2025

# STRATEGIC ROADMAP FOR UNLOCKING UKRAINE'S CRITICAL RAW MATERIALS POTENTIAL

This White Paper was co-authored by the Kyiv School of Economics and SYSTEMIQ in coordination with the Ministry of Environmental Protection and Natural Resources of Ukraine and the Ministry of Economy of Ukraine. Peter Handley, Senior Fellow at the European Initiative for Energy Security, contributed to the document.

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Ministry of Environmental Protection and Natural Resources of Ukraine

MINISTRY OF ECONOMY OF UKRAINE

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# Executive summary

**The global race to secure critical raw materials (CRMs) has intensified in recent years, driven by the accelerating transition to green energy, rapid technological advancement, and evolving security imperatives.** Demand for materials such as lithium, cobalt, nickel, rare earth elements, and graphite is expected to double or even triple by 2030. The green energy transition—anchored in the widespread deployment of batteries, electric vehicles, solar panels, and wind turbines—is a main driver of this surge. Concurrently, the growing semiconductor industry is increasing demand for specialized inputs like gallium and germanium, essential for chip fabrication and high-performance electronics. Rising geopolitical tensions and defense modernization are also heightening the need for CRMs used in advanced weapons systems, aerospace components, and secure communication infrastructure, including titanium, graphite, cobalt, and rare earth elements. Combined, these trends are placing unprecedented pressure on global supply chains and prompting governments and industries to rethink long-term sourcing strategies.

Nevertheless, the supply outlook for CRMs remains extremely constrained and vulnerable to geopolitical risk. Global supply chains are heavily concentrated, with a small number of countries dominating mining, processing, and refining. As of 2023, China was responsible for nearly 100% of global graphite and manganese processing, 87% of rare earth element (REE) processing, 72% of lithium processing, and 44% of copper processing. China also has significant control over titanium value chain, holding more than 55% of titanium dioxide production capacity[1] and more than 65% of titanium sponge production capacity[2]. While mining operations are somewhat more geographically distributed, they are concentrated in a few countries. For example, China mines over 35% of ilmenite, 81% of REEs, Indonesia 53% of nickel, Australia 41% of lithium, South Africa 38% of manganese, and Chile 23% of copper[3].

This heavy reliance on imported critical raw materials leaves economies increasingly exposed to geopolitical shocks, export restrictions, and price volatility. A recent example is June 2025 announcement of Niger's plans to nationalize the Somair uranium mine, previously operated by French state-owned company Orano[4]. The move sent shockwaves through the industry, highlighting the growing risks to foreign mining operations in politically unstable regions and underscoring the fragility of global supply chains for strategic commodities.

Several key trends are emerging in response. National governments are increasingly designating CRM supply as a strategic priority, unlocking regulatory reforms and funding

1 S&P
2 McKinsey Titanium Commodity Perspective
3 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)
4 Reuters

mechanisms to support domestic production and recycling. The EU's Critical Raw Materials Act, for example, sets 2030 targets to extract at least 10%, process at least 40%, and recycle at least 25% of its strategic CRM demand within the EU, while limiting reliance on any single third country to no more than 65% per material[5]. Investments are flowing into lithium refining, synthetic graphite production, and titanium recovery technologies. Yet these efforts face persistent barriers: high costs, permitting delays, and technological challenges are slowing scale-up. Without faster progress, the widening supply-demand gap could become a bottleneck not only for Europe's green and digital transitions but increasingly for its security and defense needs.

**In this context, Ukraine has a unique opportunity to emerge as a strategic supplier and help bridge this critical gap.**

Ukraine possesses the largest known reserves in Europe of several strategic minerals—8.4 million tons of titanium[6] (conservative USGS estimate based on Soviet-era exploration and estimation methodologies, real potential could be significantly higher), 17.9 million tons of graphite[7], 140 million tons of manganese[8], and 100 thousand tons of uranium of competitive quality[9]. Additionally, Ukraine holds the third-largest lithium reserves in Europe, estimated at 500 thousand tons of lithium carbonate equivalent (LCE)[10].

Ukraine's rich natural endowments are complemented by its established mining capabilities, strategic proximity to EU markets, and a strong commitment to developing efficient regulatory frameworks and streamlined permitting processes. Its strategic position is further strengthened by international partnerships—both bilateral and regional—including agreements with the EU and the United States. These collaborations create new opportunities for mining and processing projects while advancing Ukraine's integration into global critical raw material value chains.

Ukraine aims to position itself not just as a supplier of raw materials, but as a fully integrated hub for critical materials processing within European and global supply chains. By scaling up domestic processing and value-added production—such as battery manufacturing and titanium metal output—Ukraine can offer a reliable, competitive alternative for the EU, the United States, and other allies seeking to reduce dependence on high-risk sources.

**To achieve this vision, Ukraine could pursue a dual-focus approach for CRM sector development.**

- First, Ukraine could focus on advancing flagship projects in materials where development is already underway—such as titanium, graphite, lithium, and potentially manganese and uranium. Successfully executing these projects will help build investor confidence and serve as a catalyst for broader industry growth. Developing these flagship projects would require close collaboration between private and public sectors and targeted support from the Ukrainian government and the donor community. Long term efforts could shift toward building domestic processing capacity and developing downstream manufacturing, positioning Ukraine higher in the value chain.
- Second, Ukraine could implement a sector-wide exploration program and reforms to create a transparent, investor-friendly environment that supports sustained growth. Ukraine could invest in geological exploration and feasibility studies to evaluate its potential in other critical materials, including rare earth elements. This also includes strengthening institutional capacity, fostering an innovation ecosystem, and promoting international technological cooperation—all essential foundations for a globally competitive critical raw materials sector.

Unlocking Ukraine's critical raw materials (CRM) potential would require close collaboration between the government, international partners, and the private sector. The government may lead with regulatory reforms, targeted incentives, and support for

5 The European Commission: Critical Raw Materials Act
6 USGS estimate
7 S&P Global estimate
8 USGS estimate
9 World Nuclear Association: Uranium resources to 130 USD/kg U by country in 2023 (reasonably assured resources plus inferred resources)
10 Ukraine Geology Service estimate

flagship projects. International donors can provide financial tools, reduce investment risk, and foster innovation through global partnerships. Meanwhile, the private sector plays a vital role in driving project development, innovation, and commercialization. By aligning efforts, these stakeholders can transform Ukraine into a strategic CRM hub, strengthen global supply chains, and support the country's long-term recovery and resilience.

A focused and coherent approach to ecosystem development—centered on prioritizing value chains and technologies around key strategic materials with strong value propositions in Ukraine—will be essential for ensuring success while making efficient use of government resources and invested capital.

**Graphic 1. Proposed roadmap for development of Ukraine's CRM sector**

| | HORIZON 1 (2025-2030)<br>Catalyzing Industry Development | HORIZON 2 (2030 and beyond)<br>Expansion and Industry Growth |
|---|---|---|
| **Accelerating flagship projects** | Providing targeted state and donor support for 3–5 high-priority, mature projects (e.g., titanium, graphite, lithium, manganese, uranium projects), with a focus on:<br>• Establishment of funds and deploying de-risking financial instruments to secure finance for research and development of new projects<br>• Expanding the number of projects included in strategic international partnerships (e.g., with the EU and USA)<br>• Providing targeted incentives (including tax breaks) for priority projects<br>Launching development of downstream manufacturing capacity (feasibility studies, project preparation) | Mobilizing additional private investment, including in new projects and the exploration of untapped deposits<br>Ramping up processing capacity, with aim to turn Ukraine into a processing hub for Europe, the USA, and other partners in G7+<br>Providing targeted state and donor support for downstream manufacturing initiatives, such as titanium metal production and battery value chain development |
| **Implementing industry-wide reforms** | Initiating key reforms to address critical gaps, including:<br>• Enhancing transparency of mineral reserve data<br>• Digitalizing the national resource database<br>• Adopting internationally recognized classification systems<br>• Modernizing the regulatory framework to reflect global best practices and ensure transparency<br>• Streamlining processes for securing permits and access to utilities for new projects, including tailings and mining waste reprocessing initiatives<br>Implementing sector-wide exploration program to map Ukraine's full potential across key strategic commodities | Strengthening competitiveness across all key investment attractiveness criteria by:<br>• Investing in capability development and building a robust innovation ecosystem around key commodity sectors (titanium, graphite, lithium, manganese, uranium, and others)<br>• Developing new research and innovation projects under the Ukraine-EU Strategic Partnership on Raw Materials<br>• Securing access to advanced technologies through collaboration with established players, including partnerships with leading international OEMs |

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# Ukraine's CRM Potential

**Ukraine stands at a pivotal moment in its economic development, with a strong and competitive base in critical raw materials. Ukraine's CRM sector is poised to play a significant role in the global market. With vast resources, proven capabilities, and strategic proximity to Europe, Ukraine offers a compelling value proposition. However, unlocking this potential requires addressing several challenges and leveraging international partnerships.**

## Ukraine's Value Proposition and Resource Overview

Ukraine boasts a rich endowment of critical raw materials, that are essential for various industries, including technology, energy, and manufacturing. However, Ukraine's value proposition goes beyond resources endowment—Ukraine has also proven technical capabilities and developed infrastructure, which secures connectivity of Ukraine to the key strategic markets, including Europe and the US.

