

# 4.6. CRITICAL RAW MATERIALS (CRMS)

## 4.6.1. Current situation and the sector role

Ukraine possesses significant potential for CRMs extraction and utilisation, which are increasingly important in the context of the global green energy transition, innovative technology, and strategic applications (e.g., aerospace and defence), among geopolitical pushes to reduce dependence on supplies from China and Russia.

The availability of CRMs such as lithium and graphite represents an enabling factor for decarbonizing energy production and mobility ecosystems. Furthermore, CRMs are in increasing demand in the majority of key industrial ecosystems from aerospace and electronics to health and construction.

**Deposits of 22 out of the EU's 34 critical minerals are found in Ukraine.** Ukraine's potential in CRMs and its importance for the strengthening of both the EU's and Ukraine's economies has been recognized by signing a Memorandum of Understanding between the EU and Ukraine on a Strategic Partnership on Raw Materials in 2021. In 2021, the EU and Ukraine entered into a strategic partnership agreement concerning raw materials, with the primary goal of enhancing the diversification, resilience, and security of the supply of critical raw materials for both parties. The EU aims to more effectively incorporate Ukraine's raw materials into the EU battery value chains, while US partners consider a strategic partnership with titanium production in Ukraine.

Figure 1: List of EU's critical minerals, with presence in Ukraine

Strategic raw material	Supply risk	Economic importance	Li-ion batteries	Fuel cells	Electrolyzers	Wind turbines	Traction motors	Photo-voltaics	Heat pumps	Data transmission networks	Data storage and servers	Smart-phones, tablets and laptops	Robotics	Drones	Space launchers and satellites	H <sub>2</sub> -DRI with EAF/SAF	Additive manufacturing
Magnesium Metal	4.1	7.4			●						●	●	●	●	●		●
Gallium	3.9	3.7						●		●	●	●	●	●	●		
REE	3.7-5.1	4.2-5.9		●	●	●	●		●	●	●	●	●	●	●		
Boron	3.6	3.9		●	●	●	●	●	●	●	●	●	●		●		
Cobalt	2.8	6.8	●	●	●					●		●	●		●		●
PGM	2.7	7.1		●	●					●	●	●	●		●		
Lithium	1.9	3.9	●							●		●	●	●	●		
Bismuth	1.9	5.7								●	●	●					
Germanium	1.8	3.6						●		●	●	●					
Natural Graphite	1.8	3.4	●	●	●					●		●	●	●	●	●	
Titanium metal	1.6	6.3										●	●	●	●		●
Silicon metal	1.4	4.9		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Manganese	1.2	6.9	●	●	●	●			●	●	●	●	●	●	●	●	●
Tungsten	1.2	8.7			●							●		●	●		●
Aluminum	1.2	5.8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Nickel	0.5	5.7	●	●	●	●		●	●	●	●	●	●	●	●	●	●
Copper	0.1	4.0	●	●	●	●	●	●	●	●	●	●	●	●	●		●

**Ukraine has a developed mining ecosystem as a base for the development of further mining and processing of critical materials, which pre-war generated over 6% of Ukraine's GDP.** Also, Ukraine historically had a powerful engineering and technical base, as well as labour skills for the implementation of complex mining and industrial

projects to support the extraction and beneficiation of minerals. Before the war, Ukraine was among the global top 10 producing countries for a number of CRMs (incl. titanium ore, titanium sponge, TiO<sub>2</sub>, titanium ingots and slabs, zirconium, graphite, and manganese).

## 4.6.2. Overview and outlook of key reforms

### 1 Strengthening strategic planning and ensuring optimum framework for strategic investors

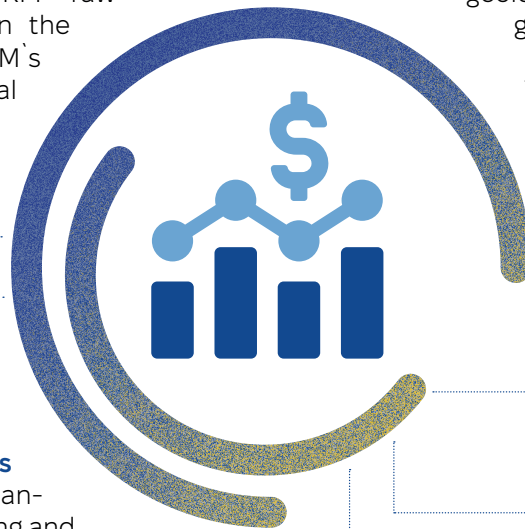
The adoption of the amendments to the State Programme of Development of Mineral Resource Base of Ukraine up to 2030 will create prerequisites for further attraction of investments in the CRM extraction and processing. In the medium to long term, this measure will unlock substantial investment, growth and employment opportunities by providing legal and financial instruments for investment promotion. Security conditions permitting, verification/re-assessment of CRM reserves of Ukraine using the international classification system as well as preparation and promotion of the list of mining investment opportunities in Ukraine through online auction bidding and Production Sharing Agreements tenders for solid minerals are both measures that could potentially have an immediate economic impact through attraction of new foreign direct investments. Verification and re-assessment of Ukrainian resources of CRMs according to the EU Critical Raw Materials Act 2030 shall stipulate forming value chains for CRM raw materials supply. The report on the reassessment of Ukrainian CRM's reserves using the international classification system will help investors to make appropriate decisions.

### 2 Improving administrative procedures and transparency

Optimising the procedure and reducing the administrative burden saves time for potential investors and reduces the total investment cost. To achieve such progress three components of reform should be realised:

- **Forming a pipeline of investment projects.** Ukraine intends to attract strategic international investors by facilitating access to mining investment opportunities
- **International Production Sharing Agreements tenders launch.** To enhance transparency, a model PSA will be developed, and procedures for concluding PSAs will be streamlined and made publicly available
- **Digitising access to geodata and services by regulator.** Efforts will continue to improve and digitise the services offered by the Ukrainian Geological Survey. This includes providing free online access to geological data, establishing a National Geological Portal to consolidate geological information, and making geological reports accessible through an investor e-cabinet

These three measures will serve to improve transparency, speed and cost efficiency for new investment decisions. Both measures have the potential of immediate economic impact through the attraction of new foreign direct investments.



### 3 Use of Modern Extraction Technologies and Integration of Ukraine into Modern Processing Value Chains

Progressive introduction of mandatory ESG reporting for the mining and extractive sectors will ensure transparency, checks and accountability as regards ESG standards for the industry. It will consequently contribute to sustainability development of the industry and attracting investments. These initiatives, in turn, contribute to climate change mitigation and adaptation efforts, as well as the protection of the water, marine resources, and biodiversity, the transition to a circular economy, and pollution prevention.

### 4 Boosting Institutional Capacity

There are plans to revitalise funding for the Ukrainian Geological Survey to bolster its institutional capacity. This move aligns with Ukraine's commitment to the EU CRM Act 2030.

### 5 Value Addition and Employment Generation

The strategic goal of CRM investments is to maximise the value of critical materials and their application within Ukraine. This involves leveraging domestic expertise and labour to positively impact employment and value addition through CRM extraction and processing, while simultaneously ensuring a sustainable supply to the EU.

### 4.6.3. Tendencies of key reforms

Lithium and graphite are essential components in the production of batteries for electric vehicles and renewable energy storage systems. **With the EU's goal of transitioning to a sustainable and low-carbon economy, the demand for related products will rise significantly.**

The critical raw materials sector for EV and battery production is one of the fast-growing global sectors where Ukraine can plug into a growing global value chain. Ukraine-based production of lithium and graphite can help to diversify and de-risk Europe's growing needs.

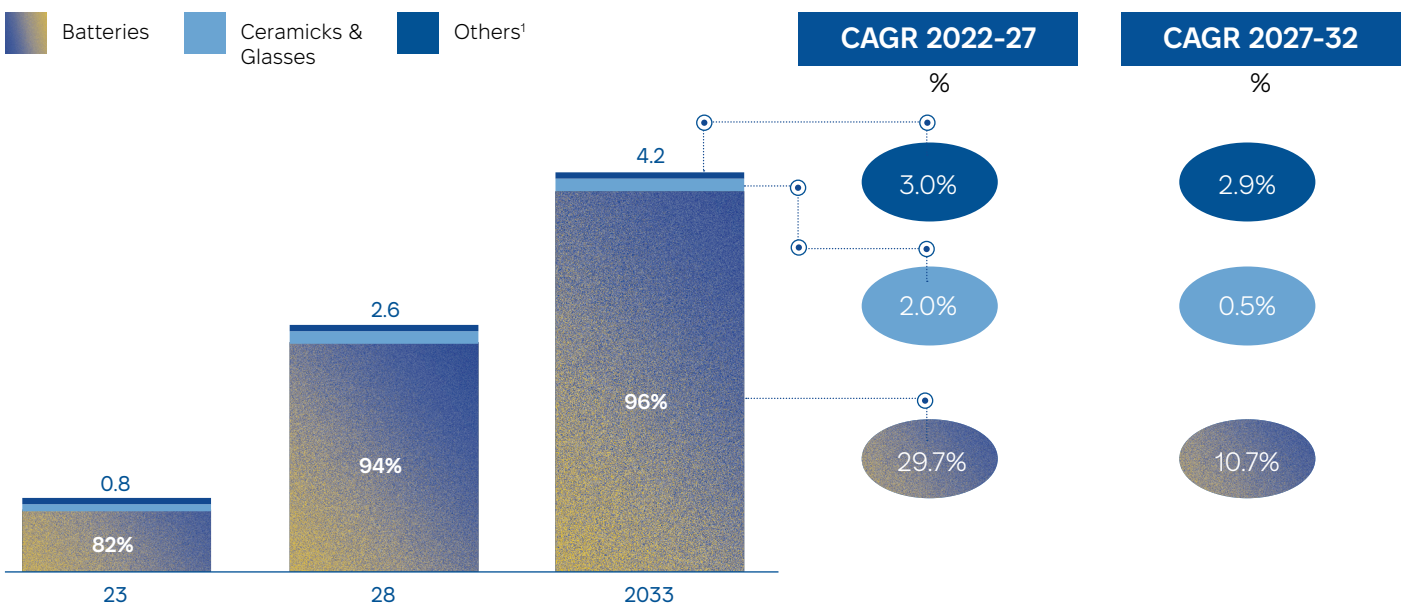
#### LITHIUM

Lithium stands as a pivotal component in the production of electric vehicle (EV) batteries, with its utilisation in batteries comprising 82% of lithium demand in 2023. Its usage is expected to be further supported by the adoption of lithium-based battery chemistries in mass market vehicle segments. Consequently, the mining and refining of lithium emerge as critical for the automotive industry and energy storage solutions worldwide.

