titanium sponge and titanium ingots and purchased the main raw materials for the company's production of titanium sponge.

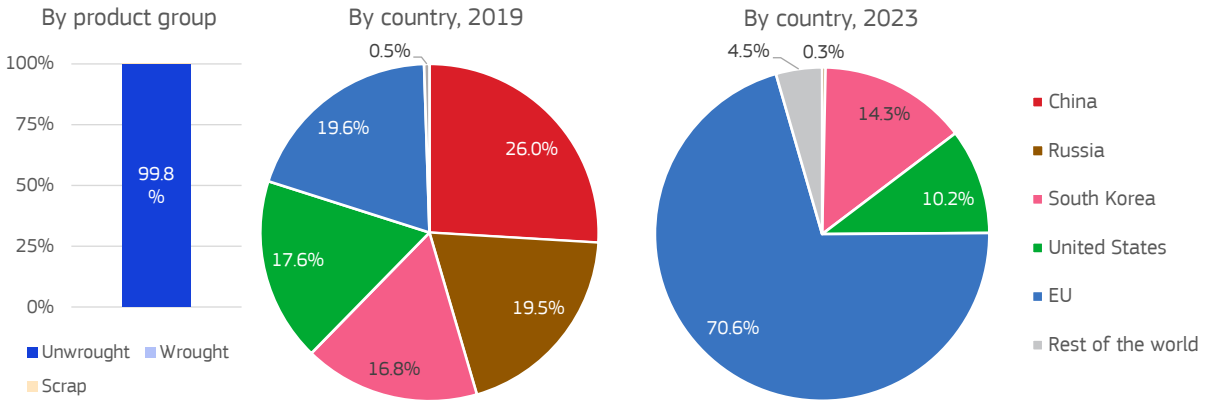
Table 8. Ecosystem of Kazakhstan's titanium industry (production/extraction facilities only)

Name of the company	Ownership structure	Place in value chain (mining / sponge production / component manufacturing)	Deposits
Ust-Kamenogorsk Titanium Magnesium Plant (UKTMP)	Offshore.	Titanium sponge, TiO_2	Satpayev deposit (ex-Bektemir): Satpayevsk Mining and Processing Plant (SGOP) is a subsidiary of UKTMP. Since 2000 joint mining enterprise "Satpayevsk Titanium Mines Ltd" LLP Satpayev deposit.
UKAD	Initially, Kazakh-French joint venture (UKTMP + Aubert & Duval), UKTMP divested in 2022.	Titanium bars, forgings, sheets and wire	Processing titanium waste at the plants in Les Ansiz (France).
EcoTitanium	*Semi-public joint venture between UKAD + French government, UKTMP divested in 2022.*	Titanium ingots	*Using raw materials from UKAD for production in Auvergne (France).*
POSUK Titanium LLP	*Private UKTMP and South Korean POSCO.*	Titanium slabs	*UKTMP production Ust-Kamenogorsk.*
Kazakhsani Tioline and Russian Bashkir company mining deposit	Kazakhstan-Russian ownership (private or public). Project "Titan" is a Russian-Kazakhstan project of joint cooperation between Bashkir Soda Company and Kaustik.	Mining and processing of ore sands	The Obukhov titanium–zirconium deposit – mineral composition of the ore sands.

Source: Salikova et al. (2021).

As a result of this level of internationalisation, Kazakhstan's industry was able to boost production and sustain it effectively even during the Covid-19 pandemic. Regarding the product composition, almost all of Kazakhstan's exports consist of sponge, classified as unwrought products (**Figure 40**). A notable aspect in 2019 was the diversity of Kazakhstan's export partners, with the EU, the US, China, Russia and South Korea each accounting for a share ranging from 15% to 25%. However, the latest data reveal that the Ukraine conflict has redirected most Kazakh exports primarily to the EU (70%), along with the US and South Korea, while exports to Russia and China have completely ceased. This shift might also reflect the EU's efforts to secure titanium metal as a critical raw material (CRM), as well as Kazakhstan's inclination toward western trade partners, as previously mentioned.

Figure 40. Export composition of titanium products from Kazakhstan



Source: Own elaboration from UN Comtrade data.

Titanium-related policies

Kazakh political elites attached significant importance to the development of the titanium industry as a driver of modernisation in the country. Within this framework, the government adopted two consecutive programmes: 'Development of the Titanium Industry of Kazakhstan for 1992-1997' and 'Development of Titanium-Magnesium Industry of the Republic of Kazakhstan for 1996-2001' (Postanovlenie, 1996). Both programmes aimed to create a full cycle of titanium production in the country, primarily by the creation of its own resource base. In particular, the programme foresaw a more active exploitation of existing ilmenite deposits in Eastern Kazakhstan and active geological research in northern and western areas of the country.

With the growing pressure of Russia on Kazakhstan to join the Russia-led Eurasian Economic Union, Kazakhstan sought to reduce reliance on Russian producers. In this context, the Kazakh government adopted several special programmes to achieve economic, industrial and transit autonomy: the 'State program of industrial and innovative development of the Republic of Kazakhstan for 2015–19' (hereinafter SPIID-2) was approved in August 2014 (Ukaz, 2014). Further to the general goal of modernisation, the Programme contained special provisions on titanium which set specific goals for industry development (e.g. specific ingot production targets) and logistics (e.g. railway connection to UKTMP) (Ukaz, 2010). The programme resulted in a strengthening of Kazakhstan's strategic autonomy: firstly, UTKMP moved to create its own mineral resource base. Secondly, Kazakhstan worked and succeeded in receiving certification and upgrading its production capacities.

4.3.3.3 Ukraine

Overview

After an extended period of oligarch control and dependence on Russia, the Ukrainian government has worked for the past 10 years to regain control over the titanium industry. Firstly, the government managed to reinstate state-controlled management at the main producer of titanium sponge – Zaporizhzhia Titanium-Magnesium Combine (ZTMK), which had previously been controlled by the Russian Group DF, owned by Dmitro Firtash ([25]) through several intermediaries holding 49% of shares. After 2014, the government created a state-owned United Mining-Chemical Company (UMCC) which took over two processing plants in Irhansk and Vilnohirsk. At the time of writing Group DF maintains control over Mechyrichenskiy MPPS, (Zhytomir region), a small deposit placer in Dnipropetrovsk regions, and the company Sumykhimprom. Group DF might also indirectly control Crimean Titanium (KT) ([26]).

While the company was integrated into the Russian economy, it kept receiving raw materials from the government-controlled territories of Ukraine. It was only in 2020 that the Security Service of Ukraine ordered that UMCC stop trading ilmenite to the Czech operator Belanto because of suspected links with KT (Censor.net, 2020). According to some assessments, the KT complex reduced its production by 60% due to raw material shortages, but still managed to receive a small amount of ilmenite from mainland Ukraine (Ukrainska Pravda, 2021; Ukrrudprom, 2022). In late 2021, Group DF announced that it had sold its KT assets to the Russian company 'Russkiy Titan' ([27]). At the time of writing the ecosystem of the Ukrainian titanium industry is in the process of transition from domination by Group DF to state control. Also, there have been some efforts by various business groups to gain control over prospective deposit locations. However, most of these companies have no real capacity to start extraction (Interfax-Ukraina, 2019). (**Table 9**)

The EU stands as the primary partner for Ukrainian titanium exports, accounting for over 60% of the total (**Figure 41**). Meanwhile, the small quantities that were previously exported to Russia have completely halted, according to the most recent data. China remains another significant partner. It is important to note that Ukrainian export volumes have drastically declined following the Russian invasion, dropping from 8.8 kt in 2019 to just 1.1 kt in 2022 (see **Figure 23**); moreover, the composition of exports has shifted almost entirely to wrought products due to the stopping of sponge production in wartime.

[25] After Russia's annexation of Crimea, the US issued an international arrest warrant against Firtash, charged with attempted bribery of Indian officials to secure unfair advantage in a tender for access to Indian ilmenite fields. Following his detention in Vienna in 2014, Firtash has been under house arrest trying to avoid extradition to the US while having a major part of his assets blocked, thus losing control over titanium industries.

[26] Firtash maintained control through the Russia-registered 'Titanium Investment' ltd, created in 2014 and belonging to Firtash through Cyprus-based Letan Investment Ltd. Until 2016, the latter was directly owned by two groups which belonged to Dmytro Firtash, Group DF Holdings Ltd. and Group DF International Consulting Ltd. However, after 2016, ownership was transferred to Firtash's long-term associate Alexander Emelin (CurrentTime, 2018).

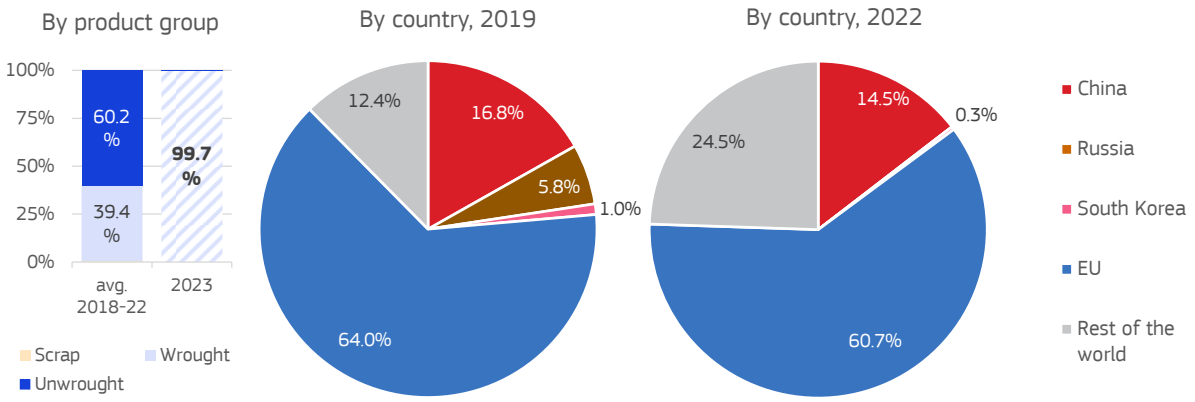
[27] The Ukrainian Anti-Monopoly Committee announced that it never approved the deal and raised suspicions that the company keeps outsourcing its raw materials from the government-controlled territories of Ukraine (Ilchenko, 2021).

Table 9. Ecosystem of Ukraine's titanium industry

Name of the company	Ownership structure	Place in value chain (mining / sponge production / component manufacturing)	Deposits/capacity of deposits
Zaporizhzhia Titan-Magnesium Combine (ZTMC).	Public/private property (currently prepared for privatisation).	Titanium sponge/titanium ingots. Before Russian invasion, it produced 20 kt/year.	
Irshansk MP Complex (IMPC).	State-owned United Mining and Chemical Company (currently offered for privatisation).	Extraction and production of ilmenite. Three ore-processing plants with total processing capacity 2.3m m^3/year. Production 100 kt/year.	Selysahinskiy deposit (Zhytomir region). Special mining permit expires on 11.02.2035.
Vilnohirsk Mining and Metallurgical Plant (VMPP)	State-owned United Mining and Chemical Company (currently offered for privatisation).	Extraction and production of ilmenite concentrate. One ore-processing plant. Ilmenite -120kt /year, rutile 20 kt/year, zirkoniy 14 kt/year.	Malyshevske, Dnipropetrovsk region, Eastern Ukraine.
Mezhyrichne Mining-Processing Plant (MMPP)	Group DF.	Extraction and production of ilmenite concentrate.	Mezyrichne deposit (Zhytomir region).
Valki Ilmenite	Group DF.		Stremigorodkiy 1.2 billion tonnes (Zytomir region) *(Licence revoked under Zelenskiy).*
Demurinski Mining and Processing Plant (Depo 2022)	Private.	Extraction of titanium-zirconium ores.	
VELTA Ltd	Private.	Ti-powder, 3D-printing.	Kryvy Rig deposits (South-East Ukraine).
Krymski Titan (Crimean Titan)	Group DF/Russian.	Titanium Dioxide, fertilisers, pigments production.	40 000 Mt/year.
SumyKhimProm	Formally 99% public. but management controlled by Group DF.		70 000 Mt/year.

Source: Own elaboration from various sources.

Figure 41. Export composition of titanium products from Ukraine



Source: Own elaboration from UN Comtrade data.

Titanium-related policies

In 1994, the Ukrainian government adopted the Complex Programme for the Development of Titanium industry (Postanova, 1994). The Programme set the goal of revitalising the national titanium industry by mobilising internal resources, establishing direct links between producers and consumers and by raising international investment. Titanium was also present in numerous speeches and working documents issued under the technocratic governments of President Kuchma. The programme was followed by a more specific one on the mining and industrial complex in 2004 which envisaged a conservative development of titanium industry. It foresaw the resumption of the production of titanium ingots, slabs and sponge (Programa 2004). As a result of this effort, the Ukrainian industry developed within the Soviet economic pattern: extracting and exporting titanium ores, producing sponge and largely relying on the same production and expanding markets only gradually. Some more advanced products were manufactured for the specific needs of the local aerospace industry.

The situation deteriorated when pro-Russian President Yanukovych decided to expedite further integration of the Ukrainian titanium industry into Russian control. In 2012, Ukraine adopted a "General State Program for development of the Mineral and Raw Materials of Ukraine for the period until 2030"; under this programme, titanium was classified as a category A mineral, defined as a type of mineral raw material that is intensively mined in Ukraine, characterised by significant explorable reserves of minerals and components, and is considered the subject of export or can be considered as such in order to ensure short-term foreign exchange revenues and revenues to the state budget (Zakon, 2011). The programme envisaged a series of measures for industrial exploration of titanium-zirconium ores in the Central and North-Western regions of Ukraine, some of which were taken over by Group DF (Kabash, 2014).

The situation dramatically changed with the rise of President Zelenskiy, who led the effort to intensify the industrial development of Ukraine. His government removed several non-transparent intermediaries and UMCC profits have increased. It also registered higher stocks of ilmenite. In October 2021, President Zelenskiy adopted an extensive list of changes and additional measures aiming at extensive and thorough mapping of the deposits of raw materials and ground waters and ensured sustainable financing of the exploration through a newly established Fund for the Development of Mineral and Raw Material Base of Ukraine. The programme differentiates between placer deposits of ilmenite ores (Irshansk deposit as well as other deposits in Central Ukraine - Cherkassy and Kirovograd regions) and primary deposits of titanium and zirconium ores in all mineral regions across Ukraine from Volyn (North-West), Stremygorod (Central) and the East of the country. To this end, a Ministry for Strategic Industries was created with the mandate to promote critical raw material production in Ukraine.

4.4 Russia's war of aggression against Ukraine and its effects

4.4.1 Introduction

Russia's unprovoked full-scale invasion of Ukraine created a series of shockwaves across the Eurasian landscape and raised the stakes for the EU. The European Union mobilised politically and put forward resources to provide support to Ukraine. At the moment of writing, 15 rounds of sanctions against Russia have seriously undermined the Kremlin's economic capacity; the Russian energy industry plumetted, production chains have been disrupted and the payments system largely blocked. The Russian titanium industry has also been seriously affected by some western sanctions. Ukraine has also stopped any export of titanium to Russia. It has also had to seriously reduce its other exports of titanium.

Ukraine has also banned export of ilmenite concentrate to Russia. Even though Moscow has sought to create some reserves of ilmenite concentrate and prepare backdoor channels for supply, these efforts have been only marginally successful. The Ukrainian government has introduced a system of strict export control on titanium and blocked numerous suspicious requests for ilmenite supply coming through third parties Mozambique, Vietnam, Mongolia and Brazil with the ultimate beneficiary unidentified. Ukraine is also working to purge Russian ownership from the titanium industry. For example, the Russian company 'Tsvetnye Metally' (*Colour Metals*) JSC – member of the Russian military industrial complex – had owned Demurinsky MPP (DMPP) since the early 2000s. Several days before Russia invaded Ukraine, DMPP was transferred into the ownership of a Cyprus-based offshore company. However, Ukraine blocked the export of ilmenite and eventually nationalised the assets of the DMPP (Nadra.info, 2023).

In addition to offshore companies, Russia also expected to use the Eurasian Economic Union as a substitute for critical efforts (EDB 2019, 66) and/or as a grand offshore territory to bypass western sanctions, which did not work out. Even though Kazakhstan supported Russia's request to swiftly abolish external trade tariffs on titanium scrap, in reality it was for its own benefit. While initially this measure boosted intra-regional trade, later Kazakhstan refused to continue exports of strategic metals to Russia and trade in titanium materials dropped to zero.

Furthermore, Kazakhstan joined the international effort to stop the war. President Tokayev explicitly declined to recognise Russia's annexation of Ukrainian territories (Tokayev, 2022); furthermore, he ordered the government to create favourable conditions for the industries that had to leave Russia to encourage their relocation to Kazakhstan (Bondal, 2022). In the titanium domain Astana swiftly redirected its titanium exports to France (increased 7.4 times), Belgium (2.6), and China (1.3), the Netherlands (1.2), as well as for the first time to new European destinations such as Romania (87.5 tonnes) and Estonia (17.5 tonnes). Kazakhstan had expressed its intention to step up its cooperation in trade of energy and strategic materials with Europe (Gotev, 2022). The Memorandum of Understanding signed by the President of the European Commission and Kazakh Foreign Minister on 8 November 2022 will be followed by a specialised action plan.

In the upstream segment of the value chain, the Russian titanium industry faces serious challenges. Several international companies, such as ATI and Boeing, have exited from their relationship with VSMPO-AVISMA. Severe sanctions were imposed by the US, while from the EU standpoint VSMPO-AVISMA remained one of the areas where sanctions could not be properly enforced: the company was officially pulled from the sanctions list (Norman and Katz, 2022).

Although Russia has titanium ore deposits (Belousova, 2018), most of those studied so far contain a high share of associated contents of non-standard composition, which requires significant time and investment, and production costs are likely to remain excessively high. Because of the lack of mining and processing enterprises and their high cost to build, it still has to use ilmenite as its main raw material. However, ilmenite deposits in Russia (e.g., in the Tomsk region) have currently not reached or shown the expected yield. According to the most optimistic estimates, Russia would require 3-5 years to develop relevant capacities to extract sufficient volumes of ilmenite or other raw materials to produce sufficient supply for VSMPO-AVISMA.

4.4.2 Setting the scene

Russia is a significant source country of titanium metal. Although it ranks third in overall titanium sponge production, significantly trailing China and Japan, it was the leading supplier of aerospace-grade titanium before 2022. Russia is one of the few countries with a complete supply chain for titanium metal, from titanium sponge to finished parts. The Russian company VSMPO-AVISMA

Corporation is the world's largest vertically integrated producer of titanium and titanium alloy products. The unjustified full-scale invasion of Ukraine in February 2022 triggered concerns about potential supply chain vulnerabilities, particularly for the aerospace industry, which relies heavily on a single supplier from Russia (**Box 5**), and it is hard to drastically lower its dependence. Russia's role in supplying titanium to the US and European aerospace industries has been assessed as crucial (Safirova et al., 2017).

Box 5. Aerospace industry's reliance on Russia

The Russian company VSMPO-AVISMA Corp. is certified to produce a great variety of titanium-based aerospace products. Through longstanding partnerships, the Russian company became a crucial player in the global aerospace market. Exact figures about the dependency on Russian titanium at company level are not publicly available. According to reports by news outlets, it used to supply nearly a quarter of global titanium, about one third of the titanium used by the aviation sector globally and more than 45% of the world's aerospace titanium parts. The aerospace sector accounted for around three quarters of its sales. It is reported that Airbus procured from 50% to 65% of its titanium from the Russian company before the pandemic, directly or indirectly through key suppliers. VSMPO-AVISMA Corp. was also the largest titanium supplier for Boeing's commercial production; a third of Boeing's titanium needs were met by Russia.

The Russian producer has also been a significant titanium provider for jet-engine makers, which are critical suppliers to commercial aviation manufacturers. According to media reports, the French Safran SA is estimated to source 20% to 50% of its titanium needs from VSMPO-AVISMA, and the British Rolls-Royce Holdings Plc used to source 20% of its titanium from Russia. On the other hand, the US General Electric Co. and Pratt & Whitney had avoided sourcing from Russia and have minimal reliance on Russia.

Western aerospace companies had been creating stocks or looking to diversify their supply base to get ahead of any supply disruption before the Russian invasion of Ukraine. According to media sources, Airbus stated that it was protected from shortfalls at the onset of Russia's illegal full-scale invasion of Ukraine, as it had been stockpiling titanium and was looking for alternative sources of titanium to safeguard its production plans. However, in July 2023, Airbus still listed VSMPO-AVISMA as a supplier. Safran announced on 24 February 2022 that it had built up titanium stocks for a few months ahead.

Boeing established a Russia-based joint venture with VSMPO-AVISMA (Ural Boeing Manufacturing (UBM)) in 2009 and expanded their production facilities in March 2013, to produce parts and forgings of advanced titanium alloys for the aerospace industry. The two companies agreed in November 2021 to expand their collaboration on technology and supply of new titanium alloys. Almost immediately after the illegal full-scale invasion of Ukraine in early March 2022 and despite their long-term partnership, Boeing suspended its titanium joint venture in Russia and halted purchases from Russia, stating it had created a sufficient titanium inventory in recent years and was able to procure enough of the metal elsewhere. Similarly, the US-based Allegheny Technologies Inc. (ATI) announced on March 2022 the termination of its joint venture with VSMPO-AVISMA to market and sell a range of titanium products for the industrial market.

Stocks accumulated by aircraft manufacturers before the invasion of Ukraine were reported to have 6 to 12 months of titanium supply on hand, whereas the inventory in the aero-engine supply chain was estimated to be tighter. Part of the challenge in supply diversification for the aerospace industry is the lengthy certification process to stringent aerospace standards for onboarding new suppliers and components, which can take between 18 and 24 months. Another critical issue reported for replacing VSMPO's capacity is the shortage of specialised labour.

Russia accounted for 14% and 20% of global output of titanium sponge and ingots in 2020, respectively (**Figure 4** and **Figure 8**), and had a 10% export share by value globally for unwrought titanium and powders (UN Comtrade, 2024). It is also among the world's leading manufacturers and exporters of titanium mill products, accounting for 14% of global production in 2020 (**Figure 12**). The exports of wrought titanium products from Russia, which made up 13% of the global export value

in 2020 (UN Comtrade, 2024), further underline its prominence. Before the Russo-Ukrainian war, Russian total exports of sponge, ingots and mill products amounted to 19 kt and 22 kt in 2020 and 2021, representing 14% and 18% of global exports, respectively; a great proportion of these volumes was destined for aerospace applications.

In Ukraine, the state-controlled Zaporizhzhia Titanium & Magnesium Combine Ltd (ZTMC Ltd.) produced titanium sponge and ingots of titanium and titanium alloys before the Russo-Ukrainian war. Ukraine accounted for 2% of the world's titanium sponge supply in 2020 and less than 1% of titanium ingots (**Figure 4** and **Figure 8**). Its share in global exports of unwrought titanium and powders equalled 5% by value in 2020 (UN Comtrade, 2024). Ukraine's sponge plant is situated in Zaporizhzhia, close to the front line, and has been inactive since Russia's invasion with no clear signs of reopening (Forrest, 2022). Ukraine's share in global exports of wrought titanium is minimal.

At present (July 2024), titanium remains exempt from restrictions on trade with Russia. Contrarily to other countries ([28]), the EU has so far not imposed sanctions on imports of Russian titanium and against VSMPO-AVISMA following Russia's full-scale unprovoked invasion of Ukraine ([29]), nor has an export embargo been imposed by Russia (Barnier, 2022).

4.4.3 EU import dependency and trade flows from Russia and Ukraine

The EU does not produce titanium sponge and depends fully on imports. Reliance on imports ([30]) of wrought titanium products is also significant, estimated to be no less than 60% before the Russo-Ukrainian war (Georgitzikis et al., 2022). Imports of titanium metal in the EU are mostly in the form of wrought products (85% by value in 2020). The EU is the top importer globally by value of wrought titanium (mill products and articles).

The US was the principal source for EU imports of titanium metal in 2020 (37% by value), as well as for each product group individually (unwrought, wrought, and scrap) (**Figure 42**), with Russia, the UK, Japan and China completing the list. Regarding unwrought titanium and powders, the EU imported from both Russia (9% of import value) and Ukraine (8% of import value) in 2020. The EU's exposure to Russian supply was higher for wrought titanium (16% of import value in 2020). Overall, the EU import flows from Russia and Ukraine corresponded to EUR 290 million in 2019 and EUR 195 million in 2020, of which more than 90% originated from Russia. As an overall share, imports from Russia and Ukraine equalled 16% of the EU import value in 2020. Finally, about 45% of the Russian export value of titanium products was destined for the EU prior to Russia's unprovoked invasion of Ukraine (Georgitzikis et al., 2022).

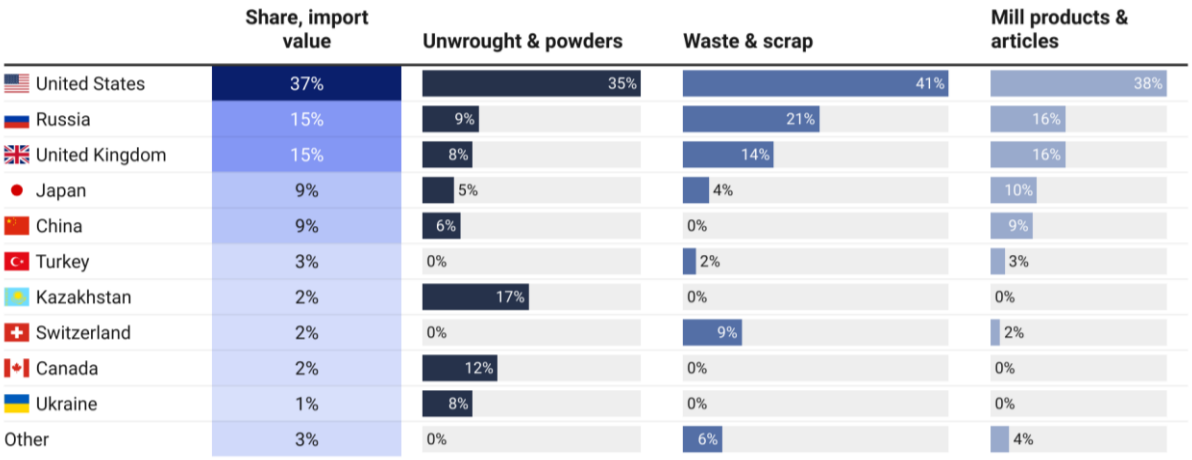
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[28] Canada imposed sanctions on VSMPO-AVISMA in 2024 (Airbus wins reprieve from Canadian sanctions on Russian titanium), and the US banned exports to the firm in September 2023 (Addition of Entities and Revision to Existing Entities on the Entity List; Removal of Existing Entity From the Military End User List)

[29] Council Regulation (EU) 2022/576 banned Russian trucks and ships in European ports. By way of derogation, the competent authorities of a Member State may authorise the transport after having determined that it is necessary for the purchase, import or transport of titanium (among other specific raw materials) into the EU.

[30] 'Import Reliance' = (Imports – Exports) / Apparent consumption; Apparent consumption = Domestic production + Imports – Exports.

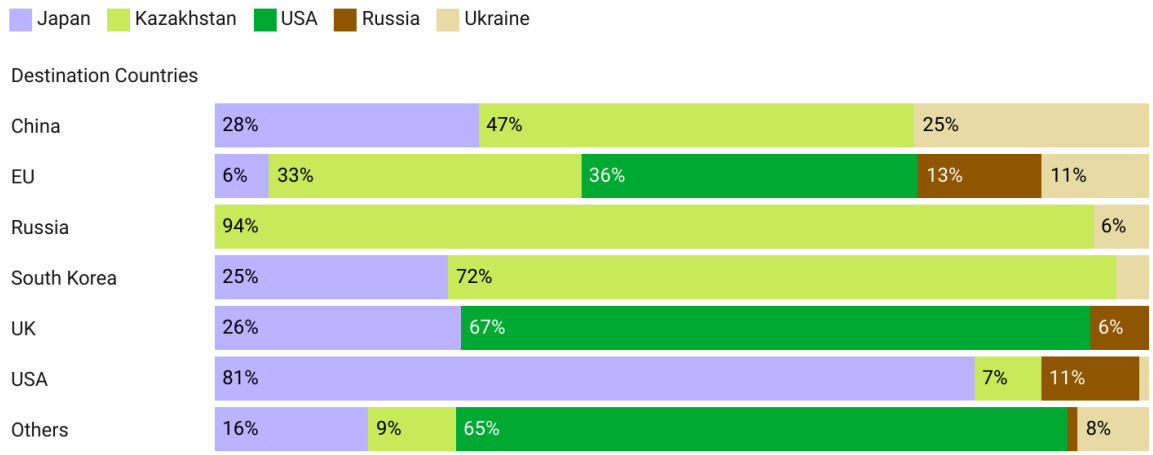
Figure 42. EU import value of titanium product groups by trade partner, in 2020



Source: Eurostat data in Georgitzikis et al. (2022). Graph created with Datawrapper.

European manufacturers sourced most of their unwrought titanium and powder inputs from Kazakhstan and the US in 2020. However, the EU's external supply has a relatively higher exposure to imports from Russia and Ukraine compared to other countries (**Figure 43**). EU imports of unwrought titanium (sponge and ingots), including powders, from Russia and Ukraine totalled 3.5 kt in 2020. In 2019, a year of record demand for titanium globally and in Europe, the EU imported 4.5 kt of unwrought titanium and powders from Russia and Ukraine. Among the top EU importers, Germany, the Netherlands and Spain relied significantly on imports of unwrought titanium and powders from Russia and Ukraine (**Figure 44**).

Figure 43. Exporters' share in value of unwrought titanium and powders, by destination (2020)



Source: WITS (2022) in Georgitzikis et al. (2022). Graph created with Datawrapper

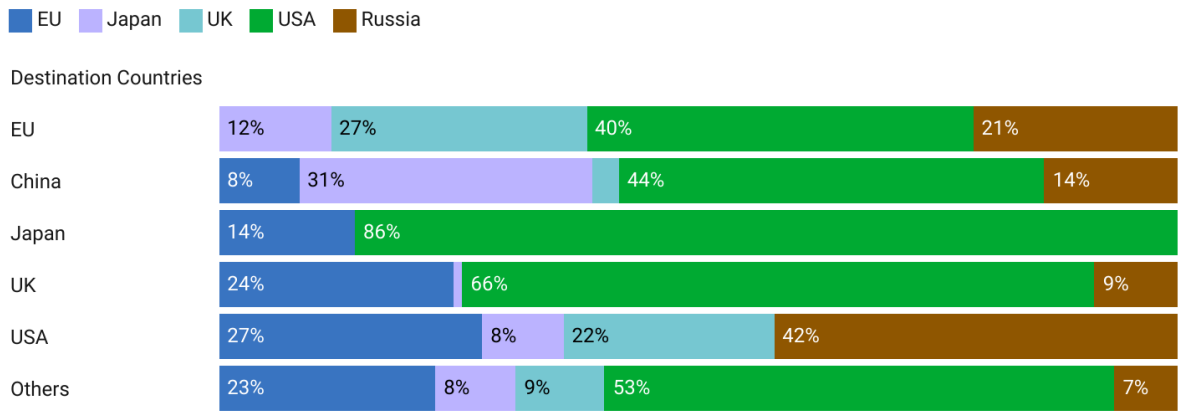
Figure 44. Unwrought titanium imports from Russia and Ukraine, by EU Member State

Country	Import Value (€ mn)	Russia (%)	Ukraine (%)	RoW (%)
France	60.9	0	0	100
Italy	36.5	2	13	85
Germany	28.1	26	18	56
Ireland	13.5	0	0	100
Netherlands	10.0	30	22	48
Spain	6.3	64	6	31
Sweden	4.1	0	5	95
Belgium	3.3	15	0	85
Estonia	1.5	74	2	24
Romania	1.4	0	14	86
Austria	1.1	0	12	88
Denmark	0.9	0	0	100
Czechia	0.6	0	50	50
Poland	0.4	0	18	82
Other EU	0.4	6	0	94

Source: Eurostat data in Georgitzikis et al. (2022). See Annex for details. Graph created with Datawrapper.

Regarding wrought products, the EU imported 4.5 kt from Russia and Ukraine in 2020, down from 7 kt in 2019. The EU's foreign supply of wrought titanium was less diversified from Russia compared with most other destination countries (**Figure 45**). The highest dependence on Russian imports of wrought titanium in the EU was identified for France, Germany, Austria, Belgium and Romania (**Figure 46**).

Figure 45. Exporters' share in export value of wrought titanium by destination country, in 2020



Source: WITS (2022) in Georgitzikis et al. (2022). Graph created with Datawrapper.

Figure 46. EU imports of wrought titanium from Russia and Ukraine by Member State

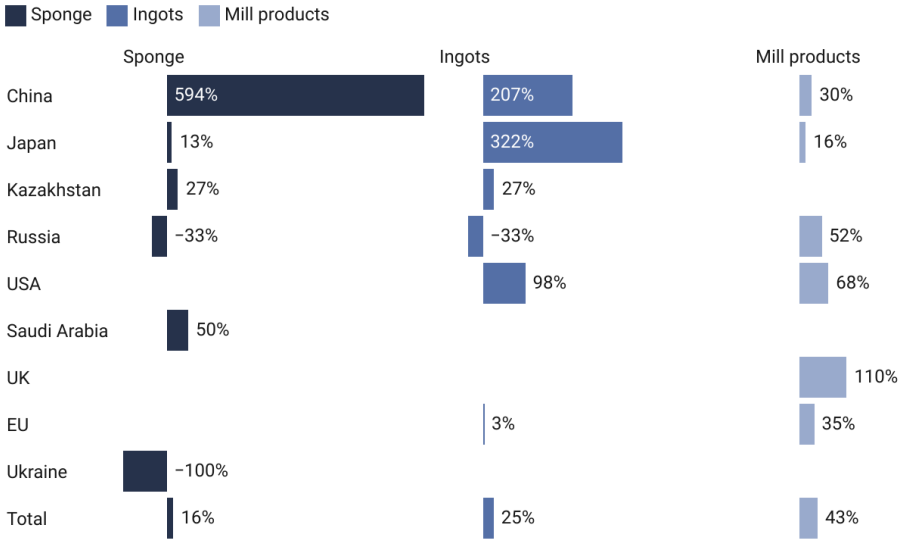
Country	Import Value (€ mn)	Russia (%)	Ukraine (%)	RoW (%)
France	341.8	19	0	81
Germany	339	26	0	74
Italy	89	3	1	97
Sweden	78.9	0	0	100
Belgium	51.3	14	4	82
Spain	34.8	4	1	96
Austria	32.1	51	2	47
Poland	27.6	1	0	99
Netherlands	23.3	0	1	99
Czechia	22.7	0	0	100
Slovenia	12.1	0	0	100
Portugal	8.2	6	0	94
Ireland	8.1	0	0	100
Denmark	7.8	0	0	100
Romania	4.2	24	0	76
Estonia	3.4	0	0	100
Hungary	2.8	1	2	97
Finland	2.5	2	1	98
Luxembourg	1.7	0	23	77
Other EU	2.1	3	0	97

Source: Eurostat data in Georgitzikis et al. (2022). See Annex for details. Graph created with Datawrapper.

4.4.4 Global and EU-wide impact

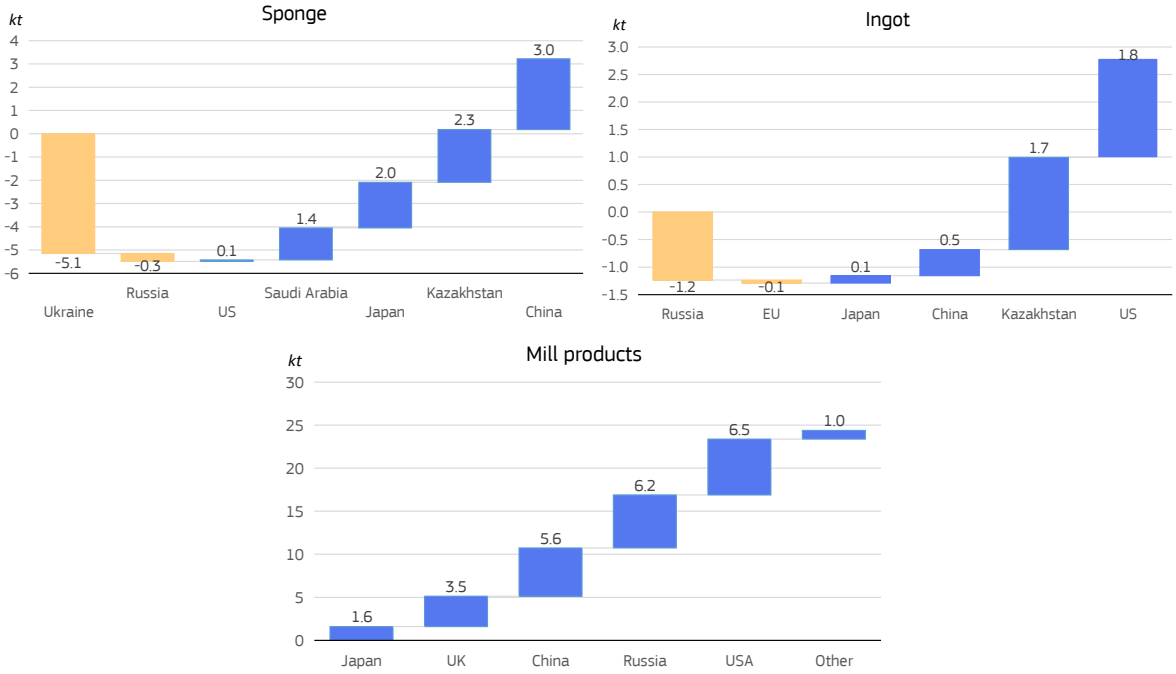
Since Russia illegally invaded Ukraine in February 2022, trade data demonstrate that Ukraine's exports of sponge dropped to zero and Russia's exports of sponge and ingots decreased by about one third in 2022-2023 (annual average) compared to 2021. Meanwhile, global exports rose by an overall rate of 16% for sponge and 25% for ingots (**Figure 47**). The Ukrainian sponge supply, and the Russian one to a lesser extent, in international markets has been replaced primarily by exports from China, Kazakhstan, Japan and Saudi Arabia, in decreasing order of magnitude. Concerning titanium ingots, the decrease of Russian exports was principally covered by the US and Kazakhstan (**Figure 48**). In contrast, Russian exports of mill products continued unabated after the 2022 invasion of Ukraine, which illustrates the West's dependency on Russia for titanium mill products.

Figure 47. Variation (%) in global exports of titanium after the Russian invasion of Ukraine



Source: UN Comtrade (2024). See Figure 24 and Figure 27. Graph created with Datawrapper.

Figure 48. Variation (kt) in global exports of titanium after the Russian invasion of Ukraine



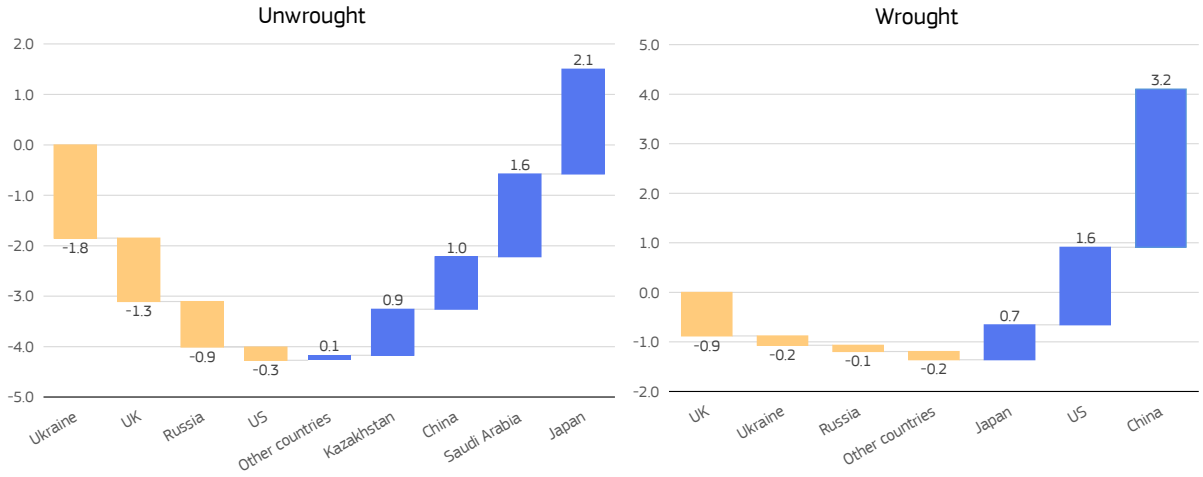
Source: UN Comtrade (2024). See Figure 24, Figure 27, and Annex for details.

Impacts on the EU

Since Russia's full-scale unprovoked invasion of Ukraine in February 2022, the EU has completely made up for the losses of Russian and Ukrainian supply of unwrought titanium products (sponge, ingots and powders), as well as managed the additional demand for imports. This has been achieved by increasing imports from a diversified base of suppliers, i.e. Japan, Saudi Arabia, China and Kazakhstan by order of import quantity increase (**Figure 49**). Regarding wrought products, increased imports from China in particular, but also from the United States and Japan, have met the higher

domestic import needs in the EU in the period after Russia invaded Ukraine. Yet, the EU's purchases from Russia have not essentially been impacted as imports have remained almost stable.

Figure 49. Variation (kt) in annualised EU imports of titanium metal after Russia's invasion of Ukraine



Source: Eurostat Comext (2024). See Annex for details.

4.4.5 Assessment

High inventory levels and lower titanium demand in the post-pandemic period have mitigated impacts on supply chains for over 2 years since the start of the unprovoked war of aggression against Ukraine. In addition, spare capacity in Japan, Kazakhstan and the US, as well as the expanding capacity in China and Saudi Arabia, has filled supply gaps for unwrought titanium (sponge and ingots).

However, Russia's influence in the global aerospace industry is substantial, given the scale of its market share and the spectrum of products that it manufactures. Western aerospace companies still buying titanium from Russia demonstrate the challenges in quickly replacing Russian supply chains and expose the risk of Russia imposing export restrictions in response to sanctions. The risk of a global titanium supply chain crisis is further aggravated by the expected rise in demand from the aerospace and defence industry in the coming years (see Section **3.2**), the few producers worldwide, and the complexity of supply diversification as titanium metal is challenging to produce from titanium minerals. Cumulatively, these factors have made supply chains vulnerable to disruption, and supply shortfalls affect manufacturers worldwide.

5 Titanium metal and the circular economy

The intersection of circularity and the use of critical raw materials (CRMs) is crucial for the green and digital transitions, as many of the technologies involved are heavily dependent on these materials. Consequently, the demand for CRMs is expected to grow rapidly alongside the expansion of these technologies, potentially outpacing the capacity of global supply chains (Sprecher and Kleijn, 2021).

While circularity can help meet this rising demand or, alternatively, reduce it by increasing reparability and through higher material efficiency, it often proves costly in the early stages if the necessary infrastructure is lacking. Similarly, substitution with alternative technologies that require fewer CRMs could also lead to higher expenses (Pommeret et al., 2022). Moreover, applying the entire spectrum of circularity strategies (i.e. reducing, reusing, recycling) to strategic value chains is important yet complex, since each product or material faces distinct drivers and barriers to increased circularity; as a result, effective policy recommendations demand a high level of specificity.

This chapter explores how circular economy strategies have permeated the titanium metal value chain, with special attention paid to the EU. The first part is based on stakeholder consultations intended to develop an in-depth map of the supply chain and identify circularity drivers and barriers, ultimately informing a PEST (*Political, Economic, Social and Technological*) analysis and follow-up quantitative modelling (Baldassarre, 2024). The second section shows the evolution of R&I in titanium circularity in terms of academic papers and patents. Finally, Section 5.3 introduces a novel methodology to extract circularity insights from granular data, then uses it to conceive circularity scenarios which can be fed into an economic and environmental model to quantify their impact in the EU.

5.1 PEST analysis: Circularity drivers and barriers

A PEST analysis is a strategic tool used to assess the external factors that may impact businesses and their operations in a supply chain. Political factors include global development across countries, as well as government policies and sectoral regulations. Economic factors involve international trade and market dynamics, and financial, cost and revenue issues. Social factors encompass cultural trends and management attitudes influencing business in the supply chain. Lastly, technological factors focus on innovations, technological advancements, and their impact on the industry. Conducting a PEST analysis helps businesses understand the broader environment in which they operate, aiding in strategic decision-making and risk management.

This PEST analysis is based on inputs from a set of interviews with stakeholders in the titanium metal supply chain based in the EU, the US, the United Kingdom, Ukraine, Russia and Kazakhstan. The aim is to provide insight into the circularity *status quo* and future potential from a European Union (EU) perspective, identifying drivers and barriers, and offering valuable information regarding the external factors shaping this industry's landscape. The entire value chain was covered, including research institutes, industry experts, public servants, Tier-3 (ore extraction and raw materials trading) companies, Tier-2 (sponge-to-metal manufacturing) actors, Tier-1 (product fabrication) firms and end-of-life and recycling companies. The following paragraphs discuss the political, economic, social and technological factors related to circularity (i.e. PEST analysis) further.

Political and regulatory factors

The geopolitical landscape presents significant challenges for the titanium metal supply chain and circular economy efforts, as some companies in different countries have been stockpiling titanium metal products, limiting collaboration. Disruptions caused by Covid-19 and Russia's unprovoked full-

scale invasion of Ukraine have exacerbated supply issues, while demand for new aircraft and defence assets continues to rise.

Shortages and price volatility are expected to impact the industry, particularly affecting the EU due to its reliance on imports and lack of unwrought and wrought (present but limited) manufacturing capabilities. Additionally, geopolitical tensions and corporate confidentiality issues alike hinder knowledge transfer and collaboration on circular innovation, limiting communication between EU firms and other businesses in foreign countries. Addressing confidentiality issues is crucial for safeguarding knowledge on advanced recycling technologies.

On the regulatory front, recertification requirements pose significant challenges for recycling and reuse within the aviation sector. Most titanium parts embedded in engine and landing gear assemblies are life-limited, meaning they cannot be used after a predefined number of flights or service-hours.

Stringent safety regulations, particularly those set by the European Union Aviation Safety Agency (EASA), further restrict the reuse of parts for certain applications. While titanium metal recycling is indeed economically sensible, safety regulations often prevent its implementation, such as restrictions on using (% above a certain share of) secondary material in turbine production.

Furthermore, EU directives classify materials from end-of-life aircraft as waste, hindering recovery and recycling efforts and incentivising dismantling in countries with less stringent regulations like China. Efforts to revise standards and directives within the EU, such as softening requirements and applying end-of-waste criteria to titanium alloys, could encourage the development of a robust EU recycling market.

Despite these challenges, there are regulatory enablers that could catalyse circularity, such as the classification of titanium metal as a critical raw and strategic material by the EU. Recent initiatives, including the Critical Raw Materials Act proposed by the European Commission, aim to increase recycling rates for materials on the CRM list[31], including titanium metal. Leveraging these developments to apply end-of-waste criteria and prevent EU exports of titanium metal scrap could, as mentioned, incentivise the development of an EU recycling market and boost the recovery of titanium parts during aircraft dismantling processes.

Economic factors

Buyback schemes for "production scrap" from manufacturing are put in place by suppliers of wrought titanium metal. Since the 1980s, the USA has assumed a leadership position in the manufacturing of wrought titanium products to ensure supply security. The private sector invested in recycling technologies, achieving over 90% closed-loop functional recycling efficiency and reducing production costs drastically. An expansion to Europe followed, where half of the global aircraft manufacturing industry is located. Competitors in the UK and France were acquired, and buyback schemes embedded in multiannual contracts were created to ensure a constant supply of production scrap to the USA from clients in the EU downstream in the supply chain. For this reason, sourcing scrap for recycling in the EU is challenging.

Processing wrought titanium metal and scrap recycling entail high capital investments and operating costs, posing additional economic challenges. Since capital and operational expenditures for wrought titanium manufacturing and recycling are high, large economies of scale are required to break even.

[31] The CRM Act establishes a target of at least 25% of the EU's annual consumption for recycling.

Although wrought titanium manufacturing requires less energy than extracting sponge from minerals, production costs remain high, especially in the EU where there is limited access to scrap and expensive electricity sources. Industrial policy and funding injections may be necessary to support competitive partnerships, with notable EU initiatives attempting to cover a significant portion of aerospace- and defence-grade material demand.

On the other hand, repair and remanufacturing of titanium aviation components present economic opportunities. Repair and remanufacturing practices are well established in the aviation industry due to the high value of materials and parts. When aircraft reach the end-of-life, a significant portion of their mass, particularly in engine and landing gear components containing titanium metal alloys, can be disassembled and sold with a profitable business case. Leasing models are also present, and they further extend the life of engines through repair and remanufacturing, with virtually all material remaining in a closed loop.