### Vast resource base

Ukraine's extensive CRM deposits offer a significant competitive advantage. The country's geological diversity ensures a steady supply of various critical materials, reducing the risk of supply disruptions.

Ukraine holds Europe's largest known reserves of titanium, graphite, manganese, and uranium, as well as third-largest reserves of lithium and rare earth elements[11].

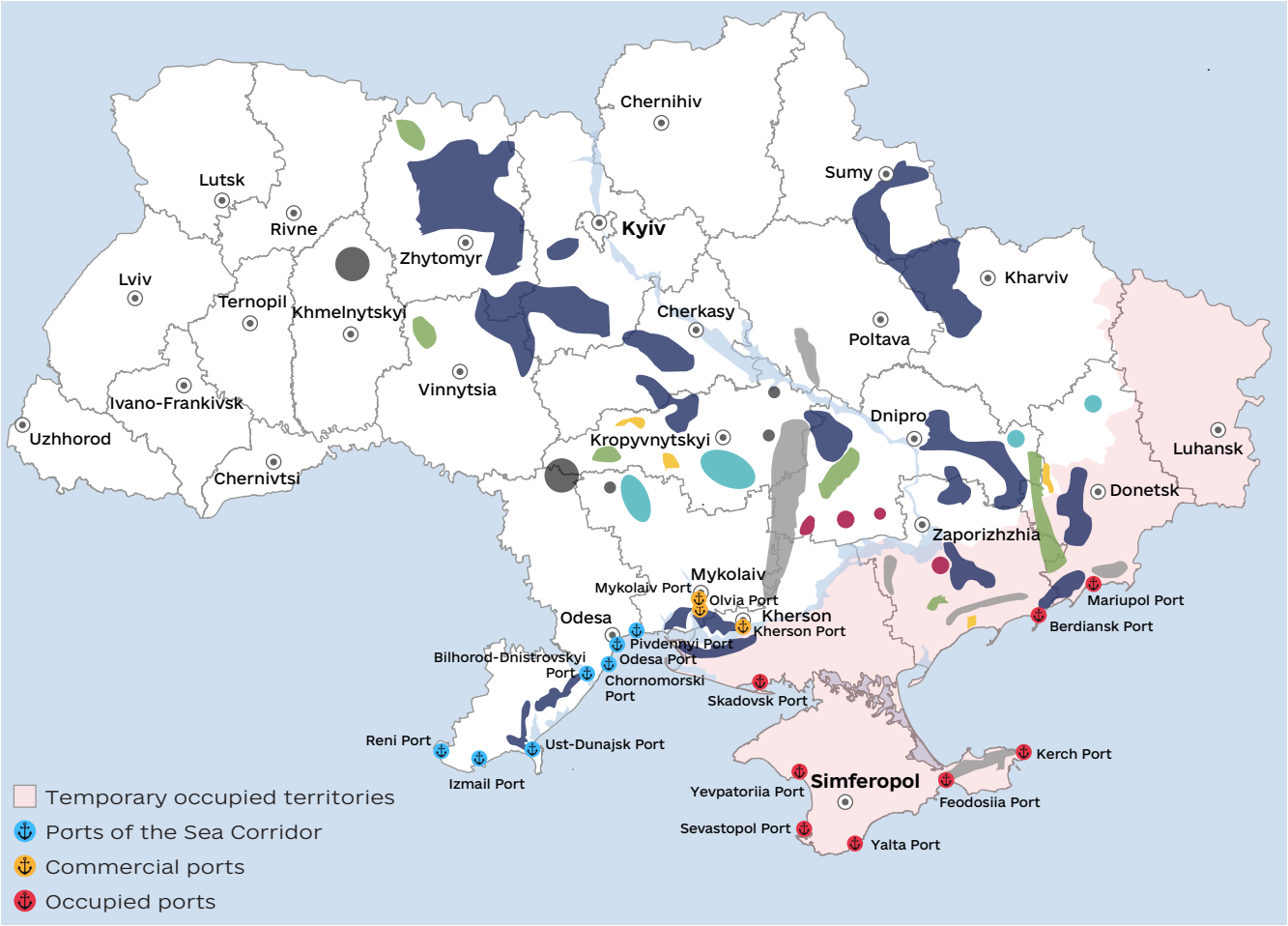
### Critical Raw Materials[12] potential

#### *Titanium*

Ukraine is one of the world's top producers of titanium, a metal crucial for aerospace, medical, and industrial applications. According to U.S. Geological Survey data, based on Soviet-era exploration and resource estimation methodologies, the country's estimated titanium reserves exceed 8.4 million tons (including 5.9 million tons of ilmenite and 2.5 million tons of rutile)[13] (mainly in Central Ukraine—Dnipropetrovsk, Kirovohrad and Zhytomyr regions). New geological exploration and resource estimation efforts could result in more than 3 times higher titanium reserve estimate. The country has a proven record of both pigment and metal production.

11 USGS estimates, Ukrainian Geological Survey estimates
12 Classification according to the European Commission: Fifth list 2023 of critical raw materials for the EU
13 USGS estimate

## Graphic 2. Map of strategic resources in Ukraine




| Critical raw materials | Rank by reserves in Europe |
|---|---|
| Titanium | #1 |
| Graphite | #1 |
| Lithium | #3 |
| Manganese | #1 |
| Rare earth elements | #3 |

| Other strategic materials | Rank by reserves in Europe |
|---|---|
| Uranium | #1 |
| Iron | #1 |

### *Graphite*

The six major deposits defined in the country are estimated to host reserves totaling 306 million tons of ore, containing 17.9 million tons of graphite[14]. Leveraging these resources, Ukraine can cater to the growing demand for this material, essential for manufacturing of batteries used in electric vehicles and renewable energy storage solutions. Tests have been carried out, confirming that quality of Ukraine's resources is suitable for EV-grade spherical graphite production.

### *Lithium*

As a key component in batteries, lithium is critical for the energy transition. Ukraine's lithium reserves position it as a potential leader in the supply of this vital material, supporting the global shift towards sustainable energy solutions. Ukraine is home to third largest lithium reserves in Europe (more than 500 thousand tons estimated reserves[15] in Central and Eastern Ukraine). However, the development of Ukraine's lithium reserves is facing challenges—part

14 S&P Global
15 Ukrainian Geological Survey estimate

of the country'sreserves is found in petalite ore, a more complex and costly material to extract than spodumene. Furthermore, a significant part of Ukraine's lithium deposits is located in Russian-occupied regions.

### *Manganese*

Ukraine's estimated reserves of manganese (concentrate) reach 140 million tons[16] (in Central and Eastern Ukraine), placing the country at #1 by reserves in Europe and #2 globally. Additional advantages lie in the low cost of open pit and underground mining and competitive ore grades (20–25%). Ukraine also has historic ferroalloy production capacities. Before the war, Ukraine was the world's 7th largest producer of manganese ore globally[17]. The country's manganese industry plays a significant role in its metallurgical sector, supplying essential raw materials for steel and ferroalloy production.

### *Rare earth elements (REE)*

Ukraine has identified reserves of rare earth elements used in electronics, EVs, wind turbines, defense systems (including lanthanoids, niobium, tantalum, zirconium, yttrium). The rare-earth deposits include the Chernihivske, Azovske (located in the currently occupied territory in Donetsk region), and Oktyabrske deposits, which hold significant potential for integrated raw material extraction and processing.