#### LITHIUM DEMAND

The annual global growth rate of electric vehicle (EV) production, forecasted at 27% over the next ten years, is driving a rise in lithium demand by 23% p.a. over the same period. **Forecasts indicate a stable growth trajectory, with projections for 2033 suggesting that 96% of total global lithium demand will be attributed to batteries alone.**

**Figure 2: Expected lithium demand growth 2023-2033**



In 2023, China accounted for 46% of the global demand. With an expected annual growth rate of 21% over the next decade, forecasts suggest a gradual reduction in China's market share to 39% by 2033, as the European Union and the United States take the lead in lithium consumption. As a result, new trade flows for lithium hydroxide (the raw material consumed in the production of cathode materials for lithium-ion batteries) are anticipated to emerge in the market.

#### LITHIUM SUPPLY

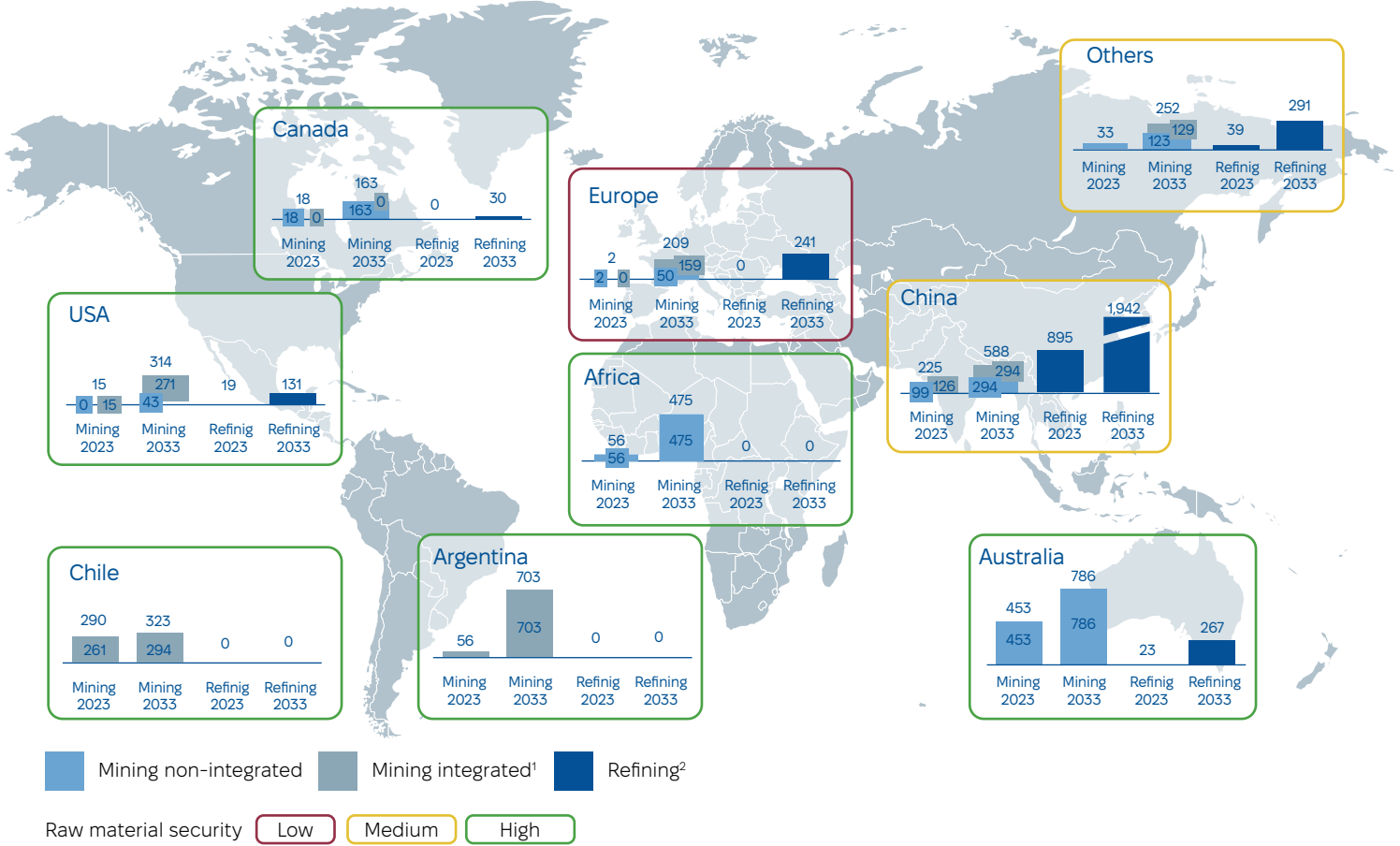
The historical demand for lithium ore has predominantly been met by reserves that have been explored and developed in key regions such as Australia, Chile, Argentina, and China, which collectively hold the majority of known reserves.

China, serving as a prominent global refinery hub and the largest producer of batteries, is projected to maintain its

position as the primary refining hub. In contrast, Europe, Australia, and the United States are actively pursuing strategies to diversify supply risks and reduce their carbon footprint, unveiling ambitious growth initiatives and making investments to increase their integrated or refinery capacity.

Figure 3: Forecasted capacity of lithium refining in 2023-2033

2024 Q1 High case



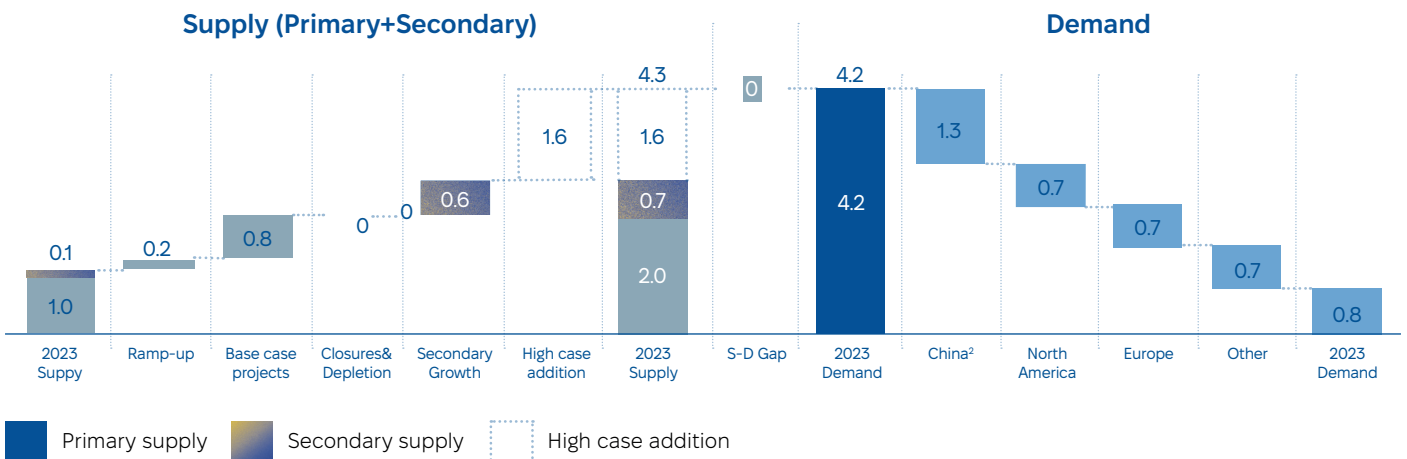
### LITHIUM SUPPLY-DEMAND BALANCE

Amid the extremely strong growth in projected demand, the industry is expected to face a significant undersupply primarily due to delays in the development and construction of new mining facilities, as well as constrained refining capacities. **In a base case scenario,**

**it is estimated that by 2033, there will be a supply-demand gap of approximately 1.6 million tonnes of LCE.** However, this gap has the potential to be filled if all new projects are successfully commissioned according to the planned timeline

Figure 4: Forecasted lithium supply-demand balance 2023-2033, Mt, LCE

2024 Q1 Further Acceleration



It is important to note that the global supply chains continue to face ongoing challenges, compounded by geopolitical tensions. These factors pose a high risk of

significant delays in the establishment of new processing capacity, which in turn could have a significant impact on the battery industry itself.

## EUROPEAN LITHIUM MARKET SITUATION

The European Union has taken proactive steps to safeguard its competitive edge by establishing The European Battery Alliance, with the primary objective of fostering innovation, competitiveness, and sustainability within the battery value chain in Europe. In 2018, the Commission introduced a strategic action plan for batteries, outlining a comprehensive framework of regulatory and non-regulatory measures to bolster all facets of the battery value chain.