Additionally, the increasing use of titanium metal in new aircraft and defence assets creates a market opportunity and new business case for end-of-life scrap recycling. As aircraft become waste according to EU directives, a significant portion of titanium is removed during dismantling, but an important share also remains in the airframe. Regulatory changes are necessary to unlock this end-of-life opportunity and achieve economies of scale in recycling, potentially reducing EU resource dependence.

Social factors

Intellectual property concerns represent a soft yet major challenge to knowledge transfer necessary for recycling titanium metal from aircraft components. While aircraft components containing titanium metal can be segregated for recycling, this process requires detailed knowledge of aircraft design specifications and the exact chemical composition of all parts. However, manufacturers' concerns about preserving intellectual property prevent them from sharing this information with dismantlers.

As a result, end-of-life actors must adopt a trial-and-error approach to build knowledge over time, which involves time-consuming and expensive composition analysis (sometimes at the atomic level) to determine the suitability of parts for recycling into aerospace applications. While innovative solutions like product passports and virtual repositories could address this bottleneck, they are not yet supported by manufacturers' top management.

Environmental awareness serves as a cultural enabler, creating incentives for companies to exploit end-of-life opportunities in the titanium metal supply chain. Public environmental awareness in the EU, alongside regulations, pressures businesses operating in carbon-intensive metal processing to transition toward less impactful circular solutions.

The significant carbon footprint difference between the production of virgin and recycled titanium metal is influencing procurement strategies, with buyers increasingly demanding more recycled options and detailed information for inclusion in Corporate Social Responsibility (CSR) reports. Environmental awareness also incentivises repair and the transition to service-based solutions, an area where the EU leads compared to Asian countries (stakeholder interview inputs). This trend is expected to accelerate in the future.

Technological factors

Titanium metal recycling technologies encounter technical challenges to widespread adoption. While capital and operational expenditure (CAPEX and OPEX) limit the adoption of recycling technologies, creating a vicious circle on the economic side, on the technical side the issue is exacerbated by scrap contamination: contaminated scrap might be more accessible than clean scrap (subject to buyback

agreements) but requires pre-processing with technologies like Plasma Arc Melting (PAM) or Electron Beam Melting (EBM) before entering the Vacuum Arc Remelting (VAR) furnace.

Proper treatment is essential for end-of-life scrap, but large aircraft components, though cost-effective to recover and recycle, are challenging to transport and should not be cut into smaller pieces to prevent further contamination. Without PAM or EBM, contaminated scrap cannot be recycled into aerospace-grade material, diminishing its value as an additive for ferrotitanium (FeTi), which is barely profitable to sell. Although wider deployment of PAM and EBM in the EU could reduce sponge imports, challenges persist in scrap segregation and treatment.

Moreover, there are technical hurdles to implementing eco-design for disassembly strategies in relation to titanium parts for aviation applications. While aviation components have traditionally been modular to facilitate repair and remanufacturing, the trend is shifting towards integrated designs like joint-pieces (e.g. "blisks," replacing separate fan blades and disks in engines to enhance fuel efficiency and reduce noise). Such designs may complicate repairs, potentially increasing profits for manufacturers, who are also inclined to prioritise compliance with climate targets over eco-design and material efficiency.

On the other hand, businesses are exploring new technologies to significantly reduce titanium metal demand, serving as technical enablers for circularity. Start-ups are collaborating with aerospace and defence incumbents to scale up additive manufacturing technologies, aiming to reduce the buy-to-fly ratio to 3:1. While virgin powder is predominantly used, experiments with scrap as an input are under way. Challenges such as investment costs, process instability, inferior mechanical properties, and the lack of certification schemes hinder widespread implementation. Additionally, the market for powder remains small compared to sponge demand.

Advanced forging facilities also offer potential to reduce reliance on raw titanium, with new programmes anticipated to decrease the need for titanium parts in civil aircraft (by lowering the buy-to-fly ratio) by 30% by 2024. These circular technologies hold promise for contributing to strategic autonomy in the EU.

Box 6. Titanium material efficiency and circularity in Additive Manufacturing applications

Material efficiency and circularity may offer Europe the potential to secure the resources it needs. Specific sectors such as aerospace have been working on recycling of titanium and other critical raw materials (EC - EISMEA, 2021). There is currently a high interest in reusing titanium powders, driven by cost especially in high-performance applications (Moghimian et al., 2021).

Additive manufacturing minimises material waste compared to subtractive manufacturing techniques, making it more sustainable and cost-effective in the long run. The potential availability of recycled materials may also reduce the consumption of imported first-use materials and the associated costs (EDA, 2024). More than 90% savings in processed titanium could be achieved through AM technologies by avoiding the production of scrap (Carrara et al., 2023).

Many additive manufacturing systems are designed with closed-loop powder handling systems to minimise contamination and facilitate recycling/recirculation of powder. It is also possible to blend recycled powder with virgin powder to dilute any potential contamination and restore desired properties. For example, in the production of Ti-6Al-4V alloy with the main process in AM technology, Laser Powder Bed Fusion (LPBF), the remaining powder that is not consumed in the production of components is usually retrieved for the next production cycle. This recycling practice is one of the most important measures to reduce the total cost of LPBF (Koushik et al., 2023).

However, several challenges arise in achieving circularity of titanium powder in AM technology. The reusability of titanium powder is hindered by limitations that significantly influence the quality of the final products.

These limitations are related to the changes in the powder chemistry, morphology and size distribution. Powder degradation occurs in powder recycling through powder bed AM production cycles, causing changes in particle sizes, particle morphologies, powder rheology, and chemical composition, leading to uncertainties in feedstock quality and part integrity (Koushik et al., 2023). Additionally, contamination with oxygen during the thermal cycle limits the powder reusability even further (Alamos et al., 2020).

The procedure for powder recycling is dependent on the material and hardware and is not regulated by any standards. Moreover, there is a lack of standardisation and regulation of conformity specifications for used powder in highly regulated industries such as aerospace and biomedical (Moghimian et al., 2021). The variation in powder characteristics across powder suppliers, AM machines/parameters, duration of exposure of powders to the energy source in an AM machine, sieving machines and processes, are among the main challenges in developing standards for powder feedstock characteristics that can ensure consistent mechanical and physical properties of the printed parts. To date, the powder recycling process is based on the "best user experience" (Leicht, 2018). Therefore, little information is available on how the recycling should be performed. This, in turn, may have an impact on the total production costs of Ti powders due to the lack of standard powder recycling procedures (Koushik et al., 2023).

Finally, some studies found that titanium powder can only be reused up to eight times without any noticeable loss in strength or ductility (Alamos et al., 2020). The more demanding the final application, the lower the number of reuses permitted.

For the most stringent applications, the qualification process and quality standards might prohibit the use of recycled powder. In such cases, secondary powder can be redirected to other industries with less stringent requirements. This approach helps reduce the demand for lower-grade powder by utilising recycled materials in sectors where the quality standards are less rigorous, thereby creating a cascading effect that optimises overall material use.

5.2 R&I in titanium metal circularity[32]

Research and innovation (R&I) in titanium metal circularity have gained significant traction over the last decade, as indicated by the increasing number of academic publications on this topic. Since 2014, there has been a noticeable upward trend in research output, reflecting growing global interest in sustainable practices involving titanium. The number of publications has steadily increased, particularly after 2018, which likely correlates with heightened environmental awareness and policy shifts toward circular economies. This trend underscores the expanding academic focus on developing strategies to reduce, reuse and recycle titanium, crucial for both economic and environmental sustainability (**Figure 50**).

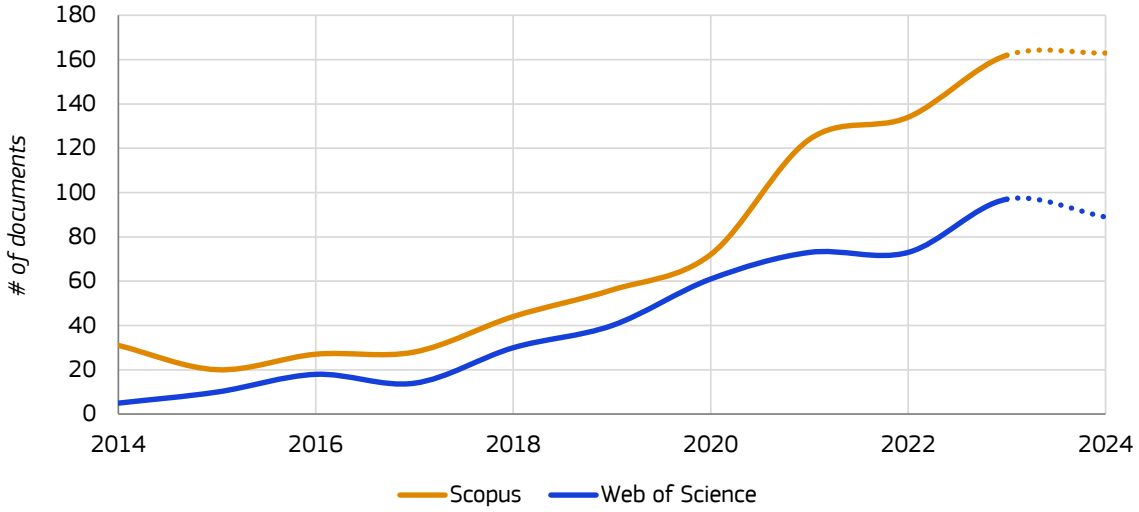
The geographical distribution of academic publications on titanium metal circularity from 2014 to 2024 reveals that Europe and China are leading regions in this research domain, each accounting for 20% of total publications. Other significant contributors include the United States, the UK, India and Japan, highlighting a diverse global interest in advancing circular economy principles within the titanium sector, especially in those countries with melting or production capacity (**Figure 51**). It is also worth noting that the EU and China are special players on the circularity scene for this material: the EU lacks unwrought titanium production capacity and needs to come up with viable alternatives to reduce its dependency, while China is the largest producer of unwrought titanium worldwide yet requires imported titanium for advanced applications such as aerospace.

[32] This subsection draws upon (and expands) the approach followed in Baldassarre et al. (2023) for other strategic components and technologies.

International collaboration in academic research on titanium circularity is possible, but not the general norm: two thirds of the articles are written by researchers from institutions based in the same country (**Figure 52**). For this subset, the EU and China once again appear as the most prominent players.

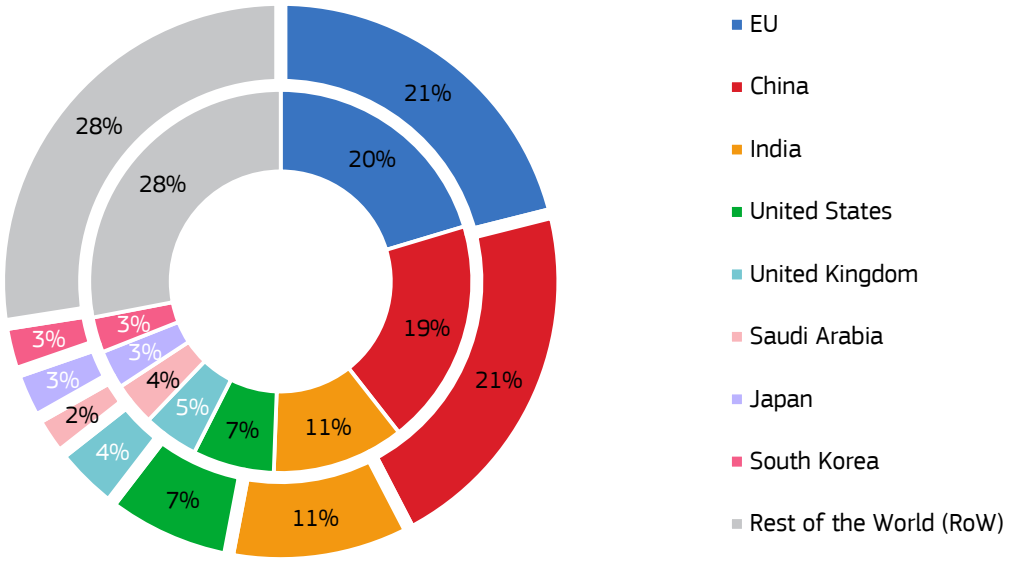
Region-wide, collaborative efforts display different patterns. Research on titanium circularity produced outside the EU, China and the US exhibits a modest degree of intra-region collaboration with authors from other countries (e.g. a scholar affiliated in South Korea co-authoring with a researcher from Vietnam) (**Figure 53**), yet interregional partnerships are much more frequent. International collaboration is strongest in South Asia, the Middle East and the aggregate of other developed economies.

Figure 50. Number of academic publications related to titanium metal circularity since 2014



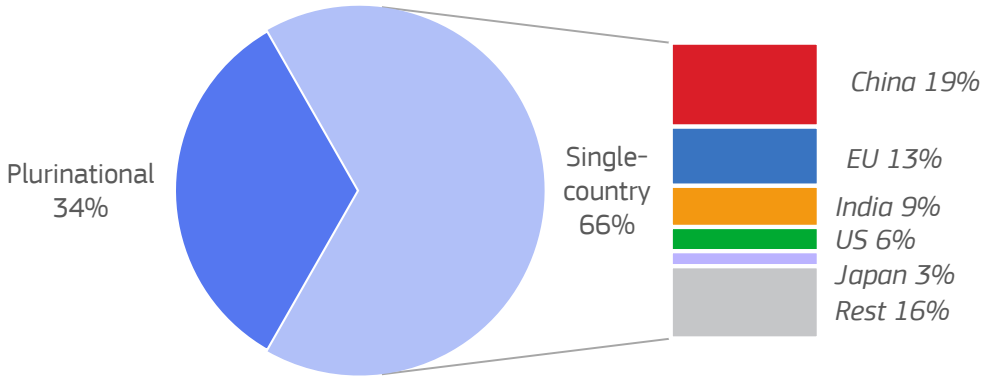
Source: Own elaboration from Scopus and Web of Science.

Figure 51. Geographical distribution of academic publications on titanium circularity, 2014-24



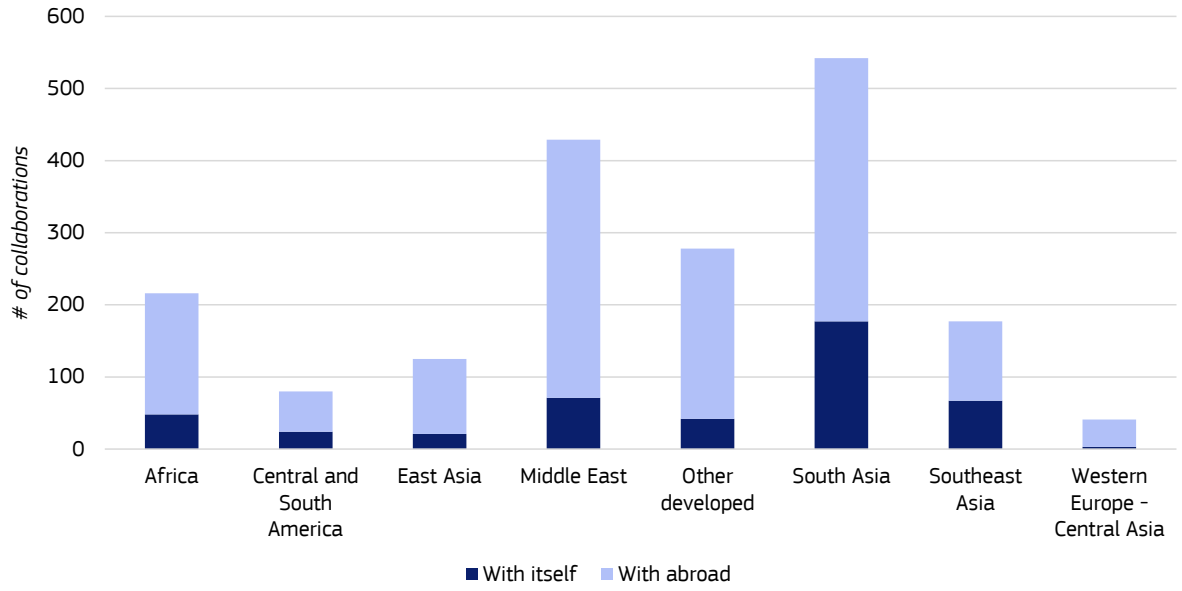
Source: Own elaboration from Scopus (inner circle) and Web of Science (outer circle). Measured by the geographical affiliation of the corresponding author.

Figure 52. Geographical collaboration in titanium metal academic publications



Source: Web of Science.

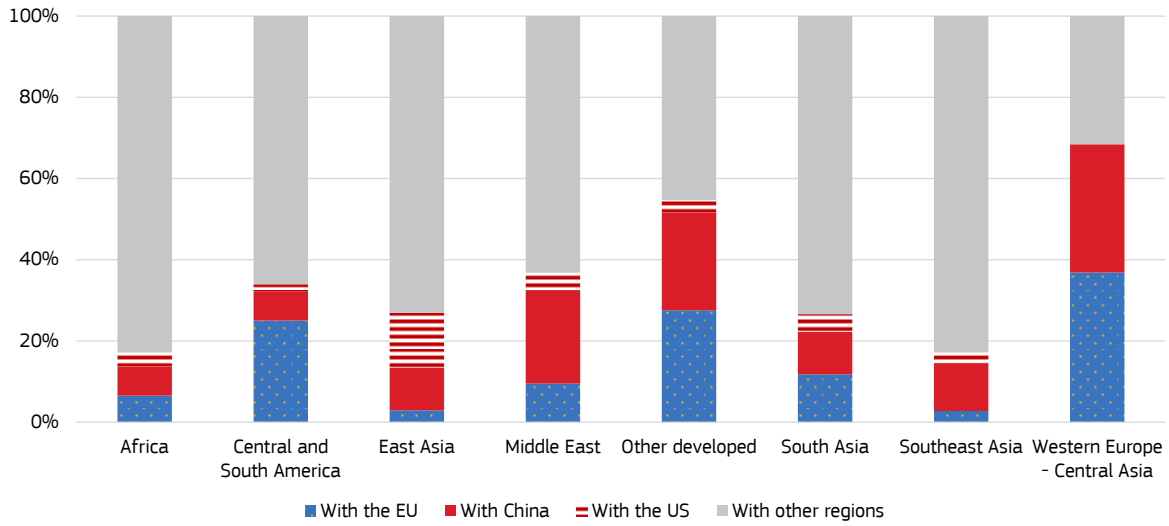
Figure 53. Collaboration intensity in selected world regions: Intra-region and interregional



Source: Own elaboration from Web of Science. See Annex for details on regional aggregates.

Figure 54 highlights co-authorship patterns between scholars from various world regions and those based in the EU, China and the US. Western Europe and Central Asia exhibit the strongest collaboration with the EU, likely due to geographic proximity and institutional ties. The EU also maintains a notable presence in Central and South America, possibly due to historical factors limiting preference for the US and to China's distance. The "Other developed economies" group, which includes the UK, Norway and Switzerland, shows strong EU collaboration as well. In contrast, East and Southeast Asia demonstrate significant ties with China, reflecting China's growing influence, investment, and "gravity effect" in research and education. The US stands out as a key collaborator in regions like the Middle East and South Asia. African researchers engage equally with both the EU and China, influenced by historical connections with the EU and China's expanding influence through the Belt and Road Initiative. Finally, substantial collaboration with regions outside these three major hubs also takes place, as illustrated above.

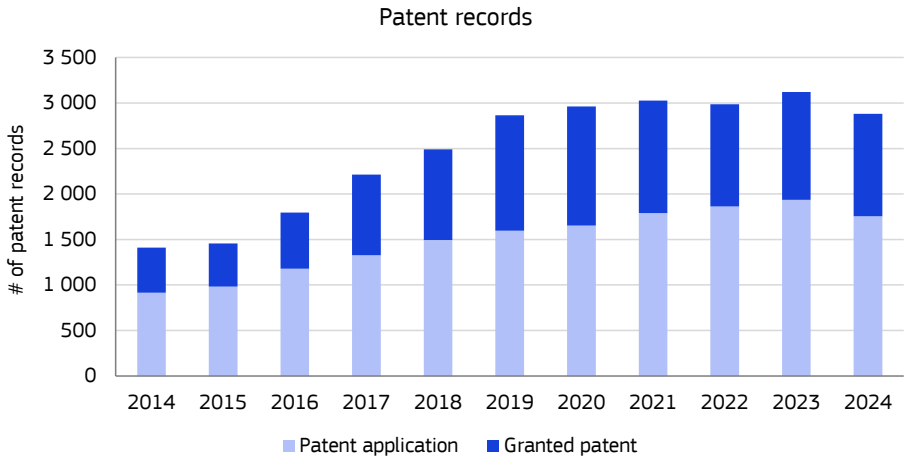
Figure 54. Foreign collaboration intensity (as a % of total foreign collaboration) in selected world regions with the EU, the US and China



Source: Own elaboration from Web of Science. See Annex for details on regional aggregates.

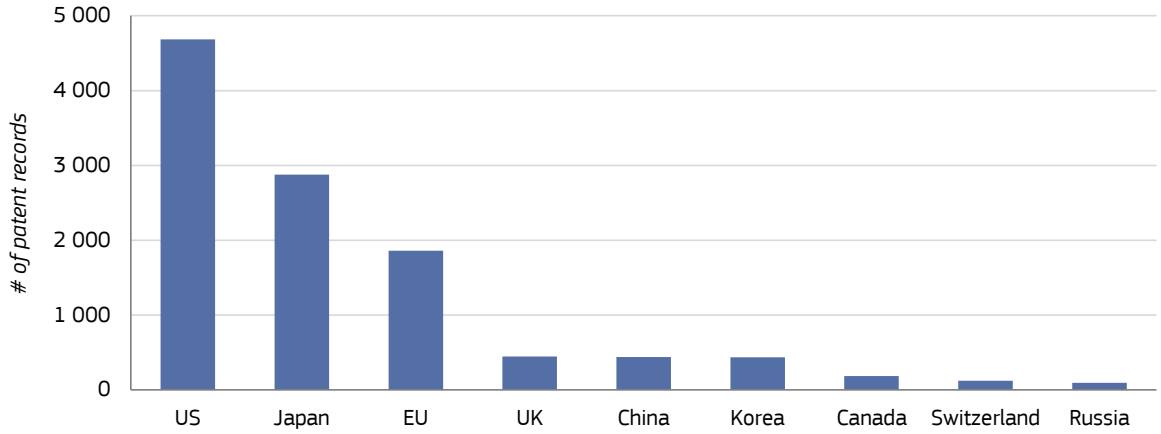
In addition to academic research, the patent landscape provides insight into the R&I intensity within the domain of titanium circularity. The number of patent applications and patents granted on this topic has shown a consistent increase since 2014 (**Figure 55**). The geographical distribution of patents presents a different structure compared to academic publications. The US leads by a significant margin, followed by Japan and the EU (**Figure 56**). Interestingly, although China and the EU are frontrunners in academic publications, China's patent activity is comparatively lower, suggesting that while China is heavily involved in research, it may be prioritising internal use and development; another explanation is that research in these areas is at a less advanced stage and hence has not yet reached the patenting stage. The EU, despite its lack of titanium production capacity, shows substantial patenting activity, reflecting efforts to establish circularity solutions and reduce dependence on imports. Japan's patent presence aligns with its consolidated industrial base, with large conglomerates involved in titanium metallurgy.

Figure 55. Patent records related to titanium metal circularity since 2014



Source: The Lens. Numbers refer to single patent families, i.e. patents filed in several countries are counted only once. Cut-off date for 2024 data: 26 November.

Figure 56. Geographical distribution of patents on titanium metal circularity, 2014-2024



Source: The Lens. The country refers to the nationality of the patent's applicant.

The top patenting firms reflect a diverse array of sectors, each leveraging titanium's unique properties for their specific needs (**Table 10**). Nippon Steel and Sumitomo are key players in the steel industry, where titanium is used to enhance the durability and performance of steel products. Other significant firms in the metallurgical sector are Posco (a Korean titanium melter), Arconic, RTX, ArcelorMittal. General Electric (GE) and Rolls Royce, which, as well as being among the top patent holders, are leaders in the aerospace and defence sectors. The presence of aviation and military technologies is also visible with Safran, Boeing and Baker Hughes in the Top 20. Additionally, large industrial conglomerates such as Mitsubishi and Toshiba operate in the electronics and energy sectors, where titanium is used for its excellent thermal and electrical conductivity, but also in industrial equipment such as robots (see Section **3.3.3**). Finally, the presence of firms such as Mitsubishi and Siemens, which span industries from infrastructure to energy, further highlights the broad applicability of titanium metal in various sectors focused on sustainability and innovation.

Table 10. Largest companies in the world by patent ownership in titanium circularity

RANKING	COMPANY	# PATENTS OWNED	RANKING	COMPANY	# PATENTS OWNED
1	Nippon Steel	695	11	Seiko Epson	169
2	General Electric	663	12	Rolls Royce	167
3	Sumitomo	387	13	Kyocera	160
4	Mitsubishi	278	14	ArcelorMittal	153
5	Posco	239	**15**	Element Six	147
6	Rtx	215	16	Hewlett Packard	146
7	Toshiba	208	17-18	Arconic	140
8	Siemens	181	17-18	Safran	140
9	Jfe Steel	177	19	Boeing	126
10	Baker Hughes	170	**20**	Samsung	120

Source: The Lens. Data as of August 2024.

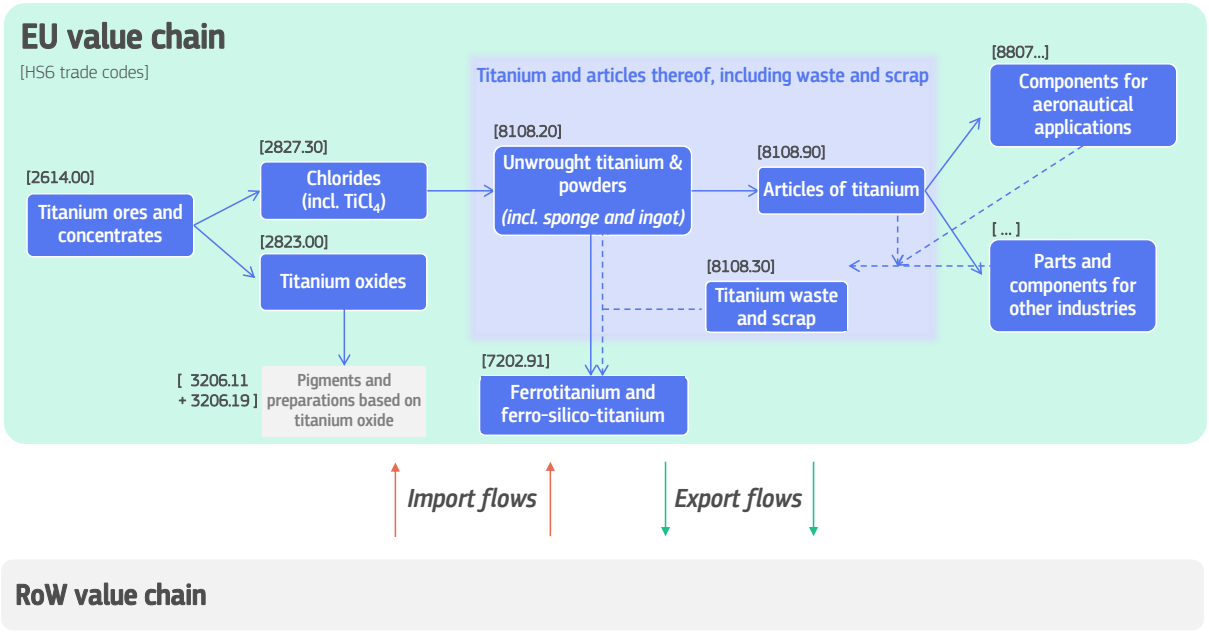
5.3 Circularity scenario modelling[33]

Two scenarios for increased circularity of titanium in the EU were evaluated: i) fewer buyback agreements with the US leading to greater retention of high-quality scrap within the EU, and ii) enhanced collection of old aeronautical scrap for remelting into primary material.

5.3.1 Identifying circular flows: beyond macro level

International trade and production statistics serve as a fundamental basis for examining material dependencies between countries. However, there are several limitations to relying solely on aggregate statistics. Firstly, they often overlook re-exports—goods in transit to their final destination—leading to potential misrepresentation of the true origin and destination of goods. Secondly, these statistics do not reflect the complex production networks, or the value added at various stages of the value chain, instead offering a static view where trade codes for different goods appear disconnected. **Figure 57** illustrates the titanium value chain in the EU from a macro-level perspective. Notably, unwrought products are not broken down into ingots and sponge. More critically, there is no information on the flows concerning scrap quality, the sectors from which it originates, or the stage of the value chain where it is produced. As a result, macroeconomic data must be supplemented with alternative sources for a more comprehensive analysis.

Figure 57. Titanium value chain as viewed from international trade data



Arrows represent theoretical primary (continuous line) and secondary (dashed line) product flows.

Source: Adapted from Buesa et al. (2024).

[33] The content of this Section is adapted from Buesa et al. (2024).

The most valuable complement to aggregate trade statistics is micro-level data obtained from customs agencies. National trade figures are typically derived from customs data, which is often difficult to access due to data protection regulations or restrictive dissemination policies. In some cases, private third-party providers purchase the rights to include these statistics in their databases. The key advantage of customs data lies in the detailed information it offers on each individual shipment. This granularity enables a more in-depth analysis of trade flows between sectors. For the purpose of circularity analysis, several features of customs data are particularly useful:

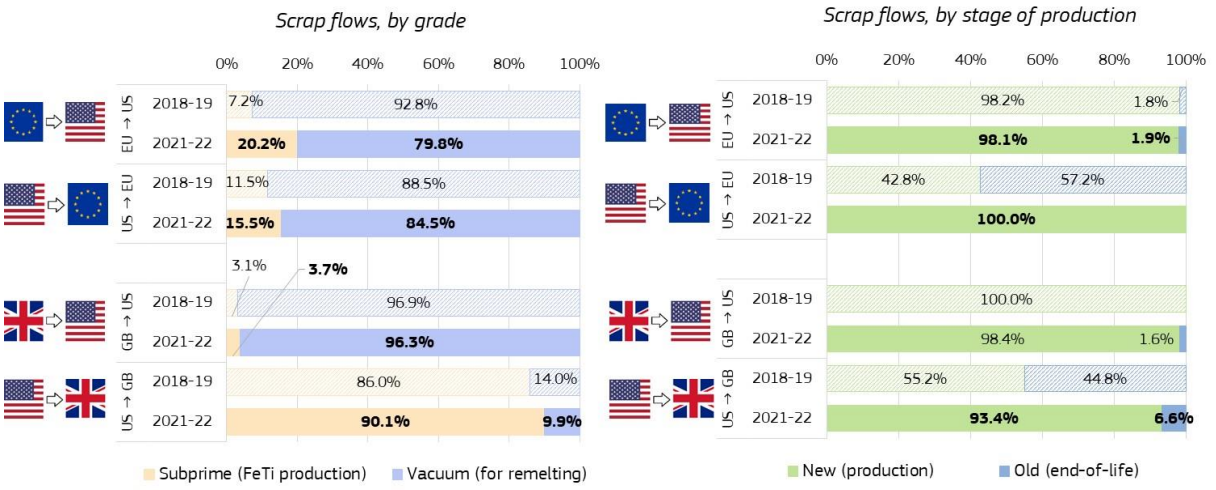
— Descriptions of shipment contents, which help identify different types of scrap.

— Shipper and consignee firm names, enabling the mapping of scrap flows between sectors (e.g. the aeronautical industry).

— Shipments that include multiple goods (e.g. titanium scrap alongside other metals), which provide insights into scrap quality.

Buesa et al. (2024) analysed a sample of approximately 100 000 shipments of titanium products from the period 2018-2022, sourced from the S&P Panjiva database. Panjiva aggregates customs datasets from 17 countries in the world accounting for 40% of global merchandise trade. US trade flows are available through Bill of Lading records. A thorough data cleaning and imputation process was carried out to retrieve information from shipments with missing fields. From this dataset, the authors extracted the shares of the most significant scrap flows, categorised by sector of origin, scrap quality, and type. The results of this analysis are presented in **Figure 58**.

Figure 58. Disaggregation of titanium scrap trade flows using shipment-level information.



Source: Buesa et al. (2024).

From a scrap quality perspective, the EU and the UK primarily export vacuum-grade scrap to the US, while the US sends a larger proportion of ferrotitanium-grade scrap to Europe. Over time, however, the EU appears to have reduced its exports of vacuum scrap to the US, possibly due to the growth of domestic recycling programmes. In terms of scrap type, Europe predominantly exports new (production) scrap to the US, probably because it is not sufficiently valued domestically. Notably, the US previously returned a higher proportion of old (end-of-life) scrap to Europe but has recently been retaining a larger share of it, possibly indicating an increasing domestic capacity for processing end-of-life scrap.

5.3.2 EU circularity scenarios

Retaining more titanium scrap within the EU would reduce reliance on imports and strengthen the EU's strategic autonomy, potentially allowing for the reversal or elimination of buyback agreements in future trade deals. However, the EU must develop a viable strategy for utilising this scrap. The two most logical approaches are expanding domestic production capacity for titanium products and advancing circularity initiatives. While some circularity is already present in the titanium value chain, much of it occurs outside the EU, and existing projects in Europe remain limited and relatively new.

The aeronautical sector, however, is more developed in this regard. Looking ahead, two key areas for circularity are emerging. First, the high buy-to-fly ratio in aerospace production results in significant volumes of new scrap, which will only increase as titanium usage in modern aircraft grows. Second, when these aircraft reach the end of their life cycle, larger quantities of old scrap will become available. Considering that approximately 40% of the cost of an aerospace titanium part comes from the sponge used in ingot fabrication (U.S. Department of Commerce, 2019), component manufacturers will have a growing incentive to recycle and exploit scrap.

Building upon these insights and the data disaggregation described in the previous section, Buesa et al. (2024) define two circularity scenarios, which are constructed and displayed below.

Scenario 1: Fewer buyback agreements for titanium scrap with the US

The focus is on scrap trade between the EU and the United States, which represents the majority of extra-EU scrap trade. Following this is trade with the UK, where many US subsidiaries are located. However, accounting for indirect flows through the UK would unnecessarily increase uncertainty due to a lack of detailed UK trade data.

In the first step, the EU retains vacuum-grade aeronautical titanium scrap that is currently returned under buyback agreements, leading to reduced exports to the US. Currently, approximately 83% of scrap flows to the US, nearly 5.8 kt, are vacuum-grade and likely subject to buyback agreements. In addition, if the EU retains scrap domestically, it is likely that scrap imports would also decrease. Vacuum-grade aeronautical scrap accounts for about 79% of all US imports of scrap in value.

The second step accounts for the impact of using the retained scrap to produce new aeronautical ingots in the EU. With a 60% scrap ratio for remelting, the estimated maximum volume of ingots that could be produced is 9.7 kt. This would necessitate importing the remaining 40% in sponge, approximately 3.9 kt, mainly from Japan and Kazakhstan. Assuming that the EU's ingot production capacity is approximately one third less than its melting capacity ([34]), this would result in approximately 6.4 kt of ingots being produced from melting 9.7 kt. The additional ingots produced would lead to a decrease in import flows, which is assessed in Step 3.

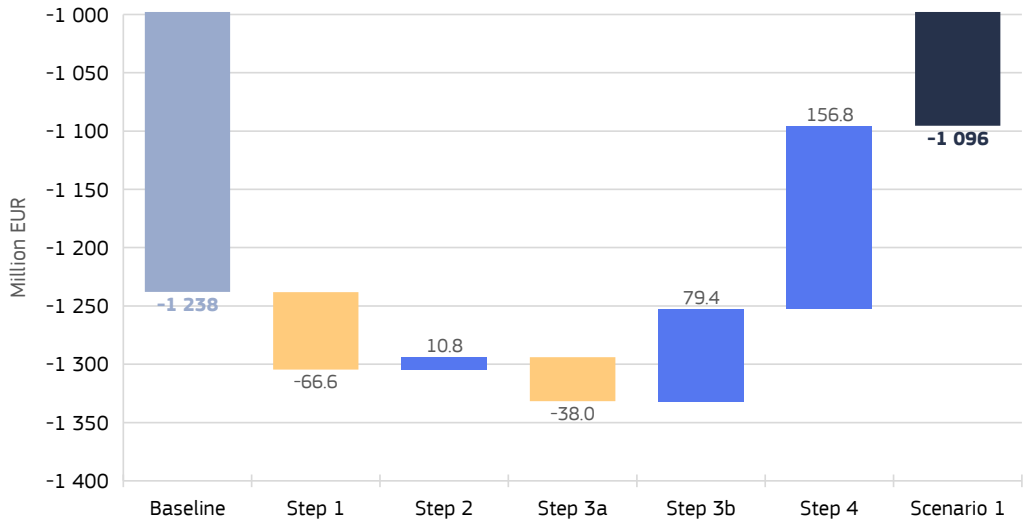
The extra 6.4 kt of ingots produced would result in an increase of 2.2 kt of finished titanium products. This could lead to a 26% reduction in import flows from the US, which is taken into account in Step 4, along with all the effects from the previous steps. Lastly, Step 5 factors in the positive impact on

[34] This ratio depends on how many melting cycles are needed for the final product: the higher the quality, the higher the number of cycles. Besides, more advanced melting technologies and furnaces allow for a smaller ratio. Our own estimates for the global ratio are around 1:2, so taking 1:3 for the EU has the implicit (perhaps strong) assumption that the EU's melting capacity is state-of-the-art and/or that it is aiming for products of higher purity/quality.

the titanium production activities required to produce 2.2 kt of finished titanium products in the main EU producers.

Figure 59 summarises the direct effects of Steps 1 to 4 on the EU trade balance for titanium (wrought, unwrought, and scrap). In value terms, the EU is a net importer. The aforementioned steps can have a beneficial effect on the trade balance (reduction of imports) or a detrimental one (reduction of exports). Overall, the net effect of Scenario 1 is positive as it reduces the trade deficit of the EU by 11.5%.

Figure 59. Construction of EU circularity scenario 1: Effects on the EU trade balance (m EUR)



Source: Own elaboration from Buesa et al. (2024).

Scenario 2: Increased collection of aero end-of-life scrap suitable for remelting

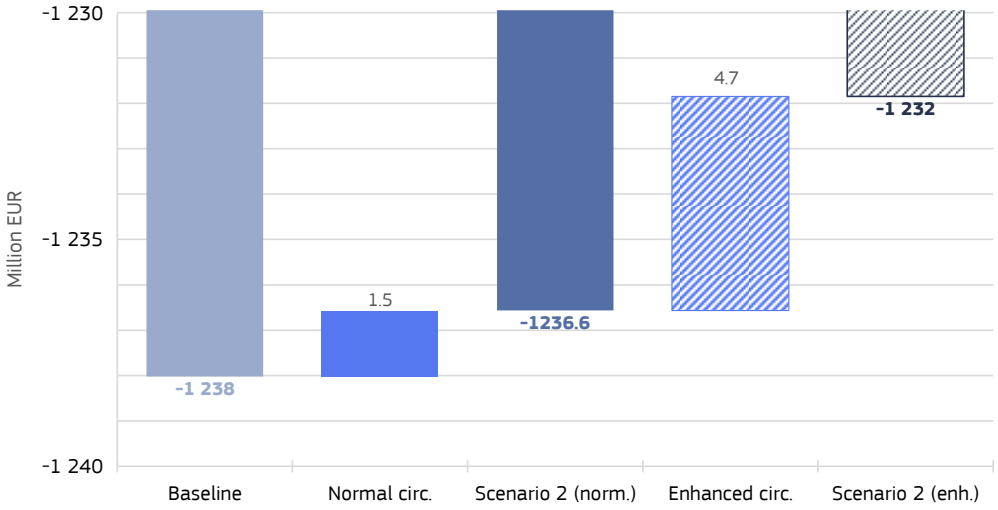
The second scenario quantifies the amount of post-consumer scrap that could be recovered from decommissioned commercial aircraft and remelted into ingots (Uhlmann et al., 2015; Al-Shamma and Ali, 2013). The first step is to model the current situation, including the amount of scrap available from retired aircraft and collection rates.

The starting point is data collection on retired aircraft, such as the number of planes retired per year, their geographical distribution, and the weight and titanium content of each model. Assumptions are also necessary about the fate of titanium in the airframe and engine components. The authors' estimate is that only 40% of the available titanium in the airframe at the end-of-life can be remelted. This results in a total of 0.24 kt of aircraft post-consumer scrap available for remelting in the EU, a small amount that will not significantly impact the titanium recycling industry and will lead to only a minor reduction in scrap imports (10.7%).

Alternatively, the authors consider a scenario with a greater number of decommissioned aircraft, a larger share of titanium in their airframe, and a higher old scrap recovery rate. In this case, 1.31 kt of scrap will be available for ingot manufacturing, leading to a 45.3% reduction in scrap imports from the US. This also increases the relevance of titanium recycling activities in the EU by 15.2%.

Figure 60 depicts the direct effect of the second scenario. The *status quo* alternative (vs. enhanced) would entail a 0.11% (0.50%) reduction in the trade deficit, considerably smaller in magnitude than Scenario 1.

Figure 60. Construction of EU circularity scenario 2: Effects on the EU trade balance (m EUR)



Source: Own elaboration from Buesa et al. (2024).

5.3.3 Input-output modelling of titanium flows

The potential effects of the two circularity scenarios are assessed using the EU Inter-Country Supply, Use and Input-Output Tables (IC-SUIOTs) (EC Eurostat, 2019), also known as the FIGARO database, which have been published as official statistics by Eurostat since 2022. However, the resolution of the FIGARO tables is not detailed enough to evaluate the impacts of these circularity scenarios; therefore, a more detailed input-output system had to be developed using the FIGARO-E3 experimental dataset (Usubiaga et al., 2023), which expands the coverage of FIGARO to 213 products and 176 industries for 2015 and includes employment and climate change emissions data. This dataset serves as the basis for a specific model for tracking the flow of titanium and aeronautical products along global value chains.

5.3.4 Model results and implications

The results of the input-output exercise for enhanced circularity are presented in **Table 11**. Starting with Scenario 1, the most significant impact from the EU perspective on international trade comes from Step 1. The reduction in scrap exports to the US results in a decrease in value added of around EUR 7 million and the loss of approximately 120 jobs. This also leads to a natural deterioration in the trade balance, decreasing total output. The reduction in scrap imports yields a negative economic impact, though of a much smaller magnitude (a mere EUR 100 000). The smaller impact compared to the first step is to be expected, as imports of scrap are notably smaller than exports in volume and value, and because the focus is on the impact in the EU economy and not in the US.

Steps 3a and 3b cover the rise in sponge imports and the reduction in ingots imported from outside the EU. Importing more (3a) has a marginally positive net effect (almost EUR 1 million and 13 full-time equivalents) due to compensation effects related to upstream interlinkages. The reduction in imports of wrought titanium in Step 4 also has a negligible impact. The final step of the scenario depicts how the larger domestic supply of scrap affects the metal manufacturing industry, increasing its production capacity and spreading to the rest of the economy through sectorial linkages. This latter effect is positive, at around EUR 20 million and nearly 380 jobs along the whole supply chain with respect to the baseline, accounting for approximately EUR 54 000 worth of value added per worker/year.

From an environmental standpoint, a decrease in trade is likely to have a positive effect by reducing greenhouse gas (GHG) emissions, while an increase in trade flows or domestic production is expected to result in higher emissions. **Table 11** shows that Step 1 reduces GHG emissions by 6.5 kt CO_2-eq, whereas Step 3(a) (vs. b) increase (decrease) emissions by 0.4 kt. Finally, Step 5 implies more industrial production in the metallurgical sector, leading to an increase in GHG emissions larger in magnitude than any preceding step: 16.4 kt CO_2-eq more than the baseline.

On the other hand, Scenario 2 is centred on collecting more aeronautical end-of-life scrap suitable for remelting, emphasising the economic potential of recycling activities within the EU. The current situation, where existing flows of decommissioned aircraft are used to recover scrap at a modest collection rate, does not show any noticeable impact. Improved scrap collection rates and the introduction of aircraft with higher titanium content, as in the enhanced case, could potentially increase this figure by a factor of 4, but the economic and environmental effect would still be minimal; the potential boost in titanium recycling activities (Step 2) results in a rise in value added of approximately EUR 100 000, and an increase in emissions of about 0.1 kt CO_2-eq. Employment levels would remain virtually unchanged.

Table 11. Economic and environmental effects of circularity scenarios on the EU

Scenario 1: Downsizing of EU buyback agreements for titanium scrap with the US							
		Value added (m EUR)	*(marg.)*	Employment (# workers)	*(marg.)*	GHG emissions (kt CO_2-eq)	*(marg.)*
Step 1	(↓ exports to US)	-7.3		-119.8		-6.5	
Step 1 to 2	(↓ imports from US)	-7.4	*-0.1*	-120.9	*-1.1*	-6.5	*0.0*
Step 1 to 3a	(↑ sponge imports from KZ and JP)	-6.5	*+0.9*	-107.5	*+13.4*	-6.1	*+0.4*
Step 1 to 3b	(↓ ingot imports from US, CN, KZ, RU)	-7.6	*-1.1*	-124.8	*-17.4*	-6.5	*-0.4*
Step 1 to 4	(↓ imports from US)	-7.7	*-0.1*	-126.4	*-1.6*	-6.5	*0.0*
Step 1 to 5	(↑ production in FR, IT and DE)	20.4	*+28.1*	377.1	*+496.9*	16.4	*+22.9*

Scenario 2: Increased collection of aeronautical end-of-life scrap suitable for remelting				
		Value added (m EUR)	Employment (# workers)	GHG emissions (kt CO_2-eq)
Status quo				
Step 1	(↓ imports from the US)	-0.0012	0.0	-0.0004
Enhanced circularity				
Step 1	(↓ imports from the US)	-0.0052	-0.1	-0.0019
Step 1 to 2	(↑ recycling activities in the EU)	0.1015	0.2	0.113

(marg.) is the difference between one step and its preceding one. kt CO_2-eq: kilotonnes CO_2 equivalent.

Source: Buesa et al. (2024).

To assess the plausibility of the proposed scenarios, a backward analysis was conducted, benchmarking the aforementioned economic impacts against actual data for the EU titanium industry. Should the final step of Scenario 1 occur, the EU economy would gain 377 jobs within the titanium supply chain, accounting for both direct and indirect contributions from suppliers, and an increase of EUR 20 million in total output. This suggests that downsizing buyback agreements could potentially double employment within the EU's titanium sector, with the positive impact on value added being

approximately equivalent to the total assets of an existing medium-sized titanium factory. In contrast, Scenario 2 indicates only a marginal sectoral gain from the recycling of additional scrap; however, the current infrastructure is sufficient to manage the increased flow without the need for additional labour or capital expenditure.

Regarding environmental impacts, Steps 1 to 4 of Scenario 1 would yield a reduction in greenhouse gas (GHG) emissions comparable to a 45% cut, while the final step would lead to a doubling of emissions (+114%). Additionally, it is important to consider that over 90% of global titanium trade occurs via maritime transportation. Hence, any reduction in imports or exports would result in decreased CO_2 emissions due to reduced cargo transport by shipping companies. For Scenario 2, no data is currently available at the necessary level of disaggregation to provide a benchmark for emission figures.

6 Conclusions and potential policy interventions[35]

The current geopolitical challenges, coupled with the EU's dependence on imports of titanium metal products, create a potential risk to security of supply and a possibility of disruption in several critical industries in Europe. Thus it warrants policy intervention, which has already been initiated in recent years with several key policy documents (as discussed in Section 4.2). However, more specific policy considerations concerning the particular value chain of titanium metal could be considered. This report suggests several policy options proposed below, which are listed in order of urgency, as based on the current priorities of the European Union in the context of decarbonisation, derisking, reshoring and critical raw materials scarcity, as they are laid down in recent and upcoming policies, such as the CRM Act, the Net Zero Industrial Act, the Green Deal Industrial Plan, the envisaged Clean Industrial Deal and the Draghi Report. All these documents prioritise European economic security and resilience of the value chains on the one hand, and decarbonisation and sustainability on the other.

Reshoring midstream industry with advanced recycling capacities in the EU

From the strategic autonomy point of view, prioritising the establishment of a titanium recycling industry within the EU is essential in light of the EU's near-complete dependence on the import of midstream and upstream segments of the titanium value chain from abroad. However, since recycling would require the same facilities as are currently used for converting sponge into ingots, this would necessitate the relocation of the midstream supply chain and the introduction of advanced titanium remelting capabilities.