## Other strategic materials potential

### *Uranium*

Ukraine holds Europe's largest estimated uranium reserves at more than 100 thousand tons U of competitive quality (accounting for 2% global reserves)[18], located mostly in Central Ukraine. The country has a proven record of mining and beneficiation of Uranium at the state-owned Eastern Mining and Processing Plant (MPP).

### *Magnetite iron ore*

Ukraine boasts substantial magnetite-rich iron ore reserves, anchored in two major mining basins in Central Ukraine—Kryvyi Rih (Dnipropetrovsk and partially Kyrovohrad regions) and Kremenchuk (located near Horishni Plavni in Poltava Region). Ukraine is estimated to hold around 6.5 billion tons of iron ore reserves (2.3 billion tons iron content)[19], much of it in the form of magnetite-bearing ore.

### *Other materials*

According to estimates, Ukraine may hold significant reserves of materials such as beryllium (13.9 thousand tons of BeO), nickel (390 thousand tons), cobalt (20 thousand tons), chromium oxide (700 thousand tons), copper (101 thousand tons), phosphorus (19–57 thousand tons of $P_2O_5$) and other rare earths[20]. Another opportunity lies in Ukraine's promising molybdenum prospects. Despite the ongoing war, a few projects involving these critical materials are actively being developed—for example, the Perzhanske beryllium deposit in the Zhytomyr region and the Chervona molybdenum prospect near Kryvyi Rih.

Ukraine's reserves of high-purity sodium and quartz offer additional opportunities in the energy sector, particularly for innovative energy storage solutions and the manufacturing of renewable power infrastructure. The strategic value of these resources will hinge on the ability to recover and process them locally into high-purity, energy-transition-grade materials in a cost-effective manner, especially amid intensifying global competition. At the same time, growing interest in other critical materials—such as gallium, which is increasingly vital for AI hardware and semiconductor production—is expanding Ukraine's potential role in future clean tech and digital supply chains.

Further research, exploration and testing is necessary to precisely map Ukraine's full potential in critical raw materials.

16 USGS estimate
17 USGS
18 World Nuclear Association: Uranium resources to 130 USD/kg U by country in 2023 (reasonably assured resources plus inferred resources)
19 USGS estimate
20 Ukrainian Geological Survey

**Sidebar:**

## Selected assets[21]

# TITANIUM

- Existing mining and concentrate production:
  - Irshansk and Vilnohirsk Mining and Processing Plants (MPPs)—privatized in 2024 by Azerbaijan's NEQSOL Group.
  - Selyshchanske deposit (Zhytomyr region)—currently developed under license by NEQSOL Holding.
  - Demurinsky MPP—available for privatization. Asset is located close to frontline of military action (in Dnipropetrovsk region).
  - Valky-Gatkivske deposit—developed under license by Group DF.
  - Mezhyrichne deposit—developed under license by Group DF.
  - Byrzulivske and Likarivske Mines—developed under license by private operators.
- Prospective greenfield projects:
  - Pravoberezhne deposit (Zhytomyr region)—potentially significant resource, requires a full geological exploration and resource estimation effort and comprehensive program for development.
  - Trostyanytske deposit (Zhytomyr region)—potentially strong value proposition in terms of potential production economics and lower overburden ratios
  - Stremyhorodske deposit (Zhytomyr region)—a large hard-rock deposit containing apatite and titanium ores.
  - Motrona-Annivske deposit (Dnipropetrovsk region)—select secti ons identified for potential development.
- Existing downstream assets:
  - ZTMC (Zaporizhzhia Titanium and Magnesium Combine)—state-owned producer of titanium sponge; in need of modernization. The company is currently being prepared for privatization.
  - Sumykhimprom—state-owned producer of titanium dioxide; also requires modernization. Privatization auction process for the company is currently underway.

# GRAPHITE

- Zavallivske deposit, consisting of multiple blocks:
  - South-East block (estimated reserves 22.9 million tons of graphite ore) is operated under license by the Australian Volt Resources, with current mining and refining capacity of 7 thousand tons per year.
  - Zarichna block (estimated reserves 33 million tons of graphite ore) is operated under license by the Ukrainian BGV Group, with project still in concept stage.
  - Licenses for Khutir Andriivka, Promizhna, Pivdenna Smuha, and Pravoberezhna blocks are being prepared for auction.
- Burtynske deposit, consisting of multiple blocks:
  - Horodniavska block (estimated reserves 130 million tons of graphite ore) is operated under license by the Turkiye's Onur Group, with project still in concept stage.
  - Licenses for Maidanska, Khmelivska and Lisova blocks are prepared for auction.
- Balakhivske deposit (estimated reserves 44 million tons of graphite ore) is operated under license by the Ukrainian BGV Group, with project in design phase.
- Petrivske deposit—license in being prepared for auction.
- Kodatskyi occurrence—license is being prepared for auction.
- Bohoslovskyi, Voievodivskyi occurrences—license is being prepared for auction.

21 Source: Ukrainian Geological Survey (unless stated otherwise)

## LITHIUM

- Polokhivske deposit (estimated reserves over 760,000 tons of lithium carbonate equivalent[22])—operated under license by the Ukrainian UkrLithiumMining (ULM), with project in feasibility study stage.
- Dobra block—license is ready for conclusion of Production Sharing Agreement (PSA).
- Kruta Balka block—located in currently occupied territory (Zaporizhzhia region).

## MANGANESE

- Ukrainian manganese resources are mainly concentrated along Nikopol basin, which includes the Velykotokmatske, Marganetske, Nikopolske and Fedorivske deposits.
  - The western part of the basin is being developed by JSC Pokrovsky GOK (with annual production of over 1 million tons of concentrate and 0.3 million tons of agglomerate)[23].
  - The eastern part of the basin is being developed by JSC Marganetske GOK (with annual production of more than 550 thousand tons concentrate[24]).

## MAGNETITE

- Several large-scale mining and processing plants owned and operated by ArcelorMittal, Metinvest and Ferrexpo.
- Shymanivske deposit located near existing mines near Kryvyi Rih have a potential for greenfield development. Shymanivske deposit is being developed under license by Canada's Black Iron.

## URANIUM

- Mining: uranium ore is currently mined at three deposits: Novokostyantynivske, Michurinske and Centralne deposits (Kyrovohrad region). The Novokostyantynivske deposit is the largest uranium deposit in Europe, with about 80,000 tons U reserves at 0.14% grade.
- Processing (yellow cake production): Eastern MPP in Zhovti Vody (Dnipropetrovsk region).

22 Statement by Ksenia Orynchak, Executive Director of the National Association of Extractive Industries of Ukraine (NADPU) in 2024
23 JSC Pokrovsky GOK
24 GMK Center

### Potential for reprocessing tailings and mining waste

Ukraine has significant potential to recover valuable materials from legacy mining waste, particularly in historically active regions such as Kryvyi Rih, Poltava, Nikopol, Donbas, and Dnipropetrovsk regions. These tailings—accumulated over decades—often contain polymineral compositions with residual concentrations of critical materials such as iron, rare earth elements, titanium, and zirconium. Many were deposited when processing technologies were less efficient, leaving behind economically viable resources. Reprocessing these sites could unlock new value while addressing environmental risks posed by aging or unstable tailings storage facilities.

To advance this opportunity, Ukraine could align with best practices outlined in the EU Critical Raw Materials Act (CRMA), which requires Member States to evaluate and report the CRM content of both ongoing and legacy waste streams. For closed or abandoned sites, the CRMA mandates public mapping of residual materials using historic permitting records and targeted sampling campaigns.

Future mining projects could prioritize integrated recovery of both primary and secondary minerals to improve resource efficiency and economic viability. Designing operations to extract by-products—such as rare earth elements, base metals, or high-purity industrial minerals—can enhance project value while reducing waste. In parallel, Ukraine could explore innovative pathways to recover critical materials from unconventional sources, such as extracting gallium and germanium from coal fly ash, supporting circular economy goals and tapping underutilized resource streams. Given Ukraine's legacy of successful extractive technologies, strong research institutions, and formerly operational chemical processing facilities, there is significant potential to revive projects focused on the extraction of germanium, gallium, hafnium, zirconium, and scandium.

Developing a streamlined, investor-friendly regulation framework and permitting process could help attract investment into mine waste and tailings processing.