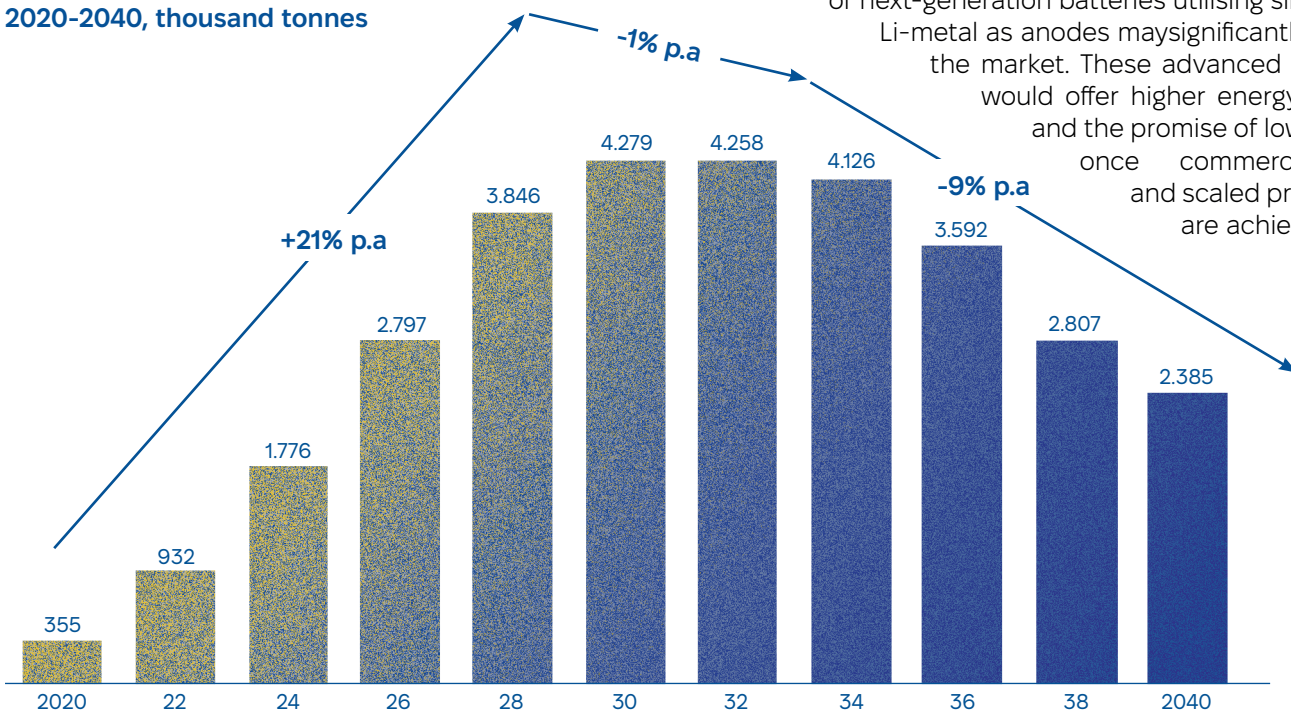
Major players in the battery industry have already announced plans or commenced construction of plants to meet the region's material requirements across the battery production spectrum.

The challenge of securing raw material supply looms large for non-integrated refining projects and battery and cell manufacturers and OEMs, particularly in Europe,

### GRAPHITE

Similarly to lithium, graphite plays a crucial role as a primary component in lithium-ion battery anodes. This positions graphite as a vital material in satisfying the increasing demand for electric vehicles and serving as a valuable resource for battery manufacturing.

**Figure 5: Global graphite anode demand balance 2020-2040, thousand tonnes**



By 2030, the market is forecasted to transition from pure graphite anodes to graphite-silicon composites. Beyond 2030, the market is expected to witness a further shift towards pure silicon and Li-metal anodes as the technology matures. This progression may cause a

As the mining and refining infrastructure continues to evolve, the focus shifts towards the development and construction of cell manufacturing facilities and gigafactories across various European nations. Companies such as Northvolt, Freyr, ACC, CATL, and the Volkswagen Group are either in the planning stages or already underway with their construction projects. This expansion aligns with the existing presence of LG Chem in Poland and Samsung SDI in Hungary.

**Automotive OEMs are actively seeking to secure a stable supply of lithium materials and are making strategic investments in assets.** Their focus is primarily on late-stage projects that have reached at least the feasibility stage of development.

highlighting the potential role of Ukraine's resources in addressing this critical aspect and securing a stable supply of raw materials.

### GRAPHITE DEMAND

**Overall demand for graphite may grow significantly, by 21% within the next 5-7 years,** however this growth in demand is expected to be moderated and ultimately capped by emergence and development of alternative technologies. This highlights the importance of accelerating current natural graphite projects, to the extent possible, to take the new supply to market while demand is still growing significantly.

The anticipated evolution of chemical technologies in the active anode materials sector over the next decade may scale down the role of graphite. The emergence of next-generation batteries utilising silicon and Li-metal as anodes may significantly impact the market. These advanced batteries would offer higher energy density and the promise of lower costs once commercialization and scaled production are achieved.

gradual decline in graphite demand in the second half of 2030s, signifying the importance of launching new natural graphite supply projects soon, while demand is growing and there is enough "runway".

## GRAPHITE SUPPLY

China currently holds a dominant position in the production of EV batteries, particularly in the active anode materials segment, with approximately three-quarters share of global graphite supplies.

Figure 6: Li-ion battery graphite supply by region 2030, thousand tonnes

Q1 2023

**%** Share of cell production capacity in 2030



This trend is expected to persist until 2030, with China maintaining its stronghold in this crucial sector producing 2.1 million tonnes of graphite anode per year. It is expected that announcements regarding the

establishment of new graphite anode capacity will be made in the coming years leading up to 2030, further solidifying China's position as a key player in the EV battery supply chain.

## GRAPHITE SUPPLY-DEMAND GAP

Simultaneously, the European and North American markets are poised to witness a substantial surge in demand coupled with minimal growth in production capacity, resulting in an undersupply scenario and heightened reliance on imports from China. This presents notable risk to the supply chain, particularly given China's intentions and recent actions to regulate its graphite exports.

Thus, market participants in the EU and NA regions aim to prioritise the development of local graphite production sources. Given the imperative for decarbonization and the energy-intensive nature of synthetic graphite production,

coupled with anticipated decarbonization mandates and energy constraints, the future supply and role of synthetic graphite is expected to be constrained. Consequently, there is a projected shift towards customer preference for natural graphite and local supply chains over distant sources, particularly those in Asia.

Leveraging its abundant resources and strategic proximity to the EU, as well as its partnership with the US, Ukraine is well-positioned to help its allies in strengthening their graphite supply chains and securing supply of premium-quality raw and semi-processed materials.

## TITANIUM

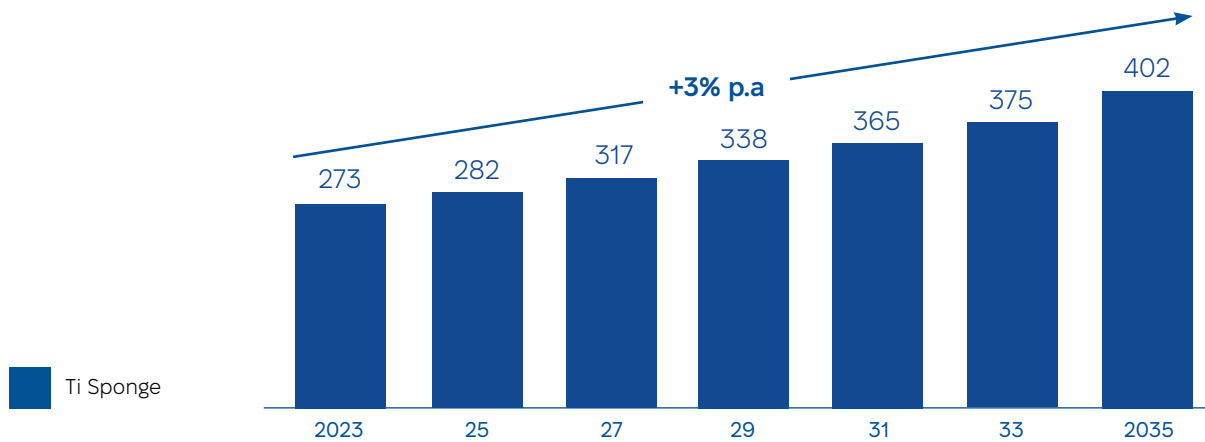
Titanium is one of the most important materials for several strategic parts of today's civilization, including the construction of aircrafts, spacecrafts, and in applications in the defence sector. Titanium was one of the materials included in the list of critical and strategic raw materials by the European Commission,

US Department of Energy and US Geological Survey, designed to incentivize investments and de-risk supply of these materials. There is a recent push by the EU and the US for diversification away from China and Russia, where significant reserves and processing capacities for titanium are concentrated.

## TITANIUM DEMAND

Historically the global demand for titanium was stably growing” на “has grown steadily with respective growth of production / processing capacity.

Figure 7: Global titanium sponge demand 2023-2035, thousand tonnes Ti



Titanium sponge demand is projected to grow at 3% p.a. from 273 thousand tonnes to 402 thousand tonnes by 2035, mainly driven by aerospace industries.

