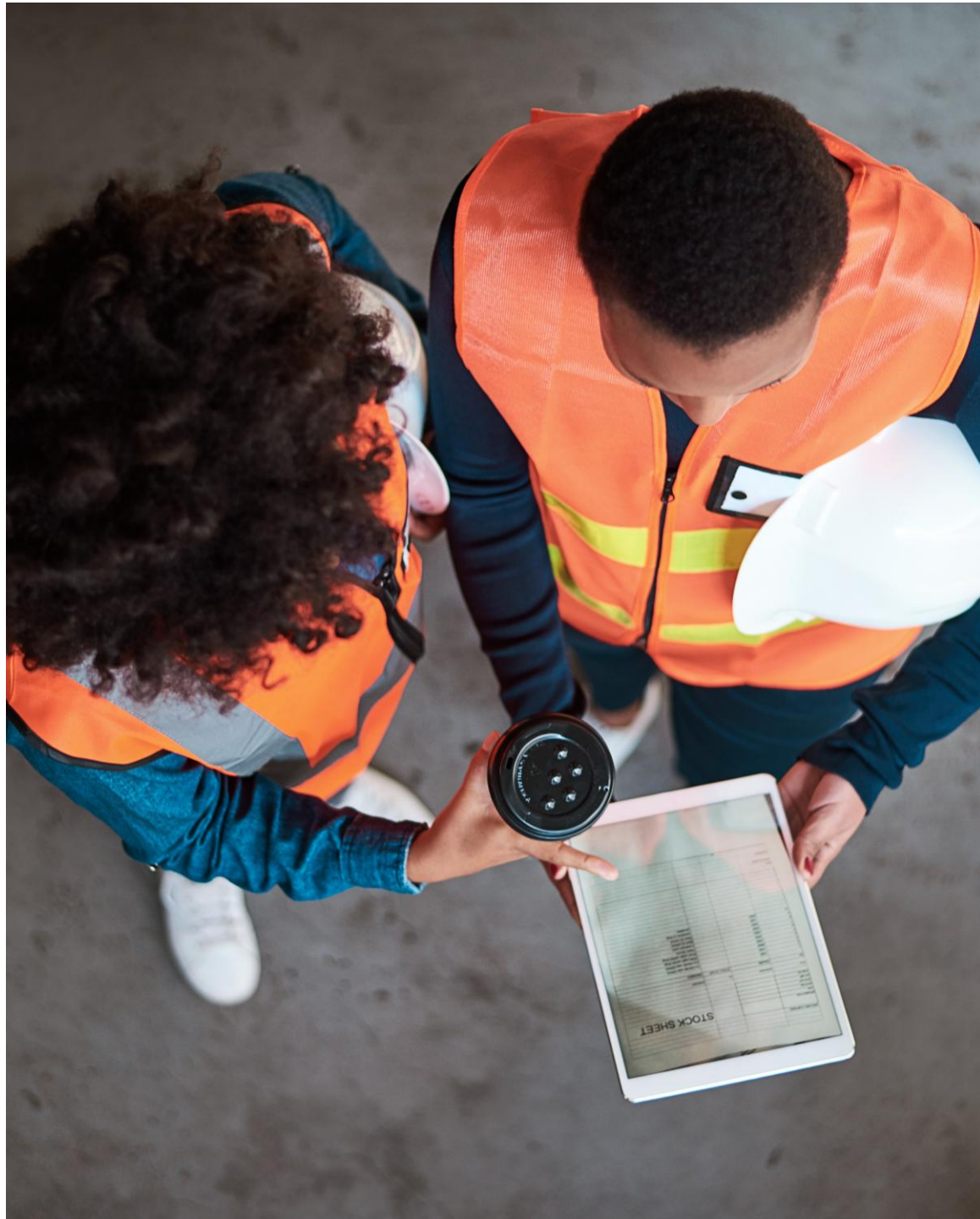
From Minerals to Manufacturing

Minerals Value Addition in Tanzania

Final Report - Annexure

July 2025



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Tanzania has large reserves of important minerals creating opportunities from exploration to value addition

Focus for report

Value addition

	Exploration	Mining	Beneficia-tion	Intermediate product manufacturing	End-use product manufacturing
Mineral value chain	**Assessing whether a site is economically viable** for mining operations	**Extracting minerals** using different mechanisms (surface, underground, etc.)	Processing the mineral ore to **remove impurities**	Converting beneficiated minerals into **intermediate products**	Manufacturing **end-use products**
Status in Tanzania	**Currently ongoing** for various minerals		**Varies by mineral** and **needs to be successful** for value addition to be realized	**Currently limited** with plans to expand in the near to medium term	
Share of value[1]	**10 – 20%**			**80 – 90%**	

1. Ranges based on distribution of value for cement and graphite. For gold, value is more concentrated in upstream

The perspective on Tanzania's Mineral Value Addition Opportunities addresses three questions

1 What are the highest value **critical and strategic minerals in Tanzania** that have significant potential for value addition?

2 Which **intermediate and end-user products** associated with the **prioritized minerals** have the highest viability in terms of **competitiveness and economic impact**?

3 Which **actions and unlocks** are **required** to realize these opportunities?

1. A “push” and “pull” approach was leveraged to identify an initial list of priority minerals with the highest potential for value addition in Tanzania

A Push ‘Supply-driven’

Minerals with current or planned (near term) production in Tanzania

Approach

- **Determine** current and planned production value by mineral
- **Select the top 8–9 minerals** based on **combined current and planned production value**
- **Overlay reserves data** to validate sustainability of production

Initial list of priority minerals for value addition

B Pull ‘Demand-driven’

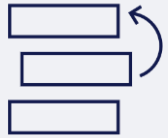
Minerals that are **major inputs** into **top imported products** across both domestic & regional markets

Approach

- Identify **Tanzania’s top imports**, which are **mineral-based** and could **potentially be produced in Tanzania**
- Assess if **similar products** are also demanded in the **region (overlay EAC demand)**
- **Identify minerals used as major** (and minor) **inputs** for producing these products

2. We used a four step-approach to identify value addition opportunities associated with these priority minerals

A



Develop a long list of **value-addition opportunities** (relevant intermediate and end-use products) **associated with priority minerals**

B

Assess the long list of value-addition opportunities using a set of criteria **to identify** those that are **feasible in Tanzania**

C

Sequence feasible value-addition opportunities **across the three-time horizons**

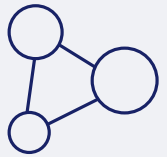
Recap three-time horizons:

1st horizon: 1-3 years

2nd horizon: 3-7 years

3rd horizon: 7+ years

D



Group similar value-addition opportunities (identify meaningful archetypes of opportunities) to enable efficient execution

2. We developed a long list of value-addition opportunities across the prioritized minerals

NON-EXHAUSTIVE

NON-EXHAUSTIVE PRELIMINARY

	Opportunity	Product Category	Description
11 Copper	• Wire Rods	• Intermediate	• Used as a raw material for electrical wiring and cables
	• Tubes	• Intermediate	• Used in plumbing, HVAC systems, & industrial heat exchangers

…uction, and precision

…s, and marine

…and circuit boards

…e, aerospace, and

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NON-EXHAUSTIVE PRELIMINARY

	Opportunity	Product Category	Description
6 Cobalt	• Cobalt metal / sulphate	• Intermediate	• Intermediate product used in industrial and battery end uses
	• NMC Batteries[1]	• End use	• Crucial for powering electric vehicles and portable devices
	• Superalloys	• End use	• High-performance, heat-resistant alloys, mainly for the

…urities

…d industrial processes

…rious other applications

… tiles, and bricks

…uction, etc.

…strial use cases

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NON-EXHAUSTIVE PRELIMINARY

	Opportunity	Product Category	Description
1 Gold	• Gold Bars	• End use	• 99.9% refined gold purchased by central and retail banks
	• Jewellery	• End use	• Refined gold purchased by individuals for beautification & value
2 REE's	• Rare earth metals	• Intermediate	• Intermediate products for permanent magnets
	• Permanent Magnets	• End use	• Critical input for electric vehicle motors
	• Catalysts	• End use	• Used in internal combustion engine car catalytic convertors
3 Iron	• Pig iron	• Intermediate	• A primary product of smelting iron ore in blast furnaces.
	• Iron Castings	• End use	• Intermediate form, used in automotive industry, construction, etc.
	• Steel	• End use	• Used in construction, infrastructure, manufacturing, and others
4 Nickel	• Nickel metal and sulphate	• Intermediate	• Intermediate product used in alloys, batteries, electroplating, etc.
	• NiMH and NCA Batteries[1]	• Intermediate	• Crucial for powering electric vehicles and portable electronic devices
	• Stainless steel	• End use	• Widely used in construction and manufacturing
5 Graphite	• Spherical Graphite (Coated / Uncoated)	• Intermediate	• Intermediate product used in anode material
	• Lithium-ion Batteries	• Intermediate	• Crucial for powering electric vehicles and portable electronics
	• Refractories	• End use	• Heat resistant components used in manufacturing
	• Foundries	• End use	• Industrial facilities where metals are melted and poured into molds
	• Lubricants	• End use	• Used to reduce friction primarily in manufacturing & automotive use cases

1. Nickel-metal hydride (NiMH) and Nickel-cobalt-aluminum (NCA) batteries

Source: Expert input, press search, industry reports

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2. Then, we utilized a set of criteria to assess the long-list of value addition opportunities

Sample assessment criteria used for graphite opportunities

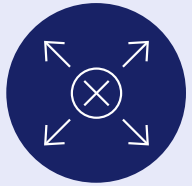
Assessment criteria		High / Favourable	Medium / Moderate	Low / Unfavourable
Market dynamics	**Demand**	• > $100 B Market Size Globally / • > $100 M Market Size in EAC (includes local demand)	• $1 - $99 B Market Size Globally / • $50 - $100 M Market Size in EAC (includes local demand) / • Projected decline in demand	• < $1 B Market Size Globally / • < $50 M Market Size in EAC (includes local demand) / • Tied to adjacent market
	Supply	• Local production already exists • Current or projected undersupply	• There are plans to develop local production with reasonable feasibility of execution • Some mismatch between supply and demand	• There is current or planned local production • Current or projected oversupply
Competitive landscape		• Highly fragmented market with top players controlling <5% of the market	• Fairly competitive market with top players controlling 5-40% of market	• Consolidated market with top players controlling >40% of market
Share of priority mineral		• >50%	• 30-49%	• <30%
Availability of inputs	**Raw materials**	• >70% of other raw materials required in production process are locally available	• 50 – 70% of other raw materials required in production process are locally available	• <50% of other raw materials required in production process are locally available
	Energy	• Does not require additional transmission capacity	• Requires additional transmission capacity but it can be supplied with existing infrastructure	• Requires new energy infrastructure (e.g., power plants, distribution networks, etc.)
	Capabilities or skills	• Relevant skill sets are available locally or can be developed easily	• Relevant skill sets are available regionally or can be developed with moderate effort	• Relevant skill sets are available globally or are very difficult to develop
	Physical Infrastructure	• No infrastructure changes required	• Infrastructure improvements could unlock efficiencies	• Current infrastructure network is a blocker
	Technology (IP)	• IP is limited or widely available	• IP can be accessed with moderate effort	• High IP and specialization
Policy and regulatory landscape		• Regulation in Tanzania is more favourable vs. other current or planned producers	• Regulatory landscape is at par with other current or planned producers	• Regulation makes Tanzania completely unfavourable versus other current or planned producers

2. We mapped the opportunities across three time horizons based on the readiness and initiatives required for realization

Our focus

Time horizons		Horizon 1 **Short/near term** (1 – 3 yrs.)	Horizon 2 **Medium term** (3 – 7 yrs.)	Horizon 3 **Long term** (7+ yrs.)
Value addition opportunities	*Minerals*	**Currently produced** or planned production will **become operational in the next 3 years**	**Clear planned projects** in development with probability of becoming operational **in 3 – 7 years**	**Currently limited to no production** but significant reserves that can be developed
	Demand	**Strong and growing near term domestic/regional demand** (EAC), e.g., import substitution	**Growing/sustained demand** locally, regionally, or globally and **opportunity for new suppliers** to enter the market	Significant **global supply deficit projected with long-term sustained demand**
	Other inputs	Required **infrastructure, technology, capabilities**, etc. **exist or can easily be built**	All other inputs **can be accessed in country/region** or **can be produced in the next 3-7 years**	Significant **time and investment required** to put in place necessary infrastructure, capabilities, tech, etc.