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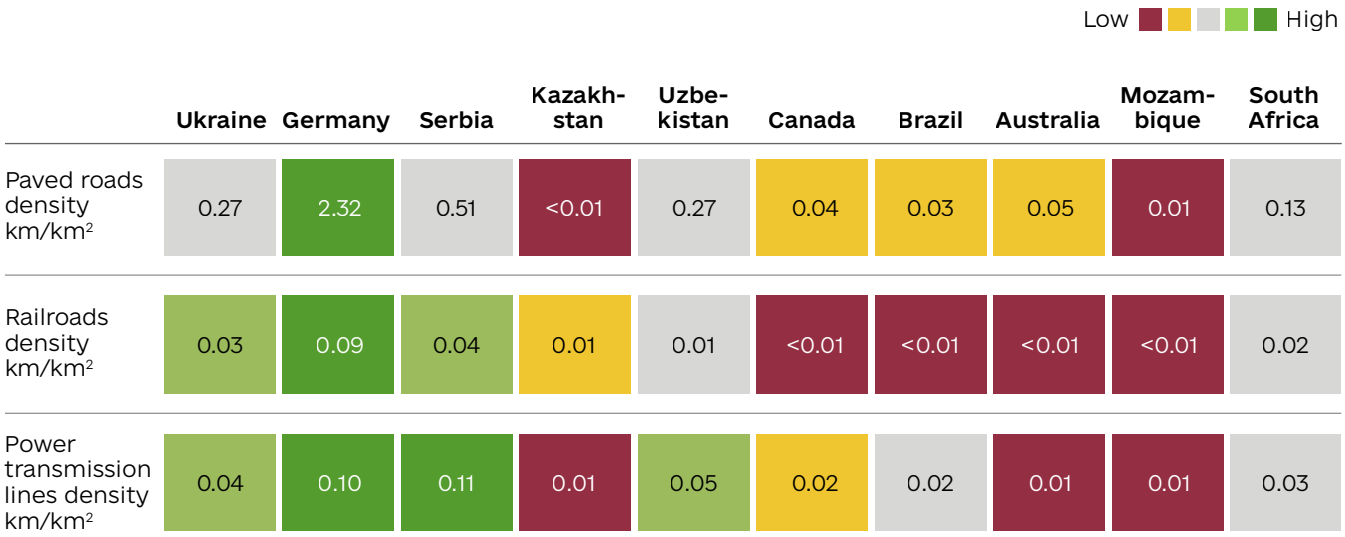
**Graphic 3. Comparative analysis of infrastructure development of key critical materials mining countries**




| | Ukraine | Germany | Serbia | Kazakh-stan | Uzbe-kistan | Canada | Brazil | Australia | Mozam-bique | South Africa |
|---|---|---|---|---|---|---|---|---|---|---|
| Paved roads density km/km² | 0.27 | 2.32 | 0.51 | <0.01 | 0.27 | 0.04 | 0.03 | 0.05 | 0.01 | 0.13 |
| Railroads density km/km² | 0.03 | 0.09 | 0.04 | 0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.02 |
| Power transmission lines density km/km² | 0.04 | 0.10 | 0.11 | 0.01 | 0.05 | 0.02 | 0.02 | 0.01 | 0.01 | 0.03 |

Source: Reports and infrastructure operators' websites

## Proven capabilities

Mining has historically been a key component of Ukraine's economy. In 2021, Ukraine's mining and quarrying industry contributed about 13 billion USD or 6.4% of the gross domestic product (GDP). The industry employed 184 thousand people (2.6% of total jobs in the country)[25].

The country's skilled workforce and strong educational institutions provide a solid foundation for the growth of the CRM sector.

## Developed infrastructure

Ukraine's strategic location, proximate to major European markets and connected via seaborne routes, offers strong logistical advantages for CRM exports, enabling lower transport costs, faster delivery, and global reach supported by Ukraine's extensive multi-modal infrastructure. The country benefits from a well-developed, dense network of paved roads and railways, along with substantial seaport capacity. The sea ports and terminals controlled by the Ukrainian government have cargo handling capacity of up to 250 million tons per year[26].

Ukraine's energy infrastructure has been severely affected by the ongoing war. Despite this, Ukraine retains strong fundamentals for generating abundant, relatively low-cost, and low-carbon electricity. The country's extensive transmission system is synchronized with European network—Ukrenergo, the Transmission System Operator (TSO) in Ukraine officially became a member of European Network of Transmission System Operators for Electricity (ENTSO-E) on January 1st, 2024[27].

25 Ukrainian Statistics Service (Derzhstat)
26 Logistics Capacity Assessments—Logistics Cluster
27 ENTSO-E

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# CRM Market Context and Opportunities

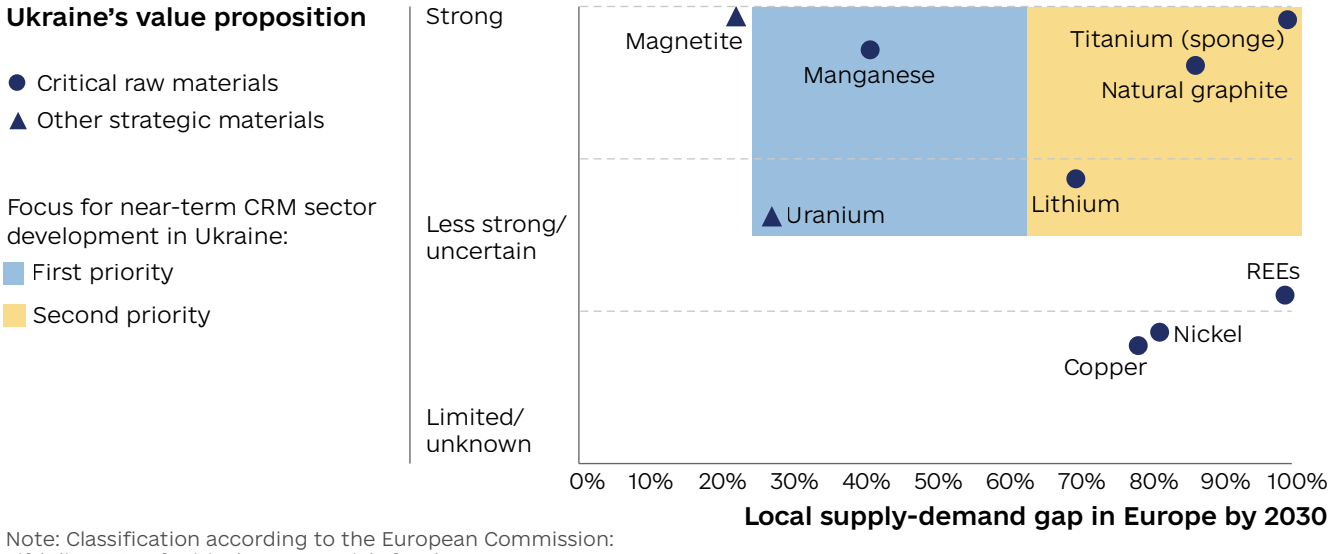
**The global demand for CRMs is on the rise, driven by technological advances and the transition to green energy. Meanwhile, supply of many critical materials highly concentrated, with a handful of players (predominantly—China) controlling significant parts of materials processing capacity. This makes supply chains vulnerable to trade disruptions and geopolitical tensions.**

To ensure access to strategic raw materials, many countries and companies are actively acquiring mining assets and securing stakes in key production facilities abroad. However, such foreign asset holdings remain highly exposed to the political and regulatory environments of the host countries. This risk is especially pronounced in jurisdictions with unstable governance or weak protections for private property and foreign investment. A recent example is Niger's June 2025 decision to nationalize the Somair uranium mine, previously operated by the French state-owned company Orano[28]. The move raised alarms among international investors and underscored the fragility of foreign mining interests in politically volatile regions.

Ukraine's strategic position and resource base make it a crucial player in meeting this demand—both for mining projects and for processing capacities. A quick overview of the market context reveals significant opportunities for Ukraine to capitalize on its CRM potential.

28 Reuters

**Graphic 4. Critical raw materials supply-demand gap in Europe and Ukraine's value proposition**




Note: Classification according to the European Commission: Fifth list 2023 of critical raw materials for the EU
Source: GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025), McKinsey Commodity Perspectives. For liquid commodities (uranium, magnetite) global demand-supply gap is considered

# TITANIUM

## Demand

Growing demand for titanium is due to its corrosion resistance and strength-to-weight ratio, which makes it essential in aerospace and defense applications. Other uses include manufacturing power generation equipment, IT equipment (smartphones, tablets and laptops), and satellites. Titanium sponge imports into the U.S. increased by 36% year-on year between 2022 and 2023[29], illustrating the rekindled interest in growing the U.S. domestic strategic industries production output. By 2030, titanium sponge demand is projected to reach 22 thousand tons in Europe and 48 thousand tons in North America[30].