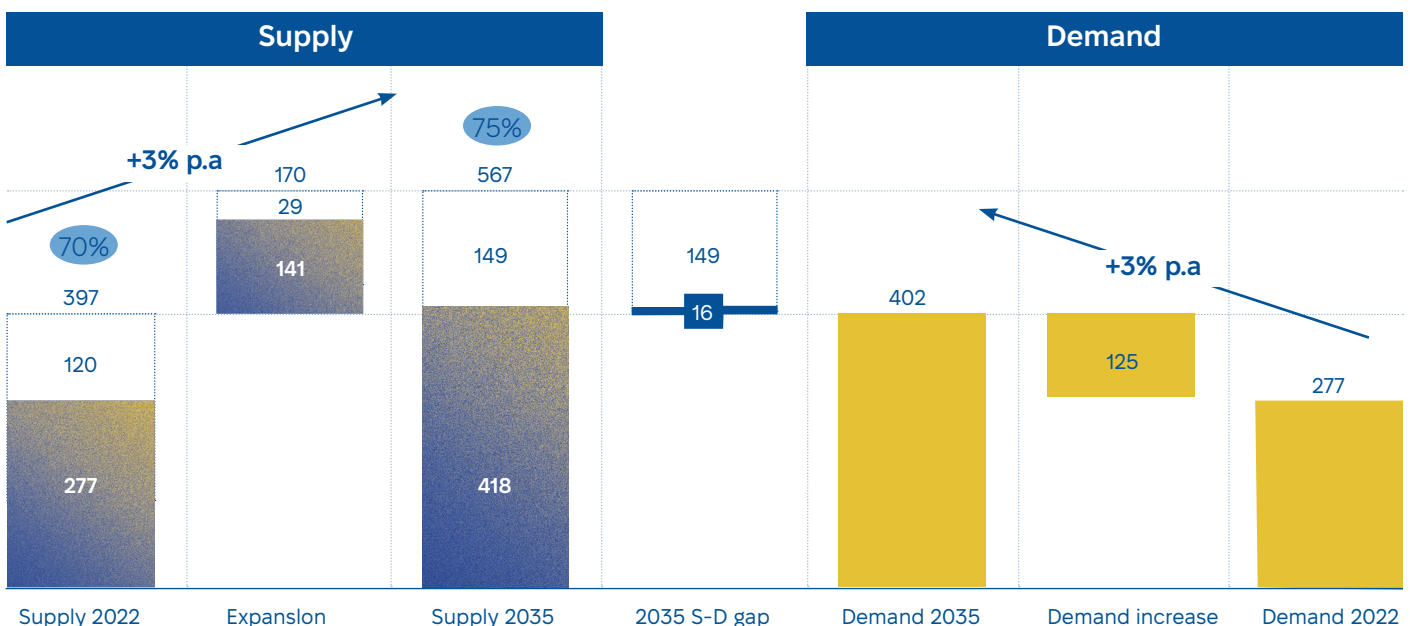
## TITANIUM SUPPLY

There is currently an excess of titanium sponge production capacity. It is expected that capacity expansion may lead to further oversupply of titanium sponge production. However, a large share of this production capacity is located in China and Russia, and the biggest part of capacity expansion is expected to be covered by China and its new production facilities (397 thousand tonnes p.a. in 2025).

## TITANIUM SUPPLY-DEMAND BALANCE

As of the 2022 majority of titanium production/processing facilities for titanium sponge were located in China and Russia with western countries depend on supplies from these two countries. Geopolitical tensions, dependence on energy sources and lessons learned by western players made it clear that supply chains for such strategic sectors like aerospace and defence should be maximally protected and supplied with raw materials from their own processing capacities or the capacities of allied countries.

Figure 8: Titanium sponge supply and demand 2022-2035, thousand tonnes

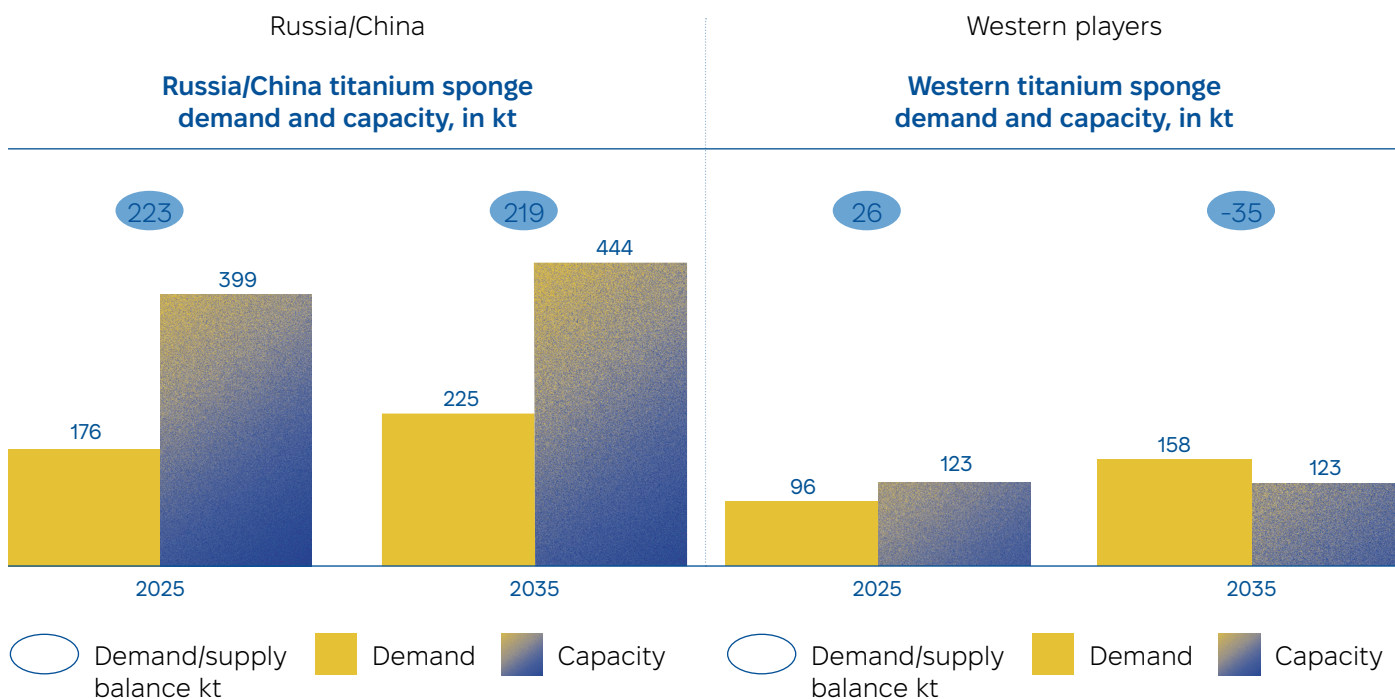


○ Utilization □ Excess-capacity ■ Production ■ Demand ■ S-D gap

As market polarisation continues to increase, with potential restrictions on titanium product trading between Russia/China and Western players, Western companies may face supply constraints. However, there is a potential solution to this issue through the

revitalization of idled capacity in the US' sponge facilities, which could help bridge the supply gap. This would require the sourcing of raw materials for sponge production from countries such as Australia, Canada, and Ukraine.

**Figure 9: Projected titanium sponge demand and capacity 2025-2033, thousand tonnes**



**In 2023, the EU commission adopted the Critical Raw Materials Act, stating regional production/processing targets for strategic minerals, incl. titanium, and goals by 2030 with regards to: recycled (>25%), processed (>40%) and mining shares (>10%), single country reliance (<65%) for strategic minerals on the list.** Such steps from the European Union will most probably lead to potential increases in local titanium ingot and sponge production, lower availability of exported processing scrap from the EU to other regions (especially USA), and lower reliance on imports from China and Russia.

In an effort to safeguard its interests, the United States has taken steps to fortify its position by unveiling the US Critical Minerals List. This list serves as a tool to assess the nation's susceptibility to potential disruptions in the global supply chain of essential minerals and metals crucial for various industries, economic stability, and national security. To ensure a stable supply of titanium sponge, US working groups and committees are actively exploring options for enhancing and modernising the existing production capacity within the country, as well as raw materials sourcing.

In response to the ongoing war in Ukraine, global players in the aerospace industry are actively seeking

to diversify their procurement and secure their supply chains. For example, titanium consumers such as Boeing and Airbus have made strategic shifts in their supply chains, leading to a reduction or cessation of sourcing from Russia, the largest manufacturer of aerospace-grade titanium.

Another example of companies taking proactive steps in securing supply of titanium is Airbus's recent acquisition of the European titanium producer and manufacturer Aubert & Duval. This strategic move allows Airbus to integrate the titanium value chain and reduce its dependence on external suppliers.

Similarly, Boeing is also taking steps to diversify its procurement and ensure a stable supply of titanium. The company has signed a memorandum of understanding (MoU) to develop an aviation-grade titanium alloy value chain in Saudi Arabia. This partnership aims to establish a localised supply chain for titanium alloys, reducing Boeing's reliance on a single source and enhancing its supply chain resilience.

Ukraine's resources and existing production assets in the titanium value chain fit well for the closer integration into European and global value chains.



## 4.6.4. Advantages of industry development in Ukraine

### LITHIUM AND GRAPHITE

Ukraine possesses proven reserves of a number of critical raw materials including lithium and graphite.

**Ukraine's abundant lithium resources present investment prospects for international players. The current reserves, strategically situated far from the front line and in close proximity to EU borders in the central and western parts of the country, account for**

**1-2% of the world's explored lithium reserves and 6% of the world's explored graphite reserves.**

As of 2023, multiple entities in Ukraine have initiated the development of lithium and graphite deposits, with a focus on attracting foreign partners for collaborative mining ventures and integrating Ukraine's CRM sector into the global or European battery production value chains.

- Lithium
- Graphite

**There are currently four explored lithium ore deposits, with two of them, Polokhivske and Dobra situated in the Kropyvnytskyi region, far from the front lines of the**

**war.** The other two, Shevchenkivske and Kruta Balka are in the currently occupied parts of Donetsk and Zaporizhia regions, and thus are currently not viable for development.

Despite its high potential and growing demand, lithium production is not yet developed in Ukraine, thus creating significant opportunity for international investors.

**Similar to lithium, graphite deposits in Ukraine are strategically located close to European borders and far from the front lines, and are widespread across the Khmelnytsky and Kropyvnytskyi regions in the western and central parts of the country.** Notably, the Horodniavska, Khmelivska, and Zavallivske deposits serve as key sites where graphite deposits are being actively extracted and developed by several local and international players.

Among these, the Zavallivske deposit stands out as Ukraine's largest graphite ore reserve and one of the world's largest, boasting estimated reserves of 6.1 million tonnes of ordinary graphite (equivalent to 97



**Figure 10: Lithium and graphite deposits in Ukraine**

million tonnes of graphite ore). The current production capacity of the Zavallivske deposit amounts to 30 thousand tons per year and secure production of 25 different types of high-quality graphite products.

Ukrainian lithium industry is currently in its early stages, with licence holders for deposit development representing the industry. However, active mining has yet to commence, and further investments are necessary to kickstart the industry.

In contrast, the graphite industry in Ukraine began its development in the 20th century and is currently represented by 6 deposits, one of which is actively developed by Zavallivsky Graphite, while other players, such as BGV Group Management, are working on the development of other deposits.