3. We identified actions and unlocks on two-levels



A Cross-cutting

High level interventions that can **support and accelerate the achievement of several value addition opportunities**

B Archetype specific

Targeted solutions to **address the unique challenges within a specific archetype** or opportunity

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Initial list of priority minerals for value addition

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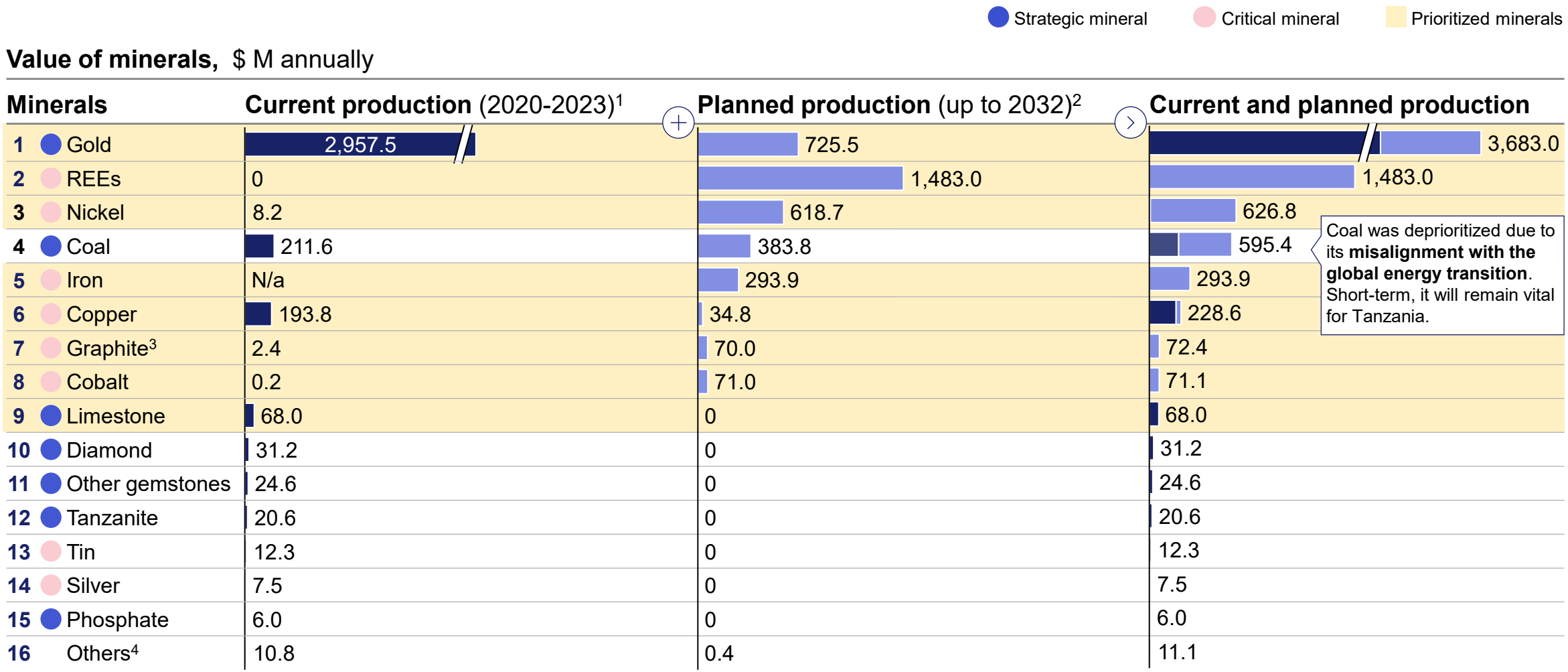
Minerals that are **major inputs** into **top imported products** across both domestic & regional markets

Approach

- Identify **Tanzania’s top imports**, which are **mineral-based** and could **potentially be produced in Tanzania**
- Assess if **similar products** are also demanded in the **region (overlay EAC demand)**
- **Identify minerals used as major** (and minor) **inputs** for producing these products

1. “Supply-driven”: 6 critical and 2 strategic minerals emerge as priority minerals for value addition based on current and planned production



1. Current production reflects the latest available production data from the mining commission. | 2. Planned production is based on public project announcements. The data does not reflect a judgement on whether the project will be realized in time and/ or at planned capacity. | 3. Future graphite production may be higher, since there are >6 planned projects, however, exact value is yet to be confirmed | 4. Zircon ($4.8M), Salt ($2.4M), Ilmenite ($1.9M), Gypsum ($0.9M), Bauxite ($0.8M), Lead ($0.14M), Manganese ($0.07M), Feldspar ($0.01M), Dolomite ($2.3k)

Source: Mining Commission annual report 2022, Tanzania Diamond production annually 2023, USGS: Tanzania 2020-21 annual tables, press search

1. “Demand-driven”: The top three regional imports have potential value of ~$6.9B p.a. indicating relevant opportunity for value addition

Tanzania Kenya Uganda DRC Rwanda Burundi Somalia South Sudan Prioritized minerals

Value in 2023, $ M

Commodity groups	Tanzania	Other EAC countries	All EAC	Relevant minerals
1 Iron and steel	775	2,163	2,938	Iron, Coal[1], and Nickel
2 Articles of iron or steel	477	2,203	2,680	Iron, Coal[1], and Nickel
3 Fertilizers	458	760	1,218	Phosphate, Potash
4 Aluminium	181	268	449	Bauxite
5 Inorganic chemicals, precious metal compound, isotope	160	741	901	Gold, silver & Palladium
6 Lubricants, waxes, candles, soaps and others	93	337	430	Graphite
7 Ceramic products	70	314	384	Kaolin and Clay
8 Miscellaneous articles of base metal	45	166	211	Copper, Zinc, Tin and Lead
9 Copper	46	97	143	Copper ore/concentrate
10 Cement, stone, plaster, asbestos, or similar materials	24	104	128	Limestone, Kaolin and Clay
Total	2,329	7,153	9,482	

- **Regionally** (EAC including Tanzania)**, the top 3 imported mineral-based products could present opportunities of ~$6.9 B**
- **Minerals associated with the top 3 imported** products **are considered further analysis**

1. Excluded due to misalignment with energy transition

Source: Trading Economics, Trade Map

1. Based on the combined pull-push approach, we identified an initial list of 11 priority minerals with the highest potential for value addition

Supply driven Demand driven

A Push 'Supply-driven'

Minerals with **current or planned (near term) production in Tanzania**

Gold	**Graphite**
REEs	**Copper**
Nickel	**Cobalt**
Iron	**Limestone**

Initial list of priority minerals for value addition

1. Gold
2. REEs
3. Iron
4. Nickel
5. Graphite
6. Copper
7. Cobalt
8. Limestone
9. Phosphate
10. Potash
11. Synergistic minerals[1]

B Pull 'Demand-Driven'

Minerals that are major inputs into top imported products (across both domestic and regional markets)

- **Potash**
- **Synergistic minerals** (Kaolin, Felspar, Pozzolana, Gypsum, Dolomite, etc.)[1]
- **Iron**
- **Nickel**
- **Phosphate**

1. Minerals that can typically be combined to produce similar products. These minerals are kaolin, feldspar, silica, pozzolana, gypsum, and dolomite. They can be used to produce cement, ceramics, glass, etc.

2. We developed a long list of more than 30 opportunities across 11 priority minerals (1/3)

NON-EXHAUSTIVE

	Opportunity	Description
1 **Gold**	• Gold Bars	• 99.9% refined gold purchased by central and retail banks
	• Jewellery	• Refined gold purchased by individuals for store of value and beautification
2 **REE's**	• Permanent Magnets	• Critical input for electric vehicle motors
	• Rare earth metals	• Intermediary products for permanent magnets
	• Catalysts	• Used in ICE cars catalytic convertors
3 **Iron**	• Steel	• Used in construction, infrastructure, manufacturing, and others
4 **Nickel**	• Nickel metal and sulphate	• Intermediary product used in end uses
	• NiMH and NCA Batteries[1]	• Crucial for powering electric vehicles and portable electronic devices
	• Stainless steel	• Widely used in construction and manufacturing
5 **Graphite**	• Spherical Graphite (Coated / Uncoated)	• Intermediary product used in anode material
	• Lithium-ion Batteries	• Crucial for powering electric vehicles
	• Refractories	• Heat resistant components used in manufacturing
	• Foundries	• Industrial facilities where metals are melted and poured into molds
	• Lubricants	• Used to reduce friction primarily in manufacturing & automotive use cases

1. Nickel-metal hydride (NiMH) and Nickel-cobalt-aluminum (NCA) batteries

2. We developed a long list of more than 30 opportunities across 11 priority minerals (2/3)

NON-EXHAUSTIVE

	Opportunity	Description
6 **Cobalt**	• Cobalt metal / sulphate	• Intermediary product used in industrial and battery end uses
	• NMC Batteries[1]	• Crucial for powering electric vehicles and portable devices
	• Superalloys	• High-performance, heat-resistant alloys, mainly for the aerospace industry.
7 **Phosphate**	• Triple Superphosphate (TSP)	• Fertilizer made with phosphoric acid
	• Single Superphosphate (SSP)	• Fertilizer made with sulfuric acid
	• Monoammonium phosphate (MAP)	• Fertilizer made with ammonia
	• Diammonium phosphate (DAP)	• Fertilizer made with ammonia
	• Nitrogen Phosphorus Potassium (NPK)	• Fertilizer made with ammonia
8 **Potash**	• Sulphate of Potash	• Fertilizer made with sulfuric acid
	• NPK compounds[2]	• Fertilizer made with ammonia
9 **Limestone & synergistic minerals** 10	• Cement	• Used in construction and other industrial use cases
	• Glass	• Used for bottling, packaging, construction and more
	• Pulp & Paper	• Used for writing, printing, packaging, and various industrial applications.
	• Ceramics	• Used to create products like pottery, tiles, and bricks
	• Lime	• Used in construction, agriculture, and industrial processes
	• Flux	• Used in iron smelting to remove impurities

1. Nickel - Magnesium - Cobalt batteries
2. Nitrogen Phosphorus Potassium (NPK) compounds

2. We developed a long list of more than 30 opportunities across 11 priority minerals (3/3)

NON-EXHAUSTIVE

	Opportunity	Description
11 **Copper**	• Copper anode	• Has 98% copper concentration, end-product of smelting
	• Copper cathode	• Has 99.9% copper concentration, end-product of electro-refining
	• Wire rods	• Used primarily for electrical applications
	• Copper tubes	• Used primarily in plumbing, HVAC systems, and industrial uses
	• Copper bars	• Used in construction and manufacturing
	• Copper plates and sheets	• Used in roofing, cladding, and industrial applications

1. Nickel - Magnesium - Cobalt batteries
2. Nitrogen Phosphorus Potassium (NPK) compounds

2. 14 value-addition opportunities that could potentially create value of ~$7.2–11.7B annually were prioritized based on economic viability

xx **($, M)** Estimated annual value to be captured from the opportunity, per annum

	Horizon 1	Horizon 2	Horizon 3
Time horizons	**Short/near term** (1–3 yrs.)	**Medium term** (3–7 yrs.)	**Long term** (7+ yrs.)
Value-addition opportunities	**1. Jewellery** (End use) ~1,000-1,500	**6. Gold Bars** (End use) ~3,000-6,000	
	2. Cement (Limestone + synergistic minerals[1] end use) ~130-160	**7. DAP** (Phosphate end use) ~67-95	
	3. Ceramics (Limestone + synergistic minerals[1] end use) ~310-370	**8. NPK** (Phosphate + Potash end use) ~65-90	
	4. Glass (Limestone + synergistic minerals[1] end use) ~220-250	**9. Spherical Graphite** (Intermediate use) ~400-650	
	5. Paper and pulp (Limestone + synergistic minerals[1] end use) ~140-190	**10. REE (Nd-Pr) metals** - (Intermediate use) ~320-400	
		11. Finished steel products[2] (End use) ~660-1,000	
		12. Nickel sulphate / nickel metal (Intermediate use) ~510-580	
		13. Cobalt sulphate/cobalt metal (Intermediate use) ~50-80	
		14. Copper cathode / wire (Intermediate use)[3] ~340-360	
Total value	~$1.8-2.5B p.a.	~$5.4-9.2B p.a.	
Estimated direct jobs[4]	~12k-16k	~6k-9k	

Currently, there is a significant oversupply of nickel and cobalt in the market, however, we assume it will resolve in the medium term

In the long term, Tanzania could unlock additional mineral value-addition opportunities. This is subject to favourable market dynamics and scaled production of required minerals

Minerals Tanzania could explore long-term value-addition opportunities, which include:

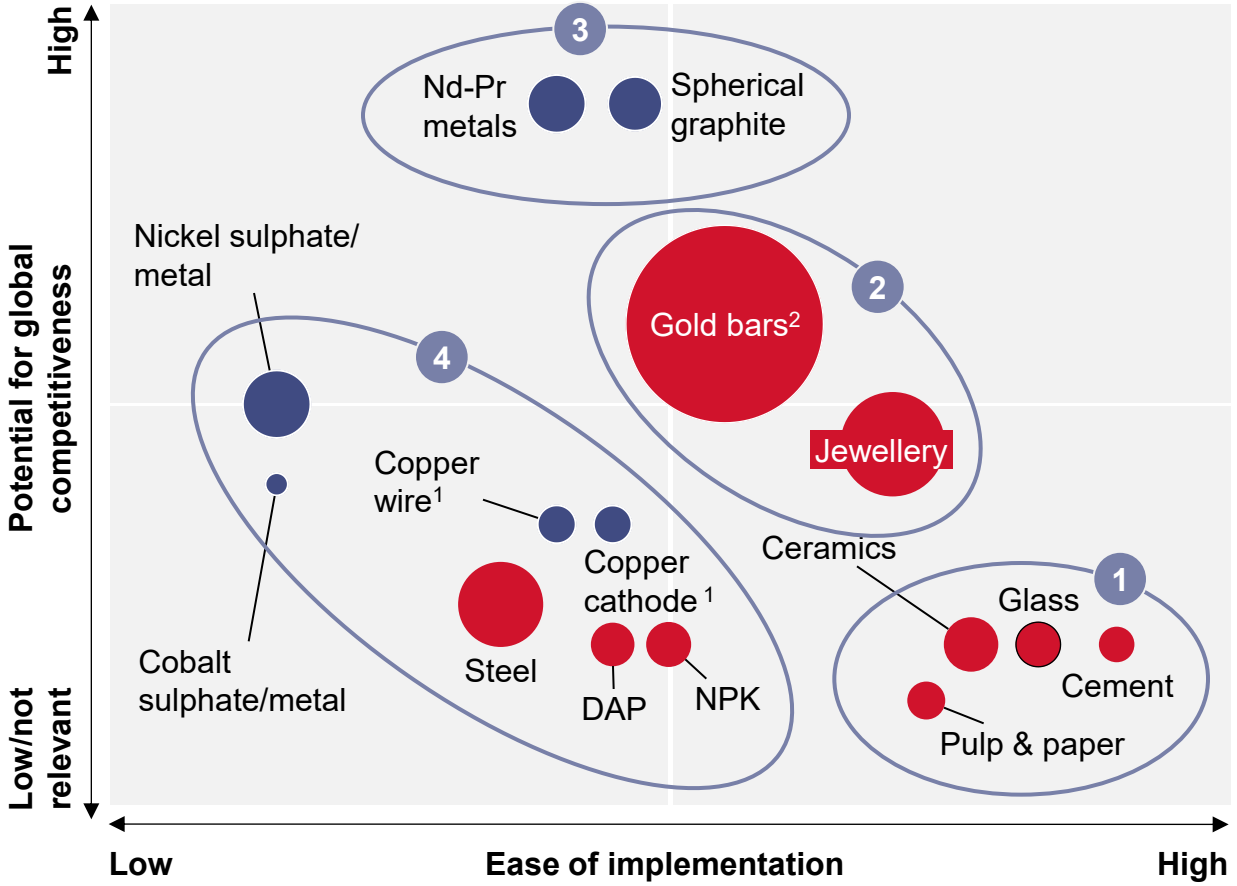
- *Bauxite* – Tanzania has some bauxite reserves, and aluminium is the 4th highest-value mineral-based import for the country
- *Lithium* – there are exploration activities and beneficiation regulations in place

1. These include kaolin, gypsum, dolomite, pozzolana, silica/quartz, feldspar and clay | 2. Hot rolled coils and plates | 3. Value addition opportunities associated with copper are assumed to be realized at the Kahama processing facilities which is tied to the Kabanga nickel opportunity | 4.Conservative bottom-up estimate, economic statistics suggest 0.3% job creation for every 1% GDP growth which would imply 100,000 additional jobs

2. Mapping these opportunities reveals four distinct archetypes that can present unique options for growth and investment

Potential value of opportunity ($) | Strategic mineral | Critical mineral

Value addition opportunities archetypes



Archetypes	Characteristics
1 Low hanging fruits	**Existing or easy-to-set-up opportunities** that will enable Tanzania to become self-sufficient and grow into a regional player
2 No Regrets	High-value opportunities that could **capitalize on existing capabilities and efforts**
3 Big Bets	Opportunities which **could make Tanzania a relevant global player in the energy transition by transforming its high-quality and abundant minerals** into highly demanded intermediate products
4 Opportunistic plays	Opportunities that **require local or global supply-demand dynamics** to improve before being pursued[1]

1.Value addition opportunities associated with copper are assumed to be realized at the Kahama processing facilities which is tied to the Kabanga nickel opportunity | 2. Note that opportunities in gold bars may not be viable in the short term

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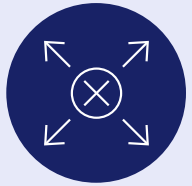
3. We identified actions/unlocks on two-levels

Details follow



A Cross-cutting

High level interventions that can **support and accelerate the achievement of several value addition opportunities**

B Archetype specific

Targeted solutions to **address the unique challenges within a specific archetype** or opportunity

Unlocks focus on actions that can be taken by public sector players. List is therefore inherently non-exhaustive.

3A. 6 cross-cutting unlocks/actions would be required to realize these value addition opportunities

Deep dive follows

Availability of minerals

Develop a strategy for each mineral ensuring scaled upstream production

Access to capital

Develop initiatives to improve investment attractiveness and mobilize funding

Policy and regulation

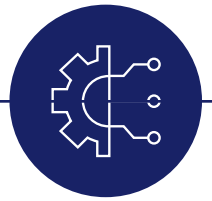
Develop a cohesive regulatory framework that provides clear and stable guidance

Global Partnerships

Encourage the formation of partnerships with global value chain players to unlock IP/tech transfer and secure demand

Capabilities

Develop a comprehensive workforce plan to ensure local talent development is aligned with skillsets demanded in the future



Infrastructure

Invest in key transport networks and expand energy transmission and distribution

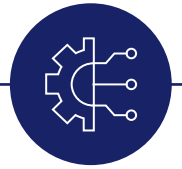
3A. Developing partnerships with local and global players will be essential for unlocking the value addition opportunities

Infrastructure Development Partnerships

- Collaborate with **integrated mining companies and manufacturers to identify infrastructure needs** to unlock local value addition
- **Build private public partnerships** to unlock and accelerate **construction of required infrastructure**

Investment Attraction Partnerships

- Establish regular exchange with **businesses, investors, industry associations and others** to identify key regulatory barriers to investments and paths to alleviate those
- Collaborate with **global investors and DFIs to develop financial products** to derisk investments



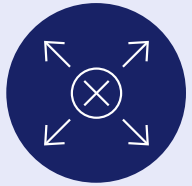
IP & Capabilities Partnerships

- Partner with global players to gain **access to critical IP**
- Develop partnerships with global research institutes and service companies to **expedite knowledge exchange**
- Collaborate with key industry players and local educational institutions to **develop tailored educational programs**

Regional Partnerships

- Engage with neighboring countries to **secure supply of input materials** required for local value addition that are unavailable in Tanzania and to explore **bi-lateral opportunities** to harvest **benefits across synergistic industries**

3. We identified actions and unlocks on two-levels



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High level interventions that can **support and accelerate the achievement of several value addition opportunities**

Details follow

B Archetype specific

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3B. Low hanging fruits: Opportunities can be unlocked by scaling & aligning production to domestic and regional demand

Overview

4 value addition opportunities associated with 2 priority minerals (limestone and synergistic minerals[1])

- **Cement**: Used in construction and demand is driven by infrastructure growth

  $130-160M
- **Ceramics**: Used in tiles, sanitaryware, and households and demand is driven by urbanization

  $310-370M
- **Glass**: Supports beverage packaging, construction, etc. and driven by manufacturing growth and consumer markets

  $220-250M
- **Paper & Pulp**: Serves packaging and printing needs driven by consumer markets

  $140-190M

Actions and unlocks required to realize these opportunities:

1. **Monitor and address unmet local and regional demand:**
   - Conduct **regular market analysis** to scale capacity based on growth in demand

2. **Leverage regulation to promote the production of low-hanging fruit opportunities and achieve full import substitution, while exploring lower carbon footprint pathways:**
   - For example, offer incentives (e.g., tax breaks and subsidies) for local cement players that will use pozzolana and kaolin instead of cement clinker. These minerals are 20% cheaper and have lower carbon footprints

3. **Support local players to become regional suppliers by improving their cost competitiveness:**
   - Optimize local supply chains and trade policies to improve operational efficiency
   - Continue investing in infrastructure improvements, focusing on expanding rail and road networks, to reduce costs and become a relevant alternative supplier in the region

3B. No-regrets: Tanzania could build on its strong gold production to unlock ~$4 - 7.5B annual value

Overview

2 value addition opportunities associated with gold:

- **Gold bars:** 99.9% refined gold, mostly from LBMA[1]-certified refineries, sold to central and retail banks globally as a stable form of value storage

  $3-6B

- **Jewellery:** Refined and reshaped gold used for beautification and storing value

  $1-1.5B

Actions and unlocks required to realize these opportunities:

1. **Increase local and regional financing solutions to increase the availability of gold for local value addition:**
   - Develop additional local financing and offtake solutions for small-scale gold miners as an alternative for prevalent offtake financing arrangements from foreign investors (currently predominantly from the Middle East)

2. **Identify opportunities for linkages with gemstone and tourism industries** to boost local demand for jewellery
   - This could also create an opportunity to support youth and women who are a large segment of jewellery and gemstone sectors globally

3. **Continue to support local refineries to secure LBMA certification** as a national priority to provide a viable option for large-scale local and regional miners seeking to supply central banks
   - Maintain and build on initiatives (both incentives and requirements) for miners supplying local refineries to accelerate the LBMA certification process and increase the production of gold bars

1. The London Bullion Market Association

3B. Big-bets: These opportunities could position Tanzania as a relevant player in the global energy transition, but require targeted actions across three areas

Overview

Spherical graphite and Nd-Pr metals (REE metals) present an opportunity for **Tanzania to become a relevant player in the global energy transition**

- **Spherical graphite:** Critical for making lithium-ion batteries, which are used in EVs and stationary energy storage

  $400-650M

- **Neodymium (Nd) and Praseodymium (Pr) metals:** Essential for high-performance magnets in EV motors and wind turbines

  $320-400M

Actions and unlocks required to realize these opportunities:

1. **Develop a targeted national strategy for graphite and REE (Nd-Pr) value chains:**
   - Develop a mineral specific strategy to grow the respective ecosystems, including linking upstream and downstream players, workforce development plans, identifying global partners, etc.
   - There is also opportunity to adjust policies to increase ease of doing business in line with peer countries.