## Supply

Global supply of titanium is highly concentrated, with over 55% of titanium dioxide production capacity and over 65% of titanium sponge production capacity controlled by China[31]. Europe in particular is reliant on imports of titanium products—ingots, bars, sheets, tube, and sponge. Resolving this dependency is EU policy priority—European Commission's Joint Research Center developed recommendations, including supporting integration of Ukraine into European titanium supply chains[32]. By 2030, Europe is not expected to have any titanium sponge production capacity, while the United States is projected to have a capacity of 500 tons[33].

## Opportunity for Ukraine

Ukraine is one of world's top producers of titanium products. The country accounted for 2% of global sponge supply and 0.3% of global ingots supply in 2020[34]. With further investment into titanium projects, Ukraine could become a key strategic partner for Europe, the United States, and other G7+ states in closing the supply-demand gap and decreasing dependence on Chinese titanium supply.

29 USGS
30 McKinsey Titanium Commodity Perspective
31 S&P, McKinsey Titanium Commodity Perspective
32 The European Commission's Joint Research Center (JRC): Science for Policy Report (2025)
33 McKinsey Titanium Commodity Perspective
34 The European Commission's Joint Research Center (JRC): Titanium metal in the EU: Strategic relevance and circularity potential (2025)

## GRAPHITE

### Demand

Graphite, widely used in anodes for nearly all lithium-ion batteries, is poised for significant demand growth. Natural graphite demand is projected to increase at a CAGR of 16% in Europe and 22% in North America by 2030. Synthetic graphite demand is expected to grow even faster, with a CAGR of 22% in Europe and 26% in North America. By 2030, Europe's total graphite demand is forecasted to reach 640,000 tons annually, comprising 265,000 tons of natural and 375,000 tons of synthetic graphite. In North America, demand is expected to reach 580,000 tons annually, including 235,000 tons of natural and 345,000 tons of synthetic graphite[35].

### Supply

European local supply is expected to cover less than 20% of demand for natural graphite by 2030, and North American local supply is expected to cover less than 50% of demand in same period. Global supply of both natural and synthetic graphite is currently extremely concentrated, with China mining over 95% and processing almost 100% of natural graphite[36].

### Opportunity for Ukraine

Ukraine is home to Europe's largest reserves of natural graphite. With further development of graphite projects (including in cooperation with international partners), it could become a key strategic partner for the EU in de-risking supplies of this critical material.

## LITHIUM

### Demand

Primarily used in electric vehicle batteries and energy storage systems, lithium is expected to face one of the most significant demand-supply gaps by 2030. Local supply in Europe and North America is projected to meet only 8–13% of demand. Lithium demand is forecasted to grow at a CAGR of 23% in Europe and 26% in North America by 2030. By that year, total lithium demand is expected to reach 485,000 tons of Lithium Carbonate Equivalent (LCE) in Europe and 465,000 tons LCE in North America.[37]

### Supply

Europe currently has almost no local supply of lithium. In the longer term, Europe could significantly bridge the demand-supply gap through development of projects currently in the pipeline, implementation of innovative chemical processes like direct lithium extraction, and shifting technology mix towards less lithium-intensive alternatives (e.g., adopting sodium-ion technologies in batteries). Similarly, should current early-stage lithium projects in North America proceed to extraction phase, North America is likely to cover 67% of its lithium demand locally by 2030[38].

### Opportunity for Ukraine

While Ukraine's lithium reserves are less promising than reserves of other critical materials (due to Russian occupation and ore mineralogy), with proper investment into exploration and development of deposits, the country could play an important role in supporting Europe's strategic goal of reducing dependency on monopolistic suppliers of critical raw materials.

35 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)
36 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)
37 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)
38 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)

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# Unlocking Ukraine's CRM Potential

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## Addressing the Key Challenges of Ukraine's CRM Sector

**A country's appeal to investors and mining companies depends on a mix of factors: resource quality and accessibility, cost-efficiency of extraction and processing, industrial ecosystem maturity, infrastructure readiness, regulatory strength, and geopolitical alignment. Assessing Ukraine's performance across these dimensions is key to pinpointing where targeted interventions can strengthen its competitive position.**

### Key Priorities to Unlock Ukraine's CRM Potential

Unlocking the potential of Ukraine's CRM sector requires a focused and strategic approach to address immediate challenges and lay the foundation for long-term growth. Realizing Ukraine's CRM potential will depend on addressing critical enablers such as transparency of geological information, access to affordable capital, ecosystem development, and fostering innovation. Additionally, securing technological partnerships, engaging the private sector, and leveraging international cooperation will be essential to accelerate the development of Ukraine's CRM sector and attract the necessary investment.

#### Geological data availability

**Existing conditions and strategic gaps:** Many of Ukraine's deposits lack detailed geological information, necessitating extensive exploration efforts. Over 5000 mineral deposits in Ukraine were classified under Soviet standards and now require reassessment.

Until recently, information about deposits of some materials was classified due to the war under the resolution of the State Security Service of Ukraine from 23rd of December 2020[39], which further hindered transparency and complicated negotiations with potential investors. In June 2025, the government made a decision to remove the "secret" classification from information about mineral resources. As of July 2025, the bureaucratic processes, required to enable public access to the data, are underway[40].

**Ongoing progress:** Under the Ukraine-EU Strategic Partnership on Raw Materials, the EU is helping Ukraine modernize its mineral resource database, ensuring internationally recognized classifications for better

39 S&P Global
40 Statement by Minister of Environmental Protection and Natural Resources of Ukraine, Svitlana Hrynchuk

transparency and investor confidence. In November 2022, the European Bank of Reconstruction and Development (EBRD) and the Ukrainian Geological Survey have signed a Memorandum of Understanding, aiming to facilitate the modernization of geodata management in Ukraine. One of the project's objectives is to digitize 60,000 geological reports. As of May 2024, the first 6,000 geological report books, or 10% of the target, had been scanned[41]. Currently, Ukraine is in the process of updating its mineral classification system to align with UNFC and CRIRSCO (Committee for Mineral Reserves International Reporting Standards) methodologies.

**Graphic 5. Assessment of investment attractiveness of Ukraine's mining sector**

| Category | Parameter | Ukraine's position* | Comment (Deterrent for investors ● ● ● ● ● Attractive for investors) |
|---|---|---|---|
| RESOURCE BASE | Resource endowment | ● | Ukraine holds the largest reserves in Europe of titanium, graphite, manganese, and uranium. While lithium deposits are significant, extraction is complicated by the ore's petalite mineralogy. Additional opportunities lie in reprocessing mining waste and tailings, drawing on Ukraine's long mining legacy |
| | Geological data availability | ● | The industry is hindered by outdated Soviet-era classifications, limited recent research, and wartime secrecy laws, resulting in scarce and unreliable public data on CRM resources |
| COST COMPETITIVENESS | Cost of energy | ● | Ukraine is structurally well-positioned for low-cost energy production, but war-related infrastructure damage has led to short-term supply disruptions and higher costs |
| | Cost of labor | ● | Ukraine offers competitive labor costs, though many mining regions in Africa, South America, and Asia remain more cost-advantaged |
| | Cost of capital and access to finance | ● | High country risk drives up financing costs for junior miners in Ukraine, but concessional and IFI funding is expected for new CRM projects through post-war recovery efforts and international partnerships |
| | Taxation | ● | Beyond standard corporate taxes, Ukrainian mining companies pay a land tax (5% of land value), rent (3.5–10% of mineral value), and fees for waste storage and disposal |
| INDUSTRY ECOSYSTEM | Availability of skilled workforce | ● | Ukraine has established expertise in mining, skilled workforce, and strong educational institutions |
| | Innovation support | ● | There is limited innovation infrastructure available in CRM sphere in the country |
| | Access to technology | ● | Ukrainian iron ore companies partner with leading international OEMs, but CRM-sector collaborations remain limited |
| | Maturity of mining industry | ● | Ukraine has a long-standing mining and processing industry, with developed supply chains and a mature ecosystem for minerals like coal, iron ore, and titanium |
| INFRASTRUCTURE | Logistics infrastructure | ● | Ukraine has well-developed multi-modal infrastructure, including access to the sea |
| | Energy infrastructure | ● | Pre-war, Ukraine had robust energy infrastructure and a dense T&D network, but war damage has disrupted generation and distribution, causing short-term supply instability |
| REGULATORY FRAMEWORK | Policy stability and rule of law | ● | Ukraine was ranked 88 out of 142 in the WJP Rule of Law Index in 2024 |
| | Alignment with international standards | ● | Ukraine is aligning its frameworks with EU and global standards (incl. as part of its EU accession process) |
| | Permitting and licensing processes | ● | Ukraine was ranked 64 out of 190 in the 2020 Ease of Doing Business assessment by the World Bank. The licensing process is relatively simple. ESG requirements are comparatively less restrictive |
| | Engaging private investors | ● | Private companies need special permits to extract natural resources, which can be revoked for legal breaches. Subsoil rights do not include land rights, which must be obtained separately |
| | Trade and export controls | ● | There are currently no trade barriers related to minerals export and import |
| | Government support and incentives | ● | Critical raw materials are a priority sector in the Ukraine Plan, backed by strong political support |
| GEOPOLITICAL CONTEXT | Geopolitical risks | ● | Ukraine was ranked 159 out of 163 by the Global Peace Index in 2024 (largely due to the war) |
| | Strategic partnerships | ● | Ukraine has concluded international CRM agreements with strategic partners (the EU, the USA). Negotiations on further partnerships, including bilateral agreements, are ongoing |