While this approach is feasible, it is slow-moving, expensive and presents uncertainties in an already highly competitive market. Previous and ongoing attempts to establish such facilities in Europe underscore the need for coordinated policy action and public funding support from the EU. For instance, a scrap recycling plant that opened in Germany in 2009 had to shut down due to financial inviability. Currently, EcoTitanium in central France is the only industrial facility in Europe recycling high-grade titanium scrap at 80-20 scrap-to-sponge ratios. In addition, there are also VAR facilities in Italy and Romania, but these only allow for 30% scrap input material. However, these and other EU companies operating in the midstream segment suffer from lack of economies of scale, lack of access to scrap (which is exported to the US), and high energy costs, especially compared to overseas (mainly US) competitors. European companies also cannot match the vertically integrated Russian and Chinese companies, which similarly benefit from lower energy costs and economies of scale.

Since the previous private investment attempts at sustained reshoring of the midstream industry failed, a coordinated public-private response, which would rely on an array of policies aimed at decreasing energy costs and galvanising public funds, could help the process. These developments have already been initiated with the 2020 European Green Deal Industrial Plan allowing the repurposing of existing funds to support domestic industries transitioning to greener technologies and facilitating permitting for 'cleantech' firms to establish production in the EU. This policy direction is further expanded in Draghi (2024), which posits the creation of a joint decarbonisation and competitiveness plan financed from new public sources. Circular titanium metal facilities would fit the current policy directions by being both geared towards achieving decarbonisation and functional to meet the raw material demands for strategic industries in the EU.

[35] This section expands on the policy recommendation section of the Jakimów et al. (2024) article.

The extent to which the process of reshoring would impact decarbonisation objectives also needs to be considered. While, the economic activities resulting from processing of titanium scrap domestically produced in the EU would increase GHG emissions (p. 87), it is important to bear in mind that this scenario was calculated on the basis of the existing EU energy mix. As the current projections indicate (IEA, 2023), by 2030 the energy mix is poised to change significantly, reaching 50% generation from renewable sources (IRENA, 2018) from a share of 22% in 2023, which will significantly lower energy prices (Draghi, 2024), possibly further accelerating the ramp-up of the industry. Since, as discussed earlier, the establishment of a titanium remelting facility in the EU requires a timescale of 5-10 years to become operational, it is likely that at that point in time the industry could benefit from access to a cheaper and cleaner energy mix.

In this vein, recent advancements in titanium production technologies also offer significant opportunities for reducing energy consumption and greenhouse gas (GHG) emissions. For instance, in the HAMR process, sponge production yields 15% lower energy consumption than the long-established Kroll process, with processing energy reduced by 27% (Xia et al., 2020). Similarly, the FFC process could reduce energy intensity by 10-15%, with further reductions of up to 30-35% possible if lower-purity TiO_2 feedstock is used (Norgate et al, 2007). On a wider scale, a study for the United States revealed that adopting emerging R&D technologies could cut energy demand of titanium production activities by 65% (U.S: Department of Energy, 2017)[36].

Furthermore, the valorisation of secondary flows can also lead to environmental gains beyond circularity itself. Replacing virgin titanium sponge with scrap as feedstock for the production of ingots spares the energy consumption and emissions that would be required to produce the sponge, whether through the Kroll process or through more recent alternatives. Recent studies suggest that this relationship is almost one-to-one, with CO_2 emissions and energy use reduced by 95.4% (Corby, 2020). In turn, since sponge production makes up roughly 80% of the energy consumption in manufacturing a semi-finished part (U.S. Department of Energy, 2017), this effect likely compounds downstream in the supply chain. By coupling energy and emission reductions from greater circularity through scrap use with more efficient production technologies, reshoring might also become more economically viable; at any rate, these considerations also have implications for the relationship between the EU and third-country sponge producers, as discussed below.

Negotiating withdrawal from the buyback agreements to ensure access to manufacturing (pre-consumer) scrap

In order to successfully reshore the midstream titanium metal industry while fostering advanced recycling capability, it is essential to ensure access to high-quality virgin scrap for European companies. While the EU produces large quantities of the scrap, buyback agreements and more broadly scrap outflows prevent domestic companies from accessing scrap for their remelting activities. As the quantitative exercise in the previous chapter indicates, retaining scrap in the EU would not only mitigate the challenge of the lack of input material which the current facilities experience at the moment, but it would also create a substantial number of new jobs and additional value added for the European economy.

[36] The study comprises titanium supply to four sectors: aerospace, automotive, gas storage, and wind turbines. Titanium production for these applications in the U.S. consumed 520 GWh of energy in 2010—comparable to 5% of Spain's total energy use that year. Energy calculations include sponge production through the Kroll process, melting ingots, and manufacturing of semi-finished goods (forging, rolling, pressing).

However, any EU policy and industry action in this space must address the challenge of how best to negotiate the gradual weaning off the current multiannual buyback agreements with American companies, which guarantee low prices of imported ingots and wrought titanium. For those reasons any withdrawal from these agreements needs to be accompanied by the growth of the EU's own titanium industrial base. A sudden export control on titanium scrap would result in increased prices of titanium parts and would most likely result in trade frictions with the US. A defensive reaction akin to a trade war seems possible in view of the tariffs imposed under President Trump's first administration, the 2004–2021 Boeing–Airbus trade dispute in the WTO, and the US government's critical reaction to recent EU regulations on hazardous and non-hazardous waste, which aim to retain metal scrap within the EU.

In parallel to reshoring efforts in the EU, joint trade talks between the EU and US stakeholders as well as governments would be beneficial in negotiating a long-term solution to the current negative trade balance of the EU and particularly to the scrap exports to the US. An effective platform for these negotiations could be, for instance, the Working Group on large civil aircraft established by the 2021 agreement on a cooperative framework for large civil aircraft, which ended the Boeing–Airbus WTO dispute. A possible compromise could be achieved by the involvement of US companies in the development of European titanium recycling infrastructure. As discussed on p. 78 of this report, US companies possess the largest numbers of patents for titanium metal circularity and have developed some cutting-edge technologies, which could benefit EU stakeholders if these companies were to invest in the EU value chains and thereby facilitate access to advanced US recycling technologies.

Integrating Ukrainian Tier-3 operations into the EU titanium value chain

According to the CRM Act's recommendations, at least 10% of strategic raw materials consumed annually should be extracted and 40% processed domestically. That would require the establishment of upstream segments of the value chain within the EU. This is also crucial given that even the most advanced technologies are not capable of recycling 100% scrap input, and the sourcing of sponge will remain crucial. Ukraine possesses high-quality titanium deposits (the only other sites in Europe are located in Norway and Greenland), and it has an established processing industry. Due to the ongoing full-scale Russian invasion, it is still uncertain whether the deposits and processing plants will remain within Ukrainian territory and if (when) Ukraine will join the EU. Therefore, substantial political and economic uncertainties remain with regard to the country's potential to be a viable part of the EU titanium value chain.

However, it is clear that there is appetite on both sides for such a development, as Ukraine's integration of EU and Ukrainian elements of the CRM value chains had been initiated before 2022. This was possible thanks to efforts on both sides. As for the Ukrainian administration under Zelenskiy, it managed to regain control over several major titanium facilities in 2020-21 from the hands of Russia-backed oligarchs. At the same time, it established a ministry of strategic industries tasked with mapping the CRM deposits, encouraging production, and securing financing for further exploration. Concomitantly, in 2021 the EU and Ukraine established the Strategic Partnership on raw materials and batteries, which provided EUR 750 000 of EU investment in technical support programmes. This was followed by the 2022 memorandum of understanding aimed at modernising Ukraine's geodata management with an eye on boosting resilience in the EU value chains essential for green and digital transition. These efforts opened the possibilities to nearshore the upstream segment of the EU titanium value chain to Ukraine.

However, major challenges remain even in the event of Ukraine winning the war and joining the EU's value chains. Ukrainian processing and extraction facilities have suffered in recent years: while extraction companies in central Ukraine have maintained their operations, the ZTMK (Zaporizhzhia

Titanium–Magnesium Plant) in eastern Ukraine has suffered Russian bombings and sabotage by pro-Russian management, leading to human resource losses and decreased production capacity. The Ukrainian facilities are therefore in need of rebuilding and revamping to bring them in line with the stringent environmental requirements.

The post-war reconstruction will be the crucial moment for such efforts, as currently there is no consensus on the future of the Ukrainian titanium industry, with battle still being fought between supporters of privatisation and State-industrialists promoting government control of the titanium industry. The EU's potential investments would have to be carefully weighed against the potential risks in the event of re-privatisation of the titanium industry, which might end up with another round of insider privatisation (as was the case in the 2000s), a scenario which could potentially lead to the de-facto Russian control over the industry; the Russians are already seeking access to Ukrainian raw materials through a set of intermediaries.

In the context of the ongoing war, the EU must weigh up the options for securing its position within the Ukrainian titanium industry, especially vis-à-vis the American competition, by offering cutting-edge technologies and integration within the European part of the value chain. Other potential short-term instruments could include the establishment of a no-fly zone over the key industrial complexes, and better enforcement of anti-Russian sanctions.

Widening international partnerships to ensure steady supply of titanium sponge

The access to sponge could also be facilitated by the establishment of strategic partnerships with relevant countries within the already existing initiatives such as the EU's own Global Gateway or by combining efforts with the EU's allies via the Mineral Security Partnership Forum, as part of the foreign economic policy. Indeed, a strategic partnership has already been established since 2022 with a key sponge exporter, Kazakhstan, whose largest state-owned enterprise, UKTMP, entered into a joint venture with EU companies in the past. This partnership helped to establish and sustain EcoTitanium operations and is an example of how investments in resource-rich countries can benefit both sides. While Kazakhstan emerges as a major unwrought titanium exporter to the EU, with a rapidly increasing presence, as discussed on p. 61, it is also important to keep the sources of imports diversified. Securing alternative sourcing from Japan could also be facilitated by the 2018 Strategic Partnership agreement, which was ratified in 2024. In addition, other emerging players in the industry, such as Saudi Arabia, should also be considered as viable partners for imports of unwrought titanium.

According to the EU's current approach to the greening of the raw materials value chains contained in the key strategies and policies of recent years, the aim is not only to inject circularity within the products that reach Europe, but across the global value chains. However, this means addressing the underlying issue of the energy mix being heavily skewed towards coal in the countries where the upstream part of the value chain is located. The ore-to-sponge processing is a heavily energy-consuming and environmentally-polluting process, with chlorination part of the processing and producing high levels of toxicity, which means that wastewater management can be challenging. This is the main reason why reshoring in the EU would be so difficult, as the environmental risks and high costs of producing titanium would make the EU business location non-competitive globally.

However, as previously discussed, there are several more environmentally and economically viable technologies which could be injected at the upstream stage of production both within the (potentially reshored) industry in the EU or in the EU's search for helping decarbonisation of the upstream industry worldwide. Some of the new technologies between extraction countries and destination countries, which aim at limiting costs and environmental damage, are already being put in place such as in the Kazakhstan-Republic of Korea partnership on three-stage improvements in the extraction and refining process of titanium ore: more economical in-situ leaching (ISL), solid-phase chlorination and reduction

of $TiCl_4$ with hydrogen instead of magnesium. The proponents of these improvements also consult the EU institutions and look for EU funding to do so. Technological upgrading and joint ventures (JVs) with the key sponge suppliers could ensure the EU not only a resilient source of sponge, but also help with greening of the upstream supply chain.

Encouraging end-of-life (EoL) circularity

As discussed earlier in the report, the old scrap from both commercial aviation and military sectors constitutes a fraction of reused titanium metal, mostly because the recovery is not financially viable, and the repurposing of scrap is curtailed by the stringent safety and recertification requirements. In order to address these limitations, some market and policy incentives need to be designed to encourage better recycling of EoL scrap.

The first question to address is that of profitability. There are several reasons for low profitability: the competition from US scrap collectors, the technical difficulty of extracting titanium from the alloys, the economies of scale, lack of disclosure of the exact chemical composition of parts by OEMs, and the recertification requirements. As to the first point, engines are the main source of income in the EoL sector, as they represent 80% of the value of the EoL aircraft and contain 60-70% of the aircraft's titanium. They go almost entirely into the reuse market and can have several life cycles with some replacements of critical parts over time. However, this market is a closed loop dominated by American companies. Creating policy incentives which would encourage the EoL domestic recycling of CRMs, could facilitate the retention of crucial EoL scrap in the domestic market.

Another issue is the design-for-recyclability. The decision to extract high-grade titanium for recycling from the airframe depends on the alloys used and the commercial viability of the mechanical dismantling. However, recycling of the airframe and the reuse of airframe parts is a potentially growing opportunity, as the ratio of titanium to other alloys in the newer types of aircraft has grown over the years. Moreover, the OEMs are now often designing the airframe in a way to facilitate easier recovery of titanium at the EoL stage. However, this is not necessarily the case for newer types of engines, which unlike old types (with separate and dismantlable parts) are now produced as composites. This lowers their use-stage carbon emissions but makes them trickier to dismantle and reuse/recycle. Indeed, the industry does not focus on the EoL-stage circularity but seeks to lower the carbon footprint in the use stage (when flying) by designing aircraft and engines which use less fuel or can be propelled with green fuels (such as hydrogen). Policy incentives which would encourage the production of easily dismantlable and recyclable parts, akin to eco-design measures, could help address some of these challenges and encourage good models in the industry.

As for the challenges of regulatory constraints for EoL scrap reinterring the aviation market, a revised recertification system could be developed which better targets EoL material, which would apply end-of-waste criteria to titanium alloys and offer greater transparency as to the compulsory chemical composition of the titanium alloys. This and the previous barriers to circularity could be addressed by the introduction of digital passports in the industry.

References

Abduljalayel, F. and Martin, M. (2024). *Boeing, Airbus working with Saudi Arabia on metals for planes*. Bloomberg, 20 May. Available at: https://www.bloomberg.com/news/articles/2024-05-20/boeing-airbus-working-with-saudi-arabia-on-metals-for-planes [Accessed 16 October 2024]

Al-Shamma, O. and Ali, R. (2013). *Aircraft weight estimation in interactive design process*. Presented at the *72nd Annual International Conference on Mass Properties Engineering*, St. Louis, MO, USA.

Alamos, F. J., Schiltz, J., Kozlovsky, K., Attardo, R., Tomonto, C., Pelletiers, T., Schmid, S. R. (2020). Effect of powder reuse on mechanical properties of Ti-6Al-4V produced through selective laser melting, *International Journal of Refractory Metals and Hard Materials* 91: 105273.

Allegheny Technologies (2022). *ATI announces termination of joint venture with Russian-based VSMPO*. 9 March. Available at: https://ir.atimaterials.com/news-events/news-details/2022/ATI-Announces-Termination-of-Joint-Venture-with-Russian-Based-VSMPO/default.aspx.

AMFG (2019). *A guide to 3D printing with titanium*. Available at: https://amfg.ai/2019/06/18/titanium-3d-printing-guide/ [Accessed 21 June 2024].

An, Z., Chen, Y. and Zhao, W. (2023). *Report on China titanium industry in 2022*. *Iron Steel Vanadium Titanium*, 44(3), pp. 1-8. DOI: 10.7513/j.issn.1004-7638.2023.03.001.

Argus Media (2020). *US looks to revive domestic titanium supply*. 29 September. Available at: https://www.argusmedia.com/en/news-and-insights/latest-market-news/2145390-us-looks-to-revive-domestic-titanium-supply.

Baldassarre, B. (2024). *Circular economy for resource security in the European Union (EU): Case study, research framework, and future directions*. *Ecological Economics*, 227, p. 108345. DOI: 10.1016/j.ecolecon.2024.108345.

Baldassarre, B., Buesa, A., Albizzati, P., Jakimów, M., Saveyn, H. and Carrara, S. (2023). *Analysis of Circular Economy Research and Innovation (R&I) intensity for critical products in the supply chains of strategic technologies*. JRC134253.

Ball, C. J. P. (1957). *The history of magnesium*. *Journal of the American Society for Naval Engineers*, 69(1), pp. 81-94.

Barnier (2022). *Airbus n'est pas encore débarrassé du titane russe*. *La Tribune*, 1 December. Available at: https://www.latribune.fr/entreprises-finance/industrie/aeronautique-defense/airbus-n-est-pas-encore-debarrasse-du-titane-russe-942988.html (in French)

BBC (2013). *Tales from the Blackbird cockpit*. Available at: https://www.bbc.com/future/article/20130701-tales-from-the-blackbird-cockpit.

Belousova, E. B. (2018). Mirovoy i rossiyskiy rynki titanovogo syria. Mineralnye resursy Rossii. *Ekonomika i upravlenie,* 6, p. 64-67. (in Russian).

Bondal (2022). *Kazakhstan tries to attract Western companies that left Russia when the war in Ukraine began* (in Russian). *Central Asia News Articles*, 20 July. Available at: https://central.asia-news.com/ru/articles/cnmi_ca/features/2022/07/22/feature-01 [Accessed 21 February 2023].

Bowden, D. M, and Peter, W. H. (2012). *Near-net shape fabrication using low-cost titanium alloy powders*. U.S. Department of Energy - Office of Scientific and Technical Information Technical Report. DOI: 10.2172/1040632. Available at: https://www.osti.gov/servlets/purl/1040632.

Britannica (2024). *Titanium processing: The metal and its alloys*. Available at: https://www.britannica.com/technology/titanium-processing/The-metal-and-its-alloys [Accessed 21 May 2024].

Bruneau, A. (2020). *Neotiss presentation. Industrial markets*, in *Titanium USA 2020 Conference*. Available at: https://titanium.org/page/ti_Proceedings.

Buesa, A., Pedauga, L., Piñero, P., Rueda-Cantuche, J.M., and Baldassarre, B. (under review). *Can greater circularity in titanium metal improve EU open strategic autonomy? Scenario modelling with heterogeneous data*. *Economic Analysis and Policy*. Earlier version published as "*Can circularity in titanium metal improve EU strategic autonomy? Scenario modelling with heterogeneous data*", JRC Working Papers in Economics and Finance, 2024/06, JRC139576.

Buesa, A., P. Albizzati, E. Garbarino, H. Saveyn, B. Baldassarre (2023). *Circular economy in EU critical value chains: The case of titanium metal in defence and civil aviation*. In K. Niinimäki, K. Cura (Eds.), *Product Lifetimes and the Environment 2023*, Aalto University Publication Series: pp. 149-154.

Bushey, C. and Pfeifer, S. (2024). *Boeing and Airbus bought plane sections with falsely certified metal*. *Financial Times*, 14 June. Available at: https://www.ft.com/content/b3dd4d8e-5c60-4b24-bdd2-b3d07a14ff7a.

Carrara, S., Bobba, S., Blagoeva, D., Alves Dias, P., Cavalli, A., Georgitzikis, K., Grohol, M., Itul, A., Kuzov, T., Latunussa, C., Lyons, L., Malano, G., Maury, T., Prior Arce, A., Somers, J., Telsnig, T., Veeh, C., Wittmer, D., Black, C., Pennington, D., and Christou, M. (2023). *Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study*. EUR JRC132889. Publications Office of the European Union.

Censor.net (2020). *SBU demands that OGKhK stop supplying ilmenite to Crimea*. *Censor News*, 30 November. Available at: https://biz.censor.net/news/3234020/sbu_trebuet_ot_oghk_ostanovit_postavki_ilmenita_v_krym_dokument [Accessed 21 February 2023]. (in Russian).

Centre for Aviation (2024). *Global aircraft order backlog hits 13 years; Airbus beats Boeing on key metrics*. Available at: https://centreforaviation.com/analysis/reports/global-aircraft-order-backlog-hits-13-years-airbus-beats-boeing-on-key-metrics-672470.

Chelekbay, A.D. (2013). *Development of International Economic Integration Based on Industrial-Innovation Clusters*. *Central Asian Economic Review*, 5 (2023), pp. 108-115. Available at: https://e.lanbook.com/journal/issue/290959 (in Russian).

Civil Aviation Administration of China (CAAC - 中国民用航空局) (2023). *Call for comment on civil aviation system*, 8 December. Available at: http://www.caac.gov.cn/HDJL/YJZJ/202312/t20231211_222291.html [Accessed: 11 December 2023]. (in Chinese).

Coggins, A. (2019). *Titanium Metal – Global Supply and Demand Trends Overview*. In: *Titanium USA 2019 Conference*, Mobile, Alabama, 22-25 September. Available at: https://titanium.org/page/TiUSA2019Proceedings.

Corby, N. (2024). *Titanium scrap trends: a brave new world*. In: *Titanium USA 2020 Conference*. Available at https://cdn.ymaws.com/titanium.org/resource/resmgr/usa_2020/Nick_Corby_2020_Titanium_Sup.pdf

Current Time (2018). *Crimean Titan: Billionaire Firtash's plant in Armyansk continues to operate after toxic emissions despite sanctions*. *Current Time*, retrieved 21 February 2023. Available at: https://www.currenttime.tv/a/crimea-papers-chapter-3-firtash/30324436.html. (in Russian).

Damen, M. (2022). *EU Strategic Autonomy 2013-2023: From Concept to Capacity*. European Parliamentary Research Service (EPRS). Available at: https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733589/EPRS_BRI(2022)733589_EN.pdf.

Draghi, M. (2024). *The Future of European Competitiveness – Part A: A Competitiveness Strategy for Europe*. Available at: https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en#paragraph_47059.

Elsner, H. (2021). *The HiTi Feedstock Market – Rutile, Leucoxene and Others*. *DERA Rohstoffinformationen*, 47. Available at: https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-47-en.html.

EOS (2015). *Airbus Defence and Space - Advanced Manufacturing Process by EOS Optimizes Satellite Technology*. Available at: https://www.eos.info/industries/customer-success-stories/airbus-space-satellite-titanium-brackets.

European Commission, DG GROW (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs), Pennington, D., Tzimas, E., Baranzelli, C., et al. (2017). *Methodology for establishing the EU list of critical raw materials: guidelines*, Publications Office of the European Union. DOI: 10.2873/769526.

European Commission, Eurostat (2019). *EU inter-country supply, use and input-output tables: full international and global accounts for research in input-output analysis (FIGARO) - 2019 edition*, Rémond-Tiedrez, I. (editor), Rueda-Cantuche, J.M.(editor), Publications Office of the European Union. DOI: 10.2785/008780

European Commission (2020). *A new Circular Economy Action Plan - For a cleaner and more competitive Europe*, communication from The Commission to the European Parliament, the European Council, the Council, the European Economic And Social Committee and the Committee Of The Regions, COM/2020/98 final.

European Commission (2020b). *A New Industrial Strategy for Europe*, communication from The Commission to the European Parliament, the European Council, the Council, the European Economic And Social Committee and the Committee Of The Regions, COM/2020/102 final.

European Commission, DG GROW (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs), Bobba, S., Carrara, S., Huisman, J., et al. (2020). *Critical raw materials for strategic technologies and sectors in the EU: a foresight study*, Publications Office of the European Union, Luxembourg.

European Commission, DG GROW (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs) (2021). *Strategic dependencies and capacities*, accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery. Commission Staff Working Document, SWD(2021)352.

European Commission, DG GROW (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs), Grohol, M. and Veeh, C. (2023). *Study on the critical raw materials for the EU 2023 – Final Report*. Publications Office of the European Union. DOI: 10.2873/725585.

European Commission, EISMEA (Executive Agency for Small and Medium-sized Enterprises), Van de Velde, E., Kretz, D. (2021). *Advanced technologies for industry: product watch: lightweight materials*, Publications Office of the European Union. DOI: 10.2826/321124.

European Commission (2021b). *Action Plan on Synergies between Civil, Defence, and Space Industries*, communication from The Commission to the European Parliament, the European Council, the Council, the European Economic And Social Committee and the Committee Of The Regions, COM/2021/70 final.

European Commission (2023). *Recommendation (EU) 2023/2113 of 3 October 2023 on critical technology areas for the EU's economic security for further risk assessment with Member States*.

European Defence Agency (EDA) (2024). *EDA Factsheet: Project idea Circularity of titanium using recycled source materials for Additive Manufacturing*. Available at: https://eda.europa.eu/docs/default-source/if-ceed/factsheets/if-ceed-factsheet---01---circularity-of-ti-and-am.pdf.

EPMA (European Powder Metallurgy Association) (2015). *Introduction to Additive Manufacturing Technology: A Guide for Designers and Engineers*. Available at: https://www.epma.com/epma-freepublications/product/introduction-to-additive-manufacturing-brochure.

European Union (2024). Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020.

Eurostat Comext (2024). *Easy Comext Database, International Trade of Goods*. Available at: https://ec.europa.eu/eurostat/comext/newxtweb/ [Accessed 22 May 2024].

Eurostat Prodcom (2024). *Statistics on the Production of Manufactured Goods. Sold Production* (last updated 11 January 2024). *Prodcom - Statistics by Product*. Available at: https://ec.europa.eu/eurostat/web/prodcom/data/database [Accessed 16 April 2024].

Ezhov, A. (2018). *Development and Evolution of the Titanium Industry in the Urals (mid 1950s-early 1990s)*. PhD thesis, Ural Federal University, Yekaterinburg.

Ferreira, P. M. (2018). *QDR methodology: understanding trade flows in the EU*, *Eurostat Review on National Accounts and Macroeconomic Indicators (EURONA)*, 2, pp. 55-70.

Fabiani, J., Soguero Escuer, J., Calza, E., Dunker, C. and De Prato, G. (2024). *Advanced Manufacturing - DGTES applied to advanced manufacturing and its contributions to industrial ecosystems*. European Commission, Ispra. JRC139068.

Forrest, B. (2022). *Ukraine Looks for Opportunity Amid Titanium Supply-Chain Crisis*. *Wall Street Journal*, 31 October. Available at: https://www.wsj.com/articles/ukraine-looks-for-opportunity-amid-titanium-supply-chain-crisis-11667221022.

Froes, F.H., Qian, M., and Niinomi, M. (2019). *Chapter 1 - An introduction to titanium in consumer applications*. In: F.H. Froes, M. Qian, and M. Niinomi, eds. *Titanium for Consumer Applications*. Elsevier, pp. 1-12. ISBN: 9780128158203. Available at: https://www.sciencedirect.com/science/book/9780128158203.

GACC (2024). *Chinese Customs Statistics*. General Administration of Customs of the People's Republic of China. Available at: http://stats.customs.gov.cn/indexEn [Accessed 3 June 2024].

Gehler, S. (2013). *Overview of titanium sponge supply*. Presentation at *Titanium Europe 2013*, Hamburg, 5-7 March. Available at: https://titanium.org/page/tieur_2013_2017.

Gehler, S. (2019) World Titanium Sponge supply trends. Presentation 16/9/2020. Available at: https://custom.cvent.com/C2795141339A407CA590D38C49421294/files/1e6f986c71364a1eaf13e5d78c24896e.pdf

Gehrke, T. (2022). *EU Open Strategic Autonomy and the Trappings of Geoeconomics*. *European Foreign Affairs Review*, 27(Special Issue), pp. 61-78. DOI: 10.54648/EERR2022012

Georgitzikis, K., D'Elia, E. and Eynard, U. (2022). *Titanium metal: Impact assessment for supply security*. European Commission. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC129594.

Gotev, G. (2022). *Kazakhstan tells EU: We can supply all 30 critical raw materials you need*. *Euractiv.com News*, 18 November. Available at: https://www.euractiv.com/section/central-asia/news/kazakhstan-tells-eu-we-can-supply-all-30-critical-raw-materials-you-need/ [Accessed 21 February 2023].

Grigorenko, Y. (2019). *Titanic labor: How to restore the potential of the country's titanium industry*. *GMK Center*, 28 November. Available at: https://gmk.center/posts/titanicheskij-trud-kak-vosstanovit-potencial-titanovoj-otrasli-strany/ [Accessed 20 February 2023]. (in Russian).

Goonan, T.G. (2010). *Titanium Recycling in the United States in 2004*. In: Sibley, S.F., ed., *Flow studies for recycling metal commodities in the United States*. U.S. Geological Survey Circular 1196, Chapter Y, pp. Y1–Y16. Available at: http://pubs.usgs.gov/circ/circ1196-Y/.

Hamilton, S. and Scott, M. (2022). *Pontifications: Suppliers don't lack for demand but haven't recovered from the pandemic crisis*. *Leeham News*, 3 October. Available at: https://leehamnews.com/2022/10/03/pontifications-suppliers-dont-lack-for-demand-but-havent-recovered-from-pandemic-crisis/.

Herman, W.A. (2005). *Titanium in combat vehicles*, presented at the ITA Conference, September 2005.

Hu, X., Luo, F., Lin, J., Wang, M. and Li, X. (2022). *Dynamic material flow analysis of titanium sponge in China: 2000–2019*. *Journal of Cleaner Production*, 371, p. 133704. DOI: 10.1016/j.jclepro.2022.133704.

Hui, X., Qi, M., Wang, W., Yang, S. and Zhang, C. (2023). *A comprehensive model for evaluating titanium industry security in China*. *Processes*, 11(8), p. 2286. DOI: 10.3390/pr11082286.

Ilchenko (2021). *Firtash sold a titanium enterprise in Crimea to Russians and registered this transaction in Ukraine*. *Dzerkalo Tyzhnia Economic Reports*, 30 December. Available at: https://zn.ua/ukr/ECONOMICS/firtash-prodav-rosijanam-titanove-pidprijemstvo-v-krimu-i-zarejestruvav-tsju-uhodu-v-ukrajini.html [Accessed 21 February 2023]. (in Ukrainian).

Imam, M.A. (2016). The 13th World Conference on Titanium (Ti-2015). *JOM - Journal of The Minerals, Metals & Materials Society*, 68(9), pp. 2492–2501. DOI: 10.1007/s11837-016-2045-4.

Inagaki, I., Takechi, T., Yoshihisa, S., and Ariyasu, N. (2014). *Application and Features of Titanium for the Aerospace Industry*. *Nippon Steel & Sumitomo Metal Technical Report*, 106, pp. 22-27. Available at: https://www.nipponsteel.com/en/tech/report/nssmc/pdf/106-05.pdf .

Interfax-Ukraina (2019). *Co-owner of the "ATB" trading network Butkevich became the owner of a company with uranium extraction licenses*, 4 January. *Interfax-Ukraine News*. Available at: https://www.pravda.com.ua/rus/news/2021/06/18/7297762/ [Accessed 23 February 2023]. (in Ukrainian).

IEA (2023). *World Energy Outlook 2023*, International Energy Agency, Paris. Available at https://www.iea.org/reports/world-energy-outlook-2023.

IRENA (2018). *Renewable Energy Prospects for the European Union*. Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Feb/IRENA_REmap_EU_2018.pdf.

ITA (2011). *Titanium — The Infinite Choice*. International Titanium Association Education Committee, p. 24. Available at: https://titanium.org/general/custom.asp?page=ebooks#s=1.

ITA (2021). *Statistical Review 2016 - 2020*. International Titanium Association. Available at: http://www.titanium.org/.

ITA (2022). *Statistical Review 2017 - 2021*. International Titanium Association. Available at: http://www.titanium.org/.

Jakimów, M., Samokhvalov, V. and Baldassarre, B. (2024). *Achieving European Union strategic autonomy: circularity in critical raw materials value chains*. *International Affairs*, 100(4), pp. 1735-1748. DOI: 10.1093/ia/iiae127.

Jefferies (2018). *Initiating on Titanium Industry: Investors, Prepare for Take-Off*. Available at: https://www.jefferies.com/wp-content/uploads/files/Insights/BasicMaterials.pdf.

Kabash, N. (2014). *"Nadra Ukraïni" openly sells titanium deposits*. *Kapital Ukraina*, 31 July. Available at: https://www.capital.ua/ru/publication/26117-nadra-ukrayini-rasprodayut-titanovye-mestorozhdeniya-i-vpervye-delayut-eto-otkryto [Accessed 21 February 2023]. (in Russian).

Koushik, T., Shen, H., Kan, W.H., Gao, M., Yi, J., Ma, C., Lim, S.C.V., Chiu, L.N.S. and Huang, A. (2023). *Effective Ti-6Al-4V powder recycling in LPBF additive manufacturing considering powder history*. *Sustainability*, 15, p. 15582.

Leicht, A. (2018). *Aspects of building geometry and powder characteristics in powder bed fusion*. Licentiate thesis, Chalmers University of Technology, Gothenburg. Available at: https://research.chalmers.se/en/publication/500036.

Louvigné, P.-F. (2021). *Rapport de veille sur le marché du titane 2018 – 2020*. Groupe de travail 'Titane', Ministère de la Transition Écologique et Solidaire, République Française. Available at: https://www.mineralinfo.fr/fr/actualite/actualite/marche-du-titane-un-metal-strategique-pour-lindustrie-europeenne-cycle-2018. (in French).

Mal'ko, L. (2015). *Titanium ingots produced in East Kazakhstan are used in the construction of nuclear power plants in South Korea (PHOTO)*. *Kazinform.kz News*, 29 October. Available at: https://www.inform.kz/ru/article/2833823 [Accessed 21 February 2023]. (in Russian).

Mansfeldt, D. (2020). *Russian titanium market*, presented at *Titanium USA 2020 Conference*. Available at: https://titanium.org/page/2020Proceedings.

Ministry of Industry and Information Technology (MIIT - 工业和信息化部) (2021). *New material products eligible for insurance subsidies guiding catalogue (2021 edition)*, 31 December. Available at: https://www.miit.gov.cn/zwgk/zcwj/wjfb/tg/art/2021/art_ba8afb04dc694ad8a5830f15bd5ffda7.html. (in Chinese).

Ministry of Housing and Urban-Rural Development (MoHURD - 住房城乡建设部) (2020). *Design standards for techniques used in titanium smelting factories (GB51326-2018)*, effective 1 April. Available at: http://www.jianbiaoku.com/webarbs/book/134722/4009621.shtml. (in Chinese).

Moghimian, P., Poirié, T., Habibnejad-Korayem, M., Arreguin Zavala, J., Kroeger, J., Marion, F., and Larouche, F. (2021). *Metal powders in additive manufacturing: A review on reusability and recyclability of common titanium, nickel, and aluminum alloys*. *Additive Manufacturing*, 43, p. 102017. DOI: 10.1016/j.addma.2021.102017.

Montgomery, J.S. and Wells, M.G.H. (2001). *Titanium armor applications in combat vehicles*. *JOM - Journal of The Minerals, Metals & Materials Society*, 53, pp. 29–32. DOI: 10.1007/s11837-001-0177-1.

Nadra.info (2023). *The Appellate Chamber of the High Anti-Corruption Court withdrew the Demurinsky GZK in favor of the state*. *Nadra.info News*, 3 February. Available at: https://nadra.info/2023/02/the-appellate-chamber-of-the-high-anti-corruption-court-withdrew-the-demurinsky-gzk-in-favor-of-the-state/ [Accessed 23 February 2023]. (in Ukrainian).

National Materials Advisory Board (NMAB), Commission on Engineering and Technical Systems, and National Research Council (1983). *Titanium: Past, Present, and Future*. Publication NMAB-392. Washington D.C.: National Academy Press. Available at: https://nap.nationalacademies.org/read/1712/chapter/4.

Ng, J. (2020). *Henderson Timet plant workers seeking federal help to prevent closure*. *Las Vegas Review Journal*, 4 August. Available at: https://www.reviewjournal.com/local/henderson/henderson-timet-plant-workers-seeking-federal-help-to-prevent-closure-2087819/.

Norgate, T. E., Jahanshahi, S., and Rankin, W. J. (2007). *Assessing the environmental impact of metal production processes*, *Journal of Cleaner Production* 15 (8-9), pp. 838-848. DOI: 10.1016/j.jclepro.2006.06.018.

Norman, L., and Katz, B. (2022). *Russian Titanium Maker Is Pulled Off Sanctions List*. *Wall Street Journal*, 21 July. Available at: https://www.wsj.com/articles/russian-titanium-maker-is-pulled-off-sanctions-list-11658425381.

North Steel Co. (2017). *Titanium in the use on the Comac C919*. 12 June. Available at: https://www.northsteel.com/2017/06/12/titanium-use-comac-c919/ [Accessed 7 April 2023].

Postanova (1994). *Decree of the Cabinet of Ministers of Ukraine on the Comprehensive Development Program of the Titanium Industry of Ukraine*, No. 783, 18 November. Available at: https://zakon.rada.gov.ua/laws/show/783-94-%D0%BF/conv#o3 [Accessed 23 February 2023]. (in Ukrainian).

Postanovlenie (1996). *Decision of the Government of the Republic of Kazakhstan on the further development of the Titanium-Magnesium Industry*, No. 517, 26 April. Available at: https://adilet.zan.kz/rus/docs/P960000517 [Accessed 23 February 2023]. (in Russian).

Qiu, G. and Guo, Y. (2022). *Current situation and development trend of titanium metal industry in China*. *International Journal of Minerals, Metallurgy, and Materials*, 29(4), pp. 599–610. DOI: 10.1007/s12613-022-2455-y.

Roskill (2020). *White Paper: Review of the year 2020*, December.

Rueda-Cantuche, J.M., Pedauga, L., and Mandras, G. (2022). *The relevance of re-exports for identifying strategic dependencies*. *Science for Policy Brief*, No. JRC128381. Publications Office of the European Union.

Safirova, E., Barry, J.J., Hastorun, S., Matos, G.R., and Perez, A.A. (2017). *Estimates of immediate effects on world markets of a hypothetical disruption to Russia's supply of six mineral commodities*. *U.S. Geological Survey Open-File Report*, 2017–1023. DOI: 10.3133/ofr20171023.

Salikova, N.S., Kucenko, N.Yu., Zhakupova, S.B., and Urazbaeva, S.E. (2021). *Economic perspectives of the development of titanium-zirconium deposits*. *Actual Scientific Research in the Modern World*, (4-10), pp. 69-73. (in Russian).

SCRREEN (2023). *Factsheets Updates Based on the EU Factsheets 2020 – Titanium*. Available at: https://scrreen.eu/wp-content/uploads/2023/08/SCRREEN2-factsheets_TITANIUM.pdf.

SIPRI (2024). *Military Expenditure Database*. Stockholm International Peace Research Institute. DOI: 10.55163/CQGC9685.

Smitz, L. and Seidl, T. (2022). *As Open As Possible, as Autonomous as Necessary: Understanding the Rise of the Open Strategic Autonomy in EU Trade Policy*. *Journal of Common Market Studies*, 61(3), pp. 834-852. DOI: 10.1111/jcms.13428.

Sokolov, M. (2011). *Titanium Metal Markets and the Russian Aviation Industry*. *Problems of Economic Transition*, 54(3), pp. 65–78.

Sprecher, B. and Kleijn, R. (2021). *Tackling material constraints on the exponential growth of the energy transition*. *One Earth*, 4(3), pp. 335-338. DOI: 10.1016/j.oneear.2021.02.020.

Starkov, M. (2022). *Created a Titanium Giant and Gave It to the State*. *66.ru News*, 22 November. Available at: https://66.ru/news/business/235340 [Accessed 23 February 2023]. (in Russian).

State Council Information Office (SCIO - 中国人民共和国国务院新闻办公室) (2024). *Press conference on writing a new chapter in Shaanxi's development and striving to be a pacesetter in China's western region*, 6 June. Available at: http://www.scio.gov.cn/live/2024/34051/tw/. (in Chinese).

Statista (2024). *Worldwide number of Airbus aircraft deliveries from 2002 to 2023*. Statista, 14 February. Available at: https://www.statista.com/statistics/264493/airbus-worldwide-aircraft-deliveries/ [Accessed 6 June 2024].

Statista (2024b). *Boeing's aircraft deliveries from 1998 to 2023*. 7 May. Available at: https://www.statista.com/statistics/273968/number-of-delivered-aircraft-by-boeing/.

Takeda, O., Ouchi, T., and Okabe, T.H. (2020). *Recent progress in titanium extraction and recycling*. *Metallurgical & Materials Transactions B: Process Metallurgy & Materials Processing Science*, 51(4), pp. 1315–1328. DOI: 10.1007/s11663-020-01898-6.

Tebaldo, V., Gautier di Confiengo, G., Duraccio, D., and Faga, M. G. (2024). *Sustainable Recovery of Titanium Alloy: From Waste to Feedstock for Additive Manufacturing*, *Sustainability* 16(1), p. 330. DOI: 10.3390/su16010330.

Timet (2011). *Titanium Metals Corporation. US Securities and Exchange Commission - Form 10-K*. Available at: https://www.sec.gov/Archives/edgar/data/1011657/000119312512087802/d228252d10k.

Timet (2018). *Petition Of Titanium Metals Corporation under Section 232 of the Trade Expansion Act of 1962 for Relief from Imports of Titanium Sponge that Threaten National Security*. Available at: https://www.timet.com/assets/local/documents/petition/Titanium-Sponge-232-Petition-09-27-2018.pdf.

Tokayev, K-J. (2022). *Speech at St Petersburg Economic Forum* (in Russian). *RIA News*, 17 June. Available at: https://ria.ru/20220617/donbass-1796281249.html [Accessed 21 February 2023].

Turkestanova, L. (2021). *Interview with Asem Mamutova* (in Kazakh). *Bilimdi News*, 5 March. Available at: https://bilimdinews.kz/?p=139794&ysclid=ldn7vb49yc942969294 [Accessed 23 February 2023].

Uhlmann, E., Kersting, R., Klein, T.B., Cruz, M.F., and Borille, A.V. (2015). *Additive Manufacturing of Titanium Alloy for Aircraft Components*. *Procedia CIRP*, 35, pp. 55–60. DOI: 10.1016/j.procir.2015.08.061.

Ukaz 2010. *Decree No. 958 of March 19, 2010, on the National Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for 2010-2014 and on the Cancellation of Certain Decrees of the President of the Republic of Kazakhstan*. *Kazakhstanskaya Pravda*, 31 March, (No. 74, 26135). (in Russian).

Ukaz 2014. *Decree of the President of the Republic of Kazakhstan No. 784 of August 1, 2014, on the Approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2015-2019*. Available at: https://adilet.zan.kz/rus/docs/U1400000874. (in Russian).

Ukrainska Pravda (2021). *Ukraine Introduced Sanctions Against Firtash and Fuks*. *Ukrainska Pravda News*, 18 November. Available at: https://www.pravda.com.ua/rus/news/2021/06/18/7297762/ [Accessed 21 February 2023]. (in Ukrainian).

Ukrrudprom (2022). *Allegedly sold by Dmitry Firtash: "Crimean Titan complains about the lack of Ukrainian raw materials"*. *Ukrrudprom News*, 18 May. Available at: https://ukrrudprom.com/news/YAkobi_prodanniy_Dmitriem_Firtashem_Krimskiy_titan_galuetsya_na_.html [Accessed 21 February 2023]. (in Russian).

UN Comtrade (2024). *International Trade Statistics Database*. Available at: https://comtrade.un.org/ [Accessed 31 May 2024].

U.S. Department of Commerce, Bureau of Industry and Security Office of Technology Evaluation. (2019). *The Effect Of Imports Of Titanium Sponge On The National Security.* Available at: https://www.bis.doc.gov/index.php/documents/section-232-investigations/2792-titanium-sponge-232-report-and-appendices-7-26-2021-redacted/file .

U.S. Department of Energy, Advanced Manufacturing Office (2017). *Bandwidth study on energy use and potential energy savings opportunities in U.S. titanium manufacturing*. Available at: https://www.energy.gov/sites/default/files/2017/12/f46/Titanium_bandwidth_study_2017.pdf.

USGS MCS (2024). *Mineral Commodity Summaries, editions 2000-2024*. U.S. Geological Survey. Available at: https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries.

USGS MIS-Ti (2024). *Mineral Industry Surveys. Titanium.* 4th Quarter editions, 2022-2023. U.S. Geological Survey. Available at: https://www.usgs.gov/centers/national-minerals-information-center/titanium-statistics-and-information.

USGS MYB-Ti (2023). *Minerals Yearbook. Titanium. Data release in xls format*. Annual editions 2016-2020. U.S. Geological Survey. Available at: https://www.usgs.gov/centers/national-minerals-information-center/titanium-statistics-and-information.

USITC (2017). *Titanium Sponge from Japan, October 2017*. U.S. International Trade Commission, 4736(October). Available at: https://www.govinfo.gov/content/pkg/GOVPUB-ITC1-PURL-gpo133328/pdf/GOVPUB-ITC1-PURL-gpo133328.pdf.

Usubiaga, A., Arto, I., Cazcarro, I., Dietzenbacher, E., Piñero, P., Román, M.V., and Rueda-Cantuche, J.M. (2023). *Expanding Eurostat's FIGARO MRIO database: industry disaggregation, and environmental and labor extension*. Presented at the *29th IIOA Conference*, Alghero, Italy.

Veiga, C., Davim, J.P. and Loureiro, A. (2012). *Properties and applications of titanium alloys: A brief review*. *Reviews on Advanced Materials Science*, 32, pp. 133–148.

Venger, V.V., Bykonia, O.S., Hakhovych, N.G., Kushnirenko, O.M. and Tsyplitska, O.O. (2024). *Development of titanium production in Ukraine: Evolving prospects based on national R&D*. *Science and Innovation*, 20(3), pp. 40–52. DOI: 10.15407/scine23.03.040.

Von der Leyen, U. (2024). *Europe's Choice – Political Guidelines for the Next European Commission 2024–2029*. Publications Office of the European Union. Available at: https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf

VSMPO-AVISMA (2007). *Boeing and VSMPO-AVISMA Corporation signed contract for delivery of titanium products until 2015*. Press release, 27 December. Available at: https://web.archive.org/web/20110721000147/http:/www.vsmpo.ru/cat_details.php?script=news.php&p=&zps=649&lang=2.

VSMPO-AVISMA (2018). *PJSC VSMPO-AVISMA Annual Report*. Available at: https://www.e-disclosure.ru/portal/files.aspx?id=1641&type=2&attempt=1.

Wang, W. (2023). *Material flows and waste management of titanium products in China from 2005 to 2020*. *Journal of Sustainable Metallurgy*, 9(2), pp. 564–577. DOI: 10.1007/s40831-023-00667-4.

Wang, W. and Wu, F. (2023). *Dataset of annual metal scrap circularity of titanium industry in China from 2005 to 2020*. *Nature Scientific Data*, 10(1), pp. 1–8. DOI: 10.1038/s41597-023-02351-4.

WITS (2022). *World Integrated Trade Solution. International merchandise trade data*. Available at: https://wits.worldbank.org/.

Woodfield, A. and Lemaitre, G. (2020). *Aerospace titanium alloy melt process quality improvements*. *MATEC Web of Conferences*, 321, p. 04008. DOI: 10.1051/matecconf/202032104008.

Wohlers, T.T., et al. (2021). *Wohlers Report 2021: 3D Printing and Additive Manufacturing Global State of the Industry*. Wohlers Associates, Fort Collins, Colorado.

Xia, Y., Lefler, H. D., Fang, Z. Z., Zhang, Y., and Sun, P. (2020). *Chapter 17 - Energy consumption of the Kroll and HAMR processes for titanium production*, in Fang, Z. Z., Froes, F. H., and Zhang, Y. (editors), "Extractive Metallurgy of Titanium", Elsevier, pp. 389-410, ISBN 9780128172001, DOI: 10.1016/B978-0-12-817200-1.00017-X.

Yan, M. and Ebel, T. (2019). *Chapter 5 - Titanium and titanium alloys in drones and other small flying objects*. In: Froes, F., Qian, M. and Niinomi, M., eds. *Titanium for Consumer Applications*. Elsevier, pp. 91-113.

Zakon (2011). *Law of Ukraine on the approval of the State-wide program for the development of the mineral and raw material base of Ukraine for the period until 2030*, *Newsletter of the Verkhovna Rada of Ukraine*, 21 April. Available at: https://zakon.rada.gov.ua/laws/show/3268-17#Text [Accessed 21 February 2023]. (in Ukrainian).

Zapariy, V.V. (2012). *Production of titanium and magnesium in Urals in the 90s of the 20th century*. *Economic History Studies Journal*, 13(2-3), pp. 167-174.

Zenglein, M. and Sebastian, G. (2023). *The sky is the limit: China's rise as a transportation superpower challenges the EU*. Mercator Institute for China Studies (MERICS). Available at: https://merics.org/en/report/sky-limit-chinas-rise-transportation-superpower-challenges-eu.

Zhao, D., Zhongbao, G, and Jinqiao, X. (2020). *Research on scrap recycling of retired civil aircraft*, *IOP Conference Series: Earth and Environmental Science* 657, p. 012062. DOI: 10.1088/1755-1315/657/1/012062.

Zhiyan Consulting (2022). *2022-2028 China Titanium Industry Market In-depth Analysis and Development Scale Forecast Report* (in Chinese). Excerpts available at: https://inf.news/ne/economy/a405958404a2af5c2adb171a3a21ac90.html.