2. **Expand Special Economic Zone (SEZ) coverage to ensure that the most competitive REE and graphite value addition opportunities can benefit from them**
   - This is particularly important for rare earth element (REE) opportunity whose upstream operations are located far from existing SEZs, but benefit from vertical integration into the mine

3. **Engage global players in big-bet opportunities to proactively shape Tanzania's role in the global value chain:**
   - Support private sector players to establish partnerships with technology players and raise capital by building on existing investor attraction programs, e.g., investor roadshows, market reports, investor summits, etc.
   - Develop a national standard for key mineral value chains to ensure global competitiveness as supply chains become more diverse within Tanzania

3B. Opportunistic plays: Opportunities could offer value of $1.3-1.8B, contingent on improvements in market dynamics and ease of implementation

Overview

5 main value addition opportunities :

- **NPK/DAP fertilizers:** Fertilizers based on phosphorus and potassium for overall plant growth
  $130 - 190M
- **Finished steel products:** Used in construction, manufacturing, and infrastructure
  $600M – 1B
- **Nickel sulfate/metal:** Nickel sulfate is used in EV battery cathodes, nickel metal is essential for stainless steel and high-strength alloys
  $510 - 580M
- **Cobalt sulfate/metal:** Cobalt sulfate is used in EV batteries, cobalt metal is used in superalloys and other applications
  $50-80M
- **Copper cathode/wire**: Used in electrical grids, electronics, etc.
  $340-360M

Actions and unlocks required to realize these opportunities:

Fertilizers and Steel

1. **Accelerate scaled production of priority minerals:**
   - Grow local phosphate and iron ore production by working with existing players to scale or attract new investment
   - Encourage exploration activities for phosphate, potash and iron ore to ensure there is a sustained scaled production of these minerals
   - Partner regionally to secure potash, if local availability of mineral remains limited
2. **Support the growth of industries that could supply critical inputs for value-addition**
   - E.g., grow availability of local sulfuric acid from smelters and ammonia from gas projects for fertilizers
3. **Accelerate expansion of the transport network** to enable efficient delivery of raw materials and finished goods

Nickel, Cobalt, and Copper

1. **Monitor global markets to inform the timing of investment** in nickel, cobalt, and copper mining as well as value-addition opportunities
2. **Identify potential niche markets** where Tanzania can still play, especially given Tanzania has one of the largest and highest quality nickel and cobalt resources globally

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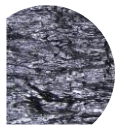
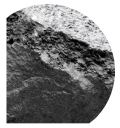
Executive summary: Investment opportunities in mineral value addition have the potential to generate between $7.2-11.7B in annual value (1/4)

Mineral	Opportunity		Description
Gold 	Jewellery	**$1,000-1,500M**	• Globally, **~90% of gold is used for gold bars and jewellery** with demand growing at 1.9% p.a. • Tanzania produces **~56 tonnes of gold annually** with ample refining capacity • **Jewellery capabilities** are **easy to develop** while **gold bar production** requires unblock through **LBMA certification** – one refinery in Tanzania is in the process of obtaining the LBMA certification • Opportunity to **invest in development of new plant** for jewellery and/or invest in **scale up of refineries**
	Gold bars	**$3-6M**	
Limestone 	Ceramics	**$310-370M**	• East African countries import >$1.4B of limestone products with paper & pulp ($700M), ceramics ($315M), glass (~$230M) and cement (~120M) being significant contributors • **Ceramics, glass and cement** have **existing production**, but there is for **scale up to substitute imports** and **expand into regional markets** • **Paper & pulp** is **currently not produced** in Tanzania, but Tanzania has the **required input materials**, including timber, and capabilities to begin production • The opportunities are associated with a **strong business case**: 200ktonnes/yr glass or ceramics manufacturing plants would have **10-15% IRR** and **~30% operating margin**[1] • Unlocking these opportunities would require **scaling existing capacity** and **optimizing logistics and supply chains to be regionally competitive**
	Glass	**$220-250M**	
	Paper & Pulp	**$140-190M**	
	Cement	**$130-160M**	
Graphite 	Spherical graphite	**$400-650M**	• Despite having **28% of global graphite reserves**, China currently produces **>75% of graphite** (1.2M tonnes). • **>1M tonnes planned production capacity** in other geographies will **drive geographic diversification**. • **Tanzania's planned projects** with >300,000 tonnes capacity could make Tanzania to a **top 3 global producer** • Establishing a 50ktpa processing facility requires **>$350M investment against** an expected **21% IRR and ~4-year payback period**[1] • **Investment opportunity** due to **large as well as high quality reserves** – but success will depend on implementation of mining projects and **global partnerships to gain access to finance and know-how**

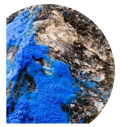
1. Assumptions detailed in business case

Executive summary: Investment opportunities in mineral value addition have the potential to generate between $7.2-11.7B in annual value (2/4)

Mineral	Opportunity		Description
Rare Earth Elements 	Nd-Pr Metals	**$320-400M**	• **Demand for Nd-Pr metals** has been growing at **14% p.a.** between 2020 and 2025 • ~70% of global production is from China, but **Tanzania holds 9% of global reserves** • Nd-Pr metals are an attractive opportunity in Tanzania driven by the **volume and quality** of the reserves. The planned Ngualla projects has **37.2K tonnes planned production** (9% of today's global annual production) • Establishing a 3.6ktpa processing plant would **require >$460M capex investment** and could generate a **20-25% IRR** with a **~40% operating margin** [1] • However, global partnerships will be required to unlock intellectual property.
Phosphate & Potash 	DAP[2]	**$67-95M**	• **Tanzania imports ~95% of its fertilizer** with DAP and NPK accounting for ~40% • There is **potential to scale production of DAP and NPK fertilizers** to meet local and regional demand driven by the availability of phosphate, high local and regional demand and availability of capabilities (e.g., labour, technology) • However, Tanzania would need to **scaled production of potash** and other input materials like ammonia and potassium chloride • Investing in a 200ktpa processing plant would require **>$210Mm capex investment** and generate **10-15% IRR** based on a **~38% operating margin**[1]
	NPK[3]	**$65-90M**	
Nickel 	Nickel Sulphate / Metal	**$510-580M**	• Nickel **demand is expected to increase at 5% p.a., through 2035 mainly driven by significant growth in batteries**, with slowdown expected beyond 2035 at 1% p.a. growth, due to high recycling rates and shifts away from nickel-based cell chemistries • Currently, nickel is **mainly used for stainless steel** (~56%), but a shift to EV batteries is expected • Rapidly ramped up production in refined nickel in the last year has led to an **oversupply that could last years, mainly driven** by production capacities in Indonesia • There is potential to produce **Nickel metal or nickel sulfate in Tanzania** with the planned **integrated Kabanga mine and Kahama refinery** which are planned to start production **from 2026.** Experts, however, suggest this **may be delayed** due to market dynamics • While this opportunity can be promising, current market dynamics create significant uncertainty and associated risks

1. Assumptions detailed in business case 2. Di-ammonium phosphate 3. Nitrogen-Phosphorus-Potassium fertilizer

Executive summary: Investment opportunities in mineral value addition have the potential to generate between $7.2-11.7B in annual value (3/4)

Mineral	Opportunity		Description
Cobalt 	Cobalt sulphate / metal	$310-370M	• **Demand for cobalt is expected to increase** driven by electric vehicle adoption which is currently 45% of demand • However, there is a **shift away from cobalt-based** to other cobalt free cell chemistries (e.g., LFP) driven by **technological advancements**, **traceability and ESG concerns** as well as it's **role in geopolitical disputes** • **Cobalt ore supply is highly consolidated** with the DRC producing 76% of cobalt and Indonesia producing 10%. 80% of refining is done in China. • The market is currently **oversupplied** due to **ramp up in production** from the DRC and Indonesia, **slower than expected EV uptake** and availability of **end-of-life batteries for recycling** • Tanzania **does not yet produce cobalt**, but the Kabanga Nickel Mine is set to produce up to 2,500 tonnes of cobalt per year which would make it the **12th largest Cobalt producer** contributing 0.9% of global supply • An **integrated refinery**, Kahama Refinery, has received **licensing for cobalt metal** which would enable local downstream processing. However, the refinery is expected to mainly refine nickel creating a **dependency on the evolution of the nickel market**
Copper 	Copper cathode / wire	$400-650M	• Copper demand is expected to grow at ~2.6% p.a. reaching 37M tonnes by 2035. China is the largest producer and consumer of refined copper and drives the global market • **Global demand** growth for copper is driven by the **increasing need for copper in modern applications** (e.g., batteries, energy infrastructure) • Tanzania **currently produces** 30,000 tonnes of **copper concentrates** from gold mines, but has no downstream processing • Tanzania **imports almost all semi-finished and end-products of copper**, with 80% of the products being copper wire • **Copper wire and cathode** emerge as **feasible value addition opportunities** driven by the potential for import substitution and the feasibility of production. • Copper refining requires **significant scale with >100,000 tonnes** to enable cost competitive production – 3x higher volumes compared to today's copper concentrates production. • There is potential to partner with Kabanga nickel project (Kahama refinery) to refine copper using its technology as well as facilities, and thereby ensuring sufficient scale

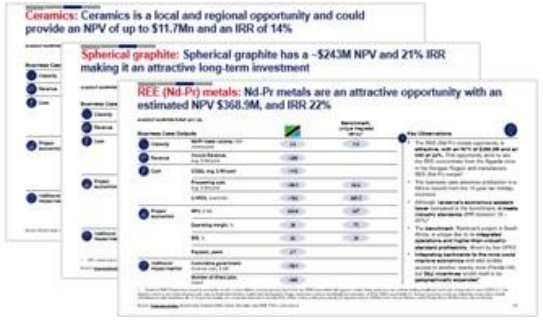
Executive summary: Investment opportunities in mineral value addition have the potential to generate between $7.2-11.7B in annual value (4/4)

Mineral	Opportunity		Description
Iron 	Finished Steel Products	**$660-1,000M**	• **Global iron ore demand is expected decrease by -0.1%** p.a. driven by a decrease in demand in China and a slow down in construction due to economic downturns globally • Tanzania's iron ore value chain is mostly focused on iron ore mining with a few players producing finished steel from imported billets or scrap • **Iron ore production** in Tanzania has **grown rapidly at ~40%, 2019-23 to reach ~67,000 tonnes,** but remains a small fraction of the world's production • Tanzania has **significant reserves (126 M tonnes)** in Ludewa district with plans to utilize it through the **Liganga and Mchuchuma integrated project** which includes **2.9 tonnes/yr of iron ore** and **1.1 M tonnes/yr finished steel production** • However, the **project has been delayed since 2011** due various reasons including financing and infrastructure development limitations • **Final steel products (hot rolled coil and hot rolled plates)** are identified as value addition opportunities for iron ore driven by potential for import substitution worth ~$**775 M.** • However, there are a few required unlocks to make this opportunity feasible, including additional financing, development of transport and energy infrastructure and capability building

Overview of the structure for the rest of the document – opportunity deep dives

HANDOUT INVESTOR EVENT (MAY 20)

Market context	Prioritization of value addition opportunities	Opportunity business cases	Required unlocks
Overview of key global and regional trends on the specific mineral's demand and supply	Assessment of mineral specific value addition opportunities and prioritization of most viable ones	Detailed business case for each prioritized value addition opportunity (incl. assumptions)	Outline of required actions and unlocks to realize the respective opportunities



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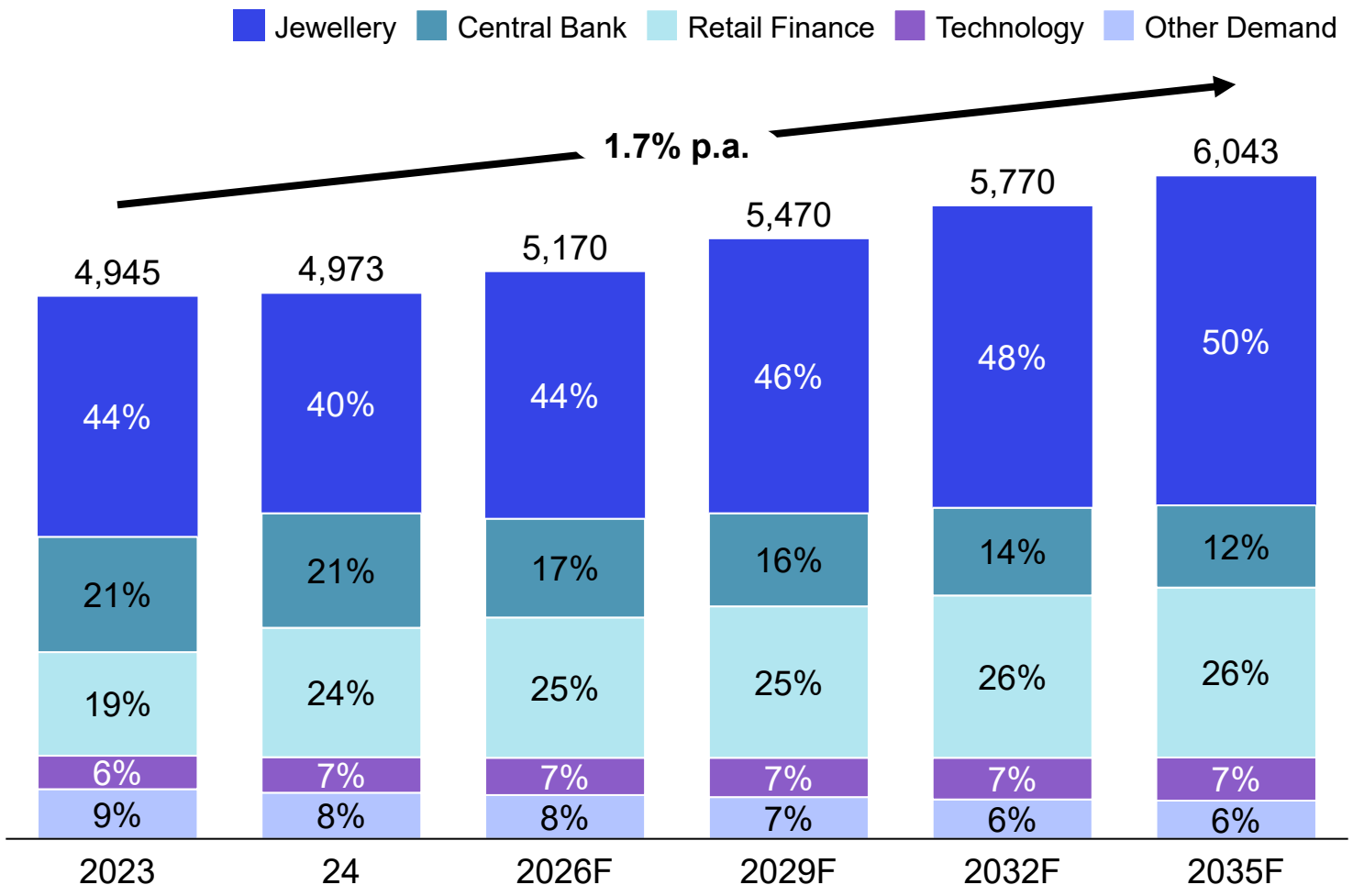
Demand for gold is driven by jewellery and financial uses which are expected to grow