■ Materials with strong value proposition in Ukraine

*Long-term, structural potential of Ukraine—not including immediate, short-term impact of war

41 Better Regulation Delivery Office (BDRO): "Green Paper: Critical Minerals in Ukraine and Worldwide" (2025)

**Potential solutions:**

- Continuing and accelerating the ongoing effort to digitize Ukraine's mineral resource database (currently undertaken as part of the program undertaken by the Ministry of Environmental Protection and Natural Resources, Ukrainian Geological Survey, and State Institute "Geoinform", with technical and financial support of EBRD).
- Finalizing efforts to synchronize Ukrainian classification systems with international standards.
- Investing in a sector-wide geological exploration program (including with technical and financial support of international partners) and implementing necessary reforms.
- Launching a new initiative to create an interactive resource map and structured geological database to identify, systematize, and analyze known deposits, encourage the discovery of new ones, and unlock additional opportunities in brownfield sites and tailings.

## Cost of capital and access to finance

**Existing conditions and strategic gaps:** Due to high country risk, traditional sources of finance for junior miners in Ukraine are available at a premium.

**Ongoing progress:** Concessional and IFI financing is anticipated for new CRM projects, supported by Ukraine's post-war recovery programs and international cooperation agreements. Ukrainian projects are eligible for incentives under international programs (e.g., the EU's Critical Raw Materials Act), which could significantly reduce overall cost of capital for the investors.

**Potential solutions:**

- Deploying de-risking financial instruments such as guarantees, blended finance to mitigate investment risks in CRM projects, with platforms like the European Commission's Ukraine Facility and the U.S.-Ukraine Reconstruction Investment Fund serving as potential support vehicles.
- Establishing investment funds focused on target sectors, potentially in collaboration with international partners.
- Ensuring alignment with environmental, social and governance standards required by IFIs and other major finance providers.

## Innovation support

**Existing conditions and strategic gaps:** Ukraine's research and innovation infrastructure has largely been formed during Soviet era and requires modernization.

**Ongoing progress:** Collaboration in research and innovation along both raw materials and battery value chains through Horizon Europe is one of the key areas defined in Memorandum of Understanding signed by Ukraine and the EU[42].

**Potential solutions:**

- Developing new research and innovation projects under the Ukraine-EU Strategic Partnership on Raw Materials.
- Concluding further strategic partnership agreements and establishing new funds and programs aimed at financially supporting talent development, research and innovation in CRM sphere.
- Building bi-lateral and multi-lateral partnerships between educational institutions, industry, and governmental organizations.
- Developing frameworks and structures aimed at promoting collaboration and knowledge-sharing between ecosystem participants—including modernization and development of regulatory frameworks protecting intellectual property.
- A focused and coherent approach to building Ukraine's innovation ecosystem is essential to maximize the efficient use of national resources and invested capital. Efforts should concentrate on key strategic materials—such as titanium, graphite, lithium, manganese, and uranium—and their downstream uses, where Ukraine holds significant potential. Engaging leading players and technology OEMs across these materials' value chains will be critical to the long-term success of flagship projects and the broader scale-up of these industries, including the development of downstream manufacturing.

42 The European Commission

- The government has a vital role to play—for example, by developing industrial and technological parks, implementing programs that could foster the development of ecosystems on a regional and national level, supporting education and training programs in priority areas, offering targeted incentives to attract industry participation, and fostering a regulatory environment that is attractive to investors (including streamlining the licensing and land zoning processes).

## Access to technology

**Existing conditions and strategic gaps:** Ukraine's iron ore mining companies are cooperating with top global OEMs to secure access to innovative technologies.

**Ongoing progress:** Access to technology in critical raw materials sphere is still limited.

**Potential solutions:**

- Collaborations with established players, including partnerships with leading international OEMs, to secure access to cutting-edge, sustainable mining and processing technologies.
- Encouraging development of domestic OEMs by fostering a thriving start-up culture (including in cooperation with international partners).
- Securing access to technology would be most effective if focused on key value-adding processes and technologies related to materials that are strategic priorities for Ukraine. These include titanium sponge production and titanium dioxide pigment manufacturing, graphite spheroidization, lithium beneficiation and conversion technologies, manganese upgrading to battery-grade material, and uranium hexafluoride ($UF_6$) production to enable further downstream integration in the nuclear fuel cycle.
- Furthermore, auxiliary value chains may need to be developed to support the establishment of a comprehensive mining and processing ecosystem in Ukraine. For example, a reliable supply of sulfuric acid is essential for leaching processes, while access to chlorides is critical for advancing the titanium metal value chain.

## Alignment with international standards

**Existing conditions and strategic gaps:** Ukraine has made significant progress in aligning its regulatory frameworks with EU legislation, particularly in the context of the EU-Ukraine Association Agreement and the broader path toward integration with the European Green Deal and CRMA. At the end of March 2023, the Law "On amendments to certain legislative acts of Ukraine on improving legislation in the field of subsoil use" entered into force in Ukraine[43]. The law introduced multiple reforms aimed at streamlining of processes and alignment with international frameworks.

In December 2024, the Ukrainian Parliament adopted the Law "On Amendments to the National Program for the Development of the Mineral and Raw Materials Base until 2030." This landmark legislation introduces major regulatory advances in Ukraine's CRM sector. Key provisions include the formal definition of minerals and components of strategic and critical importance, the establishment of a state compensation fund to support geological exploration, the introduction of special procedures for granting subsoil use rights for strategic and critical deposits, and new requirements to ensure environmental protection during subsoil operations[44].

**Ongoing progress:** One of the key areas of work, as defined in the Memorandum of Understanding outlining the Ukraine-EU Strategic Partnership on Raw Materials, is approximation of policy and regulatory mining frameworks, and notably the environmental, social and governance criteria across all activities[45]. The Ukraine Facility—one of the EU's key technical assistance instruments for developing Ukraine's industrial sectors—identifies CRM sector as a strategic priority. It envisions regulatory reforms aimed at creating favorable conditions and instruments to attract investors, including foreign ones, and mandates the introduction of ESG reporting requirements for the mining and extractive industries[46].

43 GMK Center
44 Pragma Consulting Group
45 The European Commission
46 The European Commission: Ukraine Facility


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Ukraine continues to develop permitting and ESG processes that are efficient and responsive, supporting its competitiveness as an investment destination. This balanced regulatory approach is especially important in the context of Ukraine's economic recovery and its ambition to become a strategic partner in global raw materials supply chains.

**Potential solutions:**

- Developing clear, stable, and investor-friendly legal frameworks, including fiscal incentives, standardized ESG guidelines, and dispute resolution mechanisms aligned with global best practices.
- Introducing a "fast-track" mechanism for priority CRM projects of national importance, with clear timelines, provisions for investor protections, and reduced bureaucratic steps.

## Engaging private investors

**Existing conditions and strategic gaps:** Historically, Ukraine's mining industry comprised a mix of state-owned and private players. However, private sector expansion faces significant challenges, including outdated bureaucracy, weak legal protections and corruption.