- **Zavallivsky Graphite (owned by Volt Resources):** located in the Kropyvnytskyi region of Ukraine, with a focus on the exploration of natural flake graphite deposits, a type of graphite that is particularly valuable due to its use in many high-tech applications. The 2017-2021 period saw an average annual production of 7,300 tonnes.
- **BGV Group Management:** the company's activities are aimed at the development of the Balakhivka deposit and the extraction of graphite. The company has owned a licence for the extraction of graphite ores for a period of 20 years. Despite the impact of the war and challenges in attracting investments, Ukraine's mining industry holds promising prospects. Foreign representatives recognize the sector's attractiveness and continue to invest, despite the slowdown caused by the conflict. The

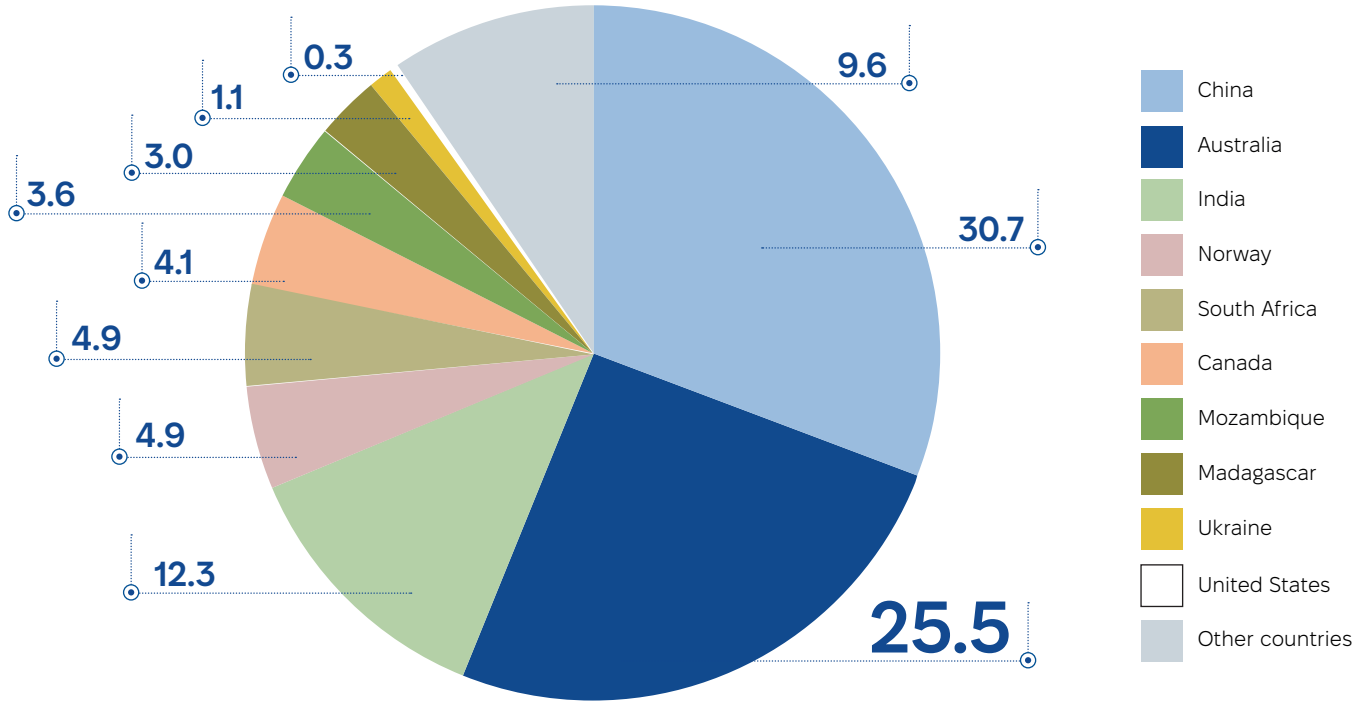
following are some instances of investments made in Ukraine since 2022. The Ukrainian investment company BGV Group Management and its founder Gennady Butkevich have invested more than USD 100 million in Ukrainian mining projects, including graphite mining of the biggest graphite deposits in Europe, the Balakhivka deposit.

- **Turkish Onur Group** allocated USD 50 million for the extraction of natural graphite in Ukraine. The extracted graphite can be utilised in the production of car batteries. Spice Ukraine LLC, a Ukrainian company under the Onur Group, has obtained a special permit from the Ukrainian Geological Survey (UGS) to extract graphite ore from the Burtynsky deposit in the Khmelnytsky region.

# TITANIUM

According to data from the US Geological Survey in 2021, Ukraine's titanium ore reserves totaled 8,400 thousand tons, with 2,500 thousand tonnes of rutile and 5,900 thousand tonnes of ilmenite. This positions Ukraine at # 9 globally in terms of titanium ore reserves by volume, and #5 in terms of rutile reserves.

Figure 11: Global titanium reserves, 2021 thousand tonnes



The upstream infrastructure comprises multiple mines situated across central regions of Ukraine, producing titanium ore concentrate and pigment, as well as titanium metal sponge in Zaporizhzhia.

**Some of the prominent companies in the Ukrainian Titanium sector include:**

<p><b>United Mining and Chemical Company (UMCC Titanium)</b></p>	<p>one of the world's leading producers of titanium and zirconium concentrates. The company's production capacity in 2021 was approximately 300,000 tons of ilmenite concentrate and 70,000 tonnes of zircon concentrate per year. UMCC's key assets include two major production facilities: Irshansk Mining and Processing Plant (one of the world's largest producers of ilmenite, a titanium-iron oxide mineral) and Vilnohirs'k Mining.</p>
<p><b>Zaporizhzhia Titanium and Magnesium Combine (ZTMC)</b></p>	<p>one of the largest European producers of titanium sponge with production capacity of up to 12,000 tons of titanium sponge per year. The company is located in Zaporizhzhia and, due to its proximity to the front line, has limited production since 2022.</p>
<p><b>Velta</b></p>	<p>company owns a deposit of ilmenite ores in the Kropyvnytskyi region. The Velta mining and processing plant is located near the city of Novomyrhorod in the Kirovohrad region and has been providing commercial supplies of titanium raw materials since 2012. The capacity of the plant is up to 270,000 tons of ilmenite concentrate per year.</p>

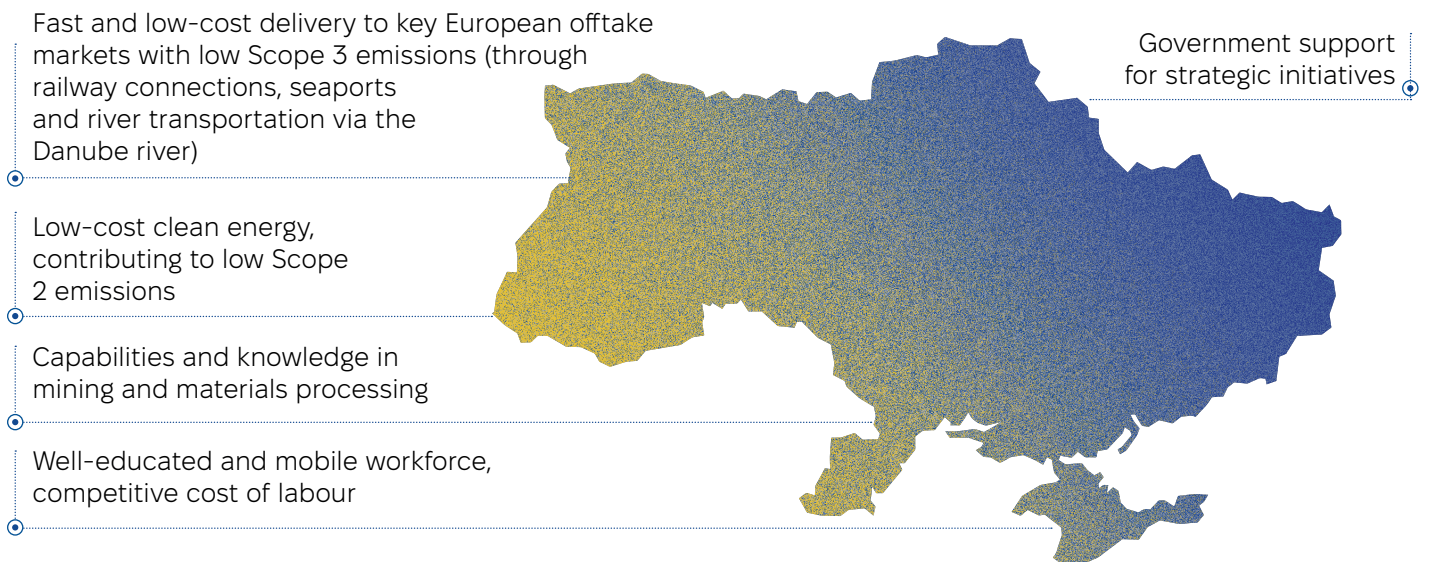
## Sumykhimprom

one of the largest Ukrainian enterprises producing complex mineral fertilizers, titanium dioxide, and other chemical products. The company had ceased operations for an extended period after operating at a loss. The company is managed by the State Property Fund of Ukraine. Ukraine's economy has significant opportunities in the titanium sector. About 80% of the feedstock for Russia's titanium metal products previously relied on Ukrainian titanium concentrates. Ukraine now has the opportunity to upgrade its titanium sector through the modernization of existing infrastructure and shifting its focus towards strategic partnerships with Europe and North America.

Despite having a well-established foundation for titanium production, investment projects focused on development (rather than on maintenance) have been limited in Ukraine since the start of the war in 2022.

## OTHER ADVANTAGES OF THE OPPORTUNITY IN UKRAINE

In addition to rich resources of the critical materials, there are some other potential advantages of further developing this sector in Ukraine, including:



However, to fully capitalise on these opportunities, international involvement is necessary. This involvement would bring in investments and advanced technologies, as well as secure potential offtake partnerships with major international industry players.