Gold demand by segment, tonnes



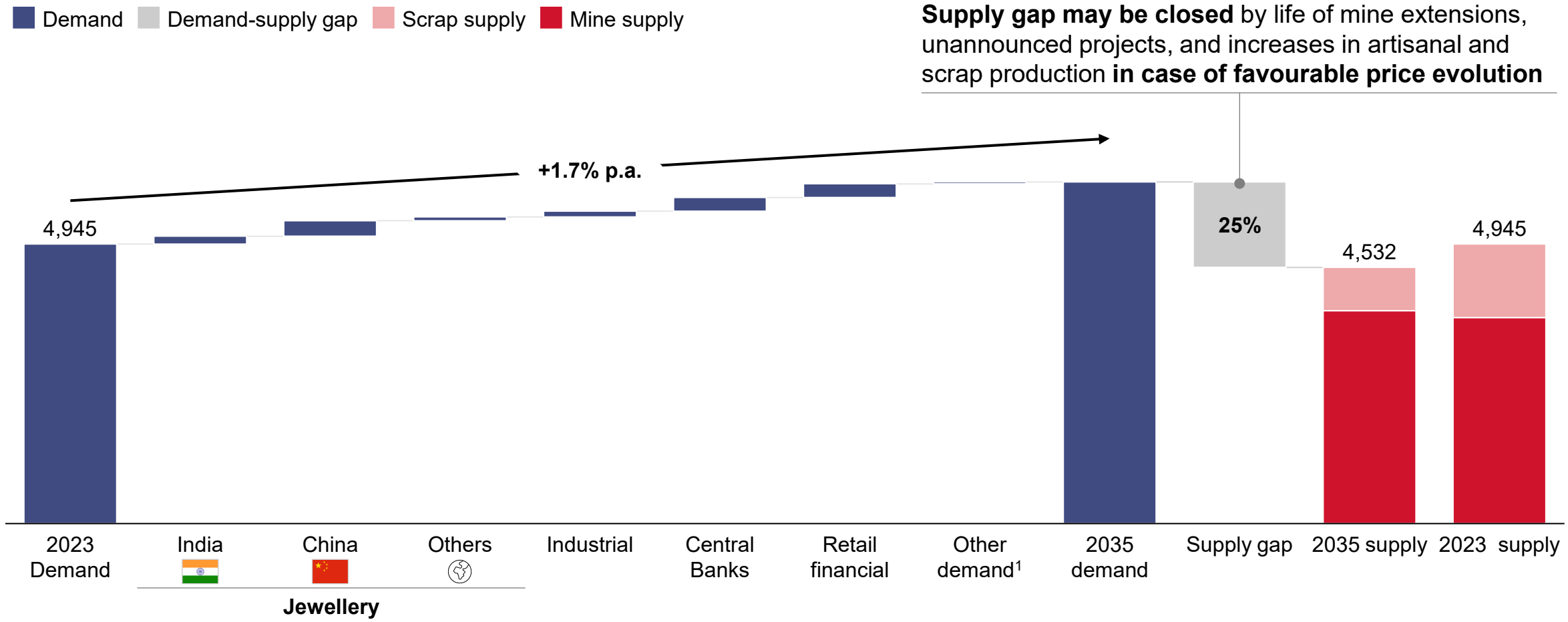
Source: World Gold Council, World Economic Forum, Invesco

Key insights

- Demand for Jewellery will grow by 37% between 2023 and 2035
- While central banks will remain net purchasers through to 2035, the rate of buying is projected to slow driven by increasing prices driven by undersupply
- Retail banks, however, will increase purchasing driven by geopolitical uncertainty, particularly in the short term
- Technology use cases will remain flat, particularly driven by smartphone applications

The gold market is anticipated to experience ~25% gap in supply by 2035 making locally integrated gold production strategically advantageous

Gold demand and supply, 2023-35, in tonnes



1. Includes: Over-the-counter market (OTC) representing unreported direct transactions

Source: MineSpans, World Gold Council

Tanzania has built a strong upstream gold sector that provides a foundation for local value addition

Overview of Tanzania's upstream gold sector

~56
tonnes produced annually

~1.5%
of global output

~2,222
tonnes of reserves

~1M
small scale miners

Key initiatives to strengthen upstream and encourage downstream activities

1. **Mining for Better Tomorrow (MBT)**

   Capability development strategy that aims to ensure youth are involved and benefitting from the mining sector

2. **Incentives for local gold sales**

   Reduction of royalty fees (from 6% to 4%) and removal of inspection fees (typically 1%) and VAT

3. **Significant local gold refining capacity**

   5 active refineries with the capacity to process up to 450 tonnes of gold per year, nearly 50% of Africa's total gold production

Source: Tanzania Minerals Investment Guide, Tanzania Mining & Investment Conference Magazine 2024, UNEP

Two value addition opportunities for gold were identified for gold

	Gold bars	Jewellery
Opportunity	• Manufacture gold bars for sale to local and global central and retail banks • Central and retail banks are projected to remain net buyers of gold bars until 2035 • $3-6B annual revenue potential	• Manufacture unbranded gold jewellery for export • Jewellery is the fastest growing end-use gold product • $1-1.5B annual revenue potential
End uses (not exhaustive)	All ideantified opportunities are end use products	
Approach (not exhaustive)	• Invest in scale-up of refinery with LBMA certificate or one that is likely to obtain LBMA certificate	• Invest in development of mid to large scale jewellery manufacturing plant • Partner with existing regional or global manufacturer to expand production to Tanzania • Opportunity to leverage synergies with tourism and gemstone sectors which are advanced in Tanzania
Requirements (not exhaustive)	• Acquire LBMA certification • Finance working capital • Develop upstream supply and downstream distribution channels	• Establish processing plants • Build local capabilities • Develop upstream supply and downstream distribution channels

Gold and jewellery were assessed as viable due to strong competitive position and good fit to Tanzania's skills and infrastructure

Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		Gold Bars	Jewellery
Market dynamics	Demand	$110B global market driven by central banks and large financial institutions	$120B global market driven by China, India, US, UAE and Russia
	Supply	Plans are underway to establish a gold bar manufacturing sector, contingent upon receiving LBMA certification	There is a small-scale jewellery sector active, how-ever most players rely on imported gold. Increasing quantities of refined gold are becoming available
Competitive landscape		Fragmented market with no differentiation between certified gold	While branded jewellery is popular for luxury and premium segments, non-branded jewellery is >75% of global demand
Share of priority mineral		100%	
Availability of inputs	Raw materials	100%	
	Energy	High energy required for melting, however refineries are already operational	
	Capabilities or skills	Readily available	
	Physical Infrastructure	Transported by air primarily	
	Technology (IP)	None	
Policy and regulatory landscape		None	

Three unlocks can help accelerate the development of Tanzania's gold bar and jewellery sector

Details follow

Unlocks required to realize these opportunities:

1. **Increase local and regional financing solutions to increase the availability of gold for local value addition:**
   - Develop additional **local financing and offtake solutions for small-scale gold miners** as an alternative for prevalent offtake financing arrangements from foreign investors (currently predominantly from the Middle East)

2. **Identify opportunities for linkages with gemstone and tourism industries** to boost local demand for jewellery
   - This could also create an opportunity to support youth and women who are a large segment of jewellery and gemstone sectors globally

3. **Continue to support local refineries to secure LBMA certification** which is required for local refineries to supply gold bars to central banks as a national priority
   - **Maintain and build on initiatives** to accelerate the LBMA certification process and increase the production of gold bars

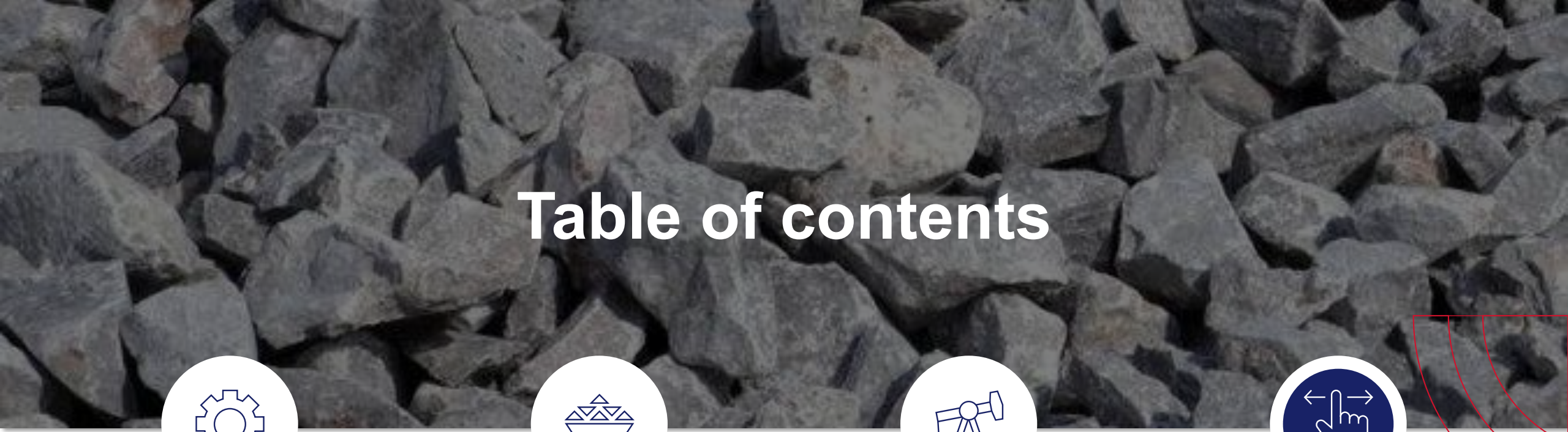
Deep dive - LBMA: Geita Gold Refinery is Tanzania's front-running refinery for LBMA certification

Front-runner | Not Achievable | In Progress | Completed

Application criteria	Geita Gold Refinery	Mwanza Precious Metals Refinery Co. Ltd.	Banjul Li	SGL SAB Gold Limited	
1 An established annual refining production (which need not be in the form of standard bars) of not less than **10 tonnes of gold**, with a minimum requirement of 3-5 tonnes in year 1, 5-10 tonnes in year 2, and 10 tonnes in year 3	✓	✓	✗	✗	✗
	Currently processing <10 tonnes annually		Currently, do not have capacity to refine 10 tonnes		
2 Been in existence for at **least five years** and been refining the metal for which you are applying for Good Delivery status for **not less than three years**	✓	✓	Criteria not assessed, due to limited production capacity which is already making the refiners an ineligible for the LBMA certification.		
	Will meet requirement in 2026				
3 Ownership, financial standing and reputation that would satisfy the **Due Diligence** tests practiced in the Loco London Market	✓	✓			
4 A tangible net worth of not less than the equivalent of **£15 M**	✓	✓			
5 The applicant must implement LBMA's Responsible Sourcing Programme and pass an independent audit prior to submitting their application for Good Delivery Listing	✓ Some preliminary certifications[1]	✓			

1. Received the Responsible Minerals Initiative Standard and 5 International Standardization Organization (ISO) certifications

Source: London Bullion Market Association (LBMA), Tanzania Minerals and Investment Conference Magazine