Zimm, P. (2023). *Charles Edwards analysts provide outlook on growth of titanium, aerospace markets*. *Titanium Today*, Q4 2023 (9). Available at: https://titanium.org/general/custom.asp?page=TitaniumToday.

List of abbreviations and definitions

Abbreviations	Definitions
AM	Additive Manufacturing
CAAC	Civil Aviation Administration of China
CAGR	Compounded annual growth rate
CAPEX	Capital expenditure
CDI	Core Dependency Indicator
CMTA	Committee of Military Technical Assistance (USSR)
CO_2-eq	CO_2 equivalent
CRM	Critical raw material
CSR	Corporate Social Responsibility
DRTS	Direct reduction of slag with magnesium hydride (production process)
EBM	Electron beam melting
EI	Economic Importance
EoL	End of life
ESZ	Russian for Special Economic Zone (SEZ), *экономическая свободная зона*
FFC	*(a.k.a. Cambridge)* Fray-Farthing-Chen (Titanium production process)
FIGARO	Full International and Global Accounts for Research in input-Output analysis
GVA	Gross Value Added
HAMR	Hydrogen-assisted magnesiothermic reduction (production process)
GWh	Gigawatt-hour (energy unit). 1 GWh = 3,600,000 MJ.
HS	Harmonised System
IC-SUIOT	EU Inter-Country Supply, Use and Input-Output Tables
kt	Kilotonnes (million kilograms)
LNG	Liquified Natural Gas
OEM	Original Equipment Manufacturer
MJ	Megajoule (energy unit). 1 MJ = 10^6 J.
OPEX	Operational expenditure
PAM	Plasma arc melting
PEST	Political, Economic, Social and Technological factors
PQ	Premium quality sponge

Abbreviations	Definitions
PTA	Purified terephthalic acid ($C_6H_4(CO_2H)_2$). Chemical used in plastic production
R&I	Research and Innovation
SOE	State-owned enterprise
SQ	Standard quality
SR	Supply Risk
SWD	Staff Working Document
Ti-6Al-4V	Also TA6V, titanium alloy containing 6% aluminium and 4% vanadium
UAV	Unmanned aerial vehicle
VAR	Vacuum arc remelting
VAT	Value-Added Tax

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Figure 4. *Global production of titanium sponge by country, 2008-2023, in kt*

i) Statistics on global titanium sponge production are not available. Country-specific data are not always consistent and may vary according to the reporter. ii) The US production in 2020-2023 is estimated on the basis of US operating capacity in each year and the global capacity utilisation rate.

Figure 5. *Operating capacity for titanium sponge by quality, 2023*

The aerospace-grade sponge capacity of China is estimated on the assumption that 30% of the Chinese demand for aerospace applications is covered by domestic production in accordance with Hu et al. (2022). Data used in the estimation are sourced from Wang (2023).

Figure 6. *Evolution of global capacity and production of titanium sponge, 2008-23, in kt*

i) The capacity of aerospace-grade sponge over time is derived from certifications received by producing companies. ii) The aerospace-grade capacity in China is approximated on the basis of information provided by Hu et al. (2022) and Wang (2023).

Figure 8. *Global production of melted products (ingots), 2008-2020, in kt*

i) Statistics on titanium metal ingot production are not available. ii) EU and UK production data in 2008-2011 and 2019-2020, US production data in 2019-2020, and Russian production in 2020 are an estimate based on the operating melting capacity and the production-to-capacity ratio (solid-to-liquid) for each country, as reported in the period 2008-2020. iii) Ukraine's and Kazakhstan's production of titanium ingots in 2020 is assumed equal to exports.

Figure 10. *Evolution of global melting capacity (liquid) and production (solid), in kt*

The melting capacity (liquid) is higher than the actual output of ingots, and at least twice that of sponge output, due in part to the practice of multiple melting to produce a titanium ingot, and in part to the use of scrap in the melt feedstock.

Figure 12. *Global production of titanium mill products, 2008-2021, in kt*

i) Production statistics for titanium mill products are not available. ii) The EU production is an estimate from Eurostat Prodcom (2024) for code 24.45.30.43 - Titanium and articles thereof, excluding waste and scrap, n.e.c. The split between EU shipments of unwrought and wrought products is based on 2022 data for the more granular codes 24.45.30.41 - Titanium, unwrought; powders and 24.45.30.42 - Titanium and articles thereof; bars and rods, profiles, wire, plates, sheets, strip and foil, tubes and pipes, other (excluding waste and scrap). iii) The US production in 2020-2021 and the Russian production in 2021 are estimated from their 2019 output levels and the percentage reduction observed in the rest-of-the-world producers (excluding China) in the same period.

Figure 16. *Trend of aircraft deliveries by Airbus and Boeing, 2008-2023, in units*

Airbus and Boeing accounted for two thirds of total aerospace titanium consumption in 2022. The remaining third was consumed by other aircraft OEMs (Zimm, 2023).

Figure 23. *Global trade trends in unwrought titanium (HS code 8108.20), in mass terms (kt*
Figure 26. *Global trade trends in other titanium products (HS code 8108.90), in mass terms (kt*
Figure 28. *Global trade trends in titanium waste & scrap (HS code 8108.30), in mass terms (kt*

While the usual approach is to reconcile exports and mirroring imports, a comparison revealed that the rest of the country flows are not significantly distorted and the general trends do not vary significantly either. EU-EU flows not shown, but RoW-RoW flows shown.

Figure 24. *Global exports of titanium sponge by quantity and countries, 2016-2021, in kt*

ii) Data for Saudi Arabia are sourced from UN Comtrade for HS 810820 *Unwrought Titanium; Powders,* as Saudi Arabia is producing only titanium sponge. ii) Data for Kazakhstan and Russia in 2021 are derived from UN Comtrade (HS 810820) based on the proportion of sponge and ingots exports reported in previous years by ITA.

Figure 25. *Global exports of titanium ingots by quantity and country, 2016-2021, in kt*

i) Data for Kazakhstan and Russia in 2021 are derived from UN Comtrade (HS 810820 'Unwrought titanium; titanium powders') based on the reported proportion of sponge and ingots in their exports in previous years. ii) EU exports of ingots are estimated from Eurostat (CN 81082000) and assuming that 73% of the reported exports by quantity corresponds to ingots and 27% to powders (based on the average distribution of US exports of ingots and powders in 2026-2021).

Figure 27. *Global exports of wrought titanium by country, 2016-22, in kt*

i) For HS 810890 'Titanium; other than unwrought, n.e.c. in heading no. 8108'. Data gaps relating to exports from the UK were estimated from the reported trade value and the unit value of the UK's exports in the previous year. Russian export data in 2022 are derived from declared imports from trade partners (mirror exports).

Figure 32. *EU production of wrought titanium by country, 2009-22, in kt*

Data refer to the sold production reported by ProdCom for codes 24.45.30.43 (for 2009-2021), and 24.45.30.42 (for 2022). Annual production figures for Germany, France and Italy are commonly reported in the dataset. However, production figures for most other EU countries are often not provided in the source. As a result, the total production for these countries is estimated roughly based on the total production (of high uncertainty) reported by Prodcom.

Figure 44. *Unwrought titanium imports from Russia and Ukraine, by EU Member State*

The Import value corresponds to the annual average of unwrought titanium imports (sponge, ingots) and powders over the period 2019-2021 (CN 81082000)

Figure 46. *EU imports of wrought titanium from Russia and Ukraine by Member State*

The Import value corresponds to the annual average of imports of titanium mill products (e.g. billets, bars, tubes, wire, plates, sheets and strips) and other articles (e.g. castings) over 2019-2021 (aggregate of CN 81083000, CN 81089050, CN 81089060, CN 81089090).

Figure 48. *Variation (kt) in global exports of titanium after the Russian invasion of Ukraine*

The exports preceding the Russo-Ukrainian war refer to the year 2021, and the post-war exports refer to the annual average from 2022-2023.

Russian export data in 2022-2023 are derived from declared imports from trade partners (sponge, ingots, mill products). Data for Kazakhstan and Japan for sponge and ingots in 2022-2023 are derived from UN Comtrade (HS 810820 'Unwrought titanium; titanium powders') based on the proportion in their reported exports of sponge and ingots in previous years.

Figure 49. *Variation (kt) in annualised EU imports of titanium metal after Russia's invasion of Ukraine*

Monthly data are analysed for a period of 25 months following the Russian aggression against Ukraine (March 2022 – March 2024) in comparison to the period January 2018 - February 2022 before the Russian invasion of Ukraine. Data refer to CN 81082000 'Unwrought titanium; titanium powders' (for the left panel: unwrought); and CN 81089030 Titanium bars, rods, profiles and wire, n.e.s., CN 81089050 Titanium plates, sheets, strip and foil, CN 81089060 Tubes and pipes of titanium, CN 81089090 Articles of titanium, n.e.s. (for the right panel: wrought).

Figure 53. *Collaboration intensity in selected world regions:*
Figure 54. *Foreign collaboration intensity (as a % of total foreign collaboration) in selected world regions with the EU, the US* and China

Regional aggregates were constructed using the United Nations geo-scheme as a starting point. For Africa, few countries appear in the dataset and smaller regions (e.g. Central Africa, Eastern Africa) were grouped into a continent-level aggregate.

- *Africa:* Egypt, Ethiopia, Libya, Nigeria, South Africa, Tunisia.
- *Central and South America:* Brazil, Chile, Colombia, Ecuador, Peru.
- *East Asia:* Japan, South Korea, Taiwan.
- *Middle East:* Iran, Iraq, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Türkiye, United Arab Emirates.
- *Other developed:* Australia, Canada, Iceland, New Zealand, Norway, Switzerland, United Kingdom.
- *South Asia:* India, Pakistan, Sri Lanka.
- *Southeast Asia:* Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam.
- *Western Europe - Central Asia:* Kazakhstan, Russia, Ukraine, Uzbekistan.

Table 2. *Titanium content in selected military aircraft*

For most NATO aircraft, data on the titanium content was extracted from the sources cited in the main text of the Section, together with the following websites:

- https://cdn.ymaws.com/titanium.org/resource/resmgr/2005_2009_papers/McCormackFINAL_2007.pdf
- https://es.topwar.ru/25744-rockwell-b-1-lancer-strategicheskiy-bombardirovschik-chast-3.html
- https://web.archive.org/web/20141215053512/http://www.zvo.su/VVS/istrebitel-f-15-igl.html
- http://www.boeing.com/defense-space/military/f4/images/titanium.htm
- https://www.eurasiantimes.com/key-for-stealth-fighters-f-22-f-35-us-gets-serious-over-titanium/
- https://www.yunchtitanium.com/news/titanium-alloy-for-f-15-fighter-structure-27513648.html

For Chinese and Russian aircraft, websites in both languages were consulted, among which:

- https://bmpd.livejournal.com/2451547.html
- https://ot-a-do-ya.org/Enc/RI-SSSR-RF/Airplanes/MiG31.aspx
- https://ru.tiflange.net/info/application-of-titanium-and-titanium-alloys-in-90125405.html
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- https://titangalant.com.ua/titan-v-aviastroenii/
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Closing the loop on the EU's titanium supply chain

A new JRC report explores the supply chain of titanium metal and how increasing circularity can cut imports.



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Titanium metal is critical for the EU's aerospace and defence industries and is used in several technologies key to the green and digital transitions, such as power generation, IT equipment (smartphones, tablets and laptops), or satellites. However, the EU currently faces significant challenges due to its heavy reliance on imports for titanium metal products.

This dependency exposes the EU to potential disruptions in its supply chain, particularly as the global landscape is dominated by rising protectionism, a limited number of suppliers, and global tensions such as Russia's war on Ukraine.

A new JRC Science For Policy Report, coordinated by the JRC Centre for Advanced Studies (CAS), analyses the current landscape and suggests several policy options like strengthening international partnerships, boosting circularity, or bringing back part of the production to the EU. These measures could help secure a sustainable titanium ecosystem, enhance the EU's open strategic autonomy, and even double employment in the internal titanium sector.

The strategic relevance of titanium

The EU is a key consumer of titanium, with the use of the metal only expected to grow in the upcoming years. However, Europe's very limited capacity to produce titanium metal domestically makes it a net importer, meaning it imports more titanium than it exports.

Titanium products – ingots, bars, sheets, tube - represent the largest share of these imports, with an overall import-to-export ratio in volume terms of 6:1; the ratio for unwrought titanium – mostly sponge used to manufacture wrought products - is 10:1.

Two thirds of the EU's titanium demand are currently tied to civil aerospace applications, which provide over 400,000 jobs and account for over 2% of EU GDP; while the rest is distributed among applications outside of the aviation and the space sectors like chemical technologies, automotive, robotics, defence, or additive manufacturing (i.e. 3D printing).

Geopolitical and supply chain challenges

The EU's dependency on imports, coupled with geopolitical upheavals such as Russia's war in Ukraine, and the expected rise in demand from the aerospace and defence industries, highlights the urgency to reduce external reliance. In addition to this, there are still a very limited number of titanium producers worldwide, which makes it harder for the EU to diversify suppliers.

The global titanium landscape is concentrated in a few key regions, including China, Japan, Russia and Kazakhstan. From these, Japan focuses mostly on the production of wrought titanium, while China lacks high-grade titanium to export.

And while the EU has successfully compensated for the loss of Russian and Ukrainian titanium supplies following Russia's aggression against Ukraine, risks to the titanium supply chain persist and Russia continues to hold significant influence in the global aerospace industry as the world's largest producer of aviation-grade titanium.

Closing the loop

According to the JRC experts, improving the circularity in titanium use could help solve the EU's dependency on external countries. The circular economy also presents an opportunity to reduce titanium's environmental impact and dependency on virgin material and could help decrease titanium imports.

A key step in closing the loop could be retaining aeronautical titanium scrap and recycling it instead of returning it to non-EU suppliers. Redirecting this scrap to European facilities while supporting domestic production infrastructures could double employment in the EU's titanium sector while adding significant economic value.

Policy recommendations

In its new Science for Policy report, the JRC has come up with policy suggestions based on the EU's current priorities on decarbonisation, derisking, reshoring and critical raw materials scarcity. These support recent and upcoming policies and guidelines, such as the Critical Raw Materials (CRM) Act, the Net Zero Industry Act, the Green Deal Industrial Plan, the envisaged Clean Industrial Deal, the review of the WEEE Directive, or the Draghi Report.

These EU policy recommendations, aimed to secure a sustainable titanium ecosystem, include:

- Reshoring titanium processing: Establishing midstream production capabilities within the EU will reduce import dependency.
- Improving titanium recycling from decommissioned aircraft: Recycling titanium from decommissioned aircraft is feasible, but challenges related to profitability, regulations, and technical constraints have limited its large-scale implementation. Advancing eco-design practices and streamlining material certification processes could help overcome these barriers
- Strengthening international partnerships: Collaborations with titanium producers like Kazakhstan can diversify sourcing while encouraging sustainable practices in extraction and processing.
- Supporting Ukraine's titanium industry: Post-conflict reconstruction efforts in Ukraine should integrate its titanium production into the EU value chain.

The JRC report provides a timely and comprehensive analysis of the titanium value chain, a strategic raw material, offering valuable insights for the implementation of the Critical Raw Materials Act and supporting evidence-based decision-making. In it, experts underscore the urgent need for the EU to strengthen its open strategic autonomy in the titanium supply chain.

By advancing circularity, reshoring production, fostering international partnerships, and supporting Ukraine's titanium industry, the EU can address vulnerabilities in the metal's supply chain while aligning with broader sustainability and industrial goals. Efforts such as the European Defence Agency's (EDA) work on titanium circularity, exemplified by initiatives within the Incubation Forum for Circular Economy in European Defence (IF CEED), illustrate the practical steps that can be taken to achieve these objectives.

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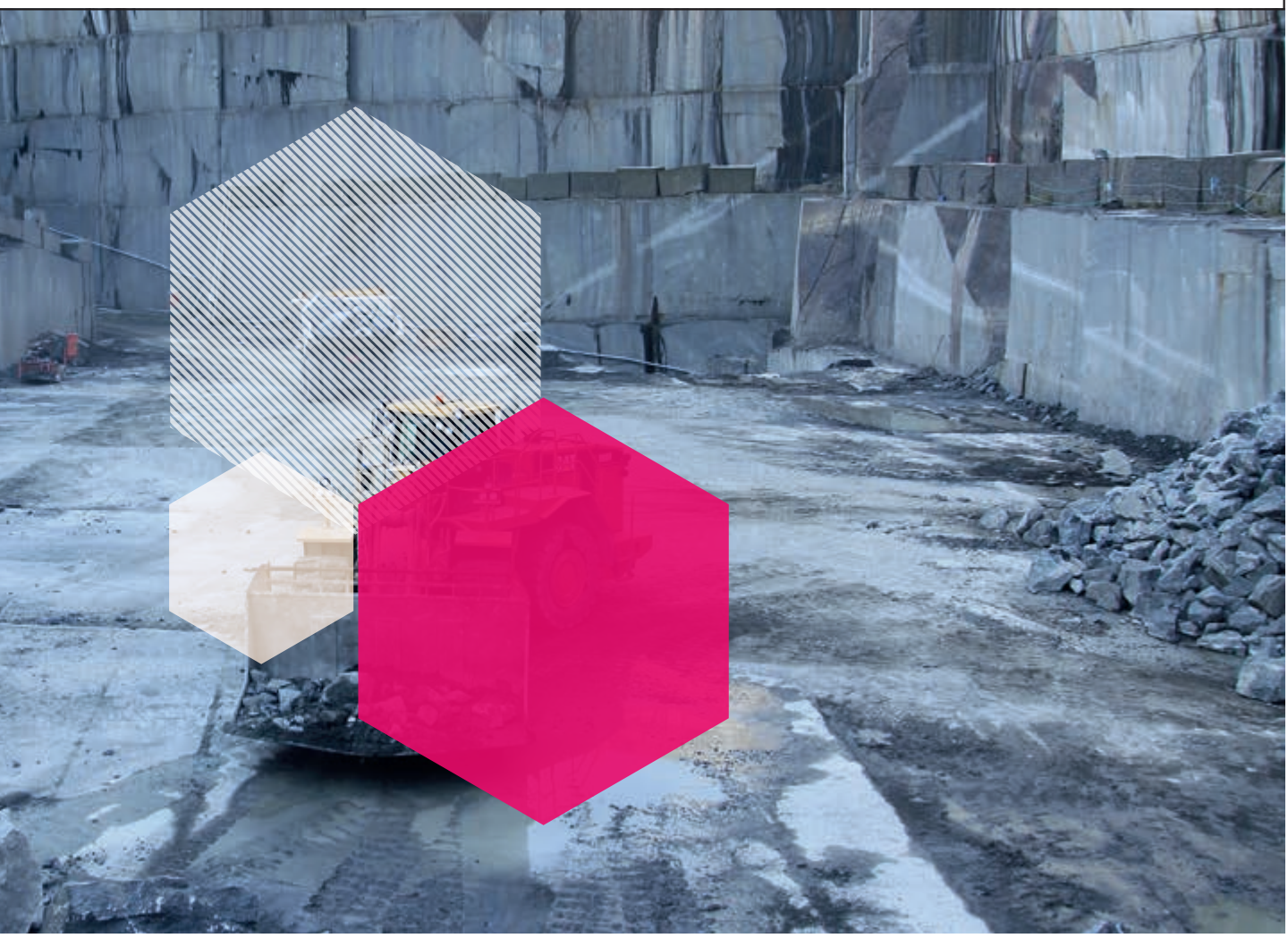
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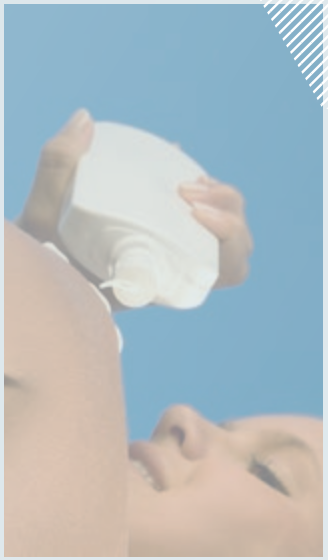


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«

Regjeringen ønsker at Norge skal være et attraktivt land å drive mineralvirksomhet i. Dette er bakgrunnen for at vi nå legger frem en strategi for mineralnæringen.

Forord

De fleste gjenstander vi omgir oss med, inneholder mineraler. Når vi bygger veier eller utvikler teknologiske produkter, er vi avhengige av mineralske råstoffer – for å nevne noen områder.

Men også vekst og stabilitet i verdensøkonomien forutsetter god tilgang på mineraler. Norske fjell inneholder store verdier i form av mineralressurser. Det er derfor avgjørende at vi forvalter mineralressursene på en god måte.

Økt internasjonal etterspørsel etter mineraler og metaller har gitt høyere priser og ført til mer interesse for norske mineralressurser. Det er økende optimisme i mineralnæringen, og mange mineralbedrifter jobber aktivt for å utnytte mulighetene som ligger i norske fjell.

I 2010 la regjeringen frem en ny minerallov som erstattet fem andre lover. Mineralloven var et viktig skritt for å forenkle regelverket på mineralfeltet, og for å skape oversiktlige og forutsigbare rammebetingelser for mineralnæringen. Saksordføreren for mineralloven, Arne L. Haugen fra bergverksbygda Løkken, sa den gangen:

«Når det gjelder de ufattelige verdiene i berggrunnen, så lar vi i alt for stor grad tilfeldighetene råde. Det må det bli slutt på. Disse verdiene må også forvaltes bærekraftig og til befolkningens beste.»

Den nye mineralloven var en god start. Denne strategien er et godt grunnlag for videre felles arbeid. Med ny teknologi, nye markedsmuligheter og nye verktøy skal vi bygge på den stolte historien bergverkindustrien har i Norge.

Regjeringen ønsker at Norge skal være et attraktivt land å drive mineralvirksomhet i. Norsk mineralnæring har gode muligheter for vekst. Lønnsomme mineralbedrifter kan skape nye verdier, bidra til flere arbeidsplasser og gi lokale, positive ringvirkninger. Ved en målrettet og langsiktig satsing på kompetanse, nyskaping og ny teknologi, kan næringen bli av stor betydning, ikke minst i distriktene.

Norsk mineralnæring skal være blant verdens mest miljøvennlige. Mineralbedriftene skal vise samfunnsansvar, og jeg er opptatt av å bidra til en god sameksistens mellom mineralnæringen, lokalsamfunnet, andre næringer og samiske interesser.

Arbeidet med strategien har vært lagt opp som en bred prosess. Vi har hatt en god dialog med mineralbedriftene, Norsk Bergindustri, mineralforvaltningen, miljøorganisasjoner, sjømatnæringen, Sametinget og andre berørte myndigheter og interessegrupper. Takk til alle som har vist et stort engasjement og gitt verdifulle innspill.

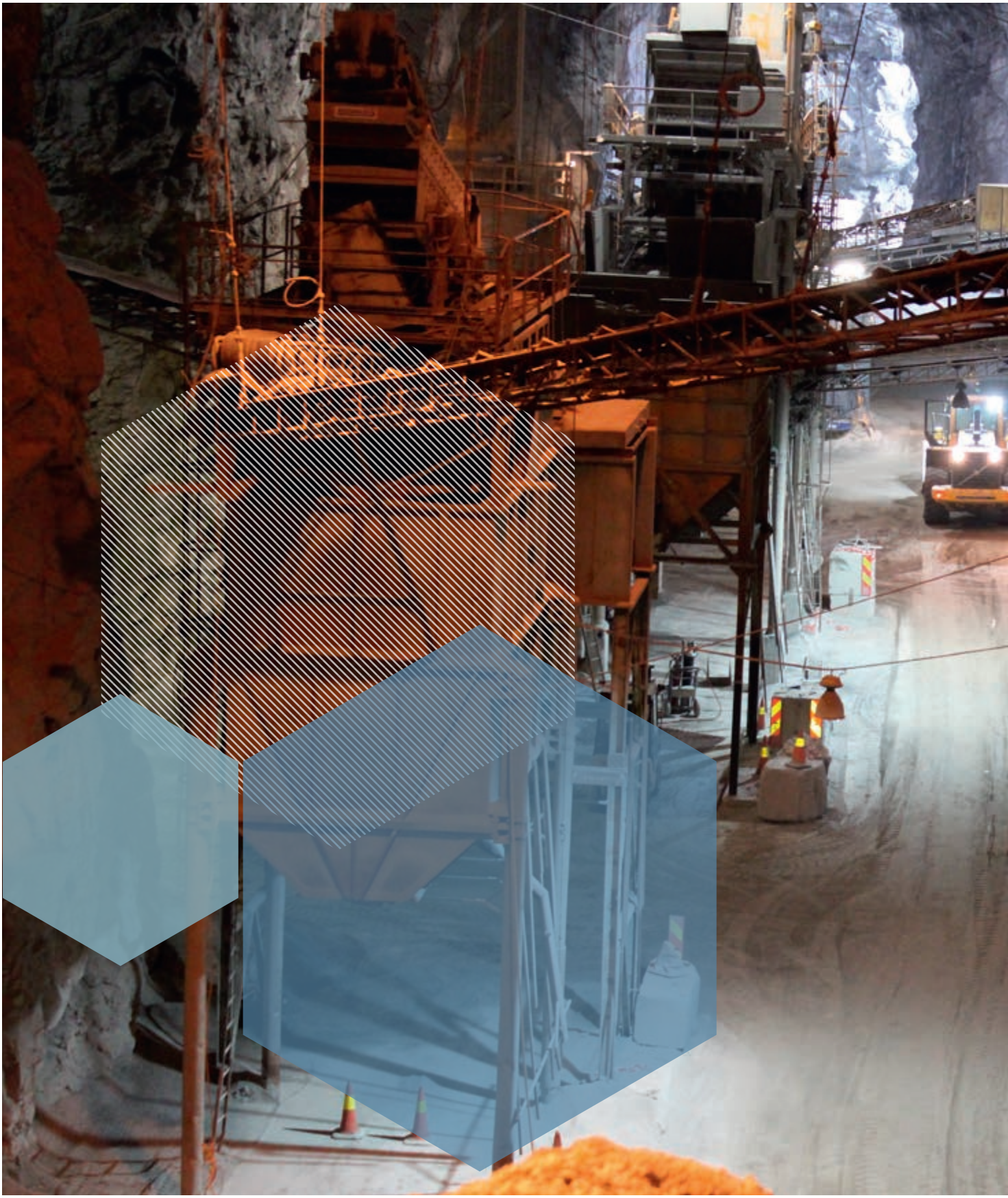
Sammen har vi lagt et solid grunnlag for å utvikle en miljømessig forsvarlig og vekstkraftig mineralnæring. Jeg vil følge opp strategien i nært samarbeid med næringen, berørte myndigheter og andre interesser for å finne solide løsninger på utfordringene. Sammen skal vi gjøre de store visjonene til virkelighet.

God lesning!



Trond Giske

Trond Giske
Nærings- og handelsminister



Arna steinknuseverk utenfor Bergen. Foto: NCC



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Regjeringens mål er en verdiskapende og lønnsom mineralnæring med god vekstkraft.

Borring i Skaland Graphites grafittgruve i Troms. Grafitt er ett av råstoffene der tilgangen for EU-landenes industri vurderes som kritisk av EU-kommisjonen.
Foto: Reiner Schaufler, Skaland Graphite



1 Sammendrag

Økte priser på metaller og mineraler har ført til en oppblomstring av mineralproduksjon flere steder i verden. Ny teknologi og utviklingen og utbredelsen av forbrukerelektronikk har gitt økt etterspørsel etter sjeldne metaller og mineraler. Dette har ført til større interesse fra EU, Kina, USA og flere andre land for å sikre tilgangen på strategisk og økonomisk viktige mineraler og metaller.

Kapittel 2 presenterer bakteppet for regjeringens strategi for mineralnæringen. Mineralnæringen bidrar med en rekke mineraler som er nødvendig for samfunnet. Mineralvirksomhet gir sysselsetting, skaper positive lokale og regionale ringvirkninger og gir skatteinntekter til samfunnet. Norge er rikt på mineralressurser, og utviklingen åpner for nye muligheter for mineralnæringen i Norge. Regjeringens mål er en verdiskapende og lønnsom mineralnæring med god vekstkraft. Norsk mineralnæring skal være blant verdens mest miljøvennlige og aktivt søke fremtidsrettede løsninger. Forutsigbar og effektiv saksbehandling skal være en rettesnor for praktisering av regelverk overfor næringen.

Kapittel 3 beskriver norsk mineralnæring og norske ressurser og muligheter. Norges geologiske undersøkelse har anslått verdien «i bakken» av kjente og undersøkte metallressurser som vurderes som lønnsomme å utvinne, til om lag 1 400 mrd. kroner. I tillegg kommer verdien av pukk- og grusressurser, naturstein, kull og industrimineraler.

Norsk mineralnæring omsatte i 2011 for 12,4 mrd. kroner og hadde 6 000 ansatte. De viktigste delene av næringen målt i omsetning er byggeråstoffer (pukk og grus) med 4,7 mrd. kroner i omsetning, industrimineraler med omsetning på 2,9 mrd. kroner, metaller (hovedsakelig jern) med 2,5 mrd. kroner i omsetning, kull for 1,4 mrd. kroner og naturstein for 900 mill. kroner. Næringen er en utpreget distriktsnæring, med Rogaland, Nordland, Finnmark og Møre og Romsdal som de viktigste fylkene målt i antall ansatte og omsetning. I tillegg er aktiviteten på Svalbard betydelig.

Kapittel 4 beskriver regjeringens strategiske innsatsområder. Samfunnsansvar og miljø, betydningen av et forutsigbart rammeverk, kartlegging av mineralressurser og viktigheten av en effektiv, kompetent og fremtidsrettet mineralforvaltning er viktige innsatsområder. Det samme

er investeringer og kapitaltilgang, utdanning og FoU. Det skal legges til rette for sameksistens mellom mineralvirksomhet, andre næringer og samiske interesser.

Mineralvirksomhet har konsekvenser for miljøet. Slik virksomhet kan også ha konsekvenser for andre næringer. En seriøs mineralnæring må ha en aktiv tilnærming til samfunnsansvar, finne de beste miljøløsningene og være en positiv drivkraft i vertskapskommunene. Miljømessig forsvarlig deponering av avgangsmasser er viktig for å få til god sameksistens med andre næringer og for å sikre at naturmiljøet ivaretas på en god måte.

Kamp om arealer kan føre til at verdifulle mineralressurser båndlegges til annen bruk. For å sikre samfunnets fremtidige behov for mineralressurser, må hensynet til mineralressurser ivaretas i den kommunale og regionale arealplanleggingen. Dette forutsetter god kunnskap om mineralressursene.

Ved vurdering av nye mineraluttak skal det gjennomføres grundige konsekvensutredninger som gir et faglig godt grunnlag for beslutninger. Samtidig må det sikres effektive og forutsigbare myndighetsprosesser. Rammeverket for mineralvirksomhet skal bli tydeligere, gi bedre forutsigbarhet og gi grunnlag for tids- og kostnadseffektive beslutningsprosesser.

Direktoratet for mineralforvaltning er statens sentrale fagetat for forvaltning og utnyttelse av mineralressursene i Norge inkludert på Svalbard. Etaten skal styrkes for bedre å kunne bistå næringen og ivareta sin rolle i forvaltningen av norske mineralressurser.

Den forsterkede satsingen på kartlegging av mineralressurser i Norge skal videreføres.

Norges geologiske undersøkelse startet i 2011 et fireårig kartleggingsprogram for geofysisk kartlegging av Nord-Norge. Når kartleggingsprogrammet er sluttført, vil om lag tre fjerdedeler av Nord-Norge være geofysisk kartlagt. I 2013 starter en tilsvarende kartlegging for Sør-Norge.

Virkemiddelapparatet har flere låne-, garanti- og tilskuddsordninger som er relevante for mineralnæringen. Det skal legges til rette for at eksisterende ordninger i det næringsrettede virkemiddelapparatet er tilgjengelige og aktuelle for aktører i mineralnæringen og at de bidrar til å utløse finansiering fra andre kilder.

Tilgang på kompetent arbeidskraft er avgjørende for mineralnæringen. Det er krevende å rekruttere nødvendig personell. Regjeringen støtter allerede et professorat i malmgeologi ved Universitetet i Tromsø og vil støtte opprettelsen av et femårig professorat i mineralteknikk ved NTNU. Regjeringen vil vurdere flere studieplasser innenfor realfag og teknologi og utvikling av fag i grunnopplæringen som er relevante for mineralnæringen. Utvikling av oppdatert kunnskap og innhenting av ny kunnskap forutsetter aktive FoU-miljøer, internasjonalt samarbeid og forsknings- og utviklingsaktivitet i bedriftene. Dette er viktig for vekst og verdiskaping i mineralnæringen, for miljøet og for samfunnet.

Regelverket for undersøkelse og utvinning av mineralressurser på den norske kontinentalsokkelen er ikke tilpasset dagens situasjon. Det er behov for en reform av regelverket.

Det er av stor betydning å skape et grunnlag for sameksistens mellom mineralnæringen, samiske interesser og andre berørte næringer og interesser. Det legges vekt på å finne løsninger for sameksistens basert på god dialog og en felles forståelse av utfordringene.

ČOAHKKÁIGEASSU

Metállaid ja minerálaid haddelassáneamit leat ealáskahttán minerálabuvttadeami olu báikkiin máilmmis. Ođđa teknologiija ja ovdáneapmi ja geavahuselektronihkalaš lávdadeapmi leat váikkuhan dasa ahte hárvenaš metállaid ja minerálaid jearut leat lassánan. Dat lea mielddisbuktán ahte EO, Kina, USA ja olu eará riikkat leat eanet beroštišgoahtán sihkkarastit ahte strategalaš ja ekonomalaš dehálaš metállat leat olaheamis.

Kapihtal 2 čilge duogáža ráđđehusa barggu birra minerálaealáhusa strategiijaiguin. Minerálaealáhus buvttada olu minerálaid maid servodat dárbbaša. Minerálaealáhus buktá bargosajiid, duddjo positiivva báikkálaš ja guovlulaš lassiváikkuhusaid ja addá vearrosisaboađuid servodahkii. Norggas leat olu minerálaresurssat, ja ovdáneapmi rahpá ođđa vejolašvuođaid minerálaealáhussii Norggas. Ráđđehusa ulbmil lea ovddidit árvobuvttadeaddji ja gánnáhahtti minerálaealáhusa mas lea buorre ovdánanvejolašvuohta. Norgga minerálaealáhus galgá leat okta daid gaskkas mii lea máilmmi buoremus birasseasti ja galgá árjjálačča t ohcat boahtteáigái heivehuvvon čovdosiid. Einnostahtti ja beaktilis áššemeannudeapmi galgá leat oaivadussan njuolggadusaid geavaheamis ealáhusa ektui.

Kapihtal 3 čilge minerálaealáhusa ja resurssaid ja vejolašvuođaid Norggas. Norgga geologalaš iskkadeamit leat meroštallan ahte árvu “eatnamiin” gos gávdnojit dovddus ja iskojuvvon metállaresurssat maid lea gánnáhahtti roggat, lea sullii 1400 mrd. kruvnnu. Dasa lassin boahtá vel árvu mollengeađge- ja čievraresurssain, luonddugeđggiin, čađain ja industriijaminerálain.

Jagi 2011 leai Norgga minerálaealáhusa gálvojohtu 12,4 mrd. kruvnnu ja das ledje 6000 bargi. Ealáhusa dehá leamos buktosat gálvojođu ektui leat huksenávdnasat (mollengeađggit ja čievra), mas gálvojohtu leai 4,7 mrd. kruvnnu, industriijaminerálaid árvu leai 2,9 mrd. kruvnnu, metállaid (eanaš ruovdi) 2,5 mrd. kruvnnu, čađaid gálvojohtu leai 1,4 mrd. kruvnnu ja luonddugeđggiid fas 900 miljovnna kruvnnu. Ealáhus lea čielga guovloealáhus, ja dehá leamos fylkkat meroštallojuvvon bargiid ja

gálvojođu ektui leat Rogalándda, Nordlándda, Finnmárku ja Møre ja Romsdal. Dasa lassin leat doaimmat Svalbárddas mearkkašahtti olu go árvvoštallá bargiid, gálvojođu ja eksportta ektui.

Kapihtal 4 čilge ráđđehusa strategalaš vuoruhanguovlluid. Servodatovddasvástádus ja biras, einnostahtti rámmaid mearkkašupmi, minerálaresurssaid kártendoaimmat ja beaktilis, gelbbolaš ja boahtteáigásaš minerálahálddašeapmi leat dehálaš vuoruhansuorggit. Seammá guoská investeremiidda ja ruhtadeapmái, ohppui ja FoU:ii. Diliid galgá láhččit nu ahte šattašii buorre ovttasdoaibman mineráladoaimma ja eará ealáhusaid ja sámiid beroštumiid gaskka.

Mineráladoaibma čuohcá birrasii. Dán lágan doaibma váikkuha maid eará ealáhusaide. Áššálaš minerálaealáhus galgá aktiivvalačča fuolahit servodatovddasvástádusa, gávdnat buoremus birasčovdosiid ja doaibmat positiivvalaš jođihanfápmun verddegielddain. Bázahusmássaid rádjamat mat dahkkojit biraslaš dohkálaš vugiin leat dehálačča oačču hit áigái buorre ovttasdoaibmama eará ealáhusaiguin ja sihkkarastá ahte luonddubiras bures vuhtiiváldjuvvo.

Eanet gilvu areálaid ektui sáhttá dagahit ahte dehálaš minerálaresurssat biddjojuvvojit earáid háldui. Sihkkarastin dihtii servodaga boahtteáiggi dárbbuid minerálaid ektui, ferte minerálaresurssaid deasttaid vuhtiiváldit gielddalaš- ja guovlulaš areálaplánabarggus. Dát gáibida máhtu minerálariggodagain.

Go ođđa minerálaid árvvoštallá roggagoahtit, de galget vuđolaš váikkuhusčielggadeamit čađahuvvot mat mearrádusaide addet fágalaš buori vuođu. Seammás ferte sihkkarastit beaktilis ja ollislaš eiseválddiidproseassaid. Mineráladoaimma rámmat galget šaddat čielgaseappot, addit buoret einnostahttinvejolašvuođa ja vuođu čađahit áige- ja gollobeaktilis mearridanproseassaid.

Minerálahálddašandirektoráhtta lea stáhta guovddáš fágaetáhta das mo hálddašit ja geavahit minerálaresurssaid Norggas, ja nu maiddái Svalbárddas. Etáhta galgá nannejuvvot vai sáhttá buorebut čuovvolit ja veahkehit ealáhusa ja gozihit iežas rolla norgga minerálaresurssaid hálddašeamis.

Minerálaresurssaid viiddiduvvon kártendoaibma Norggas galgá joatkašuvvat. Norgga geologalaš guorahallan (NGU) álggahii jagi 2011 njealjejagi geofysihkalaš kártenprográmma kártet Davvi-Norgga. Go kártenprográmma loahpahuvvo, de lea sullii golbma njealjádasoassi Davvi-Norggas kártejuvvon geofysihkalačča t. Jagi 2013 álggahuvvo seammalágan kártenprográmma Lulli-Norggas.

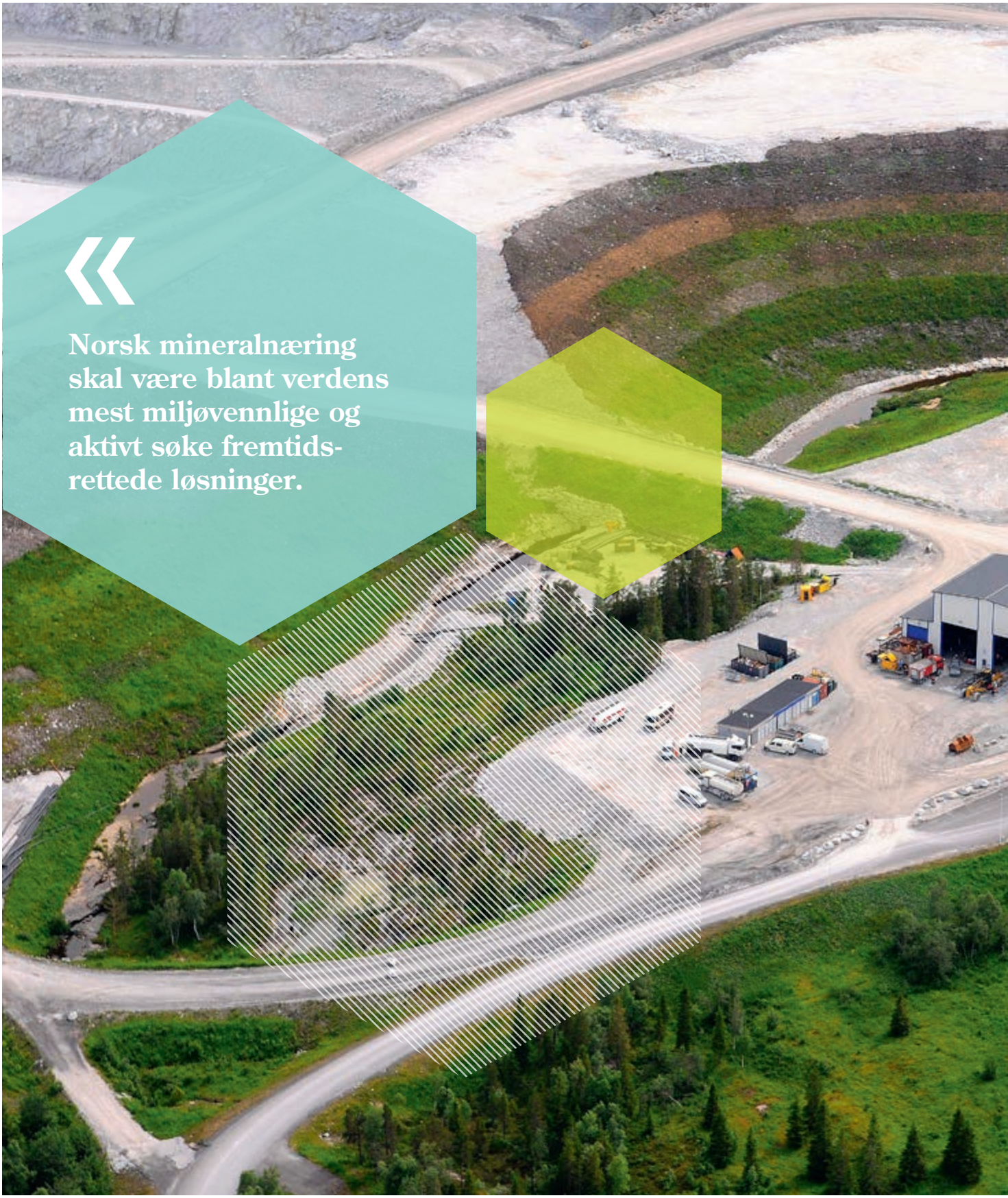
Váikkuhangaskaoapmeapparáhtas gávdnojit olu loatna-, dáhkidan- ja doarjjaortnegat maid minerálaealáhus sáhttá ávkkástallat. Dilit galget láhččojuvvot nu ahte ortnegat mat juo leat gávdnamis ealáhusguvllot váikkuhangaskaoapmeapparáhtas galget leat olámuttos ja áigeguovdil minerálaealáhusa oasálaččaide, ja váikkuhit dasa ahte earát maid servet ruhtadeapmái.

Minerálaealáhussii lea mearrideaddjin ahte gávdno gelbbolaš bargofápmu. Lea gáibideaddji háhkat dárbbašlaš bargoveaga. Ráđđehus doarju juo dál málbmageologiija professoráhta Romssa Universitehtas, ja áigu maid veahkkin ásahit viđajagi minerálateknihkalaš professoráhta NTNU:s. Ráđđehus árvvoštallá eanet lohkansajiid realfágain ja teknologiijafágain ja buoridit resurssaid dakkár fágaide vuođđooahpus mat minerálaealáhussii bohtet ávkin.

Ovddidit ođasmahttojuvvon máhtu ja čohkket ođđa dieđuid eaktuda aktiivvalaš FoU-birrasiid, riikkaidgaskasaš ovttasbarggu ja dutkan- ja ovddideaddjidoaimmaid fitnodagaid bealis. Dat lea mávssolaš minerálaealáhusa ovddideapmái ja árvobuvttadeapmái, birrasii ja servodahkii.

Njuolggadusat mat gusket minerálaresurssaid roggamušaide ja iskkademiide norgga nannánjuolggis eai leat heivehuvvon dálá áigái. Njuolggadusaid lea dárbu ođasmahttit.

Lea stuora mearkkašupmi dasa ahte minerálaealáhusa, sámi beroštumiid ja eará guoskevaš ealáhusaid ja beroštumiid gaskka ráhkaduvvo vuođđu ovttasdoaibmamii. Dan oktavuođas deattuhuvvo gávdnat ovttasdoaibmančovdosiid man vuođđun leat buorit ságastallamat ja oktasaš áddejupmi hástalusaid ektui.



Brønnøy Kalk i Nordland – eksempel på fortløpende arrondering og tilsåing/tilplanting (istandsetting) av steintipper ved dagbruddet. Foto: Brønnøy Kalk AS, Roar Berg-Hansen



2 En fremtidsrettet mineralnæring

2.1 ØKT BEHOV FOR MINERALER

Befolkningsvekst, teknologisk utvikling og økonomisk vekst, ikke minst i folkerike land i Asia, har ført til økt etterspørsel etter mineraler og metaller. Mineraler og metaller inngår i nesten all vareproduksjon, og stabil tilgang på mineraler er derfor en forutsetning for økonomisk vekst. I Norge ble det i 2011 brukt mineralske råstoffer tilsvarende 13 tonn per person.

Stigende priser på metaller og mineraler, ustabile markeder for flere mineralressurser og usikkerhet ved forsyningssituasjonen for enkelte råvarer, er utfordringer for det moderne samfunnet og for all næringsvirksomhet som benytter mineraler og metaller. Sikker tilgang på mineraler får derfor stor oppmerksomhet hos myndigheter og i næringslivet.

Norge har betydelige mineralressurser. Disse må forvaltes på en god måte for å legge til rette for vekst og for å skape lønnsomme bedrifter og arbeidsplasser i mineralnæringen. Ved å sørge for geologisk grunnlagsinformasjon av høy kvalitet, kan myndighetene gi bedriftene et godt grunnlag for å finne og utnytte nye drivverdige mineralforekomster.

Mineraler er ikke-fornybare ressurser. Sikring av tilgangen på mineraler er en stor utfordring for industriell virksomhet. Etterspørselen etter mineraler øker samtidig som mineralressursene blir mer krevende å finne og utvinne. Mineralindustrien globalt vil i økende grad ta i bruk forekomster med fattigere innhold av etterspurte mineraler. Samtidig bidrar teknologisk utvikling og produktivitetsvekst til at utvinningen stadig blir mer effektiv.

Resirkulering av metaller og mer effektiv bruk av mineraler og metaller er blitt viktigere for en bærekraftig avfalls- og ressurshåndtering og for å redusere bruken av råvarer. Noen metaller, slik som kobber, bly og aluminium, har egenskaper og bruksområder som gjør at de er godt egnet for resirkulering, og resirkuleres allerede i høy grad. Elektroniske kretskort i datamaskiner, mobiltelefoner og annet elektronisk utstyr kan inneholde flere titalls ulike metaller. Den økte bruken av elektronisk utstyr og forbruksvarer har gitt grunnlag for såkalt

«urban mining». Det vil si resirkulering av metaller fra blant annet elektronikk og hvitevarer. Effektive systemer for resirkulering bidrar til å redusere behovet for ny utvinning og er et viktig supplement til mineralutvinning for å dekke samfunnets behov for metaller.

Satsing på fornybar energi og utbredelse av mobiltelefoner, bærbare datamaskiner og andre elektroniske produkter har ført til en sterk økning i etterspørselen etter spesialmetaller. For flere av disse metallene domineres produksjonen av få land og få selskaper. For eksempel står Kina for om lag 95 pst. av produksjonen av sjeldne jordarter. I tillegg foregår en betydelig andel av verdens mineralutvinning i politisk ustabile områder. Dette er faktorer som medfører forsyningsrisiko for virksomheter som har mineraler som innsatsfaktor.

EU-landene har stor industriproduksjon sammenlignet med råvareproduksjonen. EU forbruker om lag 20 pst. av verdens metallproduksjon og står for 3 pst. av verdensproduksjonen. Usikker tilgang på metaller er derfor en betydelig utfordring for den europeiske industrien. Dette er bakgrunnen for EUs råvareinitiativ fra 2008 der den langsiktige tilgangen på råvarer, bærekraftig råvaretilgang fra europeiske kilder og resirkuleringen av metaller er sentrale elementer. Europakommisjonen fulgte i 2011 opp med en strategi for å håndtere mangelen på stabilitet i råvaremarkedene.