## PROJECT MATURATION/FEASIBILITY AND FINANCING

### Economic and technical feasibility study

Most projects in the CRM sector require additional rigorous economical assessment considering specifics within each value chain. Where production has not yet started, deposit characterization and the high level of due diligence expected of this is of utmost importance in order to assess the economic viability of the deposit and be able to engage international investors with credibility. Where processing of an ore is new to Ukraine (e.g., lithium), the feasibility of localizing the technical know-how of these chemistries will also have to be assessed. Further investigation is also required

to determine potential offtakers' requirements of the product (e.g., quality of minerals, type and form of end products, required certification, carbon footprint, etc.).

## FINANCING NEED

Investment requirements of the project could be separated into two main stages:

- 1 Project preparation finance (pre-FID);
- 2 Capital investment (post-FID).

## POTENTIAL SOURCES OF FINANCE

Considering the scale of projects and current economic situation in Ukraine, the majority of CRM-related projects will require involvement of public and private investors, as well as financial institutions. International Finance Institutions (IFIs) will have a vital role to play in providing risk mitigation and blended finance instruments, as well as technical assistance. National development finance

institutions (DFIs) and export credit agencies (ECAs) can play an important role in providing additional capital for securing contracts for import of equipment, services and technologies from international players. A syndicate of private banks will be required to provide commercial financing, led by a major international project finance specialist organisation.

A range of financial support mechanisms from public organisations can be used to reduce project risks. Grant funding is available across multiple IFIs during the ongoing war for the project preparation stage.

The EU Ukraine Facility Pillar 2 is set to unlock a further EUR 7 billion for the provision of guarantees to mobilise investment into reconstruction efforts, substantially

increasing availability of financing, including for CRM sector.

## ENGAGEMENT OF GLOBAL INVESTORS/OFFTAKE/TECHNOLOGY PARTNERS

- Engagement of global companies: Involving global companies as investors, offtakers, and technology partners brings expertise, resources, and market access to the project.
- Fit of proposed project's products to international value chains: Ensuring that the project's products align with international value chains increases market opportunities and competitiveness.

## ROADMAP FOR DEVELOPMENT

Development of CRM mining and refining in Ukraine can be accomplished in 3 steps, notably:

- Horizon 1 (1-2 years): project feasibility assessment and FID;
- Horizon 2 (3-5 years from now): pilot project launch;
- Horizon 3 (5-10 years from now): scale-up of mining and refining operations;
- Horizon 4 (10-25 years from now): long-term vision for CRM sector development

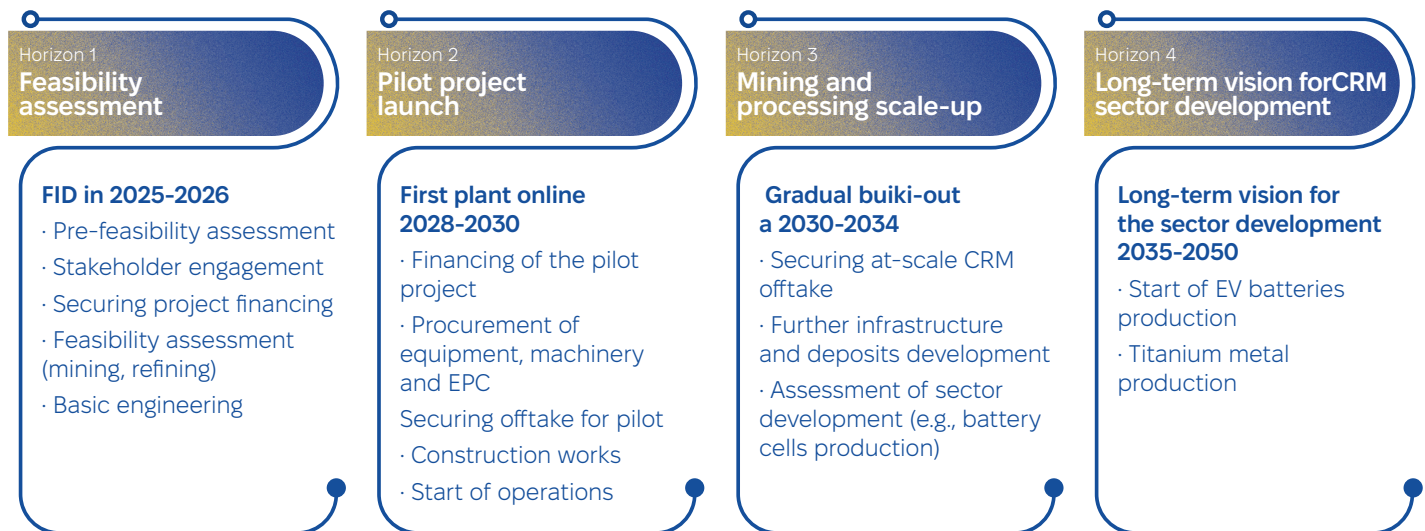


Illustration: Development horizons of the CRM sector

**By addressing these aspects, projects can move closer to successful implementation and contribute to overall development objectives.**



**CRITICAL RAW MATERIALS (CRMS)**

# Highlighted investment projects

# NEW VELTA SPV

TITANIUM ORE MINING & PROCESSING (DEVELOPMENT & CONSTRUCTION)

## LOCATION: UKRAINE, KROPYVNYTSKYI REGION

- **Brief Description:** the Project considers extension of Velta’s 1st class ilmenite resource base by the development of the second Titanium ore deposit in Kropyvnytskyi region, Ukraine, and construction of mining and processing plant.
- **Products/Services:** High grade titanium feedstock with up to 60% TIO2 and low impurities, a intermediary source for the production of high added value titanium powders and finished products.
- **Target Market:** Holding 2% of global titanium feedstock market share and long-term Off-Take agreements with industry leaders we plan to start export of titanium production with high added value to U.S. and EU.
- **Unique Selling Proposition:** In 2018 titanium receives the official status of a critical mineral in the USA. In 2020 the EU issued a Critical Minerals List Investigation with 30 items, including titanium. Titanium is identified as the most critical material for Defense, Aerospace, Healthcare, Renewable energy, Automotive.
- **Technologies and Innovations:** Velta R&D invented Velta TI Process, a technology which revolutionizes titanium production and replaces conventional “Kroll Process” with remarkably.

### Projects Highlights<sup>1</sup> (\$, mln)



**Type of financing** - equity, project finance, working capital

**Financing structure:** Debt – 70% / Equity – 30%

### Expected Financial Indicators:

- NPV15 – 50 (9 years)
- DPP (years) – 6
- Avg. 5Y Revenue – \$ 57 mln
- RR – 56%
- Project launch period – 1.5 year
- Avg. 5Y EBITDA – 24
- **Project Status:** In 2019 Velta received commercial development license for the second Titanium ore deposit in Kropyvnytskyi region, Ukraine, and aims to conduct resources and reserves estimation according to international standards (JORC or CIM) with CPR and Feasibility study obtained in H12025.

## BUSINESS MODEL

- Velta, founded by Andriy Brodsky in 2006 and headquartered in Dnipro, Ukraine, commenced first production at Berzulivske deposit in 2012. Since 2012 we retained 2% of titanium feedstock global market share, continuing ilmenite deliveries during the Russian-Ukrainian War in 2022-2024. We target

to expand our recourse base with a new ilmenite deposit and double annual production. The ilmenite feedstock produced by Velta can be naturally embedded in the Titanium Powders and Finished products Manufacturing with high value added titanium production described in the later slides.

### Key figures

2006

year of foundation

17

years of intensive growth

UP TO 60%

TIO2 contained in Velta’s ilmenite

650 +

employees

650 +

years ahead with a sufficient resource base

2%

of the titanium feedstock market share

**Implementation of the project 2025 – 2026 - increase in mining and processing capacities**

<sup>1</sup>The project information and financial indicators are provided by company-initiator of the project.

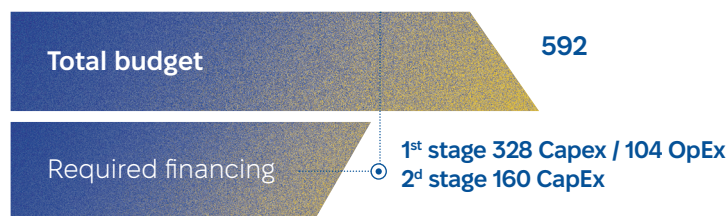
# NEW VELTA SPV

TITANIUM POWDERS AND FINISHED PRODUCTS MANUFACTURING FACILITY

## LOCATION: UKRAINE, KROPYVNYTSKYI REGION

- **Brief Description:** the Project will continue Velta's vertical integration strategy from a titanium feedstock provider, holding extensive 19 years resource base, to a high added value titanium producer and exporter.
- **Products/Services:**
  - 1st stage construction of facilities for the production of titanium metal powders with high added value
  - 2d stage construction of facilities for the production of finished parts, demanded by pivotal sectors such as Aerospace & Defense, Medical and Automotive
- **Target Market:** Possessing a strong market position and being well-recognized worldwide, Velta targets to complete vertical integration and start export of high added value titanium production to U.S. and EU for industrial Off-Takers.
- **Unique Selling Proposition:** Titanium powder market, including Additive Manufacturing, is poised for a substantial growth with CAGR of 15% and market value USD 4.5 billion reached by 2032.
- **Technologies and Innovations:** Technologies and Innovations: Velta R&D invented Velta Ti Process, a technology and replaces conventional "Kroll Process" with remarkably efficient, low-cost metal powder production.

### Projects Highlights for the 1<sup>st</sup> stage<sup>1</sup> (\$, mln)



**Type of financing** - equity, project finance, working capital

**Financing structure:** Debt – 70% / Equity – 30%

### Expected Financial Indicators:

- NPV – \$ 774 mln (9 years)
- IRR – 54%
- DPP (years) – 6.9
- Project launch period – 2 years
- Avg. 5Y Revenue – \$ 507 mln
- Avg. 5Y EBITDA – \$ 240 mln
- **Project Status:** Velta patented unique Velta Ti Process, underlying the manufacturing process. Base on the technology assessment and commercial test-runs well-known EU Institutes confirmed titanium powder's suitability for a range of additive manufacturing applications. The Project will start after second Titanium ore Mine commencement.