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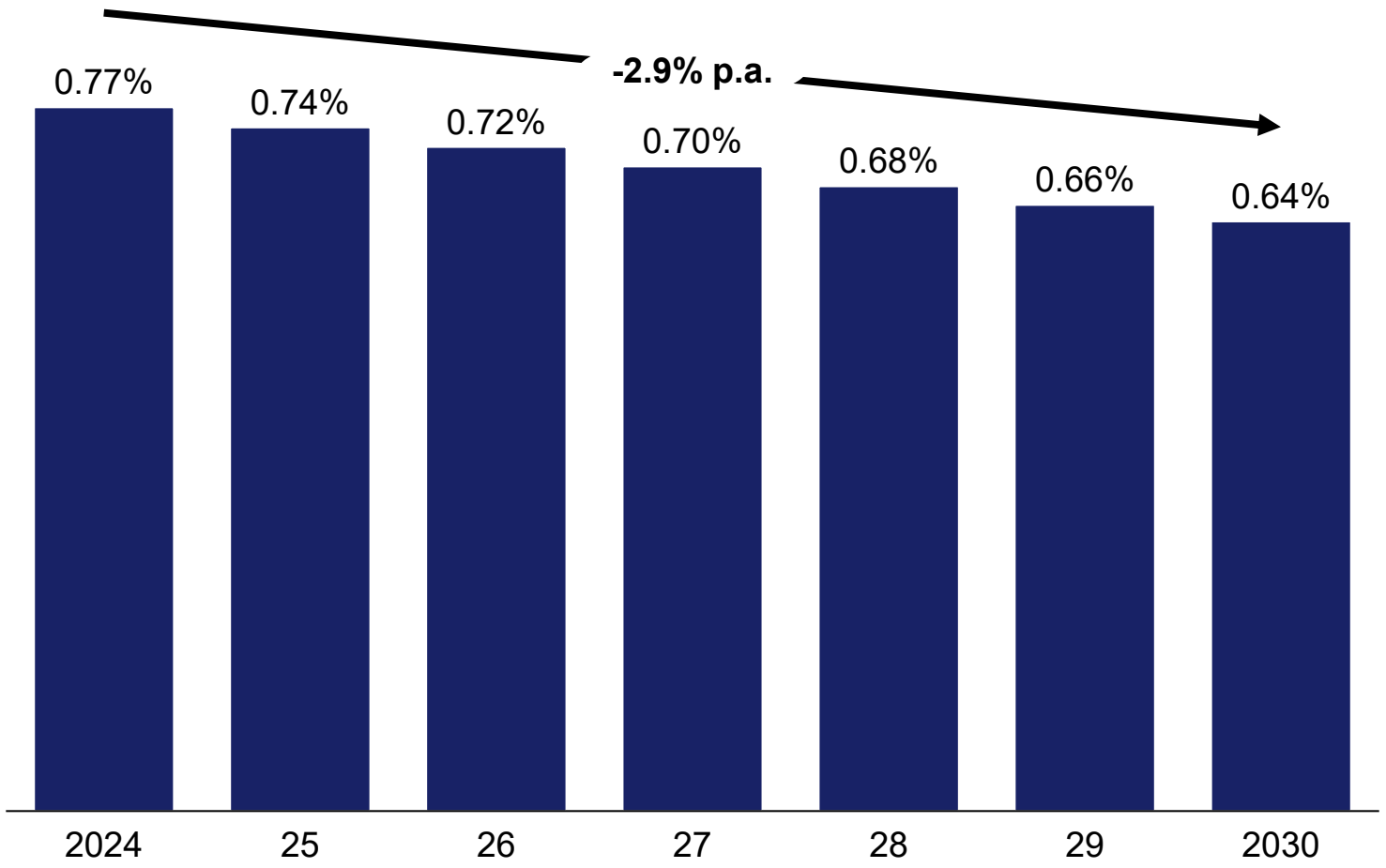
Limestone is a localized industry with trade accounting for less than 1% of total production

Share of global demand traded globally, (%)



Source: Global Limestone Report

Key insights

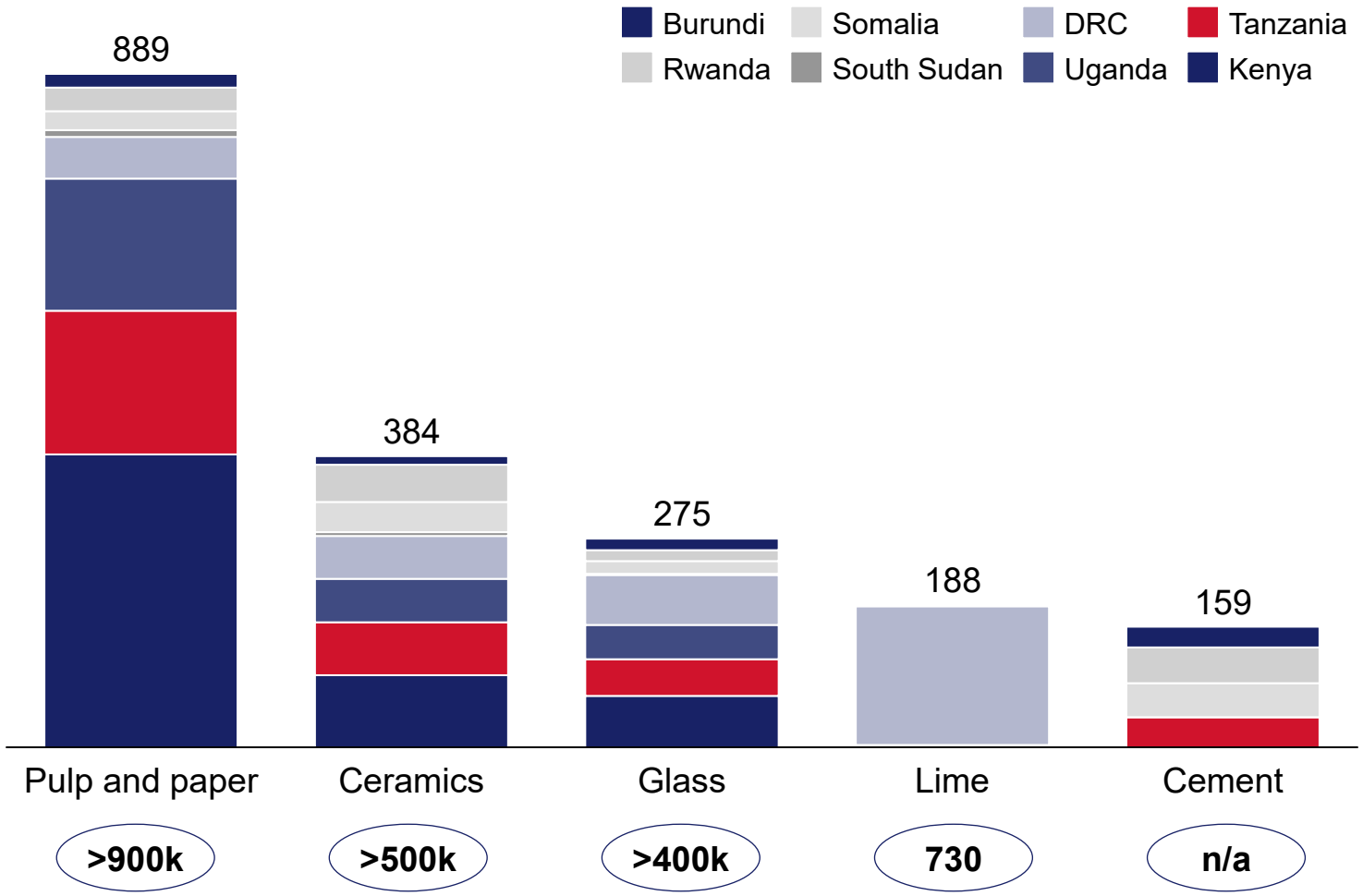
Limestone is a highly localized sector, with **<1% of the production being traded globally** as most of it is consumed domestically

- Its high weight-to-value ratio makes **long-distance transportation expensive**, limiting its global trade
- **Most countries have domestic limestone reserves**, reducing the need for imports
- While the absolute value of global limestone is growing, the share of global production traded is declining by **2.9% per year, indicating continued reliance on local production** rather than international supply chains

But there is a regional market for limestone-based products worth $1.4 B annually

xx Volume in tonnes

Limestone based intermediary and end-use products imports, 2023, M $



Source: Trade map, WITS, Tanzania cement consumption

Key insights

The region **imports over $1.4B in limestone-based products**

- Largest import category is pulp & paper at $700 M (>900K tonnes), showing strong demand across multiple countries
- Ceramics ($315 M, >500K total) and glass ($227K M, >400K total) indicate reliance on external supply, mainly for construction
- Lime sees $188 M primarily from DRC
- Cement imports of $120 M, mainly flowing to Burundi, Rwanda and Somalia

High import volumes suggest opportunities to become regional supplier

4 potential end use products have been identified for limestone

	Glass	Cement	Ceramics	Paper & Pulp
Opportunity	• Manufacturing packaging glass for Tanzania and the East African region • $220–250M potential value	• Scale green cement and clinker production for import substitution and regional demand using local semi-cementious materials. Additional potential to produce calcined clay • $130-160M potential value	• Produce ceramic products for construction and household use to meet local and regional demand • $310-370M potential value	• Establishing paper & pulp production in Tanzania for local and regional markets • $140-190M potential value
End uses (not exhaustive)	All identified opportunities are end use products			
Approach (not exhaustive)		• Greenfield: Establish production plant from scratch • Scale-up: Invest in existing operations to drive growth		• Greenfield: Establish production plant from scratch
Requirements (not exhaustive)		• Manufacturing plants with required capabilities • Cost effective logistics for regional market entry		• Manufacturing plants with required capabilities • Links to forestry industry to secure key inputs

Glass, cement, ceramics and paper and pulp were identified as value addition opportunities due to demand and ease of implementation

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Glass	B Cement	C Ceramics	D Paper and pulp
Market dynamics	Demand	~$290 B in global demand ~$227 M in regional demand	>$340 B in global demand ~120 M in EAC demand	$250 M in global demand ~300 M in EAC demand	>$350 B in global demand ~$700 M in regional demand
	Supply	Limited local production with significant mismatch & high imports	Local production exists, potentially exceeding local demand	Limited local production with significant mismatch & high imports	No production but can be manufactured with realistic
Competitive landscape		China controls ~50% of the global production	Significant local production exists, local demand being met by local players	China, India and Brazil control >60% of global	China, US and Japan control over 55% of the market
Share of priority mineral		10 – 15%	~85%	10 - 20%	10 – 25%
Availability of inputs	Raw materials	All raw materials are found locally (e.g., silica, Felspar)	All raw materials are found locally (e.g., clay, Kaolin, gypsum)		All raw materials can be sources locally (e.g., wood)
	Energy	100 kwh electricity / tonne, and ~2 GJ thermal energy / tonne	100 kwh electricity / tonne, and 3.3 GJ thermal energy / tonne	100 kwh electricity / tonne and 2.6 GJ thermal energy / tonne	Has very low energy needs
	Capabilities or skills		Knowledge is widely available, requiring less advanced technical skills		
	Physical Infrastructure		Improvements needed across rail, road and energy infrastructures		
	Technology (IP)		Widely available technology		
Policy and regulatory landscape			N/a		

Source: World Cement Association, Grand View Research, Fortune Minerals, USGS, Mordor intelligence, Cement Org, Heidelberg, Baryval, Polysius, Carmeuse, Expert interview

Lime and flux were deprioritized as value addition opportunities mainly due to limited local demand

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Lime	C Flux
Market dynamics	Demand	>$40 B in global demand with limited regional demand	Limited regional demand, as it is tied to specific industries, concentrated in China
	Supply	Local supply exists	No current or planned local production
Competitive landscape		China controls over 75% of global production	Concentrated in regions that make steel (China >50% of all steel)
Share of priority mineral		>95%	10 – 20%
Avail-ability of inputs	Raw materials	Raw materials are locally found (e.g., coal for heating)	Most raw materials are found local (e.g., silica, potash)
	Energy	100 kwh electricity / tonne, and 3 GJ thermal energy / tonne	100 kwh electricity / tonne, and ~2.6 GJ thermal energy / tonne
	Capabilities or skills	Knowledge is widely available, requiring less advanced technical skills	Some advancements on flux materials chemical composition exist & relatively easier to get
	Physical Infrastructure	Improvements needed across rail, road and energy infrastructures	
	Technology (IP)	Widely available technology	Increased precision, consistency, & efficiency involved in recent technologies
Policy and regulatory landscape		N/a	

Source: Global Market Insights, Tanzania Forest Services Agency, Expert interview

Ceramics: Ceramics is a local and regional opportunity and could provide an NPV of up to $11.7M and an IRR of 14%

Business Case Outputs

		Scenario 1 (15% discount rate, no tax break)	Scenario 2 (10% discount rate, no tax break)	Scenario 3 (10% discount rate, 5yr. tax break)
Capacity	**Ceramics volume**, '000 tonnes/yr.	200	Same as scenario 1	
Revenue	**Annual Revenue,** avg. $ M/yr.	32.7		
Cost	**COGS,** avg. $ M/year	6		
	Processing cost, avg. $ M/yr.	16.9		
	CAPEX, total $ M	48.2		
Project economics	**NPV,** $ M	-9	3.7	11.7
	Operating margin, %	30	Same as scenario 1	
	IRR, %	11	11	14
	Payback, yrs.	7	7	6.4
Additional impact metrics	**Cumulative government revenue** (tax), $ M	12.9	19.5	11.5
	Direct jobs, total #	400	Same as scenario 1	

Key Observations

- 3 scenarios for ceramics were modelled and the most attractive one has an **NPV of $11.7M and an IRR of 14%**
- The opportunity **relies on low-cost**, locally available **raw materials, which account for 30% of OPEX** (clay, limestone, silica, kaolin and feldspar).
- The **economic viability is contingent upon access to incentives** (e.g., tax holidays), which typically require a minimum of 80% of production to be allocated for export.
- The business case assumes a **200kt p.a. volume**, at which Tanzania could **meet domestic demand** (~120k tonnes p.a.) and **expand into regional markets**.