Flere land har etter EUs råvareinitiativ utarbeidet strategier for å sikre råvaretilgangen til egen industri og for å legge til rette for økt mineralutvinning. Frankrike, Tyskland og USA har utarbeidet strategier der det legges vekt på tilgangen på mineralske råvarer. Finland utarbeidet en mineralstrategi i 2010 og Sverige la frem en mineralstrategi i februar 2013.

FAKTA

Mineralske råstoffer er nødvendig for utvikling av infrastruktur, i bygninger og for utviklingen av nye industriprodukter. Mineraler er en viktig bestanddel i de fleste gjenstander som mennesker omgir seg med. Kaffekoppen du drikker av er fremstilt av feltspat og leire. Datamaskinen, PC-skjermen, mobiltelefonen og flisene på badet er fremstilt av mineraler. Utvikling av nye miljøvennlige produkter, mer energieffektive produkter og bedre klima kan ikke realiseres uten tilgang på et mangfold av mineraler og metaller. Elektronikkindustrien og ikke minst utviklingen av «grønn» teknologi er avhengig av mineraler. Edelmetall slik som platina, blir brukt i bilkatalysatorer, og sjeldne jordarter som f.eks. neodym blir brukt i supermagneter i vindmøller og hybridbiler.

Norsk mineralindustri bidrar med en rekke mineraler som er nødvendig for samfunnet. Kalsiumkarbonat og kalkstein brukes i blant annet sement og papir. Ren kvarts benyttes i glass, keramikk og komponenter til optiske og elektroniske instrumenter og grafitt i litium-ion batterier. Jernmalm går til stålindustrien og titan benyttes til hvitmaling (titandioksid), medisinske implantater og romfart.

FAKTA

RHI Normag AS åpnet høsten 2012 ny magnesiumproduksjon på Herøya i Porsgrunn. Fabrikken produserer ulike typer magnesiumoksid. Råvarene i RHI Normags produksjon er bergarten dolomitt som de skaffer fra Hammerfall Dolomitt AS i Sørfold og saltvann fra Frierfjorden. Fabrikken på Herøya med 200 årsverk vil være det største fused-magnesia anlegget utenfor Kina, og anses strategisk viktig for RHI Normag siden graden av selvforsyning øker. I tillegg til fused-magnesia vil RHI Normag levere magnesiumoksid til aktører i landbruk, dyrefôr, papirindustri, gummi-industri, kullkraftverk og annen kjemisk industri.

Etableringen av RHI Normag er et eksempel på at norske mineralressurser og norsk industrikompetanse kan ha strategisk betydning for europeisk industri.

2.2 REGJERINGENS VISJON FOR MINERALNÆRINGEN

Målet for regjeringens næringspolitikk er størst mulig samlet verdiskaping i norsk økonomi, noe som også innebærer full sysselsetting. Næringspolitikken skal bidra til at bedrifter lykkes og har god vekstevne. Myndighetene skal bidra med så stabile og forutsigbare rammebetingelser som mulig. Det er bedriftene selv som må utnytte mulighetene for lønnsom virksomhet. Dette er et grunnleggende perspektiv i regjeringens arbeid med mineralnæringen.

Det er de samlede rammebetingelsene som er avgjørende for å utløse vekst- og verdiskapingspotensialet i mineralnæringen. Regjeringens økonomiske politikk, energipolitikk, miljøpolitikk, samferdselspolitikk, utdannings-, innovasjons- og forskningspolitikk, et godt virkemiddelapparat og forenkling for å redusere næringslivets administrative byrder, er områder som er viktige for å utløse vekst på en bærekraftig måte.

Omdømme, samfunnsansvar, miljø og forholdet til lokalsamfunnet blir stadig viktigere. Lokalsamfunnene forventer positive ringvirkninger av mineralnæringens virksomhet, og at bedriftene driver miljømessig forsvarlig. Regjeringen forventer at selskaper som driver eller ønsker å drive mineralvirksomhet i Norge har en aktiv holdning

til samfunnsansvar, miljø, sin rolle i lokalsamfunnet og forholdet til andre næringer.

Mineralnæringen skaper arbeidsplasser og positive ringvirkninger i norske lokalsamfunn. Dette gjøres gjennom lønnsom drift, ved å ta i bruk moderne teknologi og effektive driftsmetoder og gjennom å ha høye krav til bærekraftig og miljømessig forsvarlig virksomhet.

Utvinning av metaller og mineraler innebærer miljøutfordringer. Det er avgjørende å finne miljømessig gode løsninger. Regjeringen forventer at belastningen på miljø fra næringens virksomhet blir så liten som mulig. Mineralvirksomhet kan kreve store arealer og virksomhetene har i mange tilfeller behov for å deponere store mengder restmasser. Det er viktig med langsiktige løsninger for håndtering av slike masser. Deponering må skje på en miljømessig forsvarlig måte. Regjeringen forventer at bransjen arbeider aktivt med å minimere mengden restmasser og medvirker til å utvikle løsninger for alternativ bruk av massene der dette er praktisk mulig.

En annen miljøutfordring er bruk av kjemikalier i flere produksjonsprosesser. Kjemikalier brukes til å skille ut verdifulle mineraler og urenheter, og for å binde avgangsmasser ved deponering. Utslipp og bruk av miljøgifter skal unngås. Regjeringen forventer at bransjen har en målrettet innsats og aktiv holdning mot utslipp av miljøfarlige kjemikalier.

Oppstart av ny mineralvirksomhet krever som oftest lang planlegging og store investeringer. For at mineralbedriftene skal ønske å investere i Norge er det behov for gode rammebetingelser som stimulerer til en verdiskapende og lønnsom mineralnæring. Rammeverket må legge til rette for gode, oversiktlige og effektive myndighetsprosesser. Det bidrar også til å øke forutsigbarheten for bedriftene i forbindelse med investeringsbeslutninger. For at Norge skal være et attraktivt investeringsland for mineralvirksomhet må det være en god forvaltning av mineralressursene. Dette omfatter effektiv mineralkartlegging og god ressursplanlegging.

Effektiv og miljøvennlig drift forutsetter bruk av ny kunnskap og teknologi. For å realisere vekstpotensialet i næringen, er tilgang på kvalifisert arbeidskraft og utvikling av ny kunnskap avgjørende. Gode utdanningstilbud og tilrettelegging for forskning og innovasjon er viktige faktorer for vekst i mineralnæringen.

Regjeringens mål for mineralnæringen er:

1. **En verdiskapende og lønnsom mineralnæring med god vekstkraft.**

2. **Norsk mineralnæring skal være blant verdens mest miljøvennlige og aktivt søke fremtidsrettede løsninger.**

3. **Forutsigbar og effektiv saksbehandling skal være en rettesnor for alle statlige, regionale og kommunale myndigheters praktisering av regelverk overfor næringen.**

4. **Vekstkraften i næringen skal styrkes gjennom fortsatt satsing på mineralkartlegging, tilgang på informasjon om norske mineralressurser, bedre ressursplanlegging, fortsatt utvikling av mineralforvaltningen og satsing på kunnskap og tilgang på kompetent arbeidskraft.**

Det er egne rammevilkår for mineralvirksomhet på Svalbard. Politikken for næringsvirksomhet på Svalbard er lagt i blant annet St.meld. nr. 22 (2008–2009) Svalbard og Stortingets behandling av denne, og setter f.eks. svært høye miljømål for Svalbard. Strategi for mineralnæringen medfører ingen endringer i gjeldende svalbardpolitikk, heller ikke når det gjelder mineralvirksomhet.

TILTAK

Nasjonalt mineralforum

Det skal opprettes et nasjonalt mineralforum for oppfølging av strategi for mineralnæringen. Forumet ledes av Nærings- og handelsdepartementet og skal bidra til god gjennomføring, fremdrift og forankring av tiltakene i strategien.



Flyfoto av Verdalskalk sitt anlegg i Tromsdalen. Foto: Franzefoss Minerals AS. DS.



3 Norske mineralressurser og mineralnæringen i Norge

3.1 MINERALVIRKSOMHET I NORGE

Mineralnæringen har historisk vært viktig for norsk økonomi og har også dannet grunnlag for annen næringsvirksomhet. Det er en typisk distriktsnæring med bedrifter i alle landets fylker. Næringen har noen få relativt store bedrifter, primært innenfor utvinning av jernmalm, enkelte industrimineraler og kull. De fleste bedriftene er relativt små.

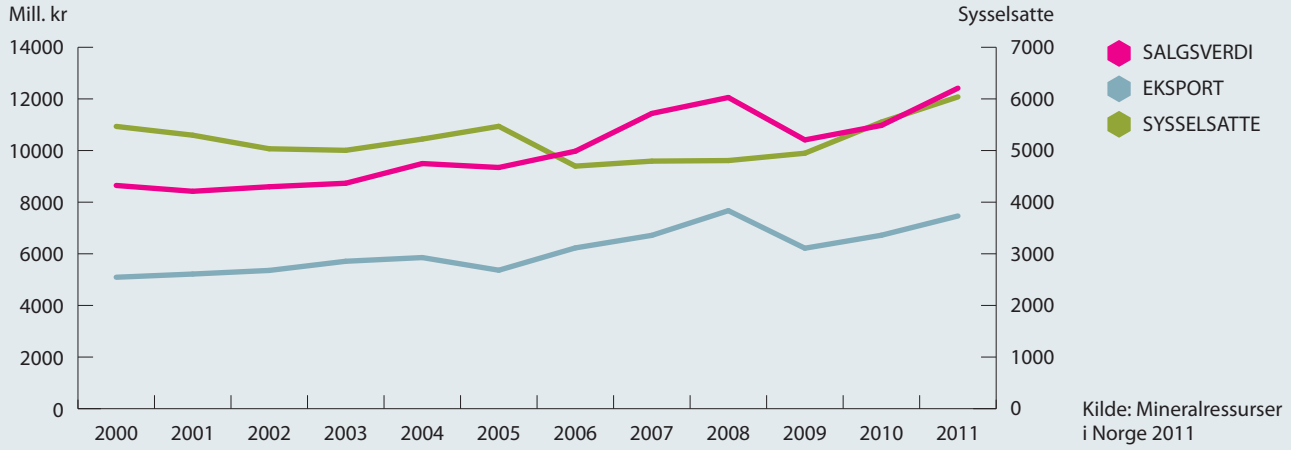
I 2011 hadde mineralnæringen vel 6 000 sysselsatte, fordelt på 1 104 uttakssteder og 833 bedrifter. Næringen omsatte for 12,4 mrd. kroner, med en eksportandel på 60 pst. Siden 2005–2006 har det vært en positiv trend i næringen med økt sysselsetting, økt omsetning og økt eksport, avbrutt av en midlertidig nedgang som følge av virkningen av finanskrisen i 2008. Det har vært relativt sterk vekst i omsetning og sysselsetting i næringen i perioden 2010–2011. I 2010 var omsetningen 10,8 mrd. kroner, og næringen hadde om lag 5 500 sysselsatte.

Det største mineralfylket i Norge målt i sysselsetting er Rogaland med om lag 800 sysselsatte i 2011. Andre store mineralfylker målt i sysselsetting er Finnmark, Nordland og Møre og Romsdal. Disse fire fylkene og Svalbard stod i 2011 for 56 pst. av samlet sysselsetting i næringen. Vestfold, Sør-Trøndelag, Akershus, Nord-Trøndelag, Sogn og Fjordane og Telemark har alle over 200 sysselsatte i næringen. Målt i omsetning er Møre og Romsdal det største mineralfylket med en samlet omsetning på 2 mrd. kroner i 2011.

Mineralbedriftene bidrar også til sysselsetting for underleverandører. Bedriftene kjøper transporttjenester, service- og vedlikeholdstjenester, og gir ringvirkninger gjennom økt aktivitet i lokalsamfunnet. Noe av produksjonen brukes også som innsatsfaktorer i industriproduksjon i Norge.

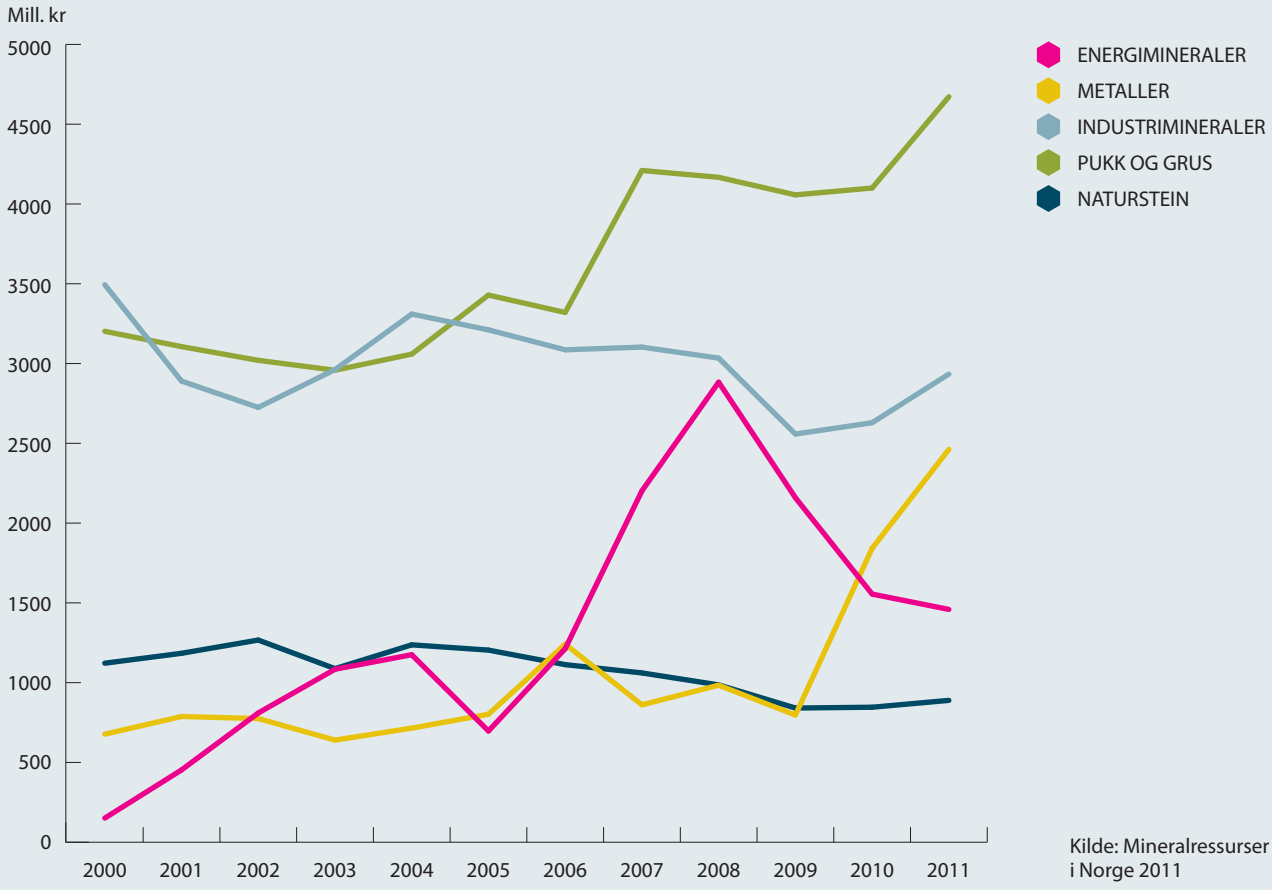
Det innenlandske forbruket av mineraler er i betydelig grad knyttet til pukk og grus til bygge- og anleggsformål, selv om også en god del av natursteinproduksjonen og noe av industrimineralproduksjonen avsettes i Norge. Innenfor

FIGUR 1 – UTVIKLING I OMSETNING (SALGSVERDI), EKSPORT OG SYSSELSATTE – PERIODEN 2000–2011



Kilde: Mineralressurser i Norge 2011

FIGUR 2 – PRODUKSJONSVERDI MINERALRESSURSER 2000–2011 (2011-VERDI)



Kilde: Mineralressurser i Norge 2011

andre deler av næringen, som malm, industrimineraler og kull, er det derimot høye eksportandeler.

Eksporten fordeler seg på en rekke mineralprodukter. De fire store eksportmineralene i 2011 var jern, kull, kalkstein og pukk. Andre viktige eksportmineraler er blokkstein (hovedsakelig larvikitt), ilmenitt (titan), olivin, nefelinsyenitt og kvarts/kvartsitt.

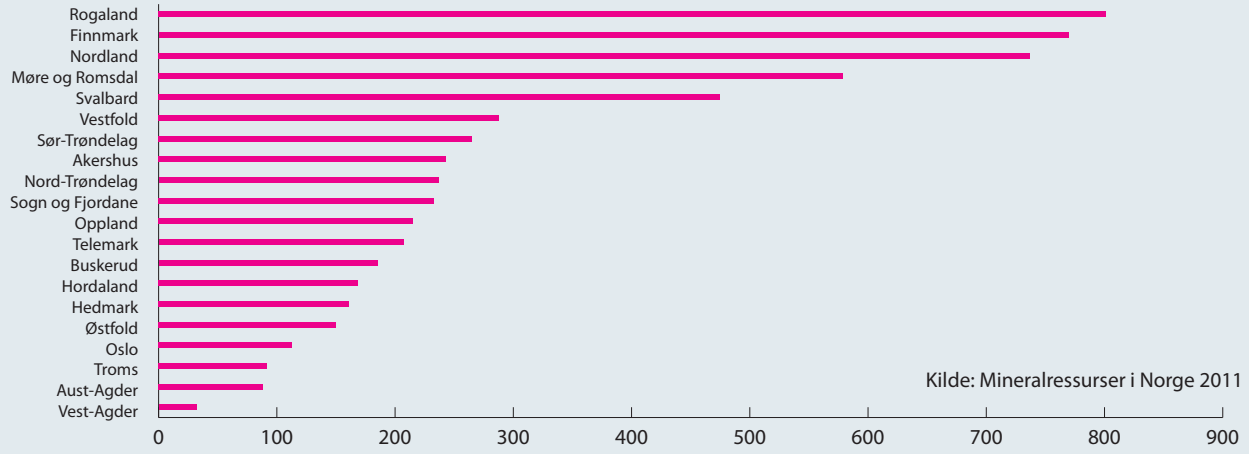
For noen tiår siden var det et betydelig innslag av offentlig eierskap i mineralnæringen. I dag har staten kun eierskap i Store Norske Spitsbergen Kulkompani AS (SNSK). Under SNSK ligger de heleide datterselskapene Store Norske Spitsbergen Grubekompani og Store Norske Gull. Det foregår utvinning av kull på Svalbard i regi av Store Norske Spitsbergen Grubekompani, mens Store Norske Gull driver lete- og undersøkelses-virksomhet på Svalbard og i Nord-Norge.

3.2 MINERALBRANSJENE

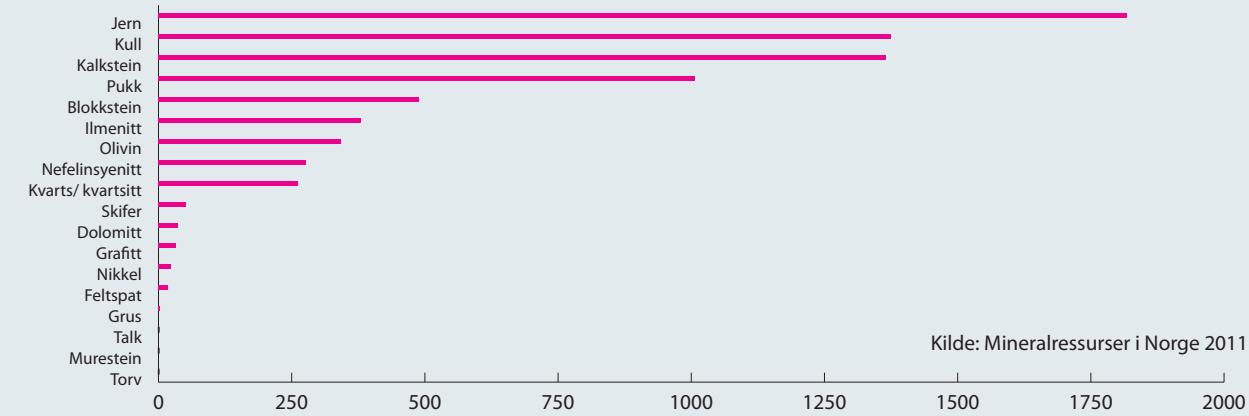
Mineralnæringen deles normalt opp etter produksjon av ulike råstoffer. Det er vanlig å skille mellom følgende fem hovedgrupper råstoffer (i parentes er utvalgte eksempler og typiske produkter angitt):

- Byggeråstoffer (pukk, sand og grus)
- Industrimineraler (kalkstein, dolomitt, olivin, kvarts og grafitt m.fl.)
- Metallmalmer (jern, nikkel og ilmenitt – titandioksid m.fl.)
- Naturstein (larvikitt, granitt, skifer m.fl.)
- Energimineraler (steinkull og torv)

FIGUR 3 – ANTALL ÅRSVERK I MINERALNÆRINGEN INKLUSIV SVALBARD – 2011



FIGUR 4 – EKSPORTVERDI ETTER RÅSTOFFTYPE –2011





Pukk brukes til veibygging, infrastruktur og husbygging. Pukk er rimelig å produsere, men dyrt å transportere. Pukk brukes fortrinnsvis lokalt. Foto: Getty Images



Bremanger Quarry i Sogn og Fjordane eksporterte i 2011 3,3 mill. tonn pukk til blant annet Nederland og Belgia. Bedriften har en CO_2-vennlig knusemetode som involverer å slippe steinen fra 200 meters høyde inne i fjellet. Her fra anlegget på Dyrstad ved Svelgen. Foto: Bremanger Quarry



Foto: NCC



BYGGERÅSTOFFER

Byggeråstoffbedriftene avsetter i hovedsak sine produkter, pukk, grus og sand, til bygge- og anleggsformål. Produktene går til mange viktige formål i samfunnet, slik som bygg, veier og anlegg, og virksomheten er i stor grad påvirket av aktivitetsnivået i disse sektorene.

Omsetningen av byggeråstoffer var i 2011 på 4,7 mrd. kroner og utgjorde dermed rundt 38 pst. av omsetningen i mineralnæringen. Om lag 2 750 personer var sysselsatte i byggeråstoffbransjen og produksjonen var fordelt på 950 små og store uttakssteder. Mange uttakssteder må ses i lys av at lange transportavstander på land ikke er forenlig med en kostnadseffektiv forsyning av pukk og grus. Beregninger foretatt av pukk- og grusnæringen antyder at ved transport over 30 kilometer fra uttaksstedet, overstiger transportkostnaden kostnaden ved selve produksjonen. Mange pukk- og grusuttak er eid av aktører innenfor bygge- og anleggssektoren.

I 2011 eksporterte bransjen for 1 mrd. kroner, noe som tilsvarer vel en femdel av omsetningen. Eksporten går til geografisk nærliggende land (Tyskland, Nederland, Danmark, Polen, Storbritannia og andre deler av Nord-Europa). Lokalisering av produksjonen i nær tilknytning til havnefasiliteter gjør eksport av pukk fra Norge lønnsomt.

BREMANGER QUARRY AS

Tidlig på 1990-tallet ble egenskapene til sandsteinen i Bremanger i Sogn og Fjordane undersøkt. Det ble konstatert at sandsteinen hadde gode egenskaper til bruk i blant annet veibygging. I dag er Bremanger Quarry AS et av de store eksportpukkverkene i Norge. Den spesielt harde sandsteinen benyttes til blant annet asfalt-produksjon i Nederland og Belgia, men også til betong, i jernbanebygging og ulike offshoreprosjekter. I 2011 eksporterte Bremanger Quarry 3,3 mill. tonn pukk og hadde en omsetning på om lag 235 mill. kroner. Selskapet i Bremanger genererer også strøm i produksjons-prosessen. Dette bidrar til mer kostnadseffektiv og bære-kraftig produksjon.



Flyfoto av Sibelco Nordics anlegg for utskipning av olivin på Åheim i Sogn og Fjordane. Foto: Harald M. Valderhaug



Kvarts brukes til blant annet solceller og glass, her i en halogenlampe. Foto: Istockphoto



Industrimineralet grafitt er en viktig bestanddel i litium-ion batterier.
Her et bilbatteri fra en Mercedes Benz. Foto: Getty Images



Titanhvitt (titandioksid) brukes som hvitfarge i blant annet plastprodukter, tannkrem, næringsmidler og kosmetikk. Foto: Istockphoto



Det er behov for mange ulike metaller ved bygging av vindmøller, blant annet jern, kobber og sjeldne jordarter. Foto: Getty Images



Nefelinsyenitt brukes som fyllstoff blant annet i keramikk, glass og maling. Foto: Shutterstock

INDUSTRIMINERALER

Industrimineraler har ofte egenskaper og kvaliteter som gir et bredt anvendelsesområde i annen industri. For enkelte industrimineraler er det smale anvendelsesområder og få produsenter på verdensbasis. Det er ikke uvanlig at produsent av industrimineralet og industribedrifter har et nært samarbeid om tilpasninger i kvalitet og egenskaper for industrimineralprodukter. Stabil tilgang på industrimineraler er helt avgjørende for den globale industrien, teknologisk utvikling og for utvikling av nye produkter. Det er sysselsatt knapt 960 personer i industrimineralbransjen. I 2011 omsatte bedriftene for 2,9 mrd. kroner, tilsvarende om lag 23 pst. av samlet omsetning i mineralnæringen. Samlet eksport av industrimineraler var 2,3 mrd. kroner, noe som innebærer at nær 80 pst. av industrimineralproduksjonen i Norge går til eksport.

En betydelig andel av industrimineralproduksjonen er knyttet til produksjon av dolomitt og kalkstein. Et tyvetalls bedrifter driver slik produksjon. Hustadmarmor i Møre og Romsdal er verdens største leverandør av kalksteinsfyllstoff til papirindustrien. Norge er også verdens største produsent av mineralet olivin som brukes i blant annet stålproduksjon. Andre industrimineraler i Norge er kvarts og kvartsitt som blant annet benyttes til fremstilling av glass, innenfor produksjon av halvledere og solceller og i metallurgisk industri. På Senja utvinner Skaland Graphite AS flakgrafitt og er en av kun to produsenter i Europa av dette mineralet.

OLIVIN I VANYLVEN

Olivin er et magnesium-jernsilikat med høyt smeltepunkt, høy egenvekt og stor varmekapasitet. Mineralet brukes blant annet i stålindustrien for å felle ut urenheter og i aluminiumsindustrien. Andre anvendelsesområder er støperisand, råstoff for ildfaste produkter og steinullproduksjon. Et nytt bruksområde for olivin som er oppdaget i den senere tid, er at mineralet egner seg godt til å absorbere en rekke tungmetaller. Ved Åheim i Vanylven utvinner Sibelco Nordic AS olivin fra en av verdens største og reneste olivinforekomster. Antatte reserver på Åheim er over 500 mill. tonn. Salget i 2011 var 2,2 mill. tonn, som utgjør om lag 40 pst. av verdens produksjon av olivin. De viktigste eksportmarkedene er Europa, men olivin fra Åheim blir i dag eksportert over hele verden.



I Klåstad brudd ved Larvik i Vestfold utvinnes om lag 20 000 m^3 granittblokker hvert år som eksporteres over hele verden. Lundhs Emerald, eller mørk larvikitt, er en granittsort som brukes til blant annet benkeplater på kjøkken, fasadeplater, gulvfliser og skulpturer. Foto: Jørn Holtan



Lundhs Antique utvinnes ved Sirevåg, Rogaland, her brukt som fliser på gulvet i Fashion avdelingen på Dubai Mall. Foto: Morten Rakke



Fasaden på Devon Tower I Calgary er kledd med Lundhs Royal Blue som er en larvikitt. Foto: Sean Phillips

NATURSTEIN

Naturstein er en samlebetegnelse på all stein som brukes i for eksempel bygninger, monumenter og utearealer. Naturstein brukes også til andre formål som eksklusive interiørprodukter. Det er vanlig å inndele naturstein i kategoriene blokkstein, skifer og murestein. Utvinning av blokkstein av larvikitt utgjør den mest betydningsfulle delen av næringen. Fra Vestfold produseres og eksporteres råblokker av larvikitt til Europa, Kina og India.

Det foregår produksjon av blokksteinprodukter i blant annet Sogn og Fjordane, Hedmark, Nordland, Buskerud og Sør-Trøndelag. I Fauskeområdet er det noe produksjon av marmor. Skifer og murestein produseres flere steder i landet. Av størst betydning er skiferproduksjonen i Alta, Oppdal og Otta.

I 2011 hadde natursteinbransjen 655 sysselsatte og den omsatte blokkstein for 534 mill. kroner, skifer for 256 mill. kroner og murestein for 131 mill. kroner. Det tilsvarer vel 7 pst. av omsetningen i mineralnæringen. Om lag 56 pst. av produksjonen går til eksport.

Bruk av mer effektivt og moderne produksjonsutstyr for utvinning av naturstein, særegen kompetanse og sjøtransport er viktige faktorer for utvikling av næringen.

LUNDHS AS – PRODUKSJON AV EKSKLUSIV LARVIKITT

Larvikitt er en av de mest eksklusive natursteintyper i verden og er kåret til Norges nasjonalbergart. Bedriften Lundhs AS er den største produsenten av naturstein i Norge med om lag 150 ansatte. Selskapet hadde en samlet omsetning på 386 mill. kroner i 2011. Nesten hele produksjonen går til eksport. De største markedene er Kina, India, Italia, Spania og Frankrike. Det er i alt 7 forskjellige typer larvikitt, med Lundhs Blue og Lundhs Emerald som de mest kjente. Larvikitt benyttes blant annet til fasadeplater, benkplater i kjøkken og bad og gulvfliser. Larvikitt pryder en rekke kjente bygg. Blant dem er verdens første syv-stjerners hotell, Burj-Al-Arab i Dubai, Jame Asr Hassanil Bolkiah-moskeen i Brunei og verdens største kjøpesenter Dubai Mall. På Manhattan i New York er en rekke butikk-fasader dekorert med larvikitt.



Oversiktsbilde dagbruddet på Tellenes, Titania A/S. Foto Titania AS/Linda Løvås

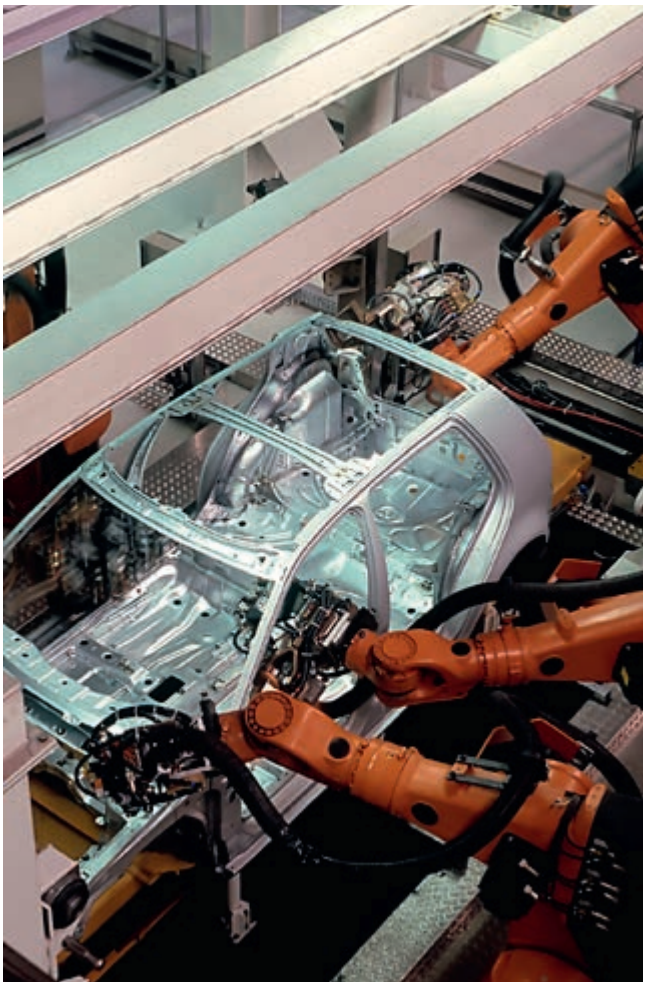
METALLMALMER

Produksjon av metallmalmer har lange tradisjoner og historisk betydning i Norge. Flere lokalsamfunn er bygget på den store økonomiske aktiviteten knyttet til utvinning av malmer. Sølvgruvene på Kongsberg, utvinning av kobberkis i trøndelagsområdet og utvinning av jern mange steder i landet er eksempler på utvinning som har hatt stor betydning.

Det var i 2011 tre produsenter av metallmalmer i Norge. Alle er blant de største mineralbedriftene i landet. I Nordland produserer Rana Gruber slig («jernpulver») og spesialprodukter med høyere bearbeidingsgrad basert på jernmalm. I Sokndal i Rogaland produserer Titania AS ilmenitt og noe nikkelkonsentrat. I Finnmark produserer Sydvaranger Gruve AS jernmalm.

Utsikter til god etterspørsel etter metaller innebærer at det igjen er økt interesse for å vurdere produksjon av malmer i Norge. Gjenåpning av jernmalmproduksjonen i Sør-Varanger høsten 2009 er et eksempel på dette. Det vurderes også oppstart av andre prosjekter. I Kvalsund i Finnmark utreder selskapet Nussir ASA muligheten for utvinning av kobbermalm, og i Sogn og Fjordane arbeider Nordic Mining ASA med planer om å utvinne rutil fra Engebøfjellet i Naustdal kommune.

I 2011 arbeidet om lag 1 060 personer i malmbransjen. Det er vekst i bransjen og omsetningen økte fra 1,8 mrd. kroner i 2010 til 2,5 mrd. kroner i 2011. Malmbransjen eksporterer nesten hele sin produksjon. I 2011 utgjorde eksportverdien 2,2 mrd. kroner, en eksportandel på nærmere 90 pst.



Jernmalm produseres hos Rana gruber og Sydvaranger gruve. Jernet produsert i disse gruvene har en rekke ulike anvendelser. Hovedproduktene går til blant annet bil- og byggeindustrien, men det produseres også spesialprodukter som går til blant annet bruk i kjemisk industri, til vannrensingsformål, malingsindustrien og betongindustrien. Foto: Istockphoto

FAKTA

Titania AS i Sokndal kommune i Rogaland er en av Europas største leverandører av råstoff til pigmentindustrien. Titania utvinner svart ilmenittkonsentrat som foredles til hvitt, rent pigment – titandioksid – som anvendes i produkter som maling, lakk, papir og plast, kosmetikk og næringsmidler. Selskapet, som ble grunnlagt i 1902, er i dag en del av det amerikanske selskapet Kronos World Wide Inc. Forekomsten i Sokndal er en av verdens største, og Titania står for om lag 6-8 pst. av årlig produksjon av dette råstoffet i verden. Kronos Titan AS i Fredrikstad er et søsterselskap av Titania. Bedriften i Fredrikstad videreforedler konsentratet til hvitt pigment.

Økte priser på jernmalm har resultert i økt jernmalmproduksjon i Norge. Veksten i mineralomsetningen i 2010 og 2011 kan delvis tilskrives dette. Rana Gruber AS er et av Norges største mineralselskaper. Produksjonen er doblet i løpet av fire år. Jernmalmforekomsten i Dunderlandsdalen er av Norges geologiske undersøkelse anslått å være Norges mest verdifulle. Sluttproduktet hematitt selges i hovedsak til metallurgisk industri og kjemisk industri. Datterselskapet RG Mineral AS produserer ulike spesialprodukter til malingprodusenter og bygge- og bilindustrien.

I Sør-Varanger har det vært lange tradisjoner for utvinning av jernmalm. Det statseide selskapet A/S Sydvaranger var i mange år en hjørnesteinsbedrift i lokalsamfunnet, men driften ble nedlagt i 1996 som følge av svak lønnsomhet. I 2009 ble det igjen startet opp jernmalmproduksjon i regi av Sydvaranger Gruve AS. Selskapet har om lag 400 ansatte og er på god vei til å nå produksjonskapasitet på 2,8 mill. tonn jernmalmkonsentrat per år. Det vurderes å øke produksjonskapasiteten ytterligere.



Utsikt fra Lunckefjellplatået mot sør over Marthabreen der vi ser utslaget fra Svea Nord under Skollfjellet og den påbegynte veien over breen mot innslaget på Lunckefjellsiden, tatt 3.mai 2012. Foto: SNSK, Malte Jochmann



ENERGIMINERALER

Energimineraler er forbindelser som avgir energi ved forbrenning. I dag er det to selskaper som driver kullproduksjon på Svalbard. Det er Store Norske Spitsbergen Grubekompani AS som har drift i Gruve 7 i Adventdalen utenfor Longyearbyen og Svea Nord om lag 60 km sør for Longyearbyen, og det russiske selskapet Trust Arktikugol i Barentsburg som startet produksjon igjen i 2011. Store Norske Spitsbergen Grubekompani er verdens nordligste gruveselskap og er fortsatt en hjørnesteinsbedrift på Svalbard.

Det er også en forholdsvis beskjeden torvproduksjon i Norge med uttak i flere fylker. Det ble omsatt kull- og torvprodukter for 1,46 mrd. kroner i 2011 og næringen hadde om lag 520 ansatte. Norsk torvproduksjon brukes hovedsakelig til jordforbedring og kompostering, men kan også brukes til energiformål. For torv er det lav eksportandel, mens eksportandelen for kull er nesten 100 pst.

3.3 MINERALRESSURSENE I NORGE

Økt lete- og undersøkelsesvirksomhet forutsetter god kunnskap om norsk berggrunn og ressurspotensial. Norges geologiske undersøkelse har som sin fremste oppgave å samle inn, bearbeide og tilrettelegge geofysiske, geokjemiske og geologiske grunnlagsdata.

Prisutviklingen på mineraler og metaller og utviklingen av ny produksjons- og leteteknologi for mineralressurser fører til at gamle ressursområder får ny verdi og at nye ressurstyper kan utforskes. En god forvaltning av mineralressursene krever et langsiktig perspektiv der både tradisjonelle råstofftyper og potensielt nye fremtidige råstofftyper blir ivaretatt. Teknologiske gjennombrudd, prisendringer og nye miljøstandarder kan utløse nye behov og betydelige endringer i etterspørsel og pris for ulike råstofftyper.

EUs råvareinitiativ påpeker svakheter og utfordringer i det globale markedet for mineralressurser, og skisserer strategier for å møte utfordringene. Også Norge og norsk næringsliv er tjent med et velfungerende globalt marked for mineraler og metaller. Blant annet importerer Norge i dag store mengder råvarer til produksjon av aluminium, nikkel og ferrolegeringer. Økt produksjon av mineraler og metaller i Norge vil være et bidrag til verdens behov for stabil tilgang på ressurser.

Norge har betydelige mineralressurser som kan bidra til Europas ressurstilgang. Norge er allerede i dag en viktig produsent av flere ressurser som eksporteres til europeiske og andre markeder. Eksempler er titanmineraler, jernmalm, kull, kalk, kvarts, nefelinsyenitt, olivin, pukk og naturstein. Norge er i tillegg Europas største produsent av aluminium, ferrolegeringer, kunstgjødsel, manganlegeringer, nikkelmetall og silisiummetall. Dette er produkter som i hovedsak er basert på import av mineralråstoff for videre bearbeiding.

Norges geologiske undersøkelse har beregnet at norske kjente og undersøkte metallressurser med dagens priser har en verdi på rundt 1 400 mrd. kroner. I tillegg kommer industrimineraler, pukk, grus, kull og naturstein, som er beregnet til anslagsvis 1 100 mrd. kroner, og alle mineralforekomster som ikke er undersøkt. Geologiske og driftstekniske forhold, prisen på arbeidskraft og andre kostnader knyttet til utvinningen vil styre hvor stor andel av «in situ» verdien som i praksis kan realiseres. Økt kartlegging og nye funn vil kunne øke verdianslagene. Priser som kan realiseres i markedet og produksjonskostnader knyttet til utvinning, vil være avgjørende for om slike ressurser kan gi grunnlag for bediftsøkonomisk lønnsom mineralvirksomhet.

De siste årene har markedene for mineralressurser endret seg betydelig. Prisene på mange mineraler og metaller har økt. Med fortsatt vekst i verdensøkonomien er det grunn til å anta at prisene på mange mineraler i fremtiden vil ligge på et høyere nivå enn i dag, selv om det også i årene fremover kan være en utfordring med svingninger i mineralprisene. Videre har den teknologiske og industrielle utviklingen medført at nye metall- og mineraltyper blir stadig viktigere. I Europa har denne utviklingen ført til en erkjennelse av at tilgangen til enkelte mineraler og metaller ikke lenger kan tas for gitt. Europakommisjonen har utarbeidet en oversikt over mineraler der produksjonen er dominert av få enkeltland. I noen tilfeller dreier det seg også om ustabile områder. Europakommisjonens mål er at industrien i EU-landene har god tilgang til mineraler fra sikre kilder.

Norge har sannsynlige forekomster av flere metaller og industrimineraler der produksjonen er dominert av et fåtall land. For noen av metallene og industrimineralene foregår det allerede produksjon i Norge. I hvilken grad det er grunnlag for fremtidig kommersiell utnytting av forekomster av andre metaller og industrimineraler som i dag ikke utvinnes i Norge, må kartlegges nærmere.

FAKTA

Norges geologiske undersøkelse har gjort anslag for in situ verdien av undersøkte mineralforekomster. Verdien er beregnet ut fra gitte råstoffpriser og anslag for mengden ressurser som antas å være lønnsomt å utvinne.

Både i Sør-Varanger i Finnmark og Rana i Nordland utvinnes jernmalm fra store forekomster. Disse har en antatt samlet in situ-verdi på om lag 400 mrd. kroner og gir dermed grunnlag for utvinning i mange år. I Naustdal kommune i Sogn og Fjordane er det funnet store forekomster av titanmineralet rutil med en anslått in situ-verdi på vel 180 mrd. kroner. I Bjerkreim i Sokndal i Rogaland er det en stor forekomst av ilmenitt, apatitt og magnetitt der in situ-verdien anslås til 230 mrd. kroner. I Oslofeltet er det funnet betydelige forekomster av molybden som antas å være blant de aller største molybdenforekomstene i Europa og der in situ-verdien anslås til om lag 50 mrd. kroner.

Kilde: Mineral- og metallressurser i Norge: «in situ» verdi av metallforekomster av nasjonal betydning

FIGUR 5: LEDENDE PRODUSENTLAND FOR UTVALGTE INDUSTRIMINERALER I 2010

	Første	%	Andre	%	Tredje	%	Σ %	Norge
Barytt	Kina	46	India	24	USA	8	78	-
Diamant	Russland	26	Botswana	20	DR Kongo	15	61	-
Feldspat	EU	33	Tyrkia	23	Kina	11	77	0.3
Flusspat	Kina	56	Mexico	18	Mongolia	7	81	-
Grafitt	Kina	86	India	5	Brasil	4	95	0.3
Gips	Kina	26	EU	15	Iran	10	51	-
Kaolin	EU	30	USA	22	Kina	11	63	-
Magnesitt	Kina	64	Russland	12	EU	12	88	-
Nefelin syenitt	Russland	84	Canada	10	Norge	6	100	6
Olivin (estimat)	Norge	43	Japan	25	EU	10	78	43
Fosfat	Kina	37	Marokko	15	USA	14	66	-
Kali salter	Canada	29	Russland	18	Hviterussland	15	62	-
Salt	Kina	23	USA	17	EU	9	49	-
Talk	Kina	27	EU	17	India	14	58	0.1

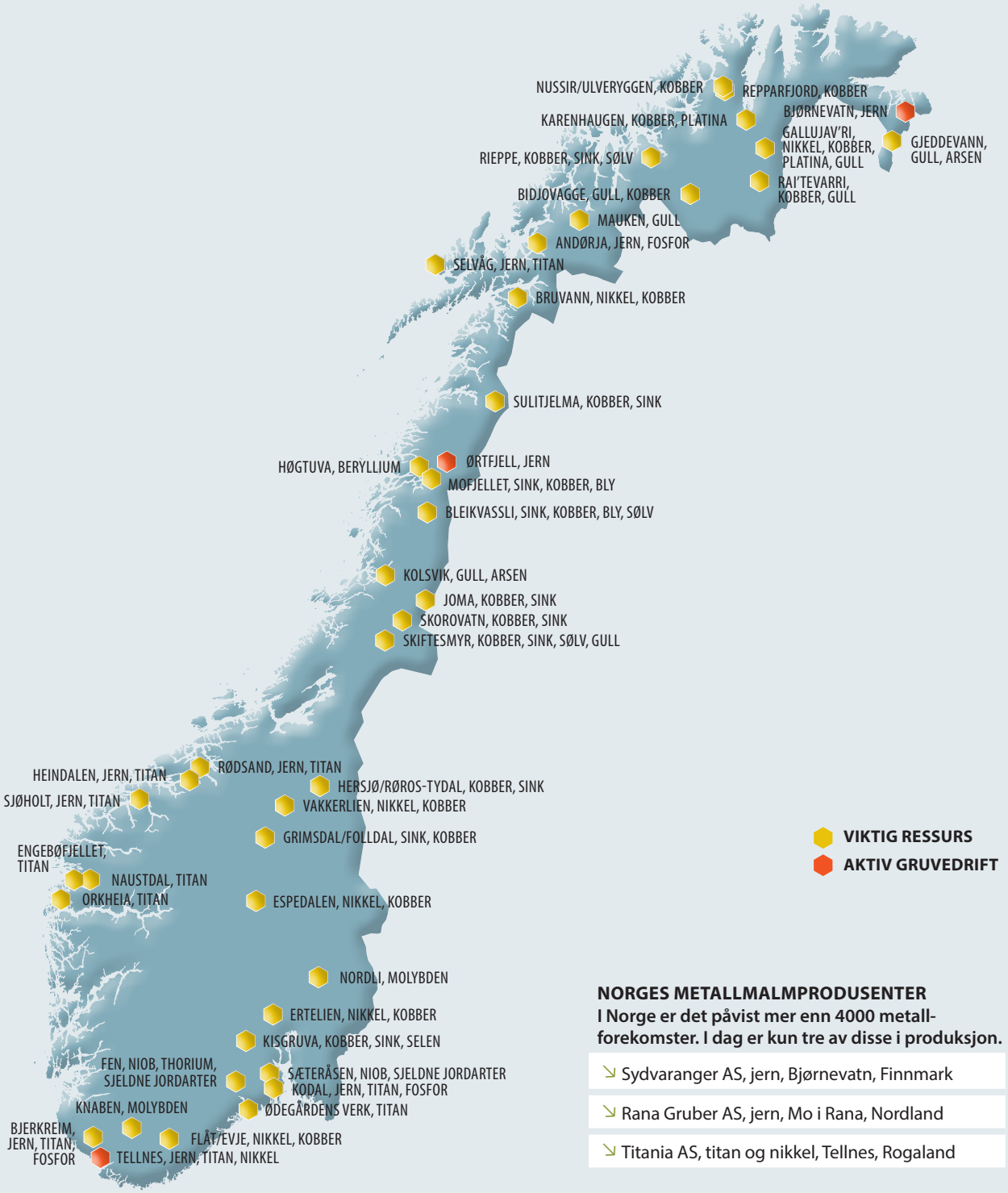
FIGUR 6: LEDENDE PRODUSENTLAND FOR UTVALGTE METALLMALMER I 2010

	Første	%	Andre	%	Tredje	%	Σ %	EU%	Norge
Antimon	Kina	88	Bolivia	3	Tadjikistan	2	93	-	-
Bauxitt	Australia	31	Brasil	15	Kina	14	60	1,4	-
Beryllium	USA	85	Kina	14	Mosambik	1	100	-	-
Krom	Sør-Afrika	36	Kazakhstan	29	India	14	79	0,3	-
Kobolt	Kongo	67	Canada	6	Australia	5	78	-	-
Kobber	Chile	33	Peru	8	Kina	7	48	4,8	-
Gull	Kina	13	Australia	10	USA	9	32	0,7	-
Jern	Kina	41	Australia	17	Brasil	14	72	1,2	0,115
Bly	Kina	43	Australia	17	USA	9	69	5,6	-
Mangan	Kina	33	Sør-Afrika	17	Australia	15	65	0,4	-
Molybden	Kina	40	USA	22	Chile	15	77	-	>0,01
Nikkel	Russland	17	Indonesia	14	Australia	11	42	4	-
Niob/Tantal	Brasil	92	Canada	7			99	-	-
Platina	Sør-Afrika	60	Russland	30	Zimbabwe	4	94	-	-
Sjeldne jordarter	Kina	98	Russland	2			100	-	-
Titanmineraler	Australia	23	Canada	22	Sør-Afrika	14	59	-	7,2
Wolfram	Kina	84	Russland	5	Bolivia	2	91	3,2	-
Vanadium	Sør-Afrika	34	Kina	33	Russland	31	98	-	-
Sink	Kina	30	Australia	12	Peru	12	54	6,6	-

Kolonnen til høyre i tabellen angir Norges andel av verdens produksjon for utvalgte mineraler. Strek betyr at det ikke er produksjon i Norge.
Rød markering betyr at det er påviste ressurser eller at det er sannsynlig at ressursen kan finnes i Norge.