## BUSINESS MODEL

- The industrial titanium site targets to revitalize an industrial enterprise closed 25 years ago. Located 20 km away from raw material deposits operating and developing by Velta the site geography provides logistics benefits to lock-up high added value titanium production in Ukraine. At the 1st stage we target to start 5 thousand tones annual production of titanium powders & alloys and at the 2d stage to expand with manufacturing titanium finished parts & end-products.
- Bolstered by the vertical integration strategy, Velta invented a unique technology to convert titanium feedstock into titanium powders and alloys. The technology has been patented in Ukraine and vetted by widely-respected EU institutions. Velta's Ti Process complies with sustainable standards, with no solid waste, full circularity and significantly lower carbon footprint. It reduces the cost of end-products within Powder metallurgy, Additive manufacturing and Metal Injection Molding.

### Implementation of the project

2025 – 2027 - 1st stage

2027 – 2028 - 2d stage

<sup>1</sup>The project information and financial indicators are provided by company-initiator of the project.

# JSC UMCC TITANIUM

SELYSHCHANSKA DEPOSIT  
(ILMENITE)

## ZHYTOMYR REGION

- **Brief Description:** Management of the company aims to expand the resource base/develop new deposits, which holds reserves of 30-35 million cubic meters within the licensed area. The expected volume of production is 800 thousand cubic meters of ore per year.
- **Products/Services:** Ilmenite Concentrate (titanium).
- **Target Market:** Holding 2% of global titanium feedstock market share and long-term Off-Take agreements with industry leaders we plan to start export of titanium production with high added value to U.S. and EU.
- **Unique Selling Proposition:** UMCC owns several mines and beneficiation plants in central and western part of Ukraine that allow integrated processing of mined ore and fast delivery to international off-takers.
- **Technologies and Innovations:** construction of an open pit, stripping and mining operations with draglines, and beneficiation at the existing facilities of the Irshansk Mining & Processing Plant.
- **Project Status:** In 2021, the company acquired special permit No. 6028 for the pilot commercial development of the deposit. As of Q1 2024, work is underway to obtain permits for geological exploration and change the status of the special permit from "pilot development" to "ilmenite mining"

### Projects Highlights<sup>1</sup> (\$ mln)



**Type of financing** - project finance

**Financing structure:** CAPEX – 100%

### Expected Financial Indicators:

- NPV – [n/a]
- IRR – 14%
- DPP (months) – 79 (PP)
- Project launch period – 2024
- Revenue – 500 / 31 per year.
- EBITDA – [n/a] (n/a year)

- Titanium pigment is a higher value-added product than ilmenite concentrate with a positioning at the "downstream" stages of the titanium value chain. It is in stable demand (with regular growth) on global markets due to its coverage of a wide range of

industries – including plastics, paints, anti-corrosion chemicals, cosmetics, food coloring, medical drugs. This project will allow UMCC to have strong positions across the titanium value chain, vertically integrating all stages until actual TiO<sub>2</sub> pigment production.

### Key Points of Project Implementation:

geological exploration, project documentation,  
construction of an open pit and primary processing plant

<sup>1</sup>The project information and financial indicators are provided by company-initiator of the project.



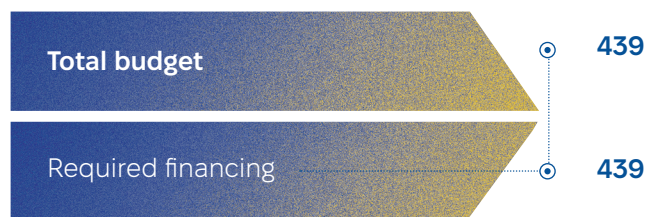
# JSC UMCC TITANIUM

PRODUCTION OF TiO2 PIGMENT

## ZHYTOMYR REGION

- **Brief Description:** Movement “downstream” through the titanium value chain with the construction of an ilmenite processing facility into TiO2 pigment using sulfate technology. Estimated production capacity is 65,000 tons of high-quality TiO2 pigment. Can be integrated with Titanium Slag production.
- **Products/Services:** Titanium pigment.
- **Target Market:** Possessing a strong market position and being well-recognized worldwide, Velta targets to complete vertical integration and start export of high added value titanium production to U.S. and EU for industrial Off-Takers.
- **Unique Selling Proposition:** UMCC owns several mines and beneficiation plants in central and western part of Ukraine that allow integrated processing of mined ore and fast delivery to international off-takers.
- **Technologies and Innovations:** Sulfate technology.
- **Project Status:** Concept (early stage concept)

### Projects Highlights<sup>1</sup> (\$ mln)



**Type of financing - project financing**  
**Financing structure: CAPEX – 100%**

### Expected Financial Indicators:

- NPV – n/a
- IRR – n/a%
- DPP (months) – n/a
- Project launch period – 2025
- Revenue – 202 per year

## BUSINESS MODEL

- Titanium pigment is a higher value-added product than ilmenite concentrate with a positioning at the “downstream” stages of the titanium value chain. It is in stable demand (with regular growth) on global markets due to its coverage of a wide range of

industries – including plastics, paints, anti-corrosion chemicals, cosmetics, food coloring, medical drugs. This project will allow UMCC to have strong positions across the titanium value chain, vertically integrating all stages until actual TiO2 pigment production.

### Implementation of the project

2025 – 2027 - 1st stage

2027 – 2028 - 2d stage

<sup>1</sup>The project information and financial indicators are provided by company-initiator of the project.

# JSC UMCC TITANIUM

PRODUCTION OF  
TITANIUM SLAG

## ZHYTOMYR REGION

- **Brief Description:** Introduction of additional technological chains for the processing of existing raw materials into titanium slag with a production capacity of 30,000 tons per year. Can be integrated with TiO2 pigment production.
- **Products/Services:** Titanium slag.
- **Target Market:** Holding 2% of global titanium feedstock market share and long-term Off-Take agreements with industry leaders we plan to start export of titanium production with high added value to U.S. and EU.
- **Unique Selling Proposition:** UMCC is the largest producer of titanium and zirconium ores in Europe, which produces more than 350,000 tons of concentrates ores of the highest quality logistical advantages, cost-effective case that will allow to take a competitive position in the market.
- **Technologies and Innovations:** High-performance technology of reduction smelting of ilmenite concentrates in closed ore-thermal furnaces with a 5000-25500 KVA power range.
- **Project Status:** Concept (early stage concept)

### Projects Highlights<sup>1</sup> (\$ mln)



**Type of financing** - project financing

**Financing structure:** CAPEX – 100%

### Expected Financial Indicators:

- NPV – n/a
- IRR – n/a%
- DPP (months) – n/a
- Project launch period – 2024
- Revenue – 25 per year

## BUSINESS MODEL

- Titanium slag is a higher value-added product, of the “feedstock” category in the titanium value chain. Titanium Slag has a higher TiO2 content and sits right after ilmenite concentrate in the titanium value chain. It has a definitive target

audience in global markets and is an effective way of moving “downstream” for UMCC in the titanium value chain. Ideally, this is a first step in moving towards the production of other higher-margin products.

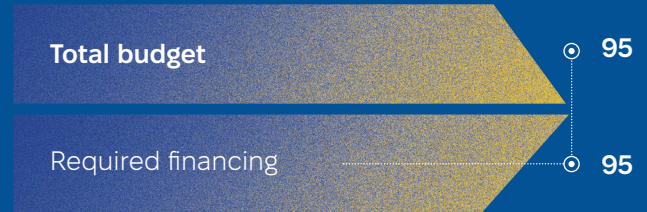
## ZHYTOMYR REGION

- **Brief Description:** Volt Resources Ltd (Volt) and its Ukraine subsidiary, Zavalievsky Graphite LLC (ZG) have developed a three-staged corporate development plan for the Zavalievsky natural graphite mine and processing facility in Ukraine. Average graphite concentrate production of 7,300 TPA in 2017-2021.
- **Stage 1:** for sustaining ZG operations and upgrading the production
- **Stage 2:** boosting production and modernising processing facilities up to 30k tpa. capacity (with the option to increase to 60 ktpa.)
- **Stage 3:** for initial capacity; (6,000 USD/t, incl. 12% contingency), for building a CSPG facility
- **Unique Selling Proposition:** The site (636ha) is adjacent to Zavallya, ~280 kms south of the Ukraine capital Kyiv, and 230 kms north of Odessa's main port.

Long life multi-decade producing graphite mine with exploration upside. Permits for subsoil use - mining licence equivalent - valid until November 2035.

According classification standard NAEN the Graphite mineralization estimate of 22.9mt @ 6.8% carbon. Is one of Europe's largest graphite resources.

### Projects Highlights<sup>1</sup> (\$ mln)



Stage 1: 5  
 Stage 2: 10  
 Stage 3: 80

**Financing structure:** CAPEX – 100%

- **Project Status:** Pre-feasibility

# BGV GROUP MANAGEMENT, LLC

DEVELOPMENT OF THE BGV  
GRAPHITE - STAGE 1

## ZHYTOMYR REGION

- **Brief Description:** The project focuses on developing the Balakhivka graphite deposit in Central Ukraine, which has 44Mt reserves in the licensed area (185Mt of explored reserves in total).
- **Products/Services:** Graphite concentrate.
- **Target Market:** European Union countries.
- **Unique Selling Proposition:** Large proven reserves with 44Mt of graphite ore available in the most productive Southern area. High-quality graphite suitable for anode material: 74% fine flake graphite produced (-150µm, -100 mesh for SPG production) shows above-average performance for Li-ion batteries. Advantageous location for EU customers with good immediate highway and railway links.
- **Technologies and Innovations:** Technology for graphite concentrate production developed by ANZAPLAN Dorfner Group (Germany) with application of EU standardst.
- **Project Status:** accomplished PEA, PFS and updated PFS in 2023, successfully finalized pilot tests for the concentrator plant and started Basic Engineering in 2024. Currently project is in the FS stage according to Ukrainian standards (1st stage – Technical-Economic Assessment; 2nd stage - Design).