Source: Expert input, press search, Twyford Ceramics factory (Ghana)

Ceramics: Business case key assumptions

High-level assumptions

- The opportunity **assumes developing a ceramic tile manufacturing facility** in Tanzania and sourcing raw materials locally
- This opportunity is assumed to be integrated and placed in the Pwani, Lindi, or Morogoro regions, in the vicinity of raw material deposits

Opportunity setup assumptions

Average unit price (market price)	
• **Ceramics,** *$/tonne*	170
• **Raw materials[1],** *$/tonne*	31.3
Volume	
• **Total raw materials input,** *'000 tonnes p.a.*	220
– **Clay,** *'000 tonnes p.a.*	99 (45%)
– **Silica ,** *'000 tonnes p.a.*	44 (20%)
– **Kaolin,** *'000 tonnes p.a.*	33 (15%)
– **Feldspar,** *'000 tonnes p.a.*	22 (10%)
– **Limestone,** *'000 tonnes p.a.*	15 (7%)
– **Others[3],** *'000 tonnes p.a.*	6 (3%)
Ramp up volume (share of output)	
• **Year 1 ramp up,** *%*	50%
• **Year 2 ramp up,** *%*	80%
• **Year 3 ramp up,** *%*	100%

Ghana average CAPEX (Twyford ceramics as proxy)	
• **CAPEX,** *$/tonne*	238
Tanzania Processing OPEX & CAPEX	
• **Tanzania cost premium,** *%*	5
• **Processing cost[2],** *$/tonne*	87.8
• **CAPEX,** *$/tonne*	241
Other assumptions	
• **Project start timeline,** *yr*	2027
• **Project timeline,** *yrs*	19
• **Corporate tax,** *%*	30
• **Discount rate**	
– **Scenario 1,** %	15
– **Scenario 2 & 3,** %	10
• **Tax holiday,** *yrs*	
– **Scenario 1 & 2,** %	N/a
– **Scenario 3,** %	5 yrs.

1. Six raw materials assumed such as clay (24% of cogs), silica (23% of cogs) , limestone (2% of cogs), kaolin (34% of cogs), feldspar, (15%), and Others (3%). These may change based on different compositions of raw materials used |
2. Represents 70% of total OPEX and used COGS (which is 30% of total OPEX) to calculate the processing cost | 3. Other inputs such as dolomite and sand

Source: Twyford Ceramics, Expert input, PWC, press search

Glass: Glass could provide an NPV of up to $34.3M and an IRR of 14% - contingent on a 10% cost of capital and 5-year tax break

Business Case Outputs

		Scenario 1 (15% discount rate, no tax break)	Scenario 2 (10% discount rate, no tax break)	Scenario 3 (10% discount rate, 5yr. tax break)
Capacity	**Glass volume,** '000 tonnes/yr.	250	Same as scenario 1	
Revenue	**Annual Revenue,** avg. $ M/yr.	99.2		
Cost	**COGS,** avg. $ M/yr.	25.6		
	Processing cost, avg. $ M/yr.	46.2		
	CAPEX, total $ M	133.2		
Project economics	**NPV,** $ M	-23.7	11.9	34.3
	Operating margin, %	28	Same as scenario 1	
	IRR, %	11	11	14
	Payback, yrs.	6.9	6.9	6.3
Additional impact metrics	**Cumulative government revenue (tax),** $ M	36.2	54.6	52
	Direct jobs, total #	400	Same as scenario 1	

Key Observations

- 3 scenarios were modelled for float glass production, and the most attractive one could give **an NPV of $34.3M and an IRR of 14%**[1]
- For float glass production to be economically viable, it requires
  - **Scale:** The industry is a highly capital-intensive industry and needs to reach the necessary scale (e.g., ~250ktonne annually in Tanzania)
  - **Preferential terms:** Lower cost of capital and government incentives (e.g., 5-year tax break) are key to achieve positive NPV
- This opportunity **could be set up in Pwani, Lindi, or Morogoro regions,** where the raw materials are mainly found, allowing improved economics through vertical integration
- The business case assumes a **250kt p.a. volume**, at which Tanzania could **meet domestic demand** (~100k tonnes p.a.) and **expand into regional markets**.

1. Is both an intermediary product (processed into specialized products like tempered glass or laminated glass) and an end-product without further modification (could be used directly as standard windows for homes, mirrors, or glass tabletops)

Source: Expert input, press search, Trade map, Glas Trösch Group in Belgium

Glass: Business case key assumptions

High-level assumptions

- The opportunity **assumes developing a ceramic tile manufacturing facility** in Tanzania and sourcing raw materials locally
- This opportunity is assumed to be integrated and placed in the Pwani, Lindi, or Morogoro regions, in the vicinity of raw material deposits

Opportunity setup assumptions

Average unit price (market price)	
• **Float Glass,** $/tonne	412
• **Raw materials[1],** $/tonne	106.2
Volume	
• **Total raw materials input,** '000 tonnes p.a.	300
– **Silica ,** '000 tonnes p.a.	222(74%)
– **Soda ash,** '000 tonnes p.a.	48(16%)
– **Lime,** '000 tonnes p.a.	30(10%)
Ramp up volume (share of output)	
• **Year 1 ramp up,** %	50%
• **Year 2 ramp up,** %	80%
• **Year 3 ramp up,** %	100%
Global average CAPEX	
• **Static CAPEX[3],** %	80
• **Non-static CAPEX[4],** %	20
– **CAPEX,** $/tonne	433

Tanzania Processing OPEX & CAPEX	
• **Tanzania cost premium,** %	20
• **Processing cost[2],** $/tonne	86.9
• **Static CAPEX (global average),** $ M	104.0
• **Non-static CAPEX,** $ M	21.7
• **Tanzania premium CAPEX[5],** $ M	7.5
Other assumptions	
• **Project start timeline,** yr	2027
• **Project timeline,** yrs	19
• **Corporate tax,** %	30
• **Discount rate**	
– **Scenario 1,** %	15
– **Scenario 2 & 3,** %	10
• **Tax holiday,** *yrs*	
– **Scenario 1 & 2,** %	N/a
– **Scenario 3,** %	5 yrs.

1. Six raw materials assumed such as silica (54% of cogs), soda ash(39% of cogs), and lime (7% of cogs). These costs may change based on different compositions of raw materials used | 2. Represents 45% of total OPEX and used COGS (which is 55% of total OPEX) to calculate the processing cost | 3. Assumed 80% of CAPEX to be fixed and similar with global standards due to the expensive machinery costs such as furnace and float bath, which do not materially change with scale | 4. The remaining 20% of CAPEX is assumed to vary based on production output volume | 5. 20% Tanzania cost premium applied to 30% of the CAPEX, since 70% of the CAPEX is not localized investment (e.g., machinery)

Source: Expert input, PWC, press search

Three unlocks can help accelerate the development of Tanzania's limestone related sectors

Unlocks required to realize these opportunities:

1. **Monitor and address unmet local and regional demand:**
   - Conduct **regular market analysis** to scale capacity based on growth in demand

2. **Leverage regulation to promote the production limestone, while also exploring lower carbon footprint pathways:**
   - For example, offer incentives (e.g., tax breaks and subsidies) for local cement players that will use pozzolana and kaolin instead of cement clinker. These minerals are 20% cheaper and have lower carbon footprints

3. **Support local players to become regional suppliers by improving their cost competitiveness:**
   - Optimize local supply chains and trade policies to improve operational efficiency
   - Continue investing in infrastructure improvements, focusing on expanding rail and road networks, to reduce costs and become a relevant alternative supplier in the region

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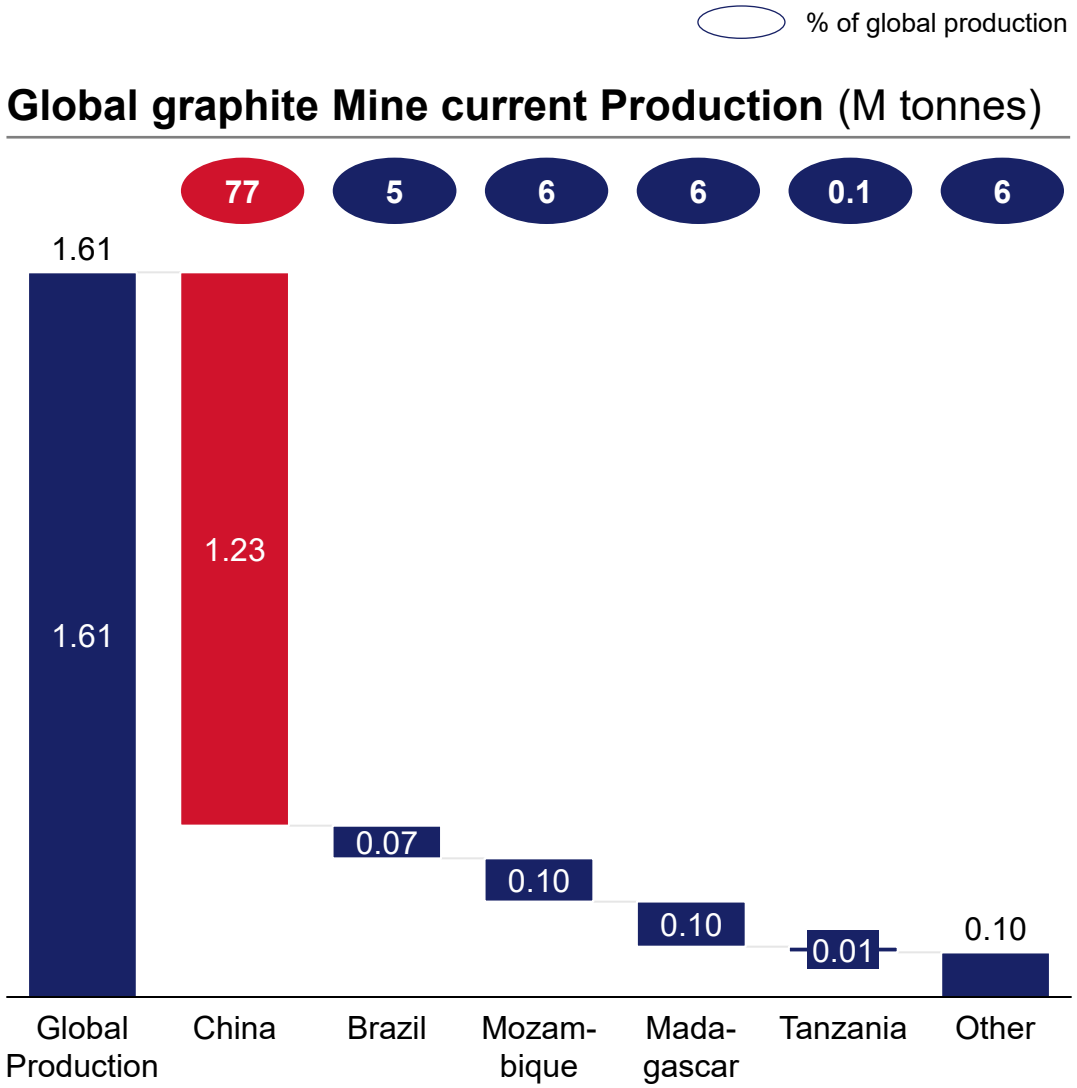
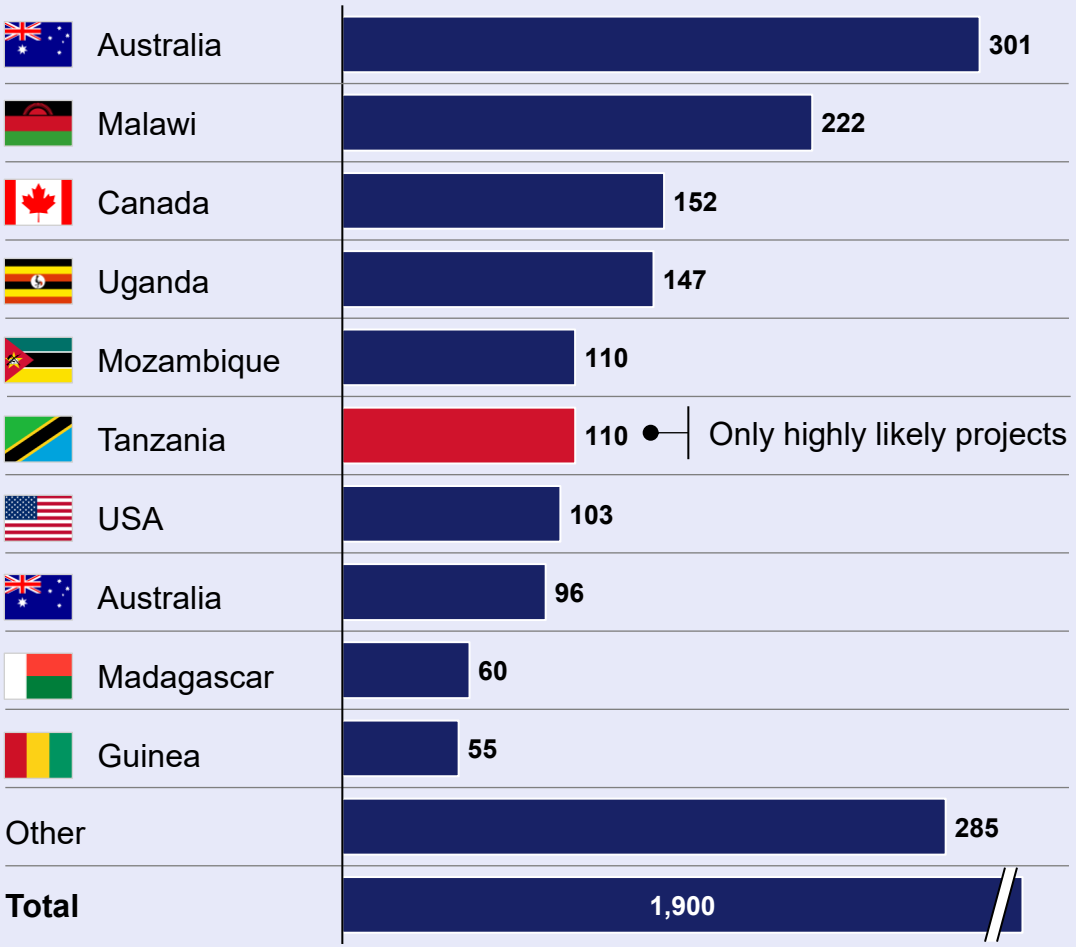
Currently China mines ~77% of the world's natural graphite …