Kilde: World Mineral Production 2006–2010 (British Geological Survey, 2012)

FIGUR 7– GEOGRAFISK OVERSIKT OVER METALLFOREKOMSTER AV NASJONAL BETYDNING



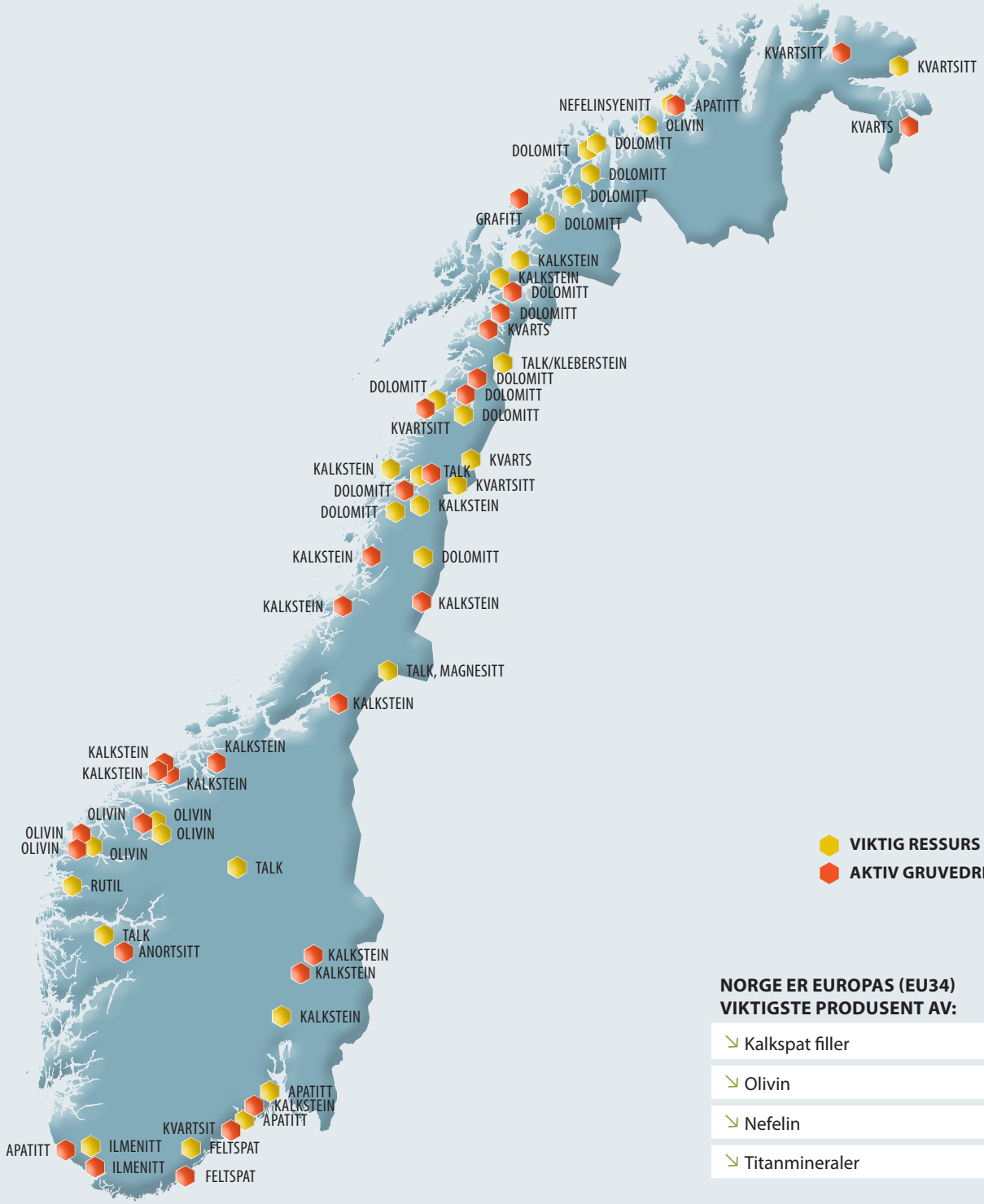
NORGES METALLMALMPRODUSENTER

I Norge er det påvist mer enn 4000 metall-forekomster. I dag er kun tre av disse i produksjon.

- Sydvaranger AS, jern, Bjørnevatn, Finnmark
- Rana Gruber AS, jern, Mo i Rana, Nordland
- Titania AS, titan og nikkel, Tellnes, Rogaland

Kilde: NGU

FIGUR 8 – GEOGRAFISK OVERSIKT OVER FOREKOMSTER AV INDUSTRIMINERALER AV NASJONAL BETYDNING



NORGE ER EUROPAS (EU34) VIKTIGSTE PRODUSENT AV:

- ↘ Kalkspat filler
- ↘ Olivin
- ↘ Nefelin
- ↘ Titanmineraler

Kilde: NGU



Gruva i Svea Nord står for det meste av Store Norskes kullproduksjon. Produksjonsmåten er longwall strossedrift. Foto: Kim Bierbauer



3.4 SÆRLIG OM MINERALVIRKSOMHET PÅ SVALBARD

St.meld. nr. 22 (2008–2009) Svalbard (Svalbardmeldingen) og Stortingets behandling av denne fastlegger hovedlinjene i regjeringens politikk for øygruppen. All virksomhet skal finne sted innenfor rammene av miljømålene som er satt for øygruppen. Disse rammene gjelder også for mineralvirksomhet.

Bergverksordningen for Spitsbergen (Svalbard) gir regler om mineralvirksomhet på øygruppen, og har blant annet bestemmelser om leting og funn, utmålsforretninger og om utmålshaveres rettigheter og plikter. Bergverksordningen administreres av Direktoratet for mineralforvaltning med Bergmesteren for Svalbard.

Leting etter og utvinning av mineraler på Svalbard er også regulert i annet regelverk som gjelder for øygruppen. Et regelverk som kan nevnes, er svalbardmiljøloven. Dette regelverket fastsetter blant annet forbud mot tyngre naturinngrep i verneområdene, krav om tillatelse for alle typer tekniske inngrep utenfor verneområdene og krav om konsekvensutredning av alle inngrep som kan antas å ha mer enn ubetydelige virkninger på naturmiljøet.

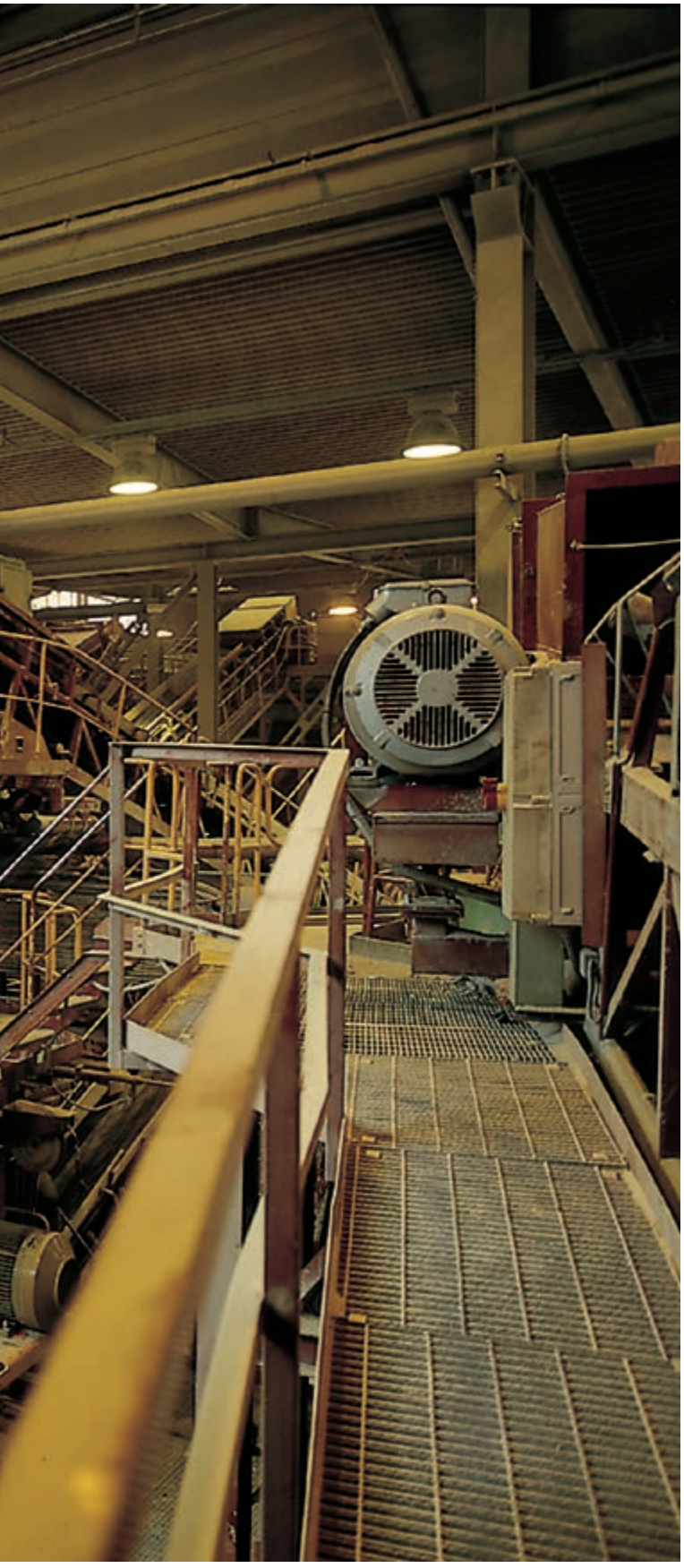
Norsk Polarinstitutt har ansvaret for den statlige geologiske kartleggingen på Svalbard. Målet for instituttets geologiske aktivitet er å gi forvaltningen og andre brukergrupper kunnskap om geologisk oppbygging, grunnforhold og geologiske ressurser i norske polarområder. Kartleggingen i regi av Norsk Polarinstitutt er av generell karakter og er ikke rettet inn mot mineralressurser.

På Svalbard utvinnes det i dag kull. Store Norske Spitsbergen Kulkompani AS produserer kull ved Longyearbyen og i Sveagruva, mens Trust Arktikugol produserer kull fra en gruve i Barentsburg. Historisk er det kun kulldrift som har vært utført i en viss målestokk på Svalbard.



Forutsigbar og effektiv saksbehandling skal være en rettesnor for alle statlige, regionale og kommunale myndigheters praktisering av regelverk overfor næringen.

Knusere i olivinsandproduksjon på Sibelco Nordics anlegg i Åheim i Sogn og Fjordane. Foto: Sibelco Nordic, P.O. Dybvik



4 Strategiske innsatsområder

4.1 KARTLEGGING AV MINERALRESSURSENE

Mineralnæringen må ha oppdatert geologisk kunnskap for å kunne drive leting, undersøkelser og utvinning. Myndighetene trenger slik informasjon for å utøve viktige samfunnsoppgaver. Norges geologiske undersøkelse er myndighetenes sentrale fagorgan for geologisk kunnskap.

Norges geologiske undersøkelse har som hovedoppgave å gjennomføre geologisk oversiktskartlegging og å produsere og distribuere kunnskap om Norges berggrunn, løsmasser, grunnvann og mineralressurser. Etaten fremskaffer og tilgjengeliggjør basisdata, utvikler kunnskap om nye typer og kvaliteter av geologiske ressurser og samarbeider nasjonalt og internasjonalt med forskningsmiljøer og industri. Informasjon om mineralressurser gir også lokale og regionale myndigheter et bedre beslutningsgrunnlag i areal- og ressursforvaltningen.

Norges geologiske undersøkelse formidler geologisk kunnskap til næringsliv og forvaltning gjennom offentlig tilgjengelige databaser, rådgivning og veiledning. Tilgang på geologiske data av god kvalitet er grunnlaget for bedriftenes leting og undersøkelser. Slike data gir bedriftene et verktøy for å finne drivverdige forekomster.

Store deler av eksisterende kartlegging av norske mineralressurser har en kvalitet som gir mineralbedriftene et begrenset grunnlag for å vurdere sannsynligheten for å finne drivverdige forekomster. Geofysisk kartlegging fra fly eller helikopter av radioaktivitet, magnetiske egenskaper og elektromagnetisk ledeevne gir mineralbedriftene et vesentlig bedre informasjonsgrunnlag. Mens Finland og Sverige har gjennomført geofysisk kartlegging av nesten hele sitt landareal, har Norge kun gjennomført slik kartlegging for om lag 30 pst. av landarealet. Norges geologiske undersøkelse startet i 2011 et program for geofysisk kartlegging i Nord-Norge (MINN – Mineralressurser i Nord-Norge). Når MINN-programmet er gjennomført, vil om lag tre fjerdedeler av landarealet i de tre nordligste fylkene være kartlagt. Tilsvarende tall for Sør-Norge er i dag 22 pst. Samlet vil Norges geologiske undersøkelse bruke i overkant av 100 mill. kroner i 2013 på kartlegging av mineralressurser. Dette er mer enn en fordobling siden 2000. Det har aldri

vært brukt så mye på kartlegging som nå. Opprettholder vi det rekordhøye nivået for kartlegging i årene fremover, vil målet om 75 pst. kartlegging kunne nås i 2018.

Norges geologiske undersøkelse disponerer et fartøy som benyttes til å kartlegge og å innhente geologisk kunnskap og kunnskap om havbunnen i kystnære områder. Nærings- og handelsdepartementet er opptatt av at kunnskapsinnhentingen på dette området er effektiv, og at det utarbeides gode marine grunnkart som kan benyttes ved planlegging av tiltak i kystsonen. Dette gir et bedre beslutningsgrunnlag ved vurderingen av blant annet utnyttelse av skjellsand- og grusforekomster og om sjøarealer eventuelt kan være egnet for sjødeponi. Departementet vil ha en nær dialog med Norges geologiske undersøkelse og berørte departementer om hvordan denne tjenesten kan utføres mest mulig effektivt. Fartøyet til Norges geologiske undersøkelse er gammelt og har høye driftskostnader.

TILTAK:

Kartlegging i Nord-Norge

Det ble i 2011 startet opp et særskilt kartleggingsprogram for Nord-Norge. Det er hittil bevilget 75 mill. kroner til kartleggingsprogrammet. Programmet har allerede bidratt til at internasjonale selskaper har vist økt interesse for Norge som mineralland.

Kartlegging i Sør-Norge

Regjeringen vil gjennomføre et særskilt program for geofysisk kartlegging i Sør-Norge. Det langsiktige målet er at 75 pst. av landarealet i Sør-Norge skal kartlegges. Det er i 2013 bevilget 10 mill. kroner til formålet.

Målrettet formidling av geologisk kunnskap

Informasjonsvirksomhet og gode nettsider skal være et prioritert innsatsområde for Norges geologiske undersøkelse. Etaten skal innen 2014 utarbeide en informasjonsstrategi om mineralforekomster i Norge rettet mot norske og utenlandske lete- og utvinningsbedrifter.

Samarbeid om geologiske kart og databaser på Nordkalotten

Land med områder nord for 60°N samarbeider om utgivelse av en serie tematiske kart og databaser for hele Nordkalotten ned til 60°N. Dette arbeidet støttes gjennom Barents 2020-tilskuddsordningen. Formålet er å gjøre geologiske data mer tilgjengelige og å harmonisere de ulike landenes datamateriale.

FAKTA

Stortinget har i 2011, 2012 og 2013 hvert år bevilget 25 mill. kroner til et kartleggingsprogram for Nord-Norge (MINN – Mineraler i Nord-Norge). Formålet er å øke kunnskapen om mineralressursene i Nord-Norge og legge til rette for økt mineralvirksomhet. Resultatene fra kartleggingen offentliggjøres gjennom nettportalen www.prospecting.no, hvor data fra Direktoratet for mineralforvaltning blir integrert med geologiske data, kartgrunnlag og arealdisponeringer. Kartleggingsprogrammet har bidratt til økt interesse for mineralvirksomhet i Norge og en betydelig økning i leteaktiviteten. Det canadiske selskapet Dalradian Resources fikk i 2011 og 2012 tildelt undersøkelsesrett til rundt 17 000 kvadratkilometer, og videreførte i 2013 undersøkelsesretten for om lag 13 000 kvadratkilometer. Selskapet rapporterte i en pressemelding i januar 2013 om lovende funn av gull i Finnmark og sølv ved Kongsberg.



Instumenter for måling av magnetiske og elektromagnetiske egenskaper i berggrunnen er plassert i en beholder som henger 30 meter under helikopteret. Foto: NGU



NGU utfører målinger av geofysiske egenskaper i berggrunnen fra helikopter som flyr lavt over terrenget. Foto: NGU

4.2 INVESTERINGER OG KAPITALTILGANG

Mineralvirksomhet er normalt kapitalintensiv og preget av høy risiko i fasen med lete- og undersøkelsesvirksomhet og i oppstartsfasen av ny gruvedrift. Det må regnes 7 til 10 år fra oppstart av en leteprosess til mineraldrift kan starte og virksomheten får inntekter. På grunn av det lange tidsperspektivet er det i tidlige faser vanlig å finansiere med egenkapital. Lånefinansiering vil i de fleste tilfeller først være aktuelt når det er etablert et grunnlag for kommersiell drift.

Mangel på tilstrekkelig egenkapital er ofte en utfordring for å kunne etablere seg i markedet.

For å supplere markedet tilbyr staten en rekke kapitalvirkemidler gjennom *Innovasjon Norge*. Disse virkemidlene kan i hovedsak deles inn i lån, garantier, tilskudd og egenkapital. Felles for kapitalvirkemidlene er at de skal bidra til å utløse bedrifts- og samfunnsøkonomisk lønnsomme prosjekter som ikke ville blitt igangsatt uten statlig støtte, eller som hadde blitt igangsatt på et senere tidspunkt eller i et mindre omfang uten den offentlige støtten. Involvering fra virkemiddelaktørene kan ha betydning for å utløse private investeringer og for etablering av ny virksomhet.

Investinor AS er et landsdekkende, statlig investeringsselskap med en bevilget egenkapital på 3,7 mrd. kroner. Selskapet bidrar med risikovillig kapital til internasjonalt orienterte og konkurransedyktige bedrifter, på forretningsmessige vilkår.

Argentum Fondsinvesteringer AS er et heleid statlig forvaltningsselskap som investerer i minoritetsandeler i spesialiserte investeringsfond for aktivt eierskap, sammen med andre fondsinvestorer. Beslutningene om hvilke selskaper fondene skal investere i, ligger til det enkelte fond. Argentum har en forvaltingskapital på om lag 6,5 mrd. kroner. Selskapet er en ledende aktør i det nordiske «private equity»-markedet, og har en portefølje på 64 fond.

SIVA – Selskapet for industrivekst SF - tilbyr tilrettelegge kommersielle investeringer i eiendom for næringsvirksomhet. SIVA jobber ofte som pådriver for større prosjekter gjennom utvikling, koordinering og mobilisering. Framover legges det til grunn at SIVA skal forsterke sitt engasjement mot større industriprosjekter av lokal, regional og nasjonal betydning. I statsbudsjettet for 2013 økes selskapets innskuddskapital med 250 mill. kroner for å styrke selskapets eiendomsvirksomhet. Dette kan være av betydning for aktører i mineralnæringen, som gjerne har prosjekter av betydelig størrelse. SIVAs virksomhet omfatter også støtte til nettverks- og inkubasjonsvirksomhet i og mellom innovasjons- og industrimiljøer i hele landet. Inkubasjon er en metode for å videreutvikle lovende forretningsideer som springer ut fra forsknings- og kunnskapsmiljøer og industrimiljøer. Nettverksutvikling og samarbeid mellom aktører kan også være aktuelt for aktører i mineralnæringen.

I mineralnæringen i Norge er det et betydelig innslag av utenlandske eiere. Dette gjelder spesielt de største bedriftene.

Det finnes norske eiere innenfor alle mineralbransjene. Disse kan ha begrenset finansiell kapasitet til å igangsette større nyetableringer på egen hånd. Det er derfor av stor betydning for mineralnæringen å tiltrekke seg seriøse internasjonale aktører med kunnskap og investeringskraft som kan bidra til å utvikle norsk mineralnæring.

AKTUELLE ORDNINGER FOR AKTØRER I MINERALNÆRINGEN UNDER INNOVASJON NORGE

LÅN OG GARANTIER

Lavrisikolån
Lavrisikolån kan benyttes til finansiering av anleggsmidler som bygninger, maskiner og driftstilbehør. Lånene gis på markedsmessige rente- og avdragsbetingelser med nedbetaling over inntil 25 år. Det kreves at låntaker har en tilfredsstillende økonomi og kan stille god pantesikkerhet for lavrisikolån, gjerne i fast eiendom, maskiner, driftstilbehør eller kausjon. Lavrisikolån kan gis over hele landet og til bedrifter i alle bransjer.

Risikolån
Risikolån/innovasjonslån kan benyttes til toppfinansiering av investeringsprosjekter som handler om nyetablering, nyskaping, omstilling, internasjonalisering og utvikling, som vanskelig lar seg finansiere i det private kredittmarkedet. Innovasjon Norges medvirkning skal ha en utløsende effekt for at prosjektet skal kunne gjennomføres. Rentene for risikolån/innovasjonslån ligger noe høyere enn de beste lånevilkårene i det private kredittmarkedet, men er gunstige sett i forhold til risikoen.

Garantier
Garanti for driftskreditt og investeringslån kan gis til små og mellomstore bedrifter som har problemer med å skaffe seg lånefinansiering i bankene på grunn av for stor antatt risiko eller manglende pantesikkerhet. En garanti fra Innovasjon Norge kan medvirke til at en lokal bank vil innvilge lån eller driftskreditt, og garantien kan slik være utløsende for realiseringen av de utviklingsplaner en bedrift har, som i en periode krever stor kapital. Garantier kan benyttes til de aller fleste prosjekter som handler om etablering, nyskaping, omstilling av nåværende virksomhet, internasjonalisering og utvikling. Målgruppen er normalt bedrifter med inntil 250 ansatte i alle bransjer over hele landet, og det er spesielt nyetableringer som prioriteres.

TILSKUDD

Innovasjon Norge har tilskuddsordninger som i prinsippet kan benyttes over hele landet, men tilskuddsrammene er størst i distriktene. Tilskudd kan i henhold til statsstøttereglene blant annet gis til følgende formål:

- SMB-støtte til konsulentbistand og andre tjenester og aktiviteter
- Støtte til opplæring
- Støtte til forskning, utvikling og innovasjon
- Støtte til investeringer

Forsknings- og utviklingskontrakter (IFU/OFU)
Industrielle forsknings- og utviklingskontrakter (IFU) skal stimulere til innovativt utviklingssamarbeid i næringslivet. Dette betyr et nært samarbeid om krevende forsknings- og utviklingsprosjekter mellom to eller flere parter, på basis av en kontraktfestet og målrettet samarbeidsavtale. IFU-kontrakten inngås mellom en kundebedrift i privat sektor og en eller flere leverandørbedrifter. Innovasjon Norge bidrar med kompetanse i internasjonal forretningsutvikling og finansielt med tilskudd for å avlaste risiko og legge til rette for iverksetting av prosjektene. IFU-tjenesten har en SMB-profil, men strategisk viktige utviklingsprosjekter i regi av større bedrifter kan også støttes. Tjenesten er også åpen for konsortier på både leverandør- og kundesiden.

Miljøteknologiordningen
Denne ordningen skal fremme norsk miljøteknologi i nasjonale og internasjonale markeder og bidra til at norsk industris konkurranseevne styrkes, blant annet gjennom utvikling og investering i pilot- og demonstrasjonsanlegg for ny norsk miljøteknologi. Ordningen er landsdekkende og rettet mot bedrifter som skal i gang med pilot- og demonstrasjonsprosjekter.

Ordningen kan være relevant for mineralnæringen pga. miljøaspektene knyttet til næringen. Støtte gjennom denne ordningen kan bidra til betydelig verdiskaping, blant annet gjennom utvikling av alternative bruksområder for restmasser, samt effektivisering av produksjonsprosesser for å redusere mengden restmasser.

Klyngeprogrammer (NCE og Arena)
Innovasjon Norge, Norges forskningsråd og SIVA samarbeider om klyngeprogrammene NCE (Norwegian Centers of Expertise) og Arena. NCE er et klyngeprogram for næringsklynger som kan hevde seg i verdenstoppen. Norge har i dag 12 sterke NCE-klynger, som er blitt utvalgt i sterk konkurranse med andre næringsmiljøer.

Arenaprogrammet er innrettet mot langsiktig utvikling av regionale næringsmiljøer. Formålet er å stimulere til økt innovasjon basert på samarbeid mellom bedrifter, FoU- og utdanningsmiljøer og offentlige utviklingsaktører. Prosjekter som opptas i programmet må være godt forankret i næringslivet, og næringsaktørene må sitte i førersetet for prosjektene.

I perioden 2008–2011 har Innovasjon Norge gitt tilsagn på totalt 470 mill. kroner i lån, tilskudd og garantier til aktører i mineralnæringen.



Kjøring av hjullaster, fra Kjellmannsåsen i Bjørnevatn i Finnmark hos Sydvaranger Gruve A/S. Foto: Bente Geving, Sydvaranger Gruve AS

TILTAK

Virkemiddelaktørene
Innovasjon Norge og SIVA skal støtte opp om regjeringens strategi for mineralnæringen gjennom å legge til rette for at gjeldende ordninger skal være aktuelle også for mineralnæringen. Virkemiddelaktørene skal bidra til å utløse finansiering fra andre aktuelle kilder.

Innovasjon Norge
Innovasjon Norges tilbud omfatter, i tillegg til finansielle ordninger, også rådgivning og nettverkssamarbeid. Regjeringen forventer at Innovasjon Norge har tilstrekkelig kompetanse om mineralnæringen til å kunne bistå bedrifter innenfor næringen på en god måte.

Invest in Norway
Det vil i 2013 bli opprettet en «Invest in Norway»-funksjon under Innovasjon Norge i samarbeid med andre virkemiddelaktører. Formålet er å tilrettelegge for en bedre håndtering av henvendelser fra utenlandske selskaper som vurderer lokalisering i Norge. Tiltaket kan være relevant for aktører i mineralnæringen som vil tiltrekke seg utenlandske investeringer.

Styrking av SIVA
SIVAs innskuddskapital økes med 250 mill. kroner i statsbudsjettet for 2013. Midlene skal gjøre selskapet i stand til å gå inn i større industrielle eiendomsprosjekter for å bidra til å realisere samfunnsøkonomisk lønnsomme investeringer og etableringer. SIVAs eiendomsvirksomhet har ingen bransjemessige føringer. Selskapets styre avgjør hvilke prosjekter selskapet engasjerer seg i.

Mineralklynge Nord
Mineralklynge Nord er valgt ut som en av syv nye næringsklynger som har fått status som Arenaprosjekt.

Miljøteknologiordning
Innovasjon Norge forvalter en egen Miljøteknologiordning. Mineralbedrifter kan søke om støtte til utvikling og investeringer knyttet til renseteknologi, mer miljøvennlige produkter og produksjonsprosesser, mer effektiv ressurshåndtering og teknologiske systemer som reduserer miljøpåvirkningen.

Investinor
Gjennom Investinor AS bidrar regjeringen med risikovillig kapital til blant annet bedrifter som utnytter viktige naturressurser eller som bidrar til mindre miljøbelastning.

Styrking og utvikling av norske bedrifter innenfor mineralnæringen
Regjeringen vil vurdere hvordan virkemidlene i næringspolitikken kan brukes for å styrke og utvikle norske bedrifter innenfor mineralnæringen.

SYDVARANGER GRUVE AS

I 2007 startet arbeidet med å gjenopprette gruvedriften ved Sydvaranger gruve. Eierne egenfinansierte den første oppstartsfasen. Innovasjon Norge bidro med 120 mill. kroner i lån og garantier. Dette utløste ytterligere lån fra andre banker og mer egenkapital fra eierne.

MINERALKLYNGE NORD

Høsten 2012 fikk syv nye prosjekter status som Arenaprosjekter. Ett av disse var Mineralklynge Nord, som samler viktige gruve- og mineralaktører fra hele Nord-Norge. Disse ønsker i felleskap å øke aktiviteten, verdiskapingen og sysselsettingen i mineralnæringen. Dette skal skje gjennom økt strategisk samarbeid, kunnskapsutvikling og internasjonal orientering. Viktige utfordringer som klyngen er opptatt av, er tilgang til kompetanse og kapital og hensyn til miljøet.

4.3 UTDANNING OG KOMPETANSE

Mineralnæringen blir stadig mer kunnskapsintensiv. Mineralbedrifter er avhengig av kompetent arbeidskraft, ikke minst innenfor teknologiske fag. Kompetent arbeidskraft er avgjørende for at mineralbedrifter skal ha høy produktivitet og være konkurransedyktige.

Kravene til innovasjon og kompetanse i mineralnæringen øker i takt med den teknologiske utviklingen, strengere miljø- og kompetansekrav, krav til økt effektivitet og bærekraftig utnyttelse av mineralressursene. Den nye mineralloven krever at drift på mineralforekomster skal skje på en bergfaglig forsvarlig måte, og at alle uttak av mineralske ressurser skal ha en person som er bergteknisk ansvarlig for driften. Dette medvirker også til skjerpede kompetansekrav til aktørene i næringen.

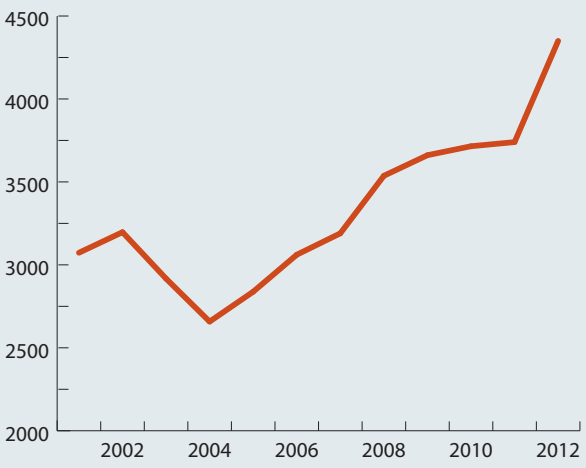
For å oppnå ambisjonen om en verdiskapende og lønnsom mineralnæring, må næringen både tiltrekke seg kompetent arbeidskraft og utvikle den eksisterende arbeidsstyrkens kompetanse. De siste årene har mineralnæringen opplevd vekst og meldt om økende problemer med rekruttering av kvalifisert personell på særlig relevante fagområder. Det er derfor behov for å stimulere til bedre rekruttering i geologiske og bergtekniske fag.

Regjeringen har lagt frem en egen realfagsstrategi (Realfag for framtida – Strategi for styrking av realfag og teknologi 2010–2014). Strategien er utviklet i samarbeid med sentrale aktører fra utdanning, forskning, næringsliv og organisasjoner. Et sentralt formål med strategien er å styrke interessen for og rekrutteringen til matematiske, naturvitenskapelige og tekniske fag (MNT-fag). Et hovedmål i strategien er å øke rekrutteringen av kvinner til MNT-fag. Mineralnæringen er i likhet med andre realfagsdominerte næringer mannsdominert.

ØKNING I OPPTAK TIL INGENIØRSTUDIER

Tall fra Samordna opptak viser at det var 25 pst. flere søkere til ingeniørutdanningen i 2012 enn i året før.

Utviklingen i opptak til 3-årig ingeniørutdanning



UTDANNINGSTILBUD SOM ER SÆRLIG AKTUELLE FOR MINERALNÆRINGEN

Utvinning og foredling av mineraler krever høy teknologisk og ingeniørfaglig kunnskap og kompetente fagarbeidere. De fleste aktørene innenfor mineralutvinning er lokalisert i distriktene. Det er derfor viktig at det lokale og regionale utdanningstilbudet har god dialog med mineralnæringen om behovet for kompetent arbeidskraft. Samtidig er det spesialiserte fagmiljøer på enkelte universiteter som kan komme hele landet til gode.

Høyere utdanningsinstitusjoner

Norges høyere utdanningstilbud innenfor geologi og andre realfaglige studier som er relevante for mineralnæringen, er spredt på universiteter og høgskoler rundt om i landet. NTNU har et av landets mest spesialiserte miljøer med et eget institutt for geologi og bergteknikk, hvor det tilbys femårig utdanning i tekniske geofag som studieretning innenfor mineralproduksjon og teknisk ressursgeologi, samt PhD-studier. Fagpersoner med utdanningen kalles ofte bergingeniør, og i dag er det stor mangel på denne ekspertisen både nasjonalt og globalt.

Bergringen er en ideell samarbeidsorganisasjon mellom studenter ved Institutt for geologi og bergteknikk på NTNU og bergindustriens bransjeorganisasjoner og bedrifter. Bergringen skal bidra til økt interesse og flere søkere til høyere utdanning innenfor bergfag.

Meld. St. 7 (2011–2012), Nordområdene – visjon og virkemidler – (Nordområdemeldingen) omtaler mineralnæringen som en mulig vekstnæring i Nord-Norge. Universitetet i Tromsø tilbyr geologistudier på bachelor- og masternivå, samt PhD-studier, og spiller en sentral rolle i kunnskapsutviklingen på lete- og prospekteringsområdet.

Høgskolen i Narvik planlegger å tilby forkurs for ingeniører på Svalbard. Kurset er utviklet i samarbeid med Longyearbyen lokalstyre, Store Norske Spitsbergen Kulkompani AS, LNS Spitsbergen AS og NITO – Norges ingeniør- og teknologorganisasjon. Dette er første gang at en utdanningsinstitusjon, en fagforening, en anleggsentreprenør, et gruveselskap og et lokalstyre går sammen om et utdanningsløp. På denne måten ønsker man å oppnå økt rekruttering til ingeniørstudier, og særlig innenfor mineralnæringen.

Regjeringen ønsker tettere koblinger mellom utdanningsinstitusjonene og næringslivet. Fra 2011 er alle statlige universiteter og høyskoler pålagt å etablere råd for samarbeid med arbeidslivet (RSA), og på den måten etablere en møteplass for tettere samhandling om utdanning og forskning som er relevant for næringslivet. Denne arenaen vil også gi mineralnæringen mulighet til å ta opp sine kompetansebehov med relevante utdanningsinstitusjoner og til å diskutere potensialet for kunnskapsutveksling med andre geologtunge næringer, i første rekke petroleumsnæringene.

Fagskoler

Fagskoleutdanningene er også en viktig bidragsyter for å utdanne kompetent arbeidskraft til mineralnæringen. Stjørdal fagskole er landets eneste fagskole som tilbyr utdanning med fordypning innenfor bygg, anlegg og bergteknikk. Dette er en mellomlederutdanning for de som har fagbrev eller lang relevant erfaring fra arbeidslivet (minimum fem år). Utdanningen gir i tillegg mulighet for generell studiekompetanse. Gjennom valgfag kan studenter som ønsker det, bygge ut studiekompetansen slik at den oppfyller krav til opptak ved videre studier i geologi og bergteknikk ved NTNU.

Fagskolene er et fylkeskommunalt ansvar og fylkeskommunene prioriterer fagskoletilbudet basert på kompetanse- og arbeidskraftsbehov i sine regioner. Dialogen mellom fylkeskommunene, fagskolene og mineralnæringen er derfor avgjørende for å sikre at det utdannes nok arbeidskraft til å møte den lokale mineralnæringens behov.

Utdanning av fagarbeidere

Mineralnæringen har et stort behov for kompetente fagarbeidere. Det er behov for yrkesfaglig kompetanse innenfor blant annet bygg og anlegg med spesialisering i fjell- og bergverksfag, men også anleggsmaskinførere og vei- og anleggsarbeidere er etterspurt kompetanse. Tilbudene til Vg2 Anleggsteknikk og Vg3 Anleggsmaskinmekaniker ved Kirkenes videregående skole har landslinjestatus. Det vil si at alle som søker til disse tilbudene, har samme rett til inntak, uansett hvor i landet de kommer fra. Videre har Fauske videregående skole en landslinje for utdanning innenfor anleggsmaskinfører og anleggsmaskinreperatør som er viktig arbeidskraft for mineralnæringen. En yrkesfaglig utdanning innebærer to år i skole og to år læretid i bedrift, med mulighet for å ta ettårig påbygning for å få generell studiekompetanse. Alternativt kan man fortsette på fagskole etter to år med fagbrev.

Etter- og videreutdanning

Betydningen av arbeidsplassen som læringsarena blir stadig viktigere, fordi virksomhetene i økende grad har spisskompetanse som ikke finnes i utdanningsinstitusjonene. Virksomhetene i mineralnæringen er spredt over store geografiske områder. I det formelle utdanningssystemet er det derfor av stor betydning at det legges til rette for fleksible og desentraliserte utdanningstilbud gjennom blant annet nettbasert undervisning, slik at det er mulig å bygge formell kompetanse samtidig som man er i jobb. Innenfor høyere utdanning tilbyr også NTNU etter- og videreutdanningskurs i ingeniørgeologi for bygge- og anleggsledere i underjordsarbeid. Kommunal- og regionaldepartementet arbeider med å fremskaffe bedre kunnskap om hva som hemmer og fremmer etter- og videreutdanning (EVU) i næringslivet på tvers av regioner og næringer.

SAMARBEID MELLOM UNIVERSITETET I TROMSØ OG MINERALNÆRINGEN

Institutt for geologi ved Universitetet i Tromsø har et omfattende samarbeid med Store Norske. På initiativ fra Store Norske, ble det opprettet et undervisningstilbud i malmgeologi ved Universitetet i Tromsø hvor Store Norske finansierer en professor 2-stilling. Dette har bidratt til at 40-50 studenter ved Universitetet i Tromsø har fått en grunnleggende utdanning i malmgeologi. Professoratet støttes også gjennom midler fra Barents 2020-programmet.

Ansatte ved Institutt for geologi har over flere år gjort geologiske observasjoner på Vannøya i Troms. Store Norske Gull har kunnet nyttiggjøre seg funnene i sin virksomhet. Etter å ha sikret seg leterettigheter over store deler av Vannøya, startet de våren 2012 med kjerneboringer. Flere studenter fra Institutt for geologi vil kobles på arbeidet gjennom sine masterstudier.

Norges geologiske undersøkelse er også en viktig samarbeidspartner for Universitetet i Tromsø, og flere av PhD- og masterstudentene mottar medveiledning og økonomisk støtte fra Norges geologiske undersøkelse. I tillegg er det samarbeid med næringslivsaktører hvor studentene utgjør en attraktiv arbeidskraft sommertids for selskaper som driver med mineralprospektering i Nord-Norge.



Montering av reguleringsventil for kjølekrets. Arbeidet utføres av lærlinger hos Hustadmarmor AS. Foto: Hustadmarmor A/S

Rekruttering av arbeidstakere
Mineralnæringen gir tilbakemelding om knapphet på arbeidskraft fra sentrale faggrupper. Foruten tiltak som rettes mot å bedre rekrutteringen til MNT-fagene nasjonalt, er arbeidsinnvandring en måte å imøtekomme behovet på. Mange av dem som nå rekrutteres til mineralnæringen fra enkelte faggrupper, kommer fra utlandet fordi det er få i Norge med riktig kompetanse.

TILTAK

Studieplasser innenfor realfag og teknologi
Regjeringen vil vurdere flere studieplasser innenfor realfag og teknologi i forbindelse med de årlige statsbudsjettene og vurdere utvikling av ressurser for fag i grunnopplæringen som er relevante for mineralnæringen.

Dialog om mineralnæringens langsiktige kompetansebehov
Regjeringen vil styrke dialogen med næringen om de langsiktige behovene for utdanning og rekruttering i næringen, og fortsette satsingen på samarbeid mellom utdanning og arbeidsliv.

Utvikling av kompetanse i mineralnæringen
I samarbeid med næringen vil regjeringen vurdere en styrking av kompetanseutvikling i mineralnæringen både for å møte kompetansekravene i mineralloven og for å sikre bærekraft i mineralutvinningen.

Professorat i mineralteknikk ved NTNU
NTNU er Norges fremste fagmiljø for høyere utdanning på mineralfeltet. Regjeringen mener det er viktig å styrke utdanningsretningen i mineralteknikk ved NTNU og har i 2013 bidratt med støtte til et professorat i mineralteknikk ved NTNU. Regjeringen vil videreføre støtten til professoratet.

Professorat i malm- og ressursgeologi ved UiT
Regjeringen bevilget høsten 2011 i alt 9 mill. kroner over fem år til et nytt professorat i malm- og ressursgeologi ved Universitetet i Tromsø. Satsingen innebærer en styrking av fagretninger som utgjør basiskunnskaper i leting, undersøkelser og analyser av mineralressurser og geologiske formasjoner.

Samarbeid med næringslivet
Regjeringen ønsker tettere koblinger mellom utdanningsinstitusjonene og arbeidslivet, og har fra 2011 pålagt alle statlige universiteter og høyskoler å etablere råd for samarbeid med arbeidslivet (RSA).

Økt rekruttering av ingeniørstudenter
Gjennom realfagstrategien arbeider regjeringen med å øke rekrutteringen til ingeniørstudier.

Landslinjetilbud
Regjeringen gir tilskudd til landslinjetilbud i blant annet Vg2 Anleggsteknikk og Vg3 Anleggsmaskinmekaniker slik at elever i hele landet kan få tilbudet.

Mer kunnskap om etterutdanning
Regjeringen vil fremskaffe mer kunnskap om hva som fremmer og hva som hemmer etter- og videreutdanning.

4.4 FORSKNING OG UTVIKLING

Forskning og kunnskapsutvikling er en forutsetning for utvikling av en effektiv, lønnsom og miljøvennlig mineralnæring i Norge. Forskning i tilknytning til leting etter, utvinning, forvaltning eller foredling av mineralske ressurser i Norge skjer både innenfor næringslivet, høyere utdanningsinstitusjoner, instituttssektoren og fagetater. Bedriftene i mineralnæringen har varierende forskningsaktivitet. Det skyldes blant annet at bedriftsstørrelsen varierer fra store internasjonale konsern til små bedrifter. Forskningsbehovet varierer også med aktivitetene. Mange bedrifter innenfor metallmalmer og industrimineraler har krevende kunder og deponeringsutfordringer som stiller krav om kontinuerlig vektlegging av FoU. Bedrifter innenfor byggeråstoffer som pukk, sand og grus, har ofte andre hovedutfordringer hvor forskning ikke står like sentralt.

Mineralvirksomhet kan påvirke natur og miljø i betydelig grad under driften og etter at den er avsluttet. For at norsk mineralnæring skal være blant verdens mest miljøvennlige, er det nødvendig at næringen kontinuerlig arbeider for en renere produksjon med mindre bruk av kjemikalier, gode deponeringsløsninger og muligheter for å redusere mengden restmasser, herunder gjennom utvikling av alternative anvendelse av restmasser. Det er også behov for mer kunnskap om miljøkonsekvenser av mineralvirksomhet.

I Nordområdemeldingen heter det at regjeringen vil legge til rette for økt verdiskaping og menneskelig aktivitet i nord, samtidig som miljøverdiene og naturmangfoldet opprettholdes. Det varsles også at kunnskapsgrunnlaget for ivaretakelse av miljøhensyn i landbasert næringsutvikling skal videreutvikles. Regjeringen vil styrke kompetansen og kunnskapen om miljø og miljøkonsekvenser av mineralvirksomhet.

Innenfor universitetsmiljøene er mye av forskningsaktiviteten konsentrert til NTNU, men også Universitetet i Bergen, Universitetet i Oslo, Universitetet i Tromsø, Universitetet for miljø- og biovitenskap og Universitetssenteret på Svalbard har virksomhet innenfor områder relatert til mineralnæringen.

Blant forskningsinstitusjonene er det spesielt SINTEF og Norges geologiske undersøkelse som har forskningsaktivitet på området. Andre nasjonale forskningsinstitusjoner som er involvert, er Norges geotekniske institutt, Institutt for energiteknikk, Norsk institutt for vannforskning og forskningskonsernet NORUT. For områdene trygg sjømat og marine økosystemer er Nasjonalt institutt for ernærings- og sjømatforskning (NIFES) og Havforskningsinstituttet sentrale.

Norges forskningsråd har en viktig rolle i det norske forskningssystemet både som forskningspolitisk rådgiver, finansiør av forskning og som møteplass. Forskningsrådet finansierer alle fagområder og alle typer forskning i spekteret fra grunnforskning til innovasjon, og skal også medvirke til internasjonalisering av norsk forskning.

Forskningsrådets støtte til forskning knyttet til mineralressurser var i 2011 på rundt 25 mill. kroner. Støtten går over flere programmer og ordninger, som Skattefunn, Brukerstyrt Innovasjonsarena (BIA), Gassmaks, Havet og Kysten, CLIMIT, senterordningen for forskningsdrevet innovasjon og ordningen med nærings-PhD. Den årlige andelen til et European Science Foundation-prosjekt [1] rettet mot mineralressurser inngår også i anslaget. Skattefunn og nærings-PhD har ikke søknadsfrist og søknader avgjøres løpende, mens øvrige ordninger er basert på nasjonal konkurranse med utlysning av midler.

Skattefunn er en rettighetsbasert skattefradragsordning der kravet til forskningshøyde ikke er stort. Bedrifter som er registrert i Norge, kan søke om fradrag på skatten for sine utgifter i forbindelse med et forsknings- eller utviklingsprosjekt. Små og mellomstore bedrifter får 20 pst. av prosjektkostnadene som skattefradrag gjennom skatteoppgjøret, mens store bedrifter får 18 pst. Kostnads-

1 European Science Foundation er en europeisk samarbeidsorganisasjon som består av i alt 79 medlemsorganisasjoner fra 30 europeiske land, vesentlig forskningsråd og vitenskapsakademier. I tillegg til Forskningsrådet er Det Norske Videnskaps-Akademi medlem på norsk side.

THE QUARTZ CORP NORWAY AS – VEKSTBEDRIFT SOM SATSER PÅ FOU

The Quartz Corp Norway (tidligere Norwegian Crystallites AS) driver mineralutvinning på Drag i Nordland. Bedriften er en av de to ledende i verden på foredling av de høyeste kvalitetene av kvarts, og har om lag 70 ansatte. Kvarts fra lokale gruver og fra forekomster i USA knuses og males til pulver som renses til svært rene produkter. Kvartspulveret fra verket eksporteres til kunder over hele verden som benytter produktene i avanserte anvendelser innenfor optisk-, solcelle- og elektronikkindustri. The Quartz Corp er en kompetansebedrift, og det utføres et betydelig utviklings- og teknologiarbeid for å øke kunnskapen om råstoffene, og forbedre renseprosessene for å kunne produsere nye og enda bedre produktkvaliteter. Bedriften har flere utviklingsprosjekter innenfor geologi, produktutvikling, prosessutvikling og bærekraft. FoU-aktiviteten skjer i betydelig grad i nært samarbeid med de norske FoU-miljøene, deriblant NTNU Institutt for geologi og bergteknikk og SINTEF Materialer og kjemi.

rammen for egenutførte FoU-prosjekter som kan inngå i fradragsgrunnlaget er 5,5 mill. kroner per bedrift per inntektsår. I ordningen ligger det et særlig incentiv til samarbeid med forskningsmiljøer ved at den årlige rammen økes til 11 mill. kroner dersom prosjektet gjennomføres med en forskningspartner. Forskningsrådet anslår næringens andel av porteføljen i Skattefunn til 0,1 pst. Bedriftene innenfor mineralnæringen synes således i liten grad å benytte seg av Skattefunn.

BIA er Forskningsrådets største program for å stimulere til økt forskningsinnsats i næringslivet. BIA støtter de beste forskningsbaserte innovasjonsprosjektene i bredden av norsk næringsliv innenfor områder som ikke er dekket av andre programmer i Forskningsrådet. Kravet til forskningshøyde er her høyere enn ved Skattefunn. I utvelgelsen av prosjekter legges det vekt på i hvilken grad prosjektene representerer innovasjon, forskningskvalitet, bedriftsøkonomisk verdi, samfunnsøkonomisk nytteverdi, internasjonal orientering og utløsende effekt på næringslivets egen FoU-innsats. Mineralnæringen har kontraktsansvar i ett av de pågående BIA-prosjektene.