**Ongoing progress:** In recent years, there have been a few cases of foreign private investors entering the market. Notable example is acquisition of the previously state-owned United Mining and Chemical Company JSC (UMCC) by Azerbaijan's NEQSOL Holding in 2024.

**Potential solutions:**

- Reforming uranium mining and processing sector to move away from state monopoly and enable private sector participation.
- Developing robust infrastructure for protection of private ownership rights (including international arbitrage).
- Developing a standard-form Production Sharing Agreement (PSA) for mining projects to reduce risk, clarify investment terms, and align incentives between the state and investors.
- Amending Ukrainian legislation to enable the reservation of land plots for subsoil use, thereby ensuring that winners of state-initiated auctions or production sharing agreement (PSA) tenders have guaranteed access to state and municipal land.
- Addressing the issue of "dormant permits" (active subsoil use licenses that remain undeveloped by the license holders, with no exploration or production activities taking place)—for example, by introducing subsoil use fees payable by permit holders who have not commenced production within a specified timeframe, depending on the type of mineral.

## Government support and incentives

**Existing conditions and strategic gaps:** Government support for mining projects in Ukraine remains limited. The country offers few incentives, primarily in the form of direct financing. In contrast, leading Western countries—including the United States, Canada, the EU, the UK, and Australia—provide a broader range of support measures for critical materials projects. These include direct financing, tax incentives, government-sponsored geological surveys, support for recycling initiatives, and innovation funding through specialized programs and dedicated funds[47].

**Ongoing progress:** CRM sector was designated as a priority sector under Ukraine Plan[48].

**Potential solutions:**

- Improving efficiency of permitting process for mining companies (including process for revocation of licenses for dormant or dead projects).
- Simplifying the process for securing infrastructure access (including power supply).
- Defining a straightforward process for initiation of new projects in re-processing of tailings and mining waste.
- Offering targeted tax incentives for new CRM projects.
- Forming public-private partnerships (including, e.g., guaranteed off-take by the state).

## Strategic partnerships

**Existing conditions and strategic gaps:** Recognizing the strategic importance of developing the critical raw materials industry, governments in Europe, the United States, and other nations have implemented legislation, programs, and funding to support development efforts. The EU has earmarked funding (for example, the Important Projects of Common European Interest state aid mechanism and the EU Innovation Fund) for such projects and involves Ukraine in its key research and innovation funding program, Horizon Europe. In 2024, the REPTiS project (Responsible Extraction and Processing of Titanium and other Primary Raw Materials for Sourcing EU Industrial Value Chains and Strategic Sectors) developed by Ukrainian titanium player Velta LLC in cooperation with 11 leading European companies and research institutes was awarded a four-year grant of more than 7 million EUR under Resilient Value Chains 2024 initiative by Horizon Europe[49].

The UK also provides funding through the Automotive Transformation Fund as part of its Critical Minerals Strategy. In the United States, projects to enhance primary supply innovation and battery and scrap recycling have benefited from tax credits (through the Inflation Reduction Act) and financial support (through the Defense Production Act Title III and Bipartisan Infrastructure Law). In Canada, funding is provided through the Strategic Innovation Fund as part of its Critical Minerals Strategy[50].

**Ongoing progress: I**n recent years, Ukraine has negotiated agreements with the EU and the United States on cooperation on development of critical raw materials industry in the country.

In July 2021, Ukraine and the European Union concluded a Memorandum on Strategic Partnership in the Raw Materials, which gives Ukraine the status of Strategic Partner. The Partnership includes activities along the entire value chain of both primary and secondary critical raw materials and batteries. The goals of the Partnership are aligned with the objectives of the EU's Critical Raw Materials Action Plan.

On 30th of April 2025, the United States and Ukraine signed the U.S.-Ukraine Minerals Deal, establishing a joint investment fund for the reconstruction of Ukraine. The fund will be capitalized, in part, by revenues from future natural resource extraction. Ukraine will maintain complete ownership over its natural resources and infrastructure, including decisions on what to extract. US-Ukraine Reconstruction Investment Fund will be jointly managed by both countries on an equal partnership basis.

47 IEA Critical Minerals Policy Tracker
48 Ministry of Economy of Ukraine: Ukraine Facility: Plan for Implementation 2024-2027
49 Velta LLC
50 GLOBSEC Bridging the Supply-Demand Gap for Critical Raw Materials by 2030 Report (2025)

**Potential solutions:**

- Strengthening cooperation with strategic partners—including the EU and its member states, UK, the United States, Canada, Australia, Japan and South Korea—through bilateral and regional agreements, targeted funding programs, and joint initiatives.
- Engagement in platforms like the EU-Ukraine Strategic Partnership on CRMs, as well as partnerships under the G7+ framework.
- Securing access to donor-backed financing and technical assistance.

## Sidebar: EU Critical Raw Materials Act (CRMA)

The Act sets out to strengthen all stages of the European critical raw materials value chain, diversify the EU's imports to reduce strategic dependencies, improve EU capacity to monitor and mitigate risks of disruptions to the supply of critical raw materials, and improve circularity and sustainability[51].

The CRMA designates Strategic Project status, for projects that are essential to securing Europe's supply of critical raw materials. It grants several benefits, including fast-track permitting (for projects in the EU) and access to EU and national funding, including support from the European Investment Bank (EIB) and European Bank for Reconstruction and Development (EBRD). The projects with this status also receive regulatory priority, making them a focus for EU trade policies and strategic agreements. In March 2025, the European Commission approved 47 CRMA strategic projects in the EU. In June 2025, it approved 13 projects outside the EU including the Balakhivka Graphite deposit in Ukraine.

### Graphic 6. Strategic projects approved under EU Critical Raw Materials[52]

| Category | Raw materials considered strategic | Strategic projects approved under CRMA* |
|---|---|---|
| Battery materials | Graphite-battery grade | 10 + 4 = 14 |
| | Lithium-battery grade | 18 + 1 = 19 |
| | Manganese-battery grade | 5 + 1 = 6 |
| | Nickel-battery grade | 11 + 3 = 14 |
| Base metals | Bauxite/alumina/aluminum | 1 |
| | Copper | 11 + 1 = 12 |
| Permanent magnets | Boron-metallurgy grade | 1 + 1 = 2 |
| | Cobalt | 10 + 3 = 13 |
| Other materials | Bismuth | |
| | Gallium | 1 |
| | Germanium | 2 |
| | Magnesium metal | 1 |
| | Platinum group metals | 6 |
| | Rare earth elements (Nd, Pr, Tb, Dy, Gd, Sm, Ce) | 5 + 2 = 7 |
| | Silicon metal | |
| | Titanium metal | |
| | Tungsten | 1 + 1 = 2 |

Strategic projects in EU | Strategic projects outside EU | Materials with strong value proposition in Ukraine

* Projects with multi-material focus show up more than once in the graph

51 The European Commission
52 The European Commission

# B Development Roadmap for Ukraine's CRM Industry

The development of Ukraine's CRM sector is pivotal for both the country's economic resilience and its strategic alignment with global partners. The roadmap for the development of Ukraine's CRM sector sets out a strategic vision to position the country as a key player in European and global supply chains. Building on its rich resource base, geopolitical alignment with the EU, and growing investor interest, the roadmap outlines clear priorities for unlocking Ukraine's CRM potential to create a resilient, transparent, and competitive CRM ecosystem that supports Ukraine's economic recovery, strengthens energy and ndustrial security in Europe, and accelerates the green and digital transitions.

The roadmap outlines both short-term (Horizon 1) and mid- to long-term (Horizon 2) priorities for the development of Ukraine's critical raw materials (CRM) sector. Across both horizons, Ukraine could pursue a dual-focus strategy: Focus 1 centers on fast-tracking flagship projects to attract investment, while Focus 2 involves implementing sector-wide reforms to enable sustainable growth and position Ukraine as a key hub for critical raw materials processing.

## Dual-Focus Approach to Industry Development

### Focus 1: Accelerating flagship projects

**In Horizon 1** (until 2030), Ukraine may prioritize mature projects that offer significant short-term development potential. This includes focusing on key materials like titanium, graphite, lithium, manganese, and uranium, which have established markets and high demand. By fast-tracking these projects, Ukraine can generate immediate economic benefits and build momentum for further development. A handful of critical raw materials projects could be developed to serve as flagship cases for the industry, building investor confidence for future growth of the industry.