### Projects Highlights<sup>1</sup> (\$ mln)



**Type of financing** - 60%/40% (debt/equity)

**Financing structure:** CAPEX – 87 / OPEX –12

### Expected Financial Indicators:

- NPV – 169
- IRR – 35%
- DPP (months) – 62
- Project launch period – 2027
- Revenue – 52 (per year)
- EBITDA >50% (per year)

\* These numbers given with consideration of potential debt financing

## BUSINESS MODEL

- Construction of graphite mining and processing plant with further downstream production of SPG for battery anodes to lock in full graphite value chain.
- Sale of Spherical Purified Graphite (SPG) for Li-ion battery anodes to the EU market (19,000 tons) and graphite concentrate.
- Basic production capacity of the concentrator plant - 50K tons with upscaling possibilities to 100K tons, out of which SPG will make 38,000 tons.

# BGV GROUP MANAGEMENT, LLC

DEVELOPMENT OF THE BGV GRAPHITE - STAGE 2

## KROPYVNYTSKY REGION

- **Brief Description:** Construction of a spherical graphite plant to lock in full graphite value chain. Production of 19,000 tons of SPG (basic scenario) for Li-ion battery anodes.
- **Target Market:** European Union countries, North America.
- **Products/Services:** Spherical Purified Graphite (SPG) for Li-ion battery anodes.
- **Technologies and Innovations:** Technology for SPG production developed by German and USA companies as more ecological alternative to the existing conventional SPG technology.
- **Unique Selling Proposition:** strategic European SPG supplier with advantageous location and good immediate highway and railway links for EU Gigafactories, ESS and anode producers. Basic supply volume 19K tons SPG with scaling possibilities up to 38K tons at further project stages.
- **Project Status:** Updated PFS (accomplished).

### Projects Highlights<sup>1</sup> (\$ mln)



Type of financing - 60%/40% (debt/equity)

Financing structure: CAPEX – 316 / OPEX – 12

### Expected Financial Indicators:

- NPV – 299
- IRR – 18%
- DPP (months) – 84
- Project launch period – 2028
- Revenue – 89 (per year)
- EBITDA >50% (per year)

The model includes production of graphite concentrate 50,000 tpa, 41,000 tpa out of which goes for SPG production

\* These numbers given with consideration of potential debt financing

## DEVELOPMENT OF THE BGV GRAPHITE – 1ST AND 2ND STAGES

### Key partners

- European anode producers, Gigafactories, EV and ESS producers (strategic);
- EU industrials in metallurgy, refractory;
- IFIs (financial) for equity; discussions ongoing with off-takers, lenders and export finance on debt.

### Stage 1:

- Pre-feasibility Q1 2023
- Feasibility Q2 2025
- Construction Q1 2026
- Expected launch Q4 2027

### Stage 2:

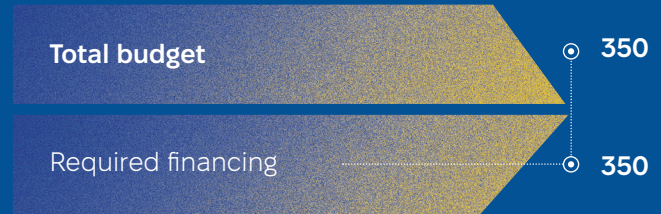
- Pre-feasibility Q2 2025
- Feasibility Q1 2026
- Construction Q1 2027
- Expected launch Q4 2028

# UKRLITHIUMMINING, LLC

## ZHYTOMYR REGION

- Brief Description:** The upstream component of the project involves construction of:
  - 1.5Mtpa lithium ore mine with 15-year life of mine (current reserve based); and
  - concentrate plant with ~ 300 ktpa petalite concentrate production capacity
  - The project sponsor also considers lithium conversion facility, which shall produce ~ 20 ktpa of lithium carbonate
- Products/Services:** Lithium concentrate/chemicals.
- Target Market:** European Union, global markets.
- Unique Selling Proposition:** Large and high-quality proven resource base with 22Mt confirmed reserves in licensed area and over 50Mt potential total resource; ~3,5% lithium grade in petalite concentrate.
- Technologies and Innovations:** one of few large scale Ukraine projects with ESIA underway.
- Project Status:** Pre-feasibility completed/start of DFS (subject to financing)

### Projects Highlights<sup>1</sup> (\$ mln)



Type of financing - 70/30 (debt/equity)

Financing structure: CAPEX – 95% / working capital and development costs – 5%

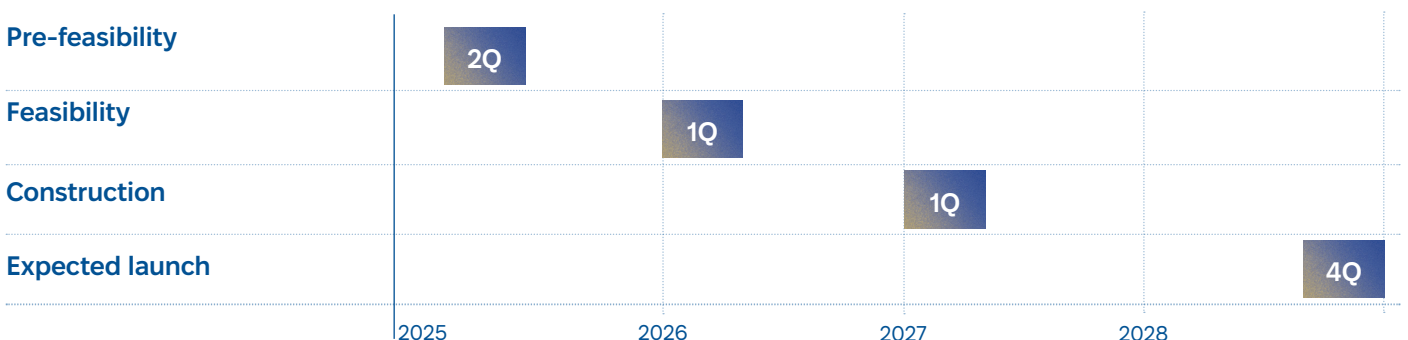
### Expected Financial Indicators:

- NPV (post tax) – 800
- DPP (months) – 48
- Revenue – 400 per annum
- RR – 50%
- Project launch period – 2024
- EBITDA – 250 per annum

## BUSINESS MODEL

- Construction of graphite mining and processing plant with further downstream production of SPG for battery anodes to lock in full graphite value chain.
- Sale of Spherical Purified Graphite (SPG) for Li-ion battery anodes to the EU market (19,000 tons) and graphite concentrate.
- Basic production capacity of the concentrator plant - 50K tons with upscaling possibilities to 100K tons, out of which SPG will make 38,000 tons.

### Key Points Of Project Implementation



## LITHIUM

# UKRAINIAN GEOLOGICAL SURVEY

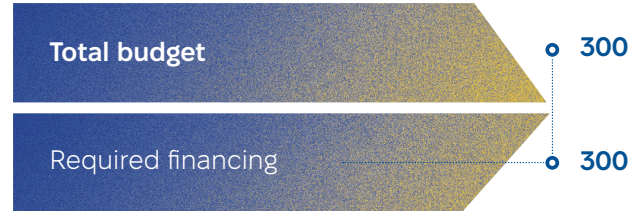
## DOBRA LITHIUM PROJECT DEVELOPMENT

### KROPYVNYTSKY REGION

#### Brief Description:

- The deposit (hard rocks) was opened in 1989 and owned by state.
  - The project is an opportunity to invest in obtaining a license (special permit) for the development of the Dobra lithium ore deposit, located in the Kropyvnytsia region, for a period of 50 years.
  - The area of the deposit is 1707 hectares and contains associated minerals - tantalum, niobium, rubidium, cesium, beryllium and gold.
- **Products/Services:** Lithium.
  - **Target Market:** European Union countries.
  - **Unique Selling Proposition:** long-term license.
  - **Technologies and Innovations:** n/a
  - **Project Status:** Concept

#### Projects Highlights<sup>1</sup> (\$ mln)



Type of financing - n/a

Financing structure: CAPEX –100%

#### Expected Financial Indicators:

- NPV – n/a
- DPP (months) – n/a
- Revenue – n/a (n/a year)
- IRR – n/a
- Project launch period – n/a
- EBITDA – n/a (n/a year)

# UKRAINIAN GEOLOGICAL SURVEY

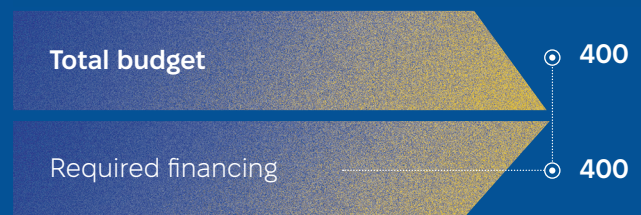
## STREMYHORODSKE DEPOSIT OF ILMENITE ORES

### KROPYVNYTSKY REGION

#### Brief Description:

- The deposit was opened in 1954 and is owned by the state.
  - The project is an opportunity to invest in obtaining a license (special permit) for the development of the Stremyhorodske ilmenite ore deposit, located in the Zhytomyr region, for a period of 50 years..
  - The area of the deposit is 225 hectares and contains associated minerals - scandium and vanadium ores.
- **Products/Services:** Ilmenite ore.
  - **Target Market:** Global market.
  - **Unique Selling Proposition:** Long-term license for one of the largest titanium ore deposits in Europe.
  - **Technologies and Innovations:** n/a
  - **Project Status:** Concept

#### Projects Highlights<sup>1</sup> (\$ mln) (if applicable)



Type of financing - n/a

Financing structure: CAPEX –100%

#### Expected Financial Indicators:

- NPV – n/a
- DPP (months) – n/a
- Revenue – n/a (n/a year)
- IRR – n/a
- Project launch period – n/a
- EBITDA – n/a (n/a year)