NÆRINGS- PhD - DOKTORGRAD I BEDRIFTEN

Per 2012 er det igangsatt 134 prosjekter under Nærings-PhD ordningen, hvorav to prosjekter er innenfor mineralnæringen:

Sibelco Nordic AS (tidl. North Cape Minerals AS)
Økte krav til HMS og produktkvalitet er klare utviklingstrender innenfor mineralbransjen. En konsekvens av dette er at mineralbedrifter som ønsker å ha et langsiktig perspektiv for sin virksomhet, må styrke sin interne kompetanse på kunnskap om mineralogien i mineralforekomstene, og hvordan mineralene opptrer i oppredningsprosessene som er nødvendig for å gjøre råstoffet om til et salgbart produkt. Dette betyr økt prosessmineralogisk kunnskap. Formålet med prosjektet er å legge grunnlaget for en økt verdiskaping for Sibelco Nordics mineralressurser, og å sikre en langsiktig god ressursforvaltning av disse, ved å styrke den interne prosessmineralogiske kompetansen på selskapets mineralforekomster.

Norsk Mineral AS (tidl. Hustadkalk AS)
Norsk Mineral AS er leverandør av nedknust karbonatråstoff til oppredningsbedriften Hustadmarmor AS. Norsk Mineral ønsker i samarbeid med Hustadmarmor å undersøke relasjoner mellom råstoffkvalitet og prosessering av karbonater til høyverdig flytende fyllstoff og bestrykningsmiddel. Formålet er å finne ut av årsakene til uønsket varierende kvalitet av nedknust karbonatråstoff for å imøtekomme kundens ønske om stabil kvalitet.

Nærings-PhD er en relativt ny ordning som skal sikre forskerrekruttering i næringslivet. Ordningen er en treårig forskerutdannelse der kandidatene tar en ordinær doktorgrad. Stipendiatene er ansatt i en bedrift, og problemstillingen som kandidaten arbeider med i sin forskning har klar relevans for bedriften. Bedriftene som inngår avtale om Nærings-PhD, får et årlig økonomisk tilskudd fra Forskningsrådet som tilsvarer maksimalt 50 pst. av gjeldende stipendsats over 3 år.

Regjeringen har mottatt innspill fra SINTEF, NGU og NTNU om en nasjonal FoU- og innovasjonsstrategi knyttet til tilgang, utnyttelse, foredling og bruk av mineralske ressurser. Aktørene anbefaler å opprette et nytt forskningsprogram i Forskningsrådet, MINFORSK. Forskningsrådet har på sin side utarbeidet et kunnskapsgrunnlag på dette feltet, basert blant annet på egne analyser, innspill fra forskningsmiljøer og dialog med relevante næringsaktører. I dette kunnskapsgrunnlagsdokumentet beskrives ressurssituasjonen, det gis en vurdering av miljø- og samfunnsmessige utfordringer, og rammer og innhold i en mulig forsterket forskningsinnsats beskrives. Viktige forskningsområder som er identifisert omfatter blant annet miljø og sider ved forvaltning av alle faser i mineralproduksjonen, geologiske modeller og letemetoder, uttak av ressurser og drift samt tekniske løsninger for foredling av mineralske råstoffer. Dette er alle områder som kan være kritisk viktig for videre utvikling av næringen. Forskningsrådet vil bruke kunnskapsgrunnlagsdokumentet i sitt videre arbeid.

Næringsaktørene synes i begrenset grad å ha utnyttet de mulighetene som ligger innenfor eksempelvis Skattefunn og andre tilgjengelige virkemidler. Regjeringen mener at en vesentlig del av de behovene som næringen skisserer vil kunne ivaretas innenfor eksisterende virkemidler. Regjeringen vurderer det derfor per i dag mindre relevant å opprette en egen, spesifikk satsing rettet mot mineralindustrien og dens forskningspartnere, men forventer at Forskningsrådet bidrar til en aktiv mobilisering av aktørene mot aktuelle virkemidler. Hvis næringen også engasjerer seg aktivt i dette, vil Nærings- og handelsdepartementet vurdere å igangsette et forskningsprogram rettet mot mineralvirksomhet med målsetting om økt verdiskaping i næringen innenfor miljømessig forsvarlige rammer i sameksistens med andre interesser.

Regjeringen mener Norge vil ha stort utbytte av å prioritere internasjonalt samarbeid innenfor mineralfeltet.

EUs rammeprogram for forskning er det mest omfattende internasjonale samarbeidet norske forskningsmiljøer deltar i. Norge deltar i EUs rammeprogrammer for forskning og teknologisk utvikling. Deltakelsen gir norske forskningsmiljøer lik tilgang til forskningsaktivitetene innenfor rammeprogrammet som forskningsmiljøene innenfor EU.



Analyser av jordprøver kan gi viktig informasjon om fordelingen av grunnstoffer i berggrunnen. Fra NGUs feltarbeid i Tysfjord 2012. Foto: NGU

I Europakommisjonens Råvareinitiativ fra 2008 er FoU om mineralressurser et viktig satsingsområde. FoU-satsingen skal erverve kunnskap for å utvikle bærekraftig tilførsel av mineralske ressurser fra europeiske kilder, og til å redusere forbruket av mineralske råvarer gjennom økt ressurseffektivitet og resirkulering. Europakommisjonen har signalisert at rammeprogrammet Horizon 2020, som starter opp i 2014, vil styrke vektleggingen av mineraler.

Regjeringen mener norske bedrifter og forskere har gode muligheter til å hevde seg i konkurransen om EUs forskningsmidler på mineralområdet. Norges forskningsråd har en viktig rolle å spille for å gjøre flere forskningsinstitusjoner og bedrifter i stand til å delta i EU-samarbeidet.

Nordisk samarbeid er viktig for utvikling av mineralnæringen. Ressursgrunnlaget for mineraler i Norge, Sverige og Finland strekker seg på tvers av landegrensene. De tre landene kan med fordel finne felles samarbeidsområder.

Nordisk ministerråd har tatt initiativ til å etablere et felles kunnskapsnettverk for mineraler – NordMin – som skal styrke samarbeidet mellom kunnskapsmiljøer, næringen og myndighetene i de nordiske landene. En felles nordisk plattform vil også ha en positiv innvirkning på deltakelsen i EUs forskningsaktiviteter. Regjeringen ser positivt på et styrket nordisk samarbeid på dette området.

Samarbeid knyttet til mineralressurser er et prioritert område for det norske formannskapet i Barentsrådet (2011–2013). Det er allerede etablert et godt samarbeid mellom de geologiske undersøkelsene i Barentsregionen om en felles database for viktige metallforekomster. Databasen utvikles til også å dekke industrimineraler.

Andre mulige samarbeidsområder er utdanning, prospektering, teknologi, begrensning av miljøkonsekvenser, konsekvenser for reindrift og andre naturbaserte næringer og forvaltningsmessig rammeverk. Regjeringen har opprettet en stilling som spesialutsending for utdanning, forskning og teknologisamarbeid ved den norske ambassaden i Moskva med mål om å styrke samarbeidet med Russland på dette området. Regjeringen vil benytte sin formannskapsperiode i Barentsrådet til å styrke samarbeidet på mineralområdet. Når det gjelder miljøkonsekvenser av mineralvirksomhet og forholdet til urfolksinteresser i Arktis og nordområdene, er også Arktisk råd et aktuelt forum for samarbeid.

TILTAK

Mobilisering for økt bruk av FoU i mineralnæringen

Regjeringen ser betydningen av at det utvikles tilstrekkelig systematisk og langsiktig kompetanse i forskningsmiljøene og at næringen kan utnytte denne kunnskapen i egen innovasjonsvirksomhet. Regjeringen legger til grunn at Norges forskningsråd, innenfor rådets gjeldende ordninger, mobiliserer næringen til økt bruk av rådets virkemidler.

Styrket kunnskap om miljøkonsekvenser av mineralutvinning

Miljøverndepartementet vil ta initiativ til å styrke kompetansen og kunnskapen om miljøkonsekvenser av mineralvirksomhet ved Framsenteret i Tromsø. Formålet er å utvikle et sterkt fagmiljø som gjennom varig, målrettet FoU-virksomhet skal bygge opp kompetanse og fremskaffe kunnskap om miljø og miljøkonsekvenser. Dette skal gi grunnlag for utvikling av forvaltningsstrategier som kan begrense miljøkonsekvensene, og sikre at natur- og miljøvernhensyn og virksomhet knyttet til bærekraftig bruk av naturen ivaretas på en best mulig måte.

Norges forskningsråd som pådriver

Norges forskningsråd skal være en pådriver for norsk deltakelse innenfor relevante europeiske samarbeidsarenaer, slik som den industrielle teknologiplattformen for bærekraftige mineralressurser, og det nye offentlig-private partnerskapet innenfor prosessindustrien i EUs rammeprogram for forskning og teknologisk utvikling. Forskningsrådet skal arbeide aktivt for å informere norske miljøer om mulighetene for europeisk forskningssamarbeid.

Oppfølging av EUs råvareinitiativ

Gjennom EU-delegasjonen i Brussel følger spesialutsendingene for forskning og næring utviklingen innenfor EUs råvareinitiativ og relevante aktiviteter for mineralnæringen.

Formannskap i Barentsrådet

Regjeringen vil benytte sin formannskapsperiode i Barentsrådet til å styrke samarbeidet på mineralområdet.

Etablering av et Nordisk kunnskapsnettverk – NordMin

De nordiske næringsministrene besluttet høsten 2012 at det skal etableres et felles kunnskapsnettverk for mineraler – NordMin. Nettverket skal bidra til å styrke det nordiske kunnskapssamarbeidet på mineralområdet for bedrifter, myndigheter og forsknings- og utdanningsinstitusjoner.

4.5 IVARETAKELSE AV MILJØHENSYN

4.5.1 INNLEDNING

Uttak av mineraler kan medføre landskapsendringer, støy, og utslipp av støv og forurensende stoffer som kan gi negative konsekvenser for naturtyper, arter og friluftsliv. I en del tilfeller innebærer mineralvirksomhet utslipp av kjemikalier.

Enkelte typer mineralvirksomhet fører til store mengder restmasser som ikke har annen anvendelse og som derfor må deponeres. Ved deponering er det viktig at miljøeffektene er godt kartlagt, og at man finner en miljømessig god løsning for deponeringen.

De direkte konsekvensene for naturtyper og artsmangfold vil hovedsakelig være tap eller forringelse av artenes leveområder eller naturtypenes utbredelse, gjennom inngrep og bruk av areal. Mineralutvinning kan også endre eller forringe livsbetingelsene for arter og naturtyper i omkringliggende områder gjennom endrede avrenningsforhold, og gjennom økning eller reduksjon i næringstilgang. For friluftsliv kan mineralvirksomhet innebære forringelse av opplevelse og reduserte bruksmuligheter. Tilførsel av fremmedstoffer til miljøet kan ha betydning for mattrygghet i sjø og ferskvann. Mineraluttak og deponering kan også ha konsekvenser for annen virksomhet.

4.5.2 NÆRMERE OM DEPONERING AV RESTMASSER

Utvinning av metaller og industrimineraler medfører ofte betydelige mengder restmasser. Utvinningen omfatter uttak av gråberg for å komme til ressursene, og nedknusing av store mengder stein for å ta ut malmen eller mineralet (oppredning). De finkornede restmassene fra oppredningen kalles avgangmasse. Mineralene males til en finhetsgrad som gjør det mulig å skille ut de enkelte mineralkornene. Deretter brukes gjerne mekaniske og kjemiske prosesser til å øke renhetsgraden i produktene. I mange tilfeller vil det derfor følge kjemikalier med restmassene når de senere skal deponeres. Mengden av restmasser kan være stor for enkelte typer mineraler. Håndtering av gråberg og avgangsmasse vil derfor være en sentral problemstilling ved planlegging av mineraluttak.

Det er et mål å minimere mengden restmasser. Restmassene har i mange tilfeller et potensial for bruk til andre formål. Dette kan for eksempel være fyllmasse, overdekking av deponier og forurenset sjøbunn, bruk til andre produkter som jordbrukskalk eller som innsatsvare i produksjon av ulike type bygningsmaterialer. Transportkostnadene er imidlertid i de fleste tilfeller høye, og enhetsprisene for de aktuelle produktene er lave. Dette begrenser mulighetene for alternativ bruk eller videresalg. Selv med en optimal utnyttelse av gråberg og avgang, vil det som oftest være nødvendig å deponere restmasser som ikke kan brukes eller omsettes på annen måte. Både under planlegging og drift av mineralvirksomhet som medfører restmasser, bør bedrifter arbeide for at en økt andel av restmassene kan benyttes til andre formål.

Tilbakefylling av gråberg eller avgang i gruver eller dagbrudd kan bidra til å redusere mengden masser som må deponeres andre steder. Når fast fjell knuses, øker volumet av massen med en faktor på 1,3-1,5. Selv med stor grad av tilbakefylling der dette er mulig, vil det likevel være behov for deponering. Tilbakefylling der dette er mulig ut fra tekniske, økonomiske og geologiske forhold kan være en god løsning. Samtidig bør tilbakefylling unngås der det fortsatt er betydelige ressurser som ikke er utvunnet.

Tilbakefylling skal utredes som et supplement til andre deponeringsløsninger, både på land og i sjø. Om tilbakefylling er et egnet tiltak, må vurderes konkret i hvert tilfelle. Dette må skje ut fra en helhetsvurdering hvor man blant annet hensyntar resterende ressurser, kostnader bedriften påføres og ulemper for miljøet ved ikke å tilbakefylle.

På grunn av kostnader til transport og infrastruktur må deponering foregå i uttakets og oppredningsverkets umiddelbare nærhet. Tilgjengelige arealer er avgjørende for valg av deponeringsløsning i tillegg til påvirkning på naturmiljøet, kostnader, muligheten for gjenbruk av masser og mulige konsekvenser for annen næringsvirksomhet og andre interesser.

Historisk har gråberg vært deponert på land, mens avgangsmasser har vært deponert i sjø eller innsjø der hvor gruven eller dagbruddet har ligget nært slike områder. Landdeponier bør helst legges i naturlige forsenkninger i naturen slik at man slipper å bygge kunstige barrierer og dammer som må etterses og vedlikeholdes i lang tid. Ved mineralutvinning i kystnære områder kan sjødeponi være et mulig alternativ til deponering på land.

Både deponi på land og sjødeponier kan ha miljøkonsekvenser. Det er ikke mulig å angi på generelt grunnlag hvilken type deponering som er miljømessig mest forsvarlig. Hvilken deponeringsløsning man bør velge må vurderes konkret i hvert enkelt tilfelle. Dette vil avhenge av bergart, driftsform, fysiske og kjemiske egenskaper ved avgangs- og deponimassene, egenskaper ved aktuelle deponiarealer, arealbeslag, miljøkonsekvenser og hvilke avbøtende tiltak som kan gjennomføres. Valg av deponiløsning må avgjøres på bakgrunn av en grundig og faktabasert vurdering av påvirkning på naturmiljøet, kostnader og mulige konsekvenser for annen næringsvirksomhet og andre interesser.

Sjødeponi og avrenning fra land kan ha negative miljøkonsekvenser, også ut over nærområdet for mineraldriften, herunder konsekvenser for gyte- og oppvekstområder for fisk og skalldyr og marine økosystemer. Slike konsekvenser må være gjenstand for en grundig

vurdering. Det samme gjelder konsekvenser for sjømattrygghet og konsekvenser for annen aktivitet. Dette omfatter også en vurdering av spredning av finpartikler i avgangsmassene og virkningene av dette.

Det har i lengre tid vært en diskusjon om hvilke forhold som bør utredes ved vurdering av mineraluttak og deponeringsløsninger. Nærings- og handelsdepartementet, Miljøverndepartementet og Fiskeri- og kystdepartementet har hatt en god dialog med mineralnæringen, sjømatnæringen og miljøorganisasjoner om dette. Regjeringen mener det er behov for å videreføre og utvikle denne dialogen. Målet er å legge grunnlag for en felles forståelse av utfordringene og finne frem til løsninger som gir grunnlag for utvikling av både sjømatnæringen og mineralnæringen innenfor rammene av en god miljø- og ressursforvaltning.

4.5.3 AVVEININGER MELLOM POSITIVE VIRKNINGER AV MINERALUTTAK OG MILJØBELASTNINGER

Ved etablering av ny mineralvirksomhet skal fordeler og ulemper knyttet til virksomheten avveies. På den ene siden er hensynet til verdiskaping, næringsutvikling, lokale og regionale ringvirkninger, skatteinntekter for samfunnet og andre viktige samfunnsinteresser som for eksempel forsyning av byggeråstoffer. På den andre siden må belastningen på naturmiljøet, muligheten for alternativ arealbruk, negative virkninger for andre næringer, kulturminner eller befolkning i form av støv, støy eller miljøskadelige utslipp og andre tungtveiende samfunnsinteresser vurderes.

Kommunen som planmyndighet må vurdere de samlede virkningene når det besluttes om det skal avsettes arealer til et mineraluttak. Regjeringen forventer at kommunene i denne prosessen har en god dialog med dem som vil berøres av et uttak, slik at den endelige beslutningen om etablering tas på et best mulig kunnskapsgrunnlag.

Mange mineralvirksomheter medfører forurensning som krever utslippstillatelse. Ved vurderingen av utslippstillatelser skal miljømyndighetene vurdere de forurensningsmessige ulempene ved mineraluttaket, sammenholdt med samfunnsmessige fordeler og ulemper tiltaket for øvrig vil medføre.

TILTAK

Etablering av møteplass mellom mineralnæringen, sjømatnæringen, miljøorganisasjonene og myndighetene

Nærings- og handelsdepartementet vil i samarbeid med Miljøverndepartementet og Fiskeri- og kystdepartementet ta et initiativ til å etablere en møteplass for dialog om miljøutfordringer og sjømattrygghet ved mineralutvinning og deponering der representanter for mineralnæringen, sjømatnæringen, miljøorganisasjonene og relevante faginstitusjoner innenfor disse områdene er representert. Målet er å legge grunnlag for en felles forståelse av utfordringene, og finne frem til løsninger for videre utvikling av både sjømatnæringen og mineralnæringen innenfor rammene av en god miljø- og ressursforvaltning.

Klarere retningslinjer for etterbruk eller tilbakeføring av områder

Direktoratet for mineralforvaltning skal i samarbeid med Klima- og forurensningsdirektoratet utarbeide veiledningsmateriell om planlegging for etterbruk eller tilbakeføring av områder etter at mineralvirksomheten er avsluttet.

Vurdering av tilbakefylling

Tilbakefylling skal vurderes som et supplement til andre deponeringsløsninger, både på land og i sjø.

Bedre kunnskap om sjødeponi

Det skal gjennomføres et toårig forskningsprosjekt for å styrke kunnskapen om ulike sider ved sjødeponi. Uavhengig av forskningsprosjektet skal søknader om sjødeponi behandles på vanlig måte, og tillatelser skal kunne gis hvis en samlet vurdering tilsier det.



I Norge har deponering av avgangsmasse i innsjøer vært brukt flere steder, blant annet knyttet til uttak av kobber. Vann fungerer som oksygenbarriere og bidrar til å stabilisere avgangsmassene. Slike deponier må anlegges slik at det ikke føres partikler fra deponiet nedstrøms i vassdraget. Foto: NTB Scanpix

4.6 OMDØMME, SAMFUNNSANSVAR OG LOKALSAMFUNNET

Mineralbedrifter må aktivt ta samfunnsansvar. Dette innebærer at samfunnsansvar er forankret i bedriftenes strategier og er en integrert del av driften. Virksomheten må drives miljømessig forsvarlig og være bærekraftig. Det krever blant annet at bedriftene tar i bruk ny miljøvennlig teknologi og har åpne prosesser med lokalsamfunnet og andre berørte parter om bedriftens virksomhet. Dialogen med vertskommuner, lokalbefolkningen og andre næringer er en viktig del av bedriftenes arbeid med omdømme og samfunnsansvar. Mineralselskaper som har eller planlegger mineralvirksomhet i områder hvor det finnes samiske interesser, må være oppmerksom på det særlige behovet for dialog og samfunnsansvar her. Å ta samfunnsansvar innebærer ikke bare plikter for mineralnæringen, men gir også muligheter ved at det gir grunnlag for økt aksept for mineralvirksomhet og et godt forhold til lokalsamfunnet.

Omdømme, samfunnsansvar og samspillet med lokalsamfunnet, andre næringer og samiske interesser har kommet høyere på agendaen for mineralselskapene. Norsk Bergindustri har utarbeidet særskilte etiske retningslinjer for å fremme seriøsitet og ryddighet i bransjen. Det er viktig at disse retningslinjene utvikles i takt med samfunnsutviklingen.

Det er i utgangspunktet kommunene som står for arealplanleggingen, og som avgjør om områder skal settes av til mineralutvinning. Lokale myndigheter forventer positive ringvirkninger av næringens virksomhet ved blant annet lokale arbeidsplasser og tiltak for å sysselsette lokalt bosatte. Mineralselskaper som vurderer å starte opp utvinning, bør derfor synliggjøre positive lokale ringvirkninger av virksomheten.

Mineralvirksomhet vil ofte kunne gi positive virkninger for flere kommuner enn vertskommunen. Samtidig vil store etableringer kunne gi kostnader for vertskommunen ved for eksempel behov for økte investeringer i infrastruktur eller økt belastning på kommunale tjenester. Små kommuner vil kunne oppleve store endringer på kort tid og få tilført flere og andre typer arbeidsplasser enn kommunens innbyggere selv kan dekke. Aktuelle vertskommuner bør derfor ha god dialog med andre berørte kommuner. De bør sammen vurdere hvilke ringvirkninger mineralvirksomheten kan ha for kommunene, og hvordan disse eventuelt kan samarbeide om å håndtere virkningene av mineralvirksomheten.

Regjeringen forventer at mineralbedrifter har en aktiv og konstruktiv holdning til lokalsamfunnet og alle berørte interesser. Samtidig må bedriftene kunne forvente å bli møtt med ansvarlighet og ryddighet fra andre samfunnsaktører.

Norge har ryddige arbeids- og lønnsforhold i næringslivet, et velutviklet rettighetssystem og åpenhet og gjennomsiktighet i forvaltningen. Dette er faktorer som kan medvirke til at internasjonale mineralbedrifter som er opptatt av forutsigbare rammer for næringsvirksomhet og eget omdømme, vurderer Norge som et interessant sted å drive mineralutvinning.

Det finnes flere eksempler i Norge der tidligere tiders gruvedrift krever opprydningstiltak. Det er særlig



Saging av blokkstein, anortsitt fra Sirevåg i Rogaland. Foto: Rolv Dahl/NGU

utvinningen av metaller fra sulfidmalmgruver hvor avrenning av surt og metallholdig gruvevann og sigevann fra deponier har redusert vannkvaliteten for elver og innsjøer, og har dermed hatt negative konsekvenser for økosystemet, spesielt fisk, i disse vannforekomstene. Denne forhistorien representerer fortsatt en omdømmemessig utfordring for næringen. Det forventes at bedrifter i dag tar ansvar for å drive miljømessig forsvarlig og ikke påfører samfunnet unødig belastning.

Økt kunnskap om miljøvirkningene av mineralvirksomhet har ført til en stadig skjerping av miljøkravene. Norge er allerede i dag blant de landene i verden med strengest miljøkrav for næringsvirksomhet. Dette gjelder også for mineralnæringen. Dette legger grunnlag for miljømessig forsvarlig drift og medvirker dermed til å bedre næringens omdømme.

Erfaringene fra flere prosesser knyttet til etablering av mineraluttak har de siste årene vist at det er et behov for å etablere en større grad av felles forståelse av hvilke forventninger mineralnæringen og andre berørte parter kan ha til prosesser knyttet til mineraluttak.

TILTAK

Utarbeidelse av en «best practice» sjekkliste
Nærings- og handelsdepartementet vil ta initiativ til at det blir utarbeidet en sjekkliste med «best practice» for leting, undersøkelser, etablering og utvidelse av ulike typer mineraluttak, herunder deponering og bruk av kjemikalier. Arbeidet vil skje i nært samarbeid med mineralnæringen, sjømatnæringen, miljømyndighetene, fiskerimyndighetene og andre berørte interesser.

Arbeid med samfunnsansvar
Regjeringen forventer at mineralnæringen arbeider målrettet med omdømme, samfunnsansvar og samspill med lokalsamfunnet og andre berørte interesser. Samtidig må mineralbedriftene kunne forvente å bli møtt med ansvarlighet og ryddighet fra andre samfunnsaktører. Mineralselskaper som har, eller planlegger mineralvirksomhet i områder hvor det er samiske interesser, må særlig være bevisst på behovet for dialog og samfunnsansvar her.

Etiske retningslinjer
Regjeringen forventer at Norsk Bergindustri utvikler sine etiske retningslinjer i takt med endringer i samfunnet.

4.7 ET FORUTSIGBART RAMMEVERK FOR MINERALVIRKSOMHET I NORGE

Mineralvirksomhet krever planlegging med omfattende kartlegging og utredninger som kan strekke seg over mange år. Forutsigbare rammer og et tydelig lovverk er grunnleggende for at mineralbedriftene skal satse i Norge, for å tiltrekke utenlandsk kapital og mineralkompetanse, og for å realisere regjeringens mål om en verdiskapende og vekstkraftig mineralnæring. Dette er også en forutsetning for å sikre en bærekraftig og samfunnsmessig forsvarlig forvaltning og utvinning av mineralressursene, og for å realisere regjeringens mål om at norsk mineralnæring skal være blant verdens mest miljøvennlige.

Lovverket skal sikre verdiskaping og samfunnets behov for mineralressurser, samtidig som det skal gjøres en avveining mot andre hensyn. Det innebærer at de positive virkningene ved en mulig ny mineralvirksomhet må avveies mot konsekvenser for andre interesser og andre hensyn. Det kan være andre næringer, naturmiljøet, kulturminner, lokalsamfunn, samiske interesser mv.

Et målrettet arbeid med sikte på et regelverk som gir god forutsigbarhet og mer tids- og kostnadseffektive planprosesser, vil bidra til å redusere næringslivets administrative kostnader, men også gi mer effektiv bruk av offentlige ressurser.

4.7.1 LOVVERKET

Mineralloven er et bransjeregelverk for mineralnæringen i Norge og fastsetter grunnleggende rammer for å drive mineralvirksomhet. Loven trådte i kraft 1. januar 2010, og erstattet fem gamle lover. Den nye mineralloven er et viktig skritt for å forenkle regelverket på mineralfeltet, og for å skape oversiktlige og forutsigbare rammebetingelser for mineralnæringen. Loven regulerer leting, undersøkelse og utvinning av mineralressurser, og erverv av bergrettigheter. Formålet med mineralloven er å fremme og sikre samfunnsmessig forsvarlig forvaltning og bruk av mineralressursene i samsvar med prinsippet

FAKTA

Forenkling er et sentralt element i regjeringens næringspolitikk. Målet er å utforme reguleringer slik at de ikke påfører norske bedrifter unødige kostnader og ulemper, og å sikre at offentlige tjenester fungerer på en måte som bygger opp under norsk næringslivs verdiskaping. Verdiskapingen blir størst dersom offentlige reguleringer og krav om informasjon tar vare på samfunnets behov, og samtidig påfører bedriftene lavest mulig ressursbruk.



Skifting av borekrone i Titanias dagbrudd på Tellenes i Rogaland. Foto: Titania AS /Linda Løvås

om en bærekraftig utvikling. Loven har bestemmelser som skal sikre at miljøhensyn blir ivaretatt, og at opprydning etter drift bekostes av tiltakshaver og tas hensyn til allerede i planleggingen av driften. Videre har loven bestemmelser for å sikre at samiske interesser ivaretas ved mineralvirksomhet.

Mineralloven skiller mellom mineraler som er eid av staten og de som er eid av grunneier. Staten eier metaller med en egenvekt på 5 gram/cm^3 og over, samt malmer av slike metaller. Dette omfatter blant annet krom, mangan, molybden, niob, vanadium, jern, nikkel, kobber, sink, sølv, gull, kobolt, bly, platina, tinn, wolfram, uran, kadmium og thorium. Også arsén og titan er statlig eid. Alle andre mineraler er eid av grunneieren. I hovedsak kan grunneiers mineraler deles inn i tre hovedkategorier; naturstein, byggeråstoffer og industrimineraler.

Det er kommunale myndigheter som gjennom plan- og bygningsloven regulerer områder til råstoffutvinning. Uttak av mineraler må foregå innenfor rammen av en godkjent reguleringsplan. Kommunen må vurdere de samlede virkningene av tiltaket når det besluttes om arealer skal settes av til mineraluttak. Dersom forslag til kommuneplanens arealdel omfatter nytt eller utvidet område for mineraluttak og/eller deponi, skal konsekvenser for miljø og samfunn utredes. Dette omfatter blant annet konsekvenser for andre næringer, transport, forurensning, naturmangfold, marine ressurser, mattrygghet og kulturminner.

Detaljert planlegging av tiltaket skjer ved utarbeidelse av reguleringsplan. Forslag til reguleringsplan med tilhørende konsekvensutredning utarbeides og bekostes normalt av den som ønsker å starte mineraluttak. Samlet uttak av mer enn 2 mill. m^3 masse, og mindre uttak som kan få vesentlige virkninger for miljø eller samfunn, omfattes av regelverket om konsekvensutredninger.

Plan- og bygningsloven åpner for fastsettelse av statlig arealplan. Staten trer da inn i reguleringsmyndigheten til kommunestyret. Dersom det er behov for å tilrettelegge for mineralutvinning i områder hvor kommunene ikke ønsker å planlegge for dette, kan staten tilrettelegge for virksomheten ved bruk av statlig arealplan dersom samfunnsmessige hensyn tilsier det. Staten kan også henstille kommunen om å utarbeide arealdel til kommuneplan eller reguleringsplan. Regjeringen mener dette er verktøy som kan være aktuelt å vurdere nærmere for å bidra til gjennomføring av betydelige prosjekter for utvinning av mineraler. Det kan også være aktuelt for å sikre verdifulle mineralressurser for fremtidig utnyttelse.

I tillegg til mineralloven og plan- og bygningsloven, reguleres mineralvirksomhet også av andre lover. Det kan være nødvendig med tillatelse eller avklaring etter blant annet naturmangfoldloven, forurensningsloven, motorferdselloven, matloven, kulturminneloven og vannressursloven. Leting, undersøkelsesarbeider og drift på mineraler vil som regel være forbudt i verneområder og i funksjonsområder for prioriterte arter. I områder med utvalgte naturtyper skal det tas særskilte hensyn.

Naturmangfoldloven er sektorovergripende og inneholder fem prinsipper for bærekraftig bruk av natur; Krav om kunnskap, føre var-prinsippet, samlet belastning, miljøpåvirker betaler, miljømessig gunstigste teknikk og lokalisering. Disse prinsippene skal legges til grunn som retningslinjer ved beslutninger som berører naturmangfoldet.

Etter forurensningsloven er det forbudt å forurense med mindre det er tillatt i lov, forskrift eller gjennom særskilt tillatelse. Forurensning ved uttak av mineraler krever utslippstillatelse. Utslippstillatelser knyttet til uttak av statens mineraler gis av Klima- og forurensningsdirektoratet, mens utslippstillatelser knyttet til uttak av grunneiers mineraler normalt gis av fylkesmannen dersom ikke annet er særskilt bestemt. Forurensning fra uttak av pukk og grus krever normalt ikke særskilt tillatelse, men er regulert i forurensningsforskriften.

Ved vurderingen av om utslippstillatelse skal gis og på hvilke vilkår, skal det legges vekt på forurensningsmessige ulemper ved tiltaket sammenholdt med fordeler og ulemper ved tiltaket for øvrig. En utslippstillatelse regulerer blant annet bruk av kjemikalier. Virksomheter som bruker produkter med innhold av kjemiske stoffer som kan medføre helseskade eller miljøforstyrrelse, skal etter produktkontrolloven vurdere om det finnes alternativer som medfører mindre risiko for slik virkning. Virksomheten skal i så fall velge et slikt alternativ hvis det kan skje uten urimelig kostnad eller ulempe.

Avfallsforskriften regulerer spesifikt håndtering av restmasser fra mineralvirksomhet. Dersom etablering av deponi vil gi negative konsekvenser for miljøtilstanden i grunnvann, ferskvann eller kystvann, må deponeringen oppfylle vannforskriftens krav til nye tiltak og aktiviteter. Etter matloven plikter bedrifter å varsle tilsynsmyndighetene dersom det foreligger grunn til mistanke om at bedriftens virksomhet kan medføre fare for at næringsmidler blir helseskadelige. Det er fastsatt øvre grenseverdier for tungmetall i fisk og sjømat i forskrift til matloven.

I henhold til «Prosedyrer for konsultasjoner mellom statlige myndigheter og Sametinget» har statlige myndigheter plikt til å konsultere Sametinget og eventuelle andre samiske interesser i saker som vil kunne påvirke samiske interesser direkte. Konsultasjonsprosedyrene har bestemmelser om hvordan konsultasjonene skal gjennomføres. Plikten til å konsultere samiske interesser vil kunne inntre når det overveies å gi tillatelse til undersøkelse eller utvinning av mineralressurser i områder med samiske interesser.

TILTAK

Ny minerallov

Regjeringen har fått på plass en ny minerallov som har erstattet fem gamle lover. Loven var et viktig skritt for å forenkle regelverket på mineralfeltet, og for å skape oversiktlige og forutsigbare rammebetingelser for mineralnæringen.

4.7.2 SAMFUNNETS BEHOV FOR EN GOD FORVALTNING AV MINERALRESSURSENE

Det er et økende arealpress i Norge. Ofte er det motstridende interesser knyttet til arealdisponeringen i kommunene. Miljøhensyn kan tilsi vern eller begrenset aktivitet. Hensynet til ulike samfunnsformål som boligbygging, friluftsliv eller annen næringsvirksomhet kan tilsi at arealer båndlegges til annen bruk enn mineralvirksomhet. Behovet for å sikre verdifulle mineralforekomster for fremtidig utnyttelse må vurderes i slike prosesser. Dette er viktig for å unngå at mineralforekomster av potensielt stor verdi blir avskåret fra fremtidig utnyttelse og verdiskaping uten at dette er vurdert nærmere.

I «Nasjonale forventninger til regional og kommunal planlegging» stadfester regjeringen at planleggingen må synliggjøre mineralressurser av nasjonal og regional betydning, slik at disse kan ivaretas på en måte som ikke er til hinder for fremtidig verdiskaping. Dette skal være retningsgivende for avveininger ved utarbeidelse av regionale og kommunale planer. For å sikre dagens og fremtidig behov for mineralressurser, forventer regjeringen at fylkeskommunene (regional planmyndighet) og kommunene vektlegger dette hensynet i sin arealplanlegging. Regjeringen forventer at ivaretakelse av mineralressurser inngår i relevante planveiledere.

For at mineralforekomster skal ivaretas i arealplanleggingen, må planmyndighetene ha tilstrekkelig kunnskap om forekomstene og om potensialet for fremtidig verdiskaping. Slik kunnskap er avgjørende for avveiningen av arealbruken til ulike formål. Noen fylker har egen region- eller fylkesgeolog som kan bistå fylkeskommunen og kommunene med verdifull kunnskap om håndtering av mineralspørsmål. Buskerud, Telemark og Vestfold fylker har valgt å ha felles regiongeolog. De har også utarbeidet en særskilt strategiplan for regiongeologen for 2013–3016 basert på det geologiske samarbeidsprogrammet mellom de tre fylkene.

Direktoratet for mineralforvaltning kan legge ned innsigelse mot kommunale planer for å sikre mineralforekomster for fremtidig mineralvirksomhet. Innsigelser kan fremmes i spørsmål som er av nasjonal eller vesentlig regional betydning, eller av andre grunner av vesentlig betydning for direktoratets saksområde. Slike innsigelser må baseres på et godt faktagrunnlag, god kartlegging og klassifisering av forekomstene.

Økt fortetting i sentrale strøk har ført til økt arealkonflikt mellom uttak av byggeråstoff og annen arealbruk. Samtidig er tilgang til byggeråstoff, slik som pukk og grus, avgjørende for utbygging av infrastruktur, boliger og næringsbygg. Det er en utvikling i enkelte regioner hvor avstanden mellom råstoffuttak og forbrukssted øker. Dette fører isolert sett til økt belastning på veinettet, økt forurensning og økte kostnader for samfunnet gjennom dyrere bygg og samferdselsprosjekter.

For å sikre en effektiv og bærekraftig ressursutnyttelse mener regjeringen at det er nødvendig at fylkeskommunene og kommunene ved utarbeidelse av planstrategier legger opp til en langsiktig og helhetlig utnyttelse av mineralressursene i fylket. Dette vil bidra til å realisere regjeringens mål om vekst og økt verdiskaping i mineralnæringen.

Det er nødvendig med en effektiv koordinering og planlegging av uttak av mineralressurser. Kommunene bør vurdere hvordan nåværende og fremtidige behov for mineralressurser kan sikres ved revisjon av kommuneplanens arealdel. Regjeringen mener det er viktig at planprosesser knyttet til mineraluttak er forutsigbare og effektive, og er basert på god kunnskap om mineralressurser, mulige konsekvenser for miljøet og andre samfunnsinteresser. En nær dialog mellom tiltakshaver, kommunen og andre berørte myndigheter og interesser er nødvendig for å oppnå dette. I fylker med store mineralforekomster bør regionale planer omfatte ressursforvaltningen av mineraler og ha retningslinjer for lokalisering av uttak.

Regjeringen mener at slike regionale planer er gode redskaper for å styrke overordnet og samordnet planlegging for å sikre fremtidig utnyttelse av mineralforekomster. Regionale planer vil bidra til å øke kommunenes og fylkeskommunenes kompetanse om mineralforekomster, og dermed også gi økt forutsigbarhet for mineralprosjekter. Samtidig kan regionale planer bidra til at hensynet til naturmangfoldet blir ivaretatt på en god måte i planleggingen.

På samme måte kan interkommunalt plansamarbeid være et egnet virkemiddel for å sikre en helhetlig forvaltning av mineralressursene, og for gjennomføring av regionale strategier på mineralområdet. Statlige eller regionale myndigheter kan også ta initiativ til utarbeidelse av planer etter plan- og bygningsloven for å ivareta planoppgaver av regional eller nasjonal betydning.

TILTAK

Sikre fremtidig behov for mineralressurser

For å sikre dagens og fremtidig behov for mineralressurser, forventer regjeringen at fylkeskommunene og kommunene vektlegger hensynet til mineralressurser i arealplanleggingen. Det er ikke minst viktig for byggeråstoffer slik som pukk- og grusforekomster.

Ivaretakelse av mineralressurser i planveiledere og planstrategier

Regjeringen forventer at ivaretakelse av mineralressurser skal inngå i relevante planveiledere og planstrategier.

Forventning om effektive planprosesser

Regjeringen forventer at planprosesser knyttet til mineraluttak er forutsigbare og effektive, og er basert på god kunnskap om mineralressurser, mulige konsekvenser for miljøet og andre samfunnsinteresser.

Lokalt samarbeid

Regjeringen mener at regionale planer og interkommunalt plansamarbeid er gode redskaper for å styrke planlegging for å sikre fremtidig utnyttelse av mineralforekomster.

Geologisk kunnskap i fylkeskommunene

Fylkeskommunene bør vurdere å tilknytte seg geologisk kunnskap, ved for eksempel bruk av fylkesgeolog.

Forvaltning av nasjonalt og regionalt viktige forekomster

En god forvaltning av mineralressursene er avgjørende for å realisere målet om økt verdiskaping i mineralnæringen. For at viktige mineralforekomster skal ivaretas i arealforvaltningen, er det nødvendig at verdien av slike ressurser synliggjøres. Norges geologiske undersøkelse skal innen 2014 utvikle et klassifikasjonssystem for mineralressurser basert på verdiskapingspotensial og regionalt ressursbehov der det fremgår om ressurser er av regional eller nasjonal betydning. Dette skal være et verktøy til bruk i kommunal, regional og statlig arealplanlegging.

Sikring av verdifulle mineralforekomster for fremtidig utnyttelse

Regjeringen vil vurdere nærmere hvordan verdifulle mineralressurser best kan ivaretas i arealplanleggingen veid opp mot andre samfunnsinteresser og arealhensyn. Formålet er å sikre dagens og fremtidig behov for mineralressurser, og legge til rette for økt verdiskaping og arbeidsplasser i distriktene. Arbeidet vil skje i regi av Miljøverndepartementet og Nærings- og handelsdepartementet. Bruk av virkemidler i plan- og bygningsloven og eventuelle behov for forbedringer i loven vil bli vurdert.

Oppdatering av temaveileder for mineraluttak

Miljøverndepartementet vil i samarbeid med Direktoratet for mineralforvaltning revidere «Temaveilederen om uttak av mineralske forekomster og planlegging etter plan- og bygningsloven» slik at den blir mer dekkende for underjordsdrift.

FAKTA

I Rogaland har fylkestinget vedtatt en regional plan (tidligere kalt fylkesdelplan) for byggeråstoffer på Jæren. Formålet med planen har vært å sikre tilgang på byggeråstoffer i Rogaland i et langt tidsperspektiv, prioritere mellom forskjellige arealbruksinteresser, koordinere mellom kommuner som utgjør det samme regionale markedet, og å prioritere planlegging og sikring av ressurstilgangen i områder der presset på ressursene og arealbrukskonfliktene er størst.

Planen inneholder en beskrivelse av aktuelle lokaliteter, vurdering av tilgjengelige mineralressurser på Jæren, omtale av deponeringsbehov og retningslinjer for planlegging. Det er foretatt en konsekvens- og ressursanalyse for hver enkelt av de vurderte lokalitetene. Denne har dannet grunnlag for konfliktavveininger og inndeling i plankategorier.

Plangrunnlaget ble utarbeidet i samarbeid mellom fylkeskommunen, berørte kommuner, fylkesmannen, Norges geologiske undersøkelse, Direktoratet for mineralforvaltning og representanter fra pukk- og grusindustrien. Endelig plan ble godkjent av Miljøverndepartementet, som mente at den kunne være et mønster for hvordan tilsvarende planer kan gjennomføres i andre fylker.

Rogaland fylkeskommune jobber nå med å utarbeide en tilsvarende regional plan for byggeråstoffer i Ryfylke.



Fra Jens Stoltenbergs besøk i separasjonsverket hos Sydvaranger Gruve i Kirkenes 6.juni 2009. Foto: Bente Geving, Sydvaranger Gruve AS

4.7.3 FORUTSIGBARE OG EFFEKTIVE PROSESSER FOR KONSEKVENSUTREDNINGER

Formålet med bestemmelsene om konsekvensutredninger i plan- og bygningsloven er å klargjøre virkningene av planer og tiltak som kan ha vesentlige konsekvenser for miljø og samfunn. Konsekvensutredninger skal sikre at vesentlige konsekvenser for miljø og samfunn tas i betraktning i planleggingen, når det tas stilling til om planen eller tiltaket kan gjennomføres, og når det besluttes hvilke vilkår som eventuelt skal stilles. Kunnskapen som fremkommer i konsekvensutredningene, brukes også i vurderingen av en eventuell utslippstillatelse.

En konsekvensutredning skal dekke alle beslutningsrelevante forhold. Dette omfatter også alternative deponeringsløsninger. For å sikre en effektiv fremdrift i utredningsprosessen bør slike forhold identifiseres i en tidlig fase. Dette forutsetter at forslaget til planprogram sendes på høring til berørte aktører og at disse deltar aktivt i høringen. Regjeringen forventer at berørte aktører gir innspill om beslutningsrelevante forhold og innenfor fastsatte tidsfrister. Relevante innspill i en tidlig fase kan redusere tidsbruk og kostnader for tiltakshaver, kommunen og andre berørte interesser.

Konsekvensutredninger ved planlegging av mineraluttak er i mange tilfeller meget omfattende, og krever en rekke delutredninger av ulike temaer. Den samlede kostnaden kan bli høy.

Etter tidligere planlovgivning godkjente Direktoratet for mineralforvaltning bedriftens forslag til utredningsprogram og konsekvensutredning, og gjennomførte høring. På bakgrunn av utredningsprogrammet, konsekvensutredningen og innspill i høringen laget direktoratet en innstilling til kommunen som inngikk i saksgrunnlaget for kommunens planvedtak.

Siden 2005 har kommunene fastsatt planprogrammet med tilhørende utredningsprogram og sendt dette på høring. Planprogram for nye mineraluttak skal forelegges Direktoratet for mineralforvaltning til uttalelse. I saker som kan komme i konflikt med nasjonale eller viktige regionale hensyn, skal planprogrammet også forelegges Miljøverndepartementet før det fastsettes av kommunen.

Etableringen av store mineraluttak skjer ofte i små kommuner. Sakene er komplekse, og krever betydelige ressurser og kompetanse. For en kommune kan det være eneste gang den koordinerer et slikt arbeid. Tilbakemeldinger fra næringen kan tyde på at det i flere planprosesser er et press på kommunene fra ulike aktører om at det må konsekvensutredes forhold som ikke nødvendigvis er beslutningsrelevante. For kommuner med små ressurser og lite fagmiljø kan det være krevende å vurdere hva som er relevant å utrede, og hvilke forhold som ikke er beslutningsrelevante. Dette kan forsinke planprosessene og føre til at konsekvensutredningen blir mangelfull eller at det brukes tid og ressurser på å utrede forhold som ikke er relevante for beslutningen.

Regjeringen vil at Direktoratet for mineralforvaltning skal få en mer aktiv rolle ved konsekvensutredning av større mineralprosjekter. Det er behov for et tettere samarbeid mellom direktoratet og kommuner i slike saker. Dette forutsetter at kommunen og direktoratet blir enige om et opplegg for gjennomføringen av konsekvensutredning etter plan- og bygningsloven. Dersom kommunen ønsker det, skal direktoratet stå for gjennomføringen av konsekvensutredningsprosessen helt eller delvis. Uansett vil kommunen fortsatt være besluttende planmyndighet. For å sikre en rask avklaring av ansvarsdelingen mellom kommunen og direktoratet, må tiltakshaver sende forslaget til planprogram til begge parter samtidig.

Dette forslaget vil gi økt fleksibilitet ved større konsekvensutredningsprosesser av mulige mineraluttak. Det vil også sikre en effektiv koordinering mot fagorganer og relevante kompetansemiljøer tidlig i arbeidet, og gi mer tids- og kostnadseffektive prosesser for alle involverte parter. Forslaget krever endring i forskrift om konsekvensutredninger.

Ansvaret for at konsekvensutredningene blir faglig gode og beslutningsrelevante ligger i stor grad hos tiltakshaver i slike prosjekter. I utredningsprogrammet som sendes på høring bør tiltakshaver redegjøre for hvordan utredningsoppgaven tenkes løst, slik at høringsinstansene kan komme med konkrete innspill til dette fremfor generelle innspill om hva de ønsker utredet. Ved å vektlegge dette kan mineralbedrifter selv bidra til mer tids- og kostnadseffektive prosesser.

FAKTA

Planlegging av mineralutvinning krever store investeringer. En betydelig del av kostnadene påløper før en investeringsbeslutning kan tas.

Selskapet Nussir ASA planlegger å starte utvinning av kobber i Kvalsund kommune i Finnmark, og tar sikte på å starte drift i 2015. Planprosessen ble påbegynt høsten 2009. Til sammen ble det utarbeidet 20 delstudier som ledd i konsekvensutredningen, herunder om samfunn, marint liv, støy og støv, biologisk diversitet, beskrivelse av avgangen, reindrift, sjøsamiske forhold, landskap og deponering. Selskapet har til sammen brukt 100 mill. kroner på prosjektet de siste seks årene. Av dette er om lag 60 mill. kroner brukt på undersøkelser, 15 mill. kroner på rettigheter, 10 mill. kroner til annen drift og 15 mill. kroner på planprosessen. Selskapet regner med å bruke ytterligere 50 mill. kroner før det tas en endelig investeringsbeslutning. I tillegg brukte andre aktører på 80- og 90-tallet anslagsvis 50 mill. kroner på undersøkelser av forekomsten.

TILTAK

Forutsigbare og effektive planprosesser

Regjeringen har som mål å redusere næringslivets administrative kostnader som følger av lovpålagte krav. Regjeringen vil identifisere tiltak for å effektivisere planleggingen med sikte på økt forutsigbarhet og mer tids- og kostnadseffektive beslutningsprosesser. Miljøverndepartementet vil i samarbeid med Nærings- og handelsdepartementet og Kommunal- og regionaldepartementet nedsette en arbeidsgruppe for dette arbeidet. Arbeidsgruppen skal vurdere bruk av virkemidler i plan- og bygningsloven, og eventuelle behov for forbedringer i loven. Berørte departementer vil bli involvert i arbeidet.