**In Horizon 2** (2030 and beyond), Ukraine could prioritize the large-scale expansion of its processing and downstream manufacturing capacities to capture greater economic benefits from its CRM resources. This includes the establishment of advanced refining facilities, battery component and cell manufacturing, as well as the development of high-value industries such as titanium metal production and permanent magnet manufacturing.

### Focus 2: Implementing industry-wide reforms

To support robust growth, Ukraine could focus on further development of the investor-friendly ecosystem around CRM sector, including advancement of investor-friendly reforms, holistic development of supply chains, and build-out of downstream manufacturing capacity.

**In Horizon 1**, the focus could be on closing critical gaps to enhance the attractiveness of Ukraine's critical raw materials (CRM) sector for investors. This includes streamlining permitting and licensing procedures,

**Graphic 7. Example flagship projects for Ukraine's CRM industry**

| Description | Annual production volumes | Required investment | |
|---|---|---|---|
| Greenfield integrated titanium metal (sponge and ingot) production at Motrono-Annyvske deposit (in Dnipropetrovsk region in Central Ukraine) | • 180–200 thousand tons of concentrate (including 120–140 thousand tons of chloride ilmenite, 40–50 thousand tons of rutile, and 20–30 thousand tons of zircon concentrate as by-product)<br>• 15 thousand tons of titanium sponge and ingots | **1.4–1.6 billion USD, including:**<br>• 500–580 million USD investment in mine development and processing/beneficiation/separation plant<br>• 600–750 million USD investment in titanium sponge plant<br>• 400 million USD investment in smelting facility (Vacuum Arc Remelting, ingot production) | TITANIUM CLUSTER |
| Greenfield graphite flake and SPG production (standalone or joint-venture in partnership with existing private operators for mining) | • 50 thousand tons of flake<br>• 20 thousand tons of SPG | **0.4–1.2 billion USD, including:**<br>• 100 million USD investment in mining and concentration<br>• 300 million USD investment in SPG production<br>• Potential to scale-up to multiple projects | GRAPHITE CLUSTER |
| Greenfield lithium carbonate processing capacity build-out (to process mining output from Dobra deposit in South-Eastern Ukraine) | • 300–400 thousand tons of concentrate<br>• 40–50 thousand tons of lithium carbonate | **1.6–2.0 billion USD, including:**<br>• 600–700 million USD investment in mine development<br>• 350–400 million USD investment in an enrichment plant processing both spodumene and petalite to produce concentrate<br>• 600–900 million USD investment in lithium carbonate production | LITHIUM CLUSTER |
| Greenfield chemical conversion plant producing High-Purity Manganese Sulphate Monohydrate (HPMSM) for battery applications | • 30 thousand tons of HPMSM | **0.2–0.4 billion USD, including:**<br>• 100 million USD investment to restart manganese mining<br>• 50 million USD to modernize beneficiation<br>• 150–250 million USD investment in chemical conversion | MANGANESE PROCESSING CLUSTER |
| Greenfield conversion plant on the basis of East MPP mines and processing plant (currently state-owned), with potential to extend to nuclear fuel value chain | • 2.5 thousand tons of yellowcake ($U_3O_8$)<br>• 6.5–7.0 thousand tons of hexafluoride ($UF_6$) | **1.5 billion USD, including:**<br>• 450 million USD investment in expansion and modernization of mining and concentration<br>• 1000 million USD investment in conversion plant | URANIUM CLUSTER |

strengthening geological data infrastructure, and ensuring public access to reliable and comprehensive resource information. Reforms aimed at modernizing the regulatory framework in line with global best practices—focusing on transparency, predictability, and efficiency—will be essential. In parallel, targeted state and donor support for early-stage exploration, infrastructure development, and institutional capacity building will help lay the foundation for the sector's long-term sustainable growth.

A comprehensive, sector-wide exploration program will be essential to unlocking Ukraine's full resource potential. By systematically mapping the country's mineral endowment, the program would identify high-potential commodities, reduce geological and investment risks, and provide a strategic foundation for long-term planning. It would also support the development of a steady pipeline of viable projects, positioning Ukraine as a reliable supplier in critical, future-oriented value chains and enabling the sector to meet growing global demand.

In Horizon 2, Ukraine may focus on fostering innovation, advancing capabilities, and securing access to cutting-edge technologies that enable value-added production across the CRM value chain. This includes investing in research and development, supporting collaboration between industry, academia, and international partners, and creating innovation-friendly ecosystems such as industrial clusters and technology parks. Building a skilled workforce and technical expertise in areas such as advanced materials processing, battery chemistry, metallurgy, and recycling will be key to driving competitiveness. At the same time, Ukraine could actively pursue strategic partnerships with leading international OEMs to facilitate knowledge transfer and integration into high-tech supply chains.

## Vision for the future of Ukraine's CRM sector

The strategic vision for Ukraine's CRM sector is to transform the country into a competitive and high-value industrial hub for critical materials processing and advanced manufacturing. This transformation will position Ukraine as a key partner in European and global supply chains, contributing meaningfully to the green and digital transitions. By capitalizing on its substantial resource base, established mining expertise, geographic proximity to the EU, and commitment to building a streamlined, investor-friendly regulatory environment aligned with best-practice industry standards, Ukraine can attract long-term private investment and industrial partnerships—positioning itself as an emerging leader in competitive and sustainable production of critical raw materials, and as a reliable strategic partner for Europe, the U.S., and beyond.

The goal is not only to strengthen the resilience and sustainability of international supply chains but also to drive Ukraine's own economic growth, job creation, and technological advancement. A fully developed CRM sector will serve as a pillar of Ukraine's post-war recovery.


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# Conclusion

Ukraine's critical raw materials (CRM) sector holds the potential to become a powerful engine of long-term economic growth, industrial modernization, and strategic alignment with global value chains. With one of the most extensive and diverse untapped CRM resource bases in Europe, Ukraine is well positioned to supply essential inputs for clean energy, defense, and advanced technologies. As the global transition toward decarbonization and digitalization accelerates, the resulting surge in CRM demand presents a historic opportunity for Ukraine to attract investment, generate high-value employment, and build modern processing and manufacturing capabilities.

Ukraine's ambition extends beyond exporting raw materials. Its vision is to become an integrated hub for critical materials processing, embedded in European and global supply chains. By scaling up domestic refining and value-added production—such as battery components and titanium metal—Ukraine can offer a reliable, competitive alternative to high-risk suppliers, strengthening the resilience of its partners across the EU, the United States, and other allied economies. This is a part of the bigger vision of the post-war reconstruction as a once-in-a-generation opportunity to reposition Ukraine at the frontier of low-carbon energy and material transition.

Realizing this vision will require sustained coordination across government, international partners, and the private sector. Each stakeholder plays a vital role.

## The role of government

The Ukrainian government could take the lead in accelerating reforms and providing targeted support to foster a favorable environment for CRM sector development. Key priorities may include modernizing the regulatory framework to align with international standards, improving transparency in geological data, and streamlining the permitting process for mining projects. In addition, offering tax incentives and facilitating public-private partnerships could help attract investment and support industry growth. By focusing on flagship projects and expanding exploration efforts, the government could build investor confidence and lay the foundation for long-term development of the sector.

## Role of international donors and partners

International donors and partners can play a vital role by introducing innovative financial instruments and supporting regulatory harmonization. Their involvement could significantly reduce the financial risks of CRM projects through guarantees, blended finance, and other de-risking tools. Moreover, international partners may support the development of Ukraine's innovation ecosystem by funding exploration, research and development, and fostering bilateral and multilateral partnerships across academia, industry, and government. These collaborations would enhance Ukraine's

capacity to grow its CRM sector and integrate more deeply into global value chains.

## Role of private investors

Private investors also have an essential part to play. Their engagement—through risk capital for research, project development, and access to cutting-edge technologies—could be a key driver of growth. Partnering with established players, including international OEMs, may allow Ukrainian firms to leverage external expertise and resources. Private sector participation will be critical for commercializing CRM projects and unlocking the sector's broader potential.

The successful implementation of Ukraine's CRM roadmap will depend on close collaboration among government, international partners, and the private sector. By aligning efforts and combining their respective strengths, these stakeholders can help unlock Ukraine's substantial CRM potential, improve global supply chain security, and support the country's post-war reconstruction and long-term economic resilience.

A coordinated approach could not only position Ukraine as a major player in the global CRM landscape but also contribute to broader goals of sustainable development and strategic autonomy for Ukraine and its partners.

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