Tettere samarbeid mellom kommuner og Direktoratet for mineralforvaltning ved konsekvensutredninger av større mineraluttak

Forslag til planprogram ved større mineraluttak skal sendes både til kommunen og til Direktoratet for mineralforvaltning. Kommunen og direktoratet blir enige om opplegget for gjennomføring av konsekvensutredning etter plan- og bygningsloven. Dersom kommunen ønsker det, skal direktoratet stå for gjennomføring av konsekvensutredningen. Kommunen skal fortsatt være beslutningende planmyndighet.

Tydelige krav til konsekvensutredninger

Regjeringen vil utarbeide veiledningsmateriell og sjekklister for å klargjøre hvilke temaer som skal konsekvensutredes ved planlegging av mineraluttak og deponeringsløsninger. Direktoratet for mineralforvaltning vil i samarbeid med Klima- og forurensningsdirektoratet ha ansvaret for å utarbeide materialet. Arbeidet skal gjennomføres i samarbeid med relevante fagmyndigheter, herunder Fiskeridirektoratet og Mattilsynet, mineralnæringen og andre berørte næringer.

4.7.4 UNDERSØKELSER ETTER STATENS MINERALER

Mineralloven har en enkel prosedyre for behandling av søknader om undersøkelsesrett til statens mineraler. Formålet er å bidra til at flere mineralforekomster blir undersøkt, noe som igjen kan gi grunnlag for utvinning. For å stimulere til undersøkelse og for å å motvirke at undersøkere båndlegger et område lenger enn nødvendig, ble det i mineralloven innført progressive avgifter for undersøkelsesrett til statens mineraler.

Mineralloven åpner for at flere aktører kan ha undersøkelsesrett i samme område. Undersøkeren med best prioritet – i praksis den som har søkt først – har fortrinnsrett til å foreta undersøkelsesarbeider. Andre kan bare undersøke etter samtykke fra den med best prioritet. Avgiften som skal betales for undersøkelsesretten, er derimot lik uavhengig av prioritet.

Etter mineralloven kan undersøkelsesrett bare nektes dersom søkeren tidligere har brutt vesentlige bestemmelser i mineralregelverket. Dagens regler sikrer ikke alltid effektiv leting i områder hvor det er gitt undersøkelsesrett. Strengere krav, for eksempel at søkeren må fremlegge en konkret plan for undersøkelsene og dokumentasjon på relevant kompetanse, vil gi mineralmyndighetene bedre styringsverktøy og en mer effektiv forvaltning.

TILTAK

Gjennomgang av reglene om undersøkelsesrett til statens mineraler

Nærings- og handelsdepartementet vil vurdere endringer i reglene om undersøkelsesrett til statens mineraler. Hensynet til kostnadseffektivitet, verdiskaping og næringsutvikling og samfunnets behov for kontroll vil vektlegges i arbeidet.

4.7.5 DIREKTORATET FOR MINERALFORVALTNING

En effektiv, kompetent og fremtidsrettet mineralforvaltning er et konkurransefortrinn for norsk mineralnæring, og bidrar til mer forutsigbare rammebetingelser for mineralvirksomhet og en bedre ressursforvaltning.

Direktoratet for mineralforvaltning med Bergmesteren for Svalbard er statens sentrale fagetat for forvaltning og utnyttelse av mineralressursene i Norge, inkludert på Svalbard. Direktoratet skal bidra til å realisere regjeringens overordnede mål om økt verdiskaping basert på en samfunnsmessig forsvarlig utvinning av mineraler. Etaten tildeler undersøkelsesrett og utvinningsrett til statens mineraler, gir driftskonsesjon for mineralvirksomhet for utvinning av alle typer mineraler og er høringsinstans i saker om mineralske ressurser etter plan- og bygningsloven.

Direktoratet for mineralforvaltning har viktige oppgaver ved fastsettelsen av planprogrammer og ved konsekvensutredninger etter plan- og bygningsloven der disse berører mineralvirksomhet. Dersom planene kan ha negative konsekvenser for mineralvirksomhet og fremtidig utnyttelse av mineralressurser, kan direktoratet fremme innsigelse.

Videre gir direktoratet tillatelser etter mineralloven, og fører tilsyn med at mineraluttak drives i samsvar med loven. Direktoratet administrerer også miljøtiltak og sikringsarbeider ved nedlagte gruver der staten har et ansvar. Mineralloven og økt aktivitet i næringen har ført til nye arbeidsoppgaver og økt arbeidsmengde for direktoratet.

For å nå regjeringens mål om vekst og bedre forutsigbarhet for næringen er det avgjørende med en kompetent

og effektiv mineralforvaltning. Høsten 2011 gjennomførte PricewaterhouseCoopers på oppdrag fra Nærings- og handelsdepartementet en ekstern evaluering av Direktoratet for mineralforvaltning. Evalueringen viser at det er behov for styrket virksomhetsstyring, bedre organisering, økt kapasitet og styrket kompetanse i etaten. Det fremgår at direktoratet ikke hadde tilstrekkelige ressurser til å utføre alle lovpålagte oppgaver. Videre fremkom det at etaten må styrkes for å ivareta sin overordnete rolle i forvaltningen av Norges mineralressurser, og for å følge opp næringen på en bedre og mer systematisk måte. Dette er også nødvendig for at etaten kan veilede næringen, kommuner og andre aktører i mineralsaker. Evalueringen er fulgt opp gjennom økte bevilgninger i statsbudsjettet for 2012 og for 2013. En økt satsing på effektiv saksbehandling, veiledning og kommunikasjon vil legge et grunnlag for nyetableringer, og økt mineralproduksjon i etablerte bedrifter.

Nærings- og handelsdepartementet mener det er nødvendig å øke bemanningen i Direktoratet for mineralforvaltning, og at etaten arbeider aktivt med å styrke kompetansen på relevante fagområder.

TILTAK

Økt bemanning i Direktoratet for mineralforvaltning

Direktoratet for mineralforvaltning skal styrkes. Formålet er at etaten skal kunne gjennomføre sine oppgaver på en effektiv og god måte. Styrkingen vil skje gradvis.

Kompetanseplan

Direktoratet for mineralforvaltning skal utarbeide en kompetanseplan som gjør etaten godt rustet til å utføre sine oppgaver. Planen skal omfatte hvordan etaten best kan utnytte sin samlede kompetanse, herunder innenfor naturmiljø og forurensning, jus og samfunnsøkonomi.

Forsterket samarbeid mellom Direktoratet for mineralforvaltning og Norges geologiske undersøkelse

Direktoratet for mineralforvaltning og Norges geologiske undersøkelse samarbeider på flere områder. Direktoratet har behov for styrket kompetanse på sentrale fagområder. Samarbeidet skal styrkes og utvides for å gi bredere kompetansetilgang og økt effektivitet i gjennomføringen av oppgaver.

Økt brukerorientering

Direktoratet for mineralforvaltning skal iverksette tiltak som gir økt brukerorientering og bedre kommunikasjon og tilgjengelighet overfor mineralnæringen, kommunene og andre brukere. Formålet er å redusere næringens administrative byrder, og bedre tilgangen på relevant kunnskap og informasjon om etablering og drift av mineralvirksomhet i Norge.

Satsing på digitale løsninger

Direktoratet for mineralforvaltning skal øke satsingen på digitale løsninger for å gi mer effektiv saksbehandling og bedre veiledning og kommunikasjon med mineralnæringen og andre brukere.

4.7.6 SKATTER OG AVGIFTER

Mineralvirksomhet genererer pengestrømmer til staten gjennom det alminnelige skatte- og avgiftsregelverket på samme måte som annen næringsvirksomhet. I tillegg kan kommunene fastsette eiendomsskatt. Ut over dette fastsettes det i mineralloven særlige avgifter ved undersøkelse og utvinning av mineralressurser.

De som har undersøkelsesrett eller utvinningsrett til statens mineraler, betaler en årsavgift til staten for å ha rettighetene. I tillegg skal den som utvinner statens mineraler, betale grunneieren en årsavgift på 0,5 pst. av omsetningsverdien. Ved utvinning av statens mineraler på Finnmarkseiendommens grunn, skal det i tillegg betales en forhøyet grunneieravgift på 0,25 pst.

Mineralloven gir Nærings- og handelsdepartementet hjemmel til å fastsette forskrift om betaling av en årlig avgift til staten ved utvinning av statens mineraler. Per i dag er det ikke fastsatt noen slik avgift.

Undersøkelse og utvinning av grunneiers mineraler genererer per i dag ikke særskilte avgiftsinntekter til staten, men til grunneieren som er eier av ressursene. Størrelsen på vederlag fastsettes i avtale mellom grunneieren og undersøkeren eller utvinneren.

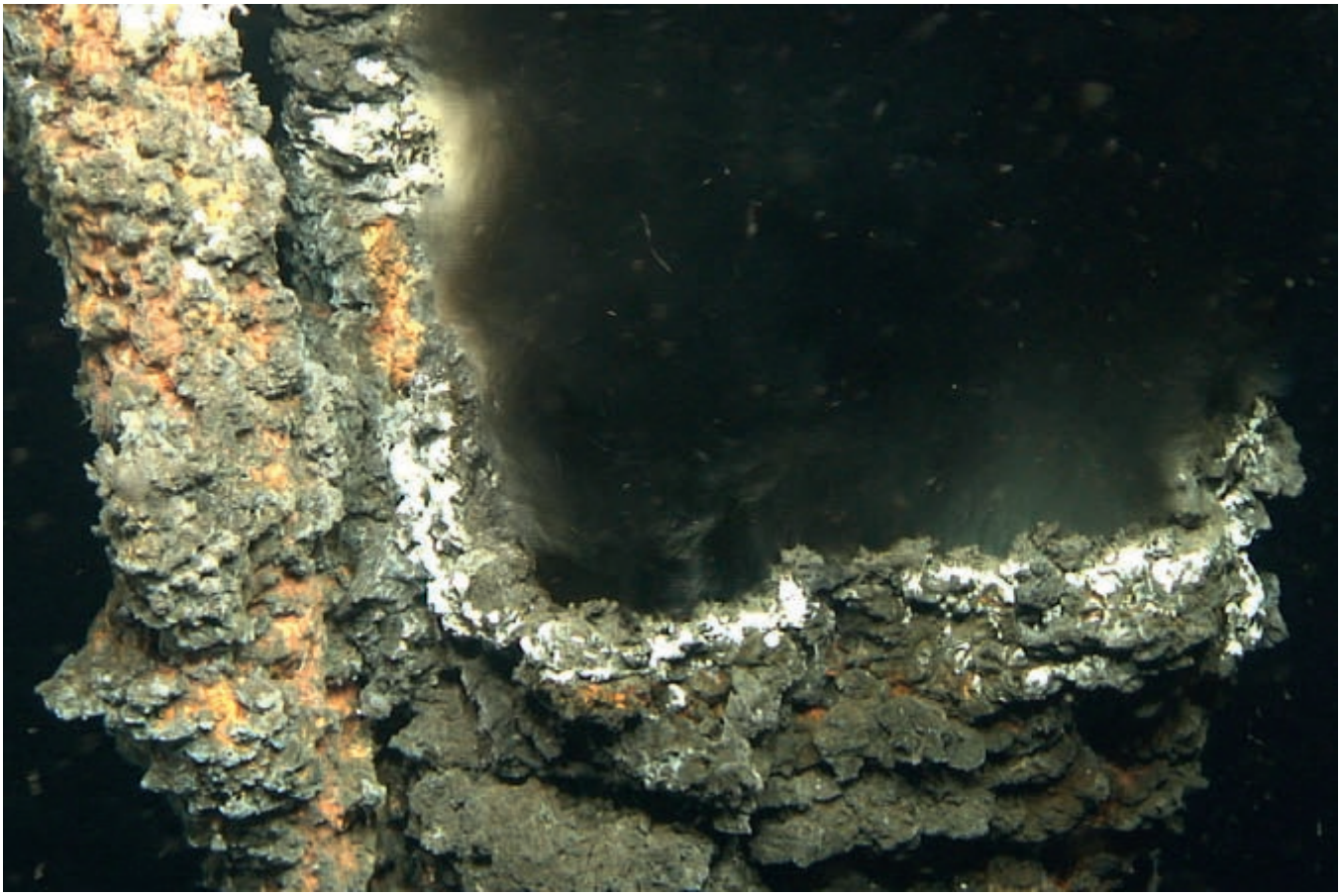
4.8 MINERALRESSURSER PÅ HAVBUNNEN

Havområder kan inneholde viktige mineralforekomster med potensial for mulig fremtidig lønnsom utvinning. Av særlig interesse er vulkanogene metallforekomster ved såkalte «svarte skorsteiner». Det finnes slike forekomster langs atlanterhavsryggen, herunder ved Jan Mayen og nordover, men omfanget er ikke kartlagt.

Norge har sterke fagmiljøer og bedrifter innenfor undervanns- og dypvannsteknologi som brukes i olje- og gassnæringen. Disse kompetansemiljøene gir muligheter for utvikling av teknologi til leting, undersøkelse og mulig fremtidig utvinning av mineralforekomster på havbunnen.

Kartlegging i regi av Skagerrak-prosjektet og flere andre prosjekter har påvist områder med sand og grus i Nordsjøen og Skagerrak. Forekomster finnes også langs norskekysten, både utenfor og innenfor grunnlinjen. Utvinning av sand og grus fra havbunnen foregår i flere land rundt Nordsjøen, men ikke i norske havområder. Kartlegging gjennom MAREANO-programmet viser at det er slike mineralressurser i Barentshavet og utenfor Lofoten og Vesterålen. Skjellsand er en annen mineralressurs i kystsonen. Utvinning foregår i mindre skala i Agder-fylkene og langs Vestlandskysten. Norske havområder er i liten grad kartlagt. Det kan derfor finnes andre mineralressurser med potensial for kommersiell utnyttelse.

Mineralvirksomhet til havs kan få økende betydning. Dagens regelverk om undersøkelser og utvinning av mineralressurser på norsk kontinentalsokkel er ufullstendig, og ikke tilpasset dagens situasjon. Det er behov for en reform av regelverket.



Sort, metallrikt vann på 300 grader celsius strømmer ut av en såkalt «skorstein» på havbunnen, 300 km vest for Bjørnøya. Langs denne undersjøiske, vulkanske fjellkjeden midt i Atlanterhavet er det påvist forekomster av kobber, sink og gull med en anslått omsetningsverdi på 1-5 mrd. kroner. Foto: Senter for Geobiologi, Universitetet i Bergen

4.9 MINERALVIRKSOMHET I OMRÅDER MED SAMISKE INTERESSER

Samiske interesser, og særlig reindrift, finnes i store områder i Norge, og særlig i de nordligste fylkene. Reindrift foregår i dag i vel 140 av landets kommuner, på et areal som utgjør om lag 140 000 km^2, eller om lag 40 pst. av Norges fastlandsareal, og strekker seg fra Finnmark i nord til Engerdal i Hedmark i sør. Fra og med Finnmark til og med Sør-Trøndelag foregår reindrift på i overkant av 80 pst. av landarealet.[2]

Regjeringen har igangsatt et ekstraordinært kartleggingsprogram for Nordland, Troms og Finnmark (MINN-programmet). Kartleggingen har vist at det i disse fylkene er mineralforekomster som kan gi grunnlag for nye lønnsomme arbeidsplasser og forsyne samfunnet med mineralressurser. Mineralvirksomhet kan være arealkrevende og innebære miljøutfordringer. Slik virksomhet kan også øke presset på samisk kultur, reindrift og næringsutøvelse. Regjeringen har som utgangspunkt at mineralvirksomhet skal drives miljøforsvarlig, og i en balansert sameksistens med reindriften og andre samiske interesser i slike områder. Samenes rettigheter som urfolk skal etterleves. Det er behov for et styrket kunnskapsgrunnlag knyttet til mineralvirksomhet i områder med samiske interesser.

En av forutsetningene for god sameksistens er at selskaper som driver mineralvirksomhet i områder med samiske interesser tar samfunnsansvar, har en åpen dialog og opptrer ansvarlig. Dette kan gjøres blant annet ved aktivt å følge OECDs retningslinjer for flernasjonale selskaper og «UN Guiding Principles on Business and Human Rights». Disse omhandler blant annet menneskerettigheter, offentlighet om vesentlige forhold ved virksomheten, lokal kapasitetsbygging og ivaretakelse av hensynet til miljø, helse og sikkerhet.

Utvikling av mineralvirksomhet krever en konstruktiv faktabasert dialog og gjensidig vilje til å foreta tilpasninger. Å legge til rette for en god sameksistens er et ansvar som påligger alle berørte parter. Det er også avgjørende at partene på et tidlig tidspunkt i utviklingen av et mulig mineralprosjekt har god kontakt med sikte på å identifisere både muligheter og utfordringer knyttet til slik virksomhet.

2 NOU 2007:13 «Den nye sameretten» pkt. 10.2.1.



Reindrift foregår på betydelige landarealer i Norge. Foto: Getty Images

Reindrift og andre samiske interesser påvirkes av en rekke planer og tiltak. Dette omfatter utbygging av vindmøller, hyttefelt, vannkraftutbygging, infrastruktur som veiutbygging og kraftnett samt mineralutvinning. Det medfører kapasitetsmessige og kompetansemessige utfordringer for samiske aktører å kunne delta aktivt i planprosesser knyttet til slike tiltak. Regjeringen vil legge til rette for at samiske aktører kan medvirke aktivt i planprosessene. For å kunne gjennomføre en aktiv medvirkning i blant annet planprosessene, er det nødvendig med kapasitets- og kompetanseoppbygging for samiske aktører.

Regjeringen har i sin nordområdestrategi påpekt behovet for å utvikle etiske retningslinjer for økonomisk virksomhet i nord, jf. «Nye byggesteiner i nord. Neste trinn i regjeringens nordområdestrategi» punkt 7.3. Det fremgår der at regjeringen vil igangsette et arbeid med utvikling av etiske retningslinjer for ivaretakelse av urfolks interesser ved økonomisk virksomhet i nordområdene. Utviklingsarbeidet skal skje i regi av Árran – lulesamisk senter, Samisk høgskole og Universitetet i Tromsø i samarbeid med energimiljøet ved Universitetet i Nordland. Industrien og nærings- og bransjeorganisasjonene skal involveres i arbeidet med å utvikle de etiske retningslinjene. Árran er i 2012 tildelt midler over tilskuddsordningen Barents 2020 til å igangsette et forprosjekt, som skal utvikle et forslag til et flerårig hovedprosjekt.

Regjeringen mener at etiske retningslinjer er viktige for å skape økt bevissthet hos bransjen om nødvendigheten av å opptre ryddig og ansvarlig overfor lokalsamfunnet og andre berørte interesser. Samtidig bør bransjen sørge for å utvikle de etiske retningslinjene i takt med endringer i samfunnet og utviklingen på feltet som sådan.

Mineralloven har regler for å sikre samiske interesser. Loven fastsetter at forvaltning og bruk av mineralressurser skal skje på en måte som ivaretar hensynet til naturgrunnlaget for samisk kultur, næringsliv og samfunnsliv. Loven skal anvendes i samsvar med folkerettens regler om urfolk og minoriteter. Disse reglene gjelder generelt for hele landet, og har betydning i alle områder med samiske interesser.

Hensynet til samiske interesser i saker som gjelder mineralvirksomhet, ivaretas også i annet regelverk. Sametinget kan fremme innsigelse mot forslag til kommuneplanens arealdel og reguleringsplaner i spørsmål som er av vesentlig betydning for samisk kultur og næringsutøvelse. Det er kommunen som planmyndighet som avgjør om et område skal reguleres til råstoffutvinning, og også på dette stadiet ivaretas hensynet til samiske interesser.

I mineralloven er det fastsatt særskilte regler for Finnmark for å styrke ivaretakelsen av samisk kultur og næringsutøvelse. Reglene omfatter særlige varslingsplikter og krav om særskilt tillatelse for å igangsette undersøkelser. Ved vurdering av slik søknad og søknader om utvinningsrett, prøveuttak og driftskonsesjon skal det legges vesentlig vekt på hensynet til samisk kultur, reindrift, næringsutøvelse og samfunnsliv. I Finnmark skal det dessuten betales en forhøyet grunneieravgift ved utvinning av statens mineraler på Finnmarkseiendommens grunn.

Regjeringen er i gang med å følge opp utredningen fra Samerettsutvalget 2 i NOU 2007:13 Den nye sameretten. Utvalget har fremsatt forslag om endringer i mineralovgivningen og i en rekke andre sektorlover. I tillegg har utvalget blant annet foreslått en ny saksbehandlings- og konsultasjonslov. Justis- og beredskapsdepartementet og Fornyings-, administrasjons- og kirkedepartementet har et hovedansvar for oppfølgingen av forslagene fra Samerettsutvalget 2, men oppfølgingen skjer i samarbeid med berørte departementer. Nærings- og handelsdepartementet vil ha et hovedansvar for oppfølgingen av forslaget til endringer i mineralloven.

I den grad det i oppfølgingen av strategi for mineralnæringen blir aktuelt med andre tiltak som vil kunne berøre samiske interesser direkte, vil det bli gjennomført konsultasjoner med Sametinget og andre samiske interesser i tråd med Prosedyrer for konsultasjoner mellom statlige myndigheter og Sametinget.

TILTAK

Ivaretakelse av samiske interesser ved mineralvirksomhet utenfor Finnmark

Som et ledd i oppfølgingen av Samerettsutvalget 2 vil regjeringen vurdere om det i mineralloven skal innføres særskilte regler for å ivareta samiske interesser ved mineralvirksomhet utenfor Finnmark. Nærings- og handelsdepartementet vil ta initiativ til konsultasjoner om saken med Sametinget og Norske Reindriftsamers Landsforbund våren 2013, og vil legge til rette for en mest mulig effektiv prosess. Arbeidet vil skje i samråd med Fornyings-, administrasjons- og kirkedepartementet. I arbeidet vil man blant annet se på de erfaringer som er gjort ved forvaltningen av reglene i mineralloven som gjelder for mineralvirksomhet i Finnmark. Regjeringen har ikke tatt stilling til om det skal foretas eventuelle endringer i mineralloven.

Styrket kunnskapsgrunnlag knyttet til mineralvirksomhet i områder med samiske interesser

Når det vurderes oppstart av undersøkelser, etablering og drift av mineralvirksomhet, er det viktig at alle interesserte parter har tilgang til et godt faktagrunnlag og kompetansestatus knyttet til slik virksomhet. Det gir et felles grunnlag for å vurdere muligheter og utfordringer knyttet til virksomheten.

Nærings- og handelsdepartementet vil gi Direktoratet for mineralforvaltning i samarbeid med Sesam (Senter for samiske studier ved UiT) i oppdrag å utarbeide et tilfredsstillende kunnskapsgrunnlag om virkninger av mineralvirksomhet for reindrift og andre samiske interesser. Arbeidet skal forankres hos mineralmyndighetene, næringen, samiske og andre berørte interesser. Nærings- og handelsdepartementet vil invitere Sametinget og Norske Reindriftsamers Landsforbund til konsultasjoner om utforming av mandatet for oppdraget.

Kapasitets- og kompetansebygging for samiske aktører

Nærings- og handelsdepartementet vil drøfte med stiftelsen Protect Sapmi muligheten for å gi støtte i en oppstartsperiode. Stiftelsen skal bistå samiske aktører med sakkyndig hjelp i prosesser som gjelder arealplanlegging og utbyggingstiltak.

Etiske retningslinjer

Regjeringen vil som et ledd i oppfølgingen av nordområdestrategien igangsette et arbeid med utvikling av etiske retningslinjer for å ivareta urfolks interesser ved økonomisk virksomhet i nordområdene. Árran er tildelt midler til å igangsette et forprosjekt.

Regjeringen forventer at selskaper som opererer i områder med samiske interesser tar samfunnsansvar. Dette kan gjøres blant annet ved aktivt å følge OECDs retningslinjer for flernasjonale selskaper og «UN Guiding Principles on Business and Human Rights».

Arktisk Råd

Arktisk råd er en arena for å diskutere virkningene av mineralvirksomhet i Arktis og nordområdene knyttet til blant annet verdiskaping, sysselsetting, naturmiljø og urfolksinteresser.

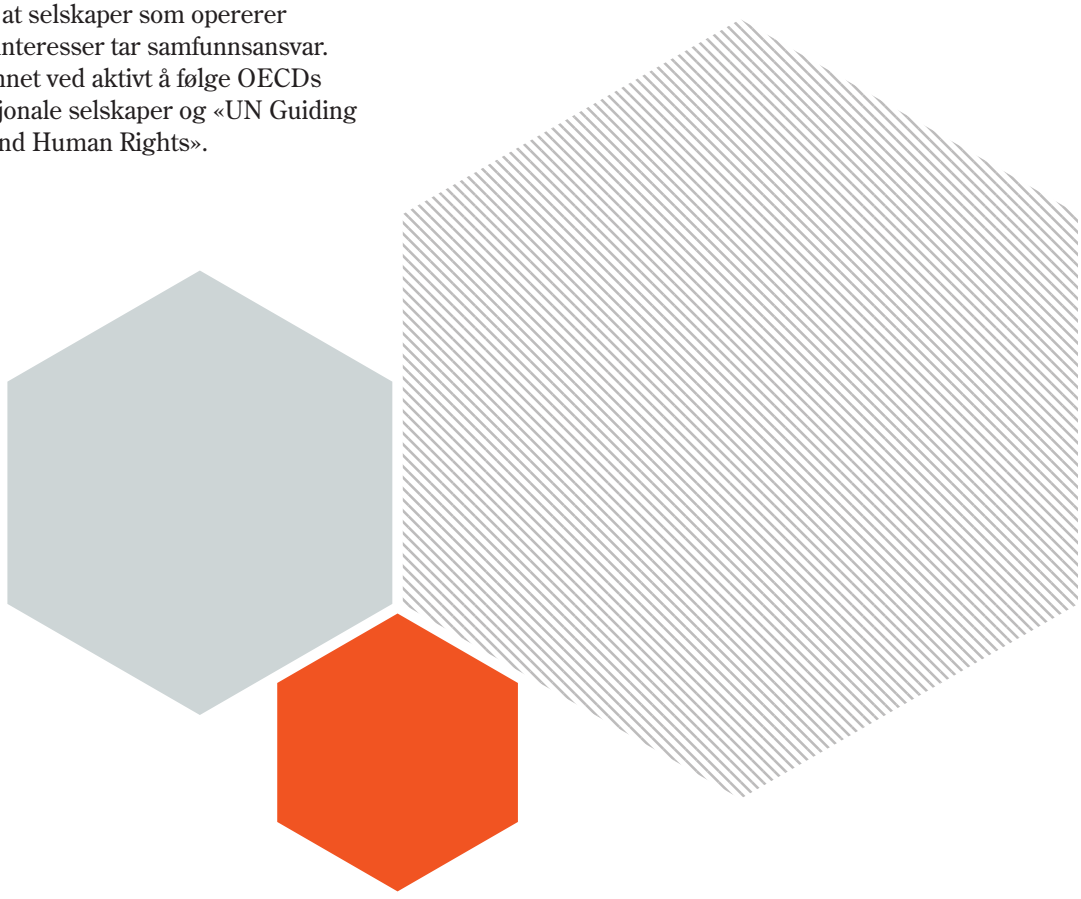




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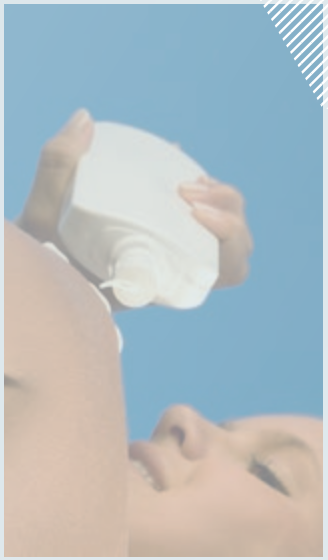


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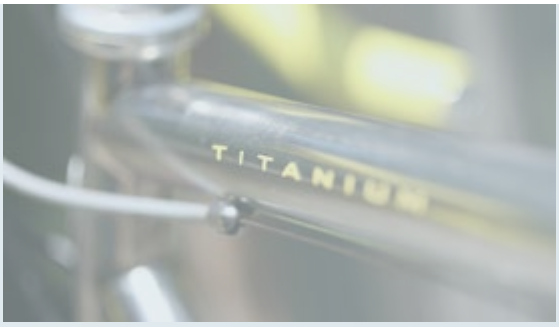


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«

Regjeringen ønsker at Norge skal være et attraktivt land å drive mineralvirksomhet i. Dette er bakgrunnen for at vi nå legger frem en strategi for mineralnæringen.

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APRIL 17, 2024

Joint Statement from the United States and Norway on Cooperation on High-Standard, Market-Oriented Trade of Critical Minerals

Today, U.S. Deputy National Security Advisor for International Economics Daleep Singh and Norwegian Minister of Trade and Industry Jan Christian Vestre signaled their intent to move forward with a U.S.-Norway Memorandum of Understanding (MOU) Concerning Cooperation on High-Standard, Market-Oriented Trade of Critical Minerals. The MoU is an important step towards further strengthening the United States and Norway’s future strategic cooperation regarding critical minerals. Under this MOU, the United States and Norway intend to build on months of constructive dialogue through a coordinated approach to the challenges and opportunities that characterize markets for critical minerals. Key focus areas of this cooperation will include advancing high-standard labor and environmental conditions in global critical minerals supply chains and examining and identifying appropriate responses to non-market policies and practices in third countries that have contributed to volatile, distorted market conditions. With this MOU, the United States and Norway intend to deepen our partnership in pursuit of the long-term commercial viability of sustainable, high-standard, market-oriented critical minerals mining and processing activities in the United States, Norway, and globally.

###

Norge og USA enige om å inngå strategisk mineralsamarbeid

Pressemelding | Dato: 18.04.2024 | Nærings- og fiskeridepartementet
(http://www.regjeringen.no/no/dep/nfd/id709/)

Dette innholdet er mer enn 1 år gammelt.

Norske og amerikanske myndigheter er enige om å starte formelle forhandlinger om strategisk mineralsamarbeid. Enigheten kom på plass etter næringsminister Jan Christian Vestres besøk i Det hvite hus i Washington DC onsdag.



Næringsminister Jan Christian Vestre i Det hvite hus i Washington DC . Foto: NFD

– Jeg er glad vi har lykkes i å få på plass forhandlinger om strategisk mineralsamarbeid og håper vi kan være i gang med konkrete samtaler i løpet av få uker, sier næringsminister Jan Christian Vestre.

Næringsministeren møtte onsdag Deputy National Security Advisor Daleep Singh, som er nivå to i Det hvite hus under National Security Advisor Jake Sullivan, med ansvar for internasjonal økonomi og handel. Vestre har tidligere hatt flere møter med National Security Council.

– Norge og USA er nære allierte og et formalisert samarbeid om mineraler vil gi en mer forutsigbar tilgang på råvarer, samtidig som det har stor betydning for norske eksportarbeidsplasser, sier Vestre.

Norge eksporterer kritiske mineraler som for eksempel kobolt og nikkel, sink, aluminium og titan. Kritiske mineraler brukes blant annet til produksjon av batterier og vindturbiner.



Næringsminister Jan Christian Vestre og Deputy National Security Advisor Daleep Singh. Foto: NFD

Norge som seriøs aktør og samarbeidspartner

Norges trepartsamarbeid og den norske modellen er en del av forholdene som trekkes frem i Washington for å vise Norge som en seriøs samarbeidspartner. LO-leder Peggy Hessen Følsvik og NHO-sjef Ole Erik Almlid deltar i møter med amerikanske myndigheter i Washington.

Norge og USA er enig i at samarbeid om stabile verdikjeder for kritiske mineraler skal inkludere arbeidsrettigheter av høy kvalitet, klima og miljøhensyn.

– I møte med amerikanske myndigheter er det viktig å vise frem Norge som en seriøs samarbeidspartner. Det unike trepartsamarbeid viser hvordan arbeidstakerrettigheter, miljø og grønn omstilling kan utvikles sammen, sier Vestre.

– Det er gode nyheter at Norge og USA skal starte formelle forhandlinger om strategisk mineralsamarbeid. Dette er viktig for mineralindustrien i Norge, og vi håper dette leder til markedsadgang for norske bedrifter. Vi har unike mineralressurser som vil være viktig for energiomstillingen, sier Ole Erik Almlid, administrerende direktør i NHO.

– Mineraler er helt avgjørende for det grønne skiftet og Norge har store mineralressurser. Forhandlinger om et strategisk mineralsamarbeid med USA er veldig positivt. Det bidrar både til utvikling av grønne verdikjeder og arbeidsplasser, sier LO-leder Peggy Hessen Følsvik.

Les mer om felleserklæringen som er publisert på nettsidene til Det hvite hus:
Joint Statement from the United States and Norway on Cooperation on High-Standard, Market-Oriented Trade of Critical Minerals | The White House
(https://www.whitehouse.gov/briefing-room/statements-releases/2024/04/17/joint-statement-from-the-united-states-and-norway-on-cooperation-on-high-standard-market-oriented-trade-of-critical-minerals/)

> Nærings- og fiskeridepartementet

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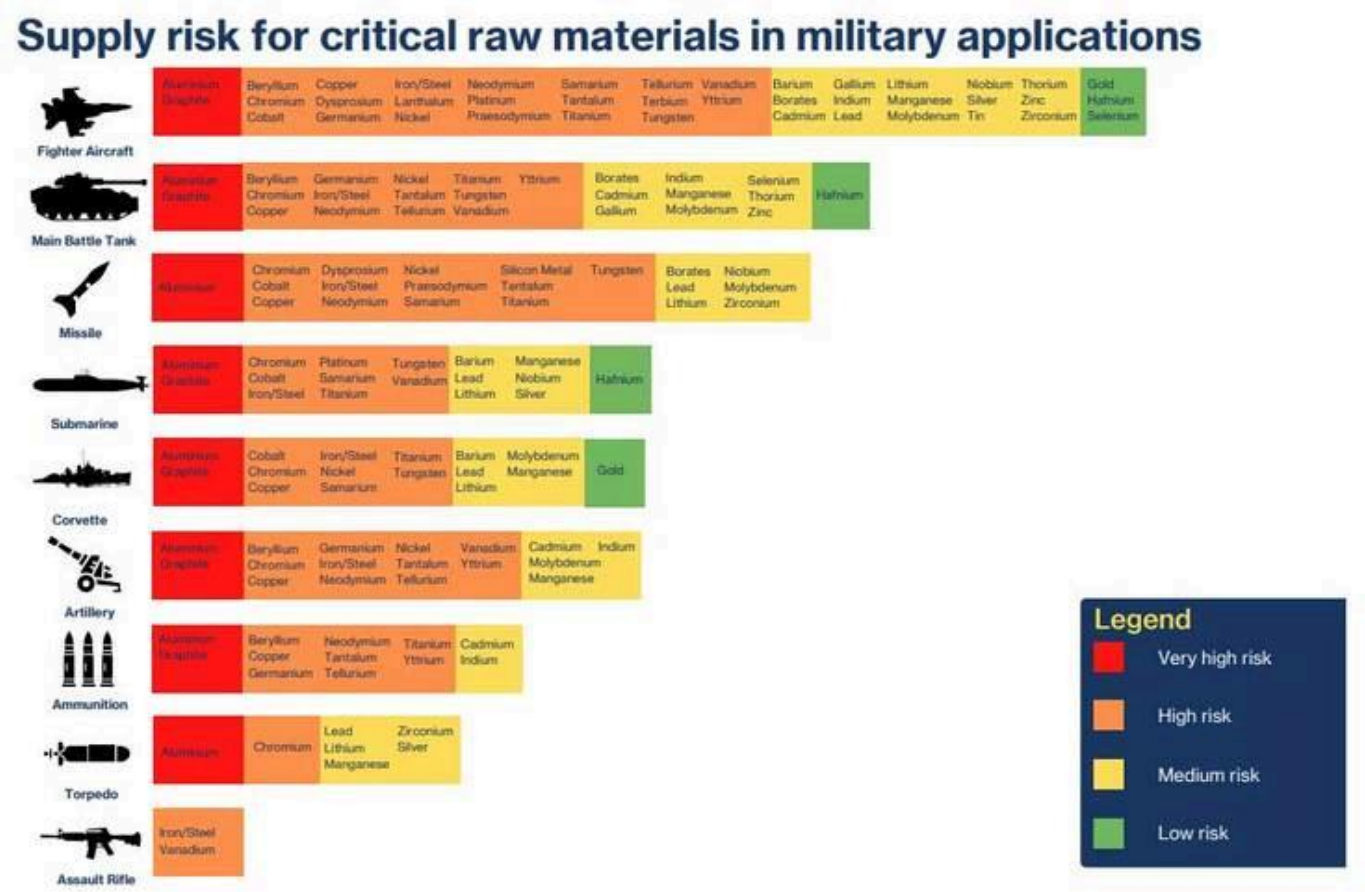
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NATO releases list of 12 defence-critical raw materials

11 Dec. 2024 - | Last updated: 16 Dec. 2024 15:48

On Wednesday 11 December, NATO published a list of 12 defence-critical raw materials essential for the Allied defence industry. These materials are integral to the manufacture of advanced defence systems and equipment.



Source: Strategic raw materials for defence Mapping European industry needs Benedetta Girardi, Irina Patrahau, Giovanni Cisco and Michel Rademaker The Hague Center for Strategic Studies, January 2023

Aluminium, for example, is pivotal in producing lightweight yet robust military aircraft and missiles, enhancing their agility and performance. Graphite is crucial for the production of main battle tanks and corvettes due to its high strength and thermal stability. In submarines, graphite is used in the construction of hulls and other structural components, significantly reducing

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The availability and secure supply of these materials are vital to maintaining NATO's technological edge and operational readiness. Disruptions in their supply could impact the production of essential defence equipment. Identifying these key materials is NATO´s first step towards building stronger, better protected supply chains, crucial for Allied defence and security.

This initiative is part of a roadmap, endorsed by NATO Defence Ministers in June 2024, to protect Allied supply chains from disruptions that could affect NATO's deterrence and defence. The list was informed by the NATO Industrial Advisory Group (NIAG), using a defence-capability focused methodology. The public release of this list highlights NATO's commitment to support Allies in securing essential materials for the development and delivery of Allied defence capabilities.

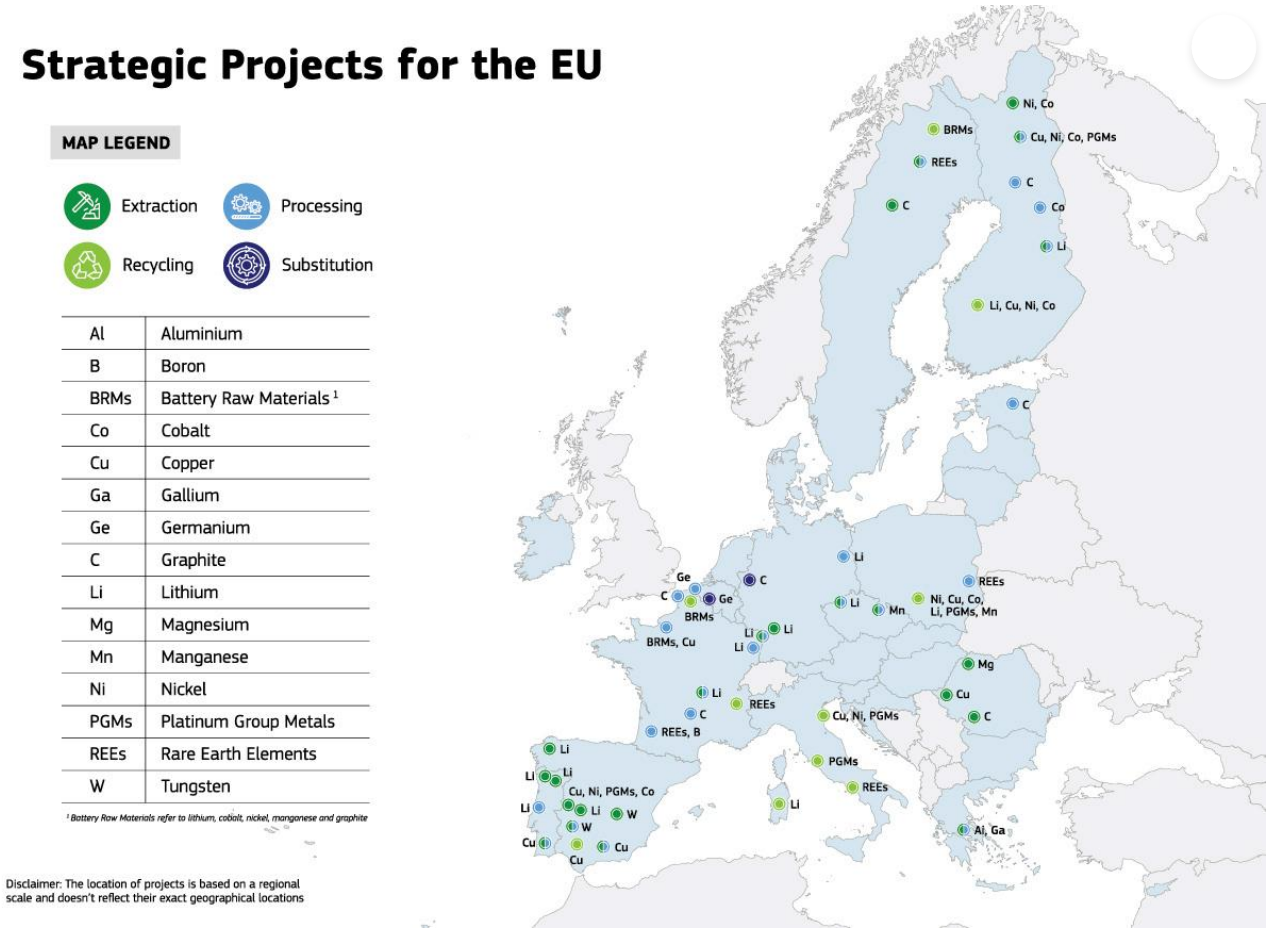
List of NATO Defence Critical Raw Materials

1. Aluminium
2. Beryllium
3. Cobalt
4. Gallium
5. Germanium
6. Graphite
7. Lithium
8. Manganese
9. Platinum
0. Rare Earth Elements
1. Titanium
2. Tungsten

PRESS RELEASE | Mar 25, 2025 | Brussels | 3 min read

Commission selects 47 Strategic Projects to secure and diversify access to raw materials in the EU

The Commission has adopted, for the first time, a list of 47 Strategic Projects to boost domestic strategic raw material capacities, which will in turn strengthen the European raw materials value chain and diversify sources of supply. The new Strategic Projects mark an important milestone in the implementation of the Critical Raw Material Act (CRMA), which aims to ensure European extraction, processing and recycling of strategic raw materials meet 10%, 40% and 25% of EU's demand by 2030, respectively. By helping Europe meet these targets, the new Strategic Projects contribute significantly to Europe's green and digital transitions, while supporting Europe's defence industry and aerospace industries.



Overview on the selected projects

The 47 new Strategic Projects are located across 13 EU Member States: Belgium, France, Italy, Germany, Spain, Estonia, Czechia, Greece, Sweden, Finland, Portugal, Poland and Romania. They cover one or more segments of the raw material value chain, with 25 projects comprising extraction activities, 24 processing, 10 recycling and 2 substitution of raw materials. The Strategic Projects cover 14 of the 17 strategic raw materials listed in the Critical Raw Materials Act. This includes several projects covering lithium (22 projects), nickel (12 projects), cobalt (10 projects), manganese (7 projects) and graphite (11 projects) which will particularly benefit the EU battery raw material value chain. These projects will ensure that the EU can fully meet its extraction, processing and recycling 2030 benchmarks for lithium and cobalt, while making substantial progress for graphite, nickel and manganese. Moreover, other strategic projects involving magnesium (1 project) and tungsten (3 projects) will contribute to the resilience of the EU's defence industry, which relies on the use of these materials.

These projects were selected as they contribute to the EU's secure supply of strategic raw materials, adhere to environmental, social and governance criteria and are technically feasible. In addition, the selected projects have also demonstrated clear cross-border benefits for the EU.

Benefits for the selected projects

To become operational, the 47 Strategic Projects have an expected overall capital investment of €22.5 billion. These projects will be able to benefit from coordinated support by the Commission, Member States and financial institutions to become operational, notably regarding access to finance and support to connect with relevant off-takers. They will also benefit from streamlined permitting provisions, to ensure predictability for project promoters while safeguarding environmental, social and governance standards. In line with the CRMA, the permit-granting process will not exceed 27 months for extraction

projects and 15 months for other projects. Currently, permitting processes can last from five to 10 years.

Background

The Critical Raw Materials Act (CRMA) entered into force on 23 May 2024. The same day, the Commission published a call for submission of proposals for recognition of projects as Strategic Projects with a cut-off date on 22 August 2024. Applications considered complete were assessed by the Commission with the support of external experts to check whether the projects meet relevant criteria under the CRMA. Based on this assessment, the Commission identified a list of projects for the extraction, processing, recycling or substitution of strategic raw materials. The Commission consulted the Critical Raw Materials Board, composed of Member States, and the European Parliament as an observer, to discuss and adopt an opinion on the list of Strategic Projects on 20 February 2025 and on 12 March 2025. The Commission also received applications for projects located in third countries. The Decision on the potential selection of such projects will be adopted at a later stage. The Commission will soon announce a new call for Strategic Project applications, currently planned for end of summer.

For More Information

List of Strategic Project

Q&A on the Strategic Projects

Interactive map and fiches

Critical Raw Materials Act - European Commission

Quote(s)



‘ At the very start of our most strategic supply chains, are raw materials. They are also indispensable to the decarbonisation of our continent. But Europe currently depends on third countries for many of the raw materials it needs the most. We must increase our own production, diversify our external supply, and make stockpiles. Today, we have identified 47 new strategic projects that, for the first time, will help us secure our own domestic supply of raw materials. This is a landmark moment for European sovereignty as an industrial powerhouse. ’

Stéphane Séjourné, Executive Vice-President for Prosperity and Industrial Strategy

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Regjeringen vil innlemme EUs regelverk for kritiske råvarer i EØS-avtalen

Pressemelding | Dato: 28.03.2025 | Nærings- og fiskeridepartementet
(http://www.regjeringen.no/no/dep/nfd/id709/)

Regjeringen vil jobbe for at EUs lovforslag om kritiske råvarer, Critical Raw Materials Act (CRMA), skal innlemmes i EØS-avtalen, og dermed bli en del av det norske regelverket

- Industri- og mineralprosjekter er ofte komplekse og tar lang tid å utvikle. En viktig del av EU-regelverket for kritiske råvarer er å legge til rette for raskere saksbehandling. Norge er allerede en viktig leverandør av kritiske råvarer til Europa, og har potensiale til å levere mer, men da må vi jobbe langs flere spor. I dag har regjeringen kommet med både en ny stortingsmelding om industri og en ny minerallov. Dette kan sammen med CRMA bidra til at vi får raskere fremdrift i nye prosjekter. Det er viktig for både Norge og Europa, sier næringsminister Cecilie Myrseth.

Norge er allerede den største leverandøren til Europa av to materialer på Europakommisjonens liste over kritiske råvarer: Aluminium og silisium. Disse produseres av norsk prosessindustri.

Det overordnede målet med EU-regelverket CRMA er å sørge for at EU får tilgang til en sikker, motstandsdyktig og bærekraftig forsyning av kritiske råvarer. Dette har stor betydning for sektorer som fornybar energi, romfart og forsvar.

– Norske myndigheter har arbeidet tett med de andre EØS-landene og EU om utviklingen av CRMA. Vi har nå gått grundig gjennom forslaget, fått tilbakemeldinger fra næringslivet gjennom innspillsmøter og sett på betydningen for norske interesser. Vår vurdering er at det er viktig, og i tråd med norske interesser, å gjøre CRMA til en del av EØS-avtalen og vi vil arbeide for dette, sier Myrseth.

Fakta om Critical Raw Materials Act

Det er et mål at EU innen 2030 skal kunne utvinne minst 10 prosent av sitt årlige forbruk av strategiske råvarer, prosessere minst 40 prosent og resirkulere minst 25 prosent.

CRMA skal gi et felles rammeverk for produksjon og gjenvinning av utvalgte metaller og mineraler, og skal bidra til et godt fungerende indre marked for kritiske råvarer.

CRMA er også en sentral del av EUs Grønne Industriplan (https://ec.europa.eu/commission/presscorner/detail/en/ip_23_510).

EUs forordning om kritiske råvarer trådte i kraft i EU i mai 2024.

CRMA har tre hoveddeler:

- Styrke insentivene for å etablere kritiske råvareprosjekter i EU ved å effektivisere søknadsprosesser og koordinere tilgang til finansiering.
- Innføre regler for å overvåke verdikjedene for kritiske råvarer og redusere forsyningsrisiko.
- Øke materialgjenvinning og etablere nasjonale programmer for sirkularitet av kritiske råvarer.

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