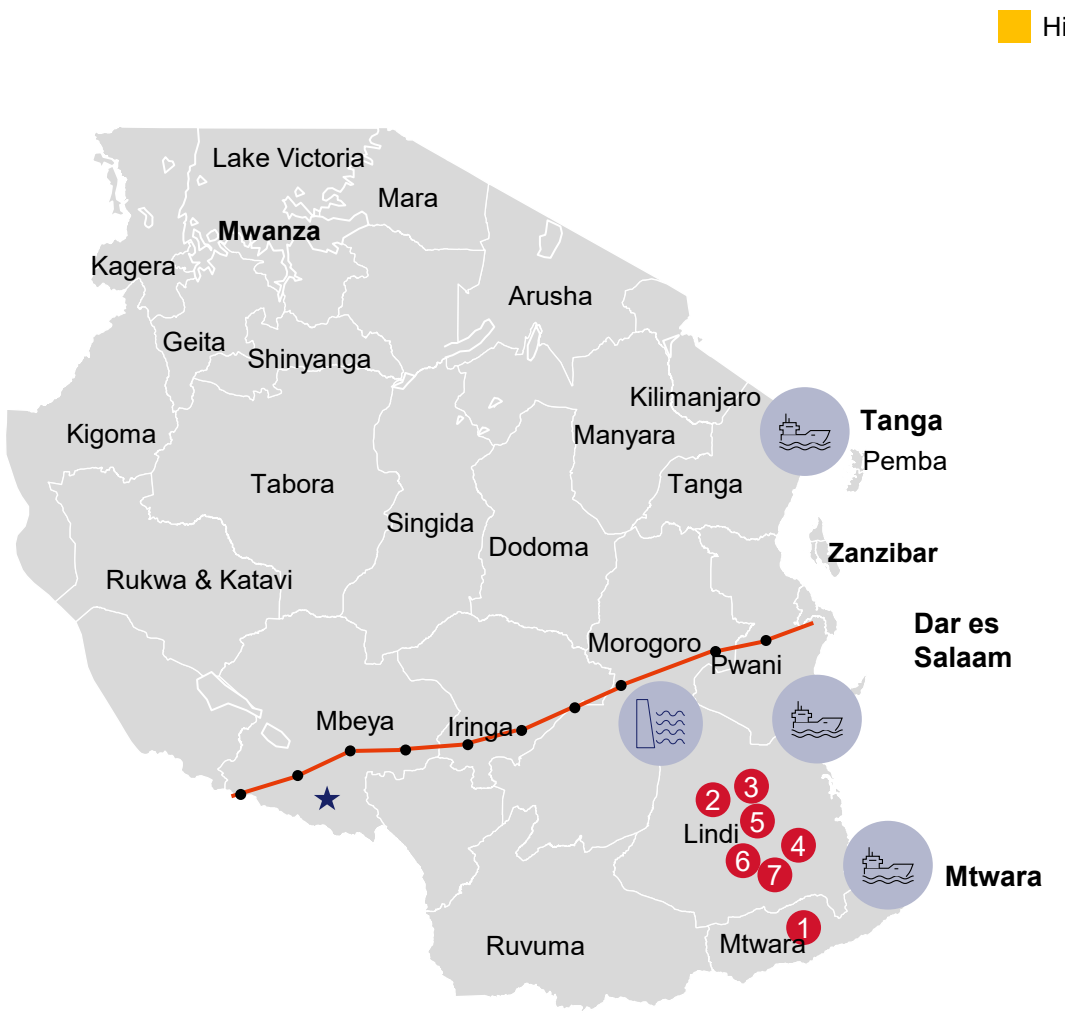


… but upcoming projects poised to diversify supply



Source: USGS, TradeMap, Northern graphite presentation

Planned graphite projects unlock +300,000 tonnes of production making Tanzania a relevant global producer



Mine	Expected Output[1]	Expected SOP	Company	Remarks
1 Bunyu	23,700	Active	VOLT RESOURCES	Offtake agreements signed for full capacity
2 Ruangwa	80,000	2024 - Delayed	PULA GROUP	Ramp-up expected to take 18 months of production
3 Nachu	14,000	2025	Magnis Resources	Production paused due to capital issues
4 Epanko	60,000	n/a	EcoGraf	Plan to build Graphite processing plant
5 Mahenge	60,000	n/a	FaruGraphite	Pre-FID, min 2 years to production
6 Chilalo	60,000	n/a	Evolution ENERGY	Downstream production capabilities with BTR
7 Lindi Jumbo	40,000	Paused	walkabout RESOURCES LTD	Offtake agreement with Tesla
Total	337,700			

1. Based on public announcements and expert interviews

Source: USGS, OEC, TanzaniaInvest, Press releases, Volt Resources, Evolution Energy, expert interviews

Leveraging its graphite reserves, Tanzania could establish local spherical graphite production for anodes of lithium-ion batteries

NON-EXHAUSTIVE

Spherical graphite is an anode material used in the production of lithium-ion batteries…

Process: Involves the purification, spherization and coating of graphite to create high conductivity graphite microns which compose **>90% of anode material in lithium-ion batteries**

Production:

China
95% of global production

South Korea

杉杉股份 Shanshan

BTR

SHINZOM

Demand:

China

USA

Japan

South Korea

Germany

Poland

CATL

BYD

…that could provide a viable investment opportunity for interested parties

Potential Opportunity

- **Greenfield:** Establish new production plant potentially in collaboration with global partners leveraging locally available beneficiated graphite

Competitive advantage

- **Availability of feedstock:** Tanzania is poised to become a top 3 producer of graphite if planned projects are realized
- **Alternative supply chains:** Offer supply-chain diversification to offtakers to reduce geopolitical risks
- **Geographic proximity:** Proximity to frontier markets in the energy transition - notably the EU

5 potential intermediate and end use products have been identified for graphite

	Coated / Uncoated Spherical Graphite	Lithium-ion Battery cell production	Refractories	Foundries	Lubricants
Opportunity	• Produce spherical graphite which is a high conductivity intermediate use product • $400-650M annual revenue potential	• Producing lithium-ion batteries for use in electric vehicles	• Specialized heat-resistant materials used to line and protect equipment that operates at extremely high temperatures	• Produce cobalt metal which is a refined form of cobalt metal	• Product superalloys which are temperature resistant, durable materials used in industrial processes
End uses (not exhaustive)	• Lithium-ion batteries	• Electric vehicles	• Used in heat intensive processes e.g lining of kiln for clinker production, steelmaking, etc.	• Used for castings in metallurgical processes	• n/a
Approach (not exhaustive)	• Build spherical graphite plant potentially in collaboration with upstream players	• Build a giga-factory for production of batteries	• Build a refractory manufacturing plant	• Establish a foundry which produces different castings	• Manufacture additives and mix in with base oils to produce finished lubricant products
Requirements (not exhaustive)	• Construct processing plant • Source input materials, especially sulfuric acid	• Access to input materials for anodes and cathodes • Intellectual property and expertise	• Access to input materials including alumina, silica, etc.	• Negotiating offtake agreements with final users, often steel manufacturers	• Importation of base oils • Technology & expertise in chemical engineering

While four other value addition opportunities were assessed, only spherical graphite emerged as a viable option

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Coated / Uncoated Spherical Graphite	B Lithium-ion Battery cell production	C Refractories	D Foundries	D Lubricants
Market dynamics	Demand	Medium: $2.2 B & growing (>20% CAGR), pressure to diversify sources	Medium: $85 B market size, forecasted growth	Medium: $35 B global market, tied to steel production	High: $150 B Market, forecasted decline	High: $125 B global market, growing
	Supply	Medium: Diversification of supply desired in the market. There are high level plans by upstream players to begin production in TZ	Low: Tanzania does not have planned or ongoing production			Medium: While there is active blending of lubricants for local use, there is no production of inputs
Competitive landscape		Medium: Top 10 players hold 67% market	Low: Top 2 players hold 50% market	Medium: Asia-pacific dominated	Low: Top 5 hold >40% market share	
Share of priority mineral		High: 100%	Low: 25% - 45%	Low: Up to 30%	Low: <10%	Low: Up to 30%
Avail-ability of inputs	Raw materials	High: Most chemical inputs can be sourced locally	Low: Import required for primary inputs	Medium: Import required for secondary inputs		Low: Import required for primary inputs
	Energy	High: High; but available and price competitive	Low: May require dedicated energy infrastructure	High: High; but available and price competitive		Medium: Medium; but available and price competitive
	Capabilities or skills	Low: Advanced technical skills required	Low: Advanced technical skills required	High: Knowledge is widely available		
	Physical Infrastructure	Medium: Improvements needed across rail, road and energy infrastructures				
	Technology (IP)	Medium: IP held by top players, can form partnerships	Low: IP held by top players, limited partnerships	High: Widely available technology		
Policy and regulatory landscape		Medium: Export controls by China and Tax incentives in the US	Medium: Tax incentives in US, EU and China which are key demand centres	High: N/A		

Source: Research and Markets, Fortune Business Insights, Springer Research, Market Research Future

Spherical graphite: Spherical graphite has a ~$243M NPV and 21% IRR making it an attractive long-term investment

Business Case Outputs[2]				
Capacity	**Spherical graphite,** '000 tonnes	50	39	32
Revenue	**Annual Revenue, full scale,** $ M	375	295	550
Cost	**COGS, full scale,** $ M/year	150	88	125
	OPEX (processing), avg. $ M/year	117	88	136
	CAPEX, total $ M	343	240	243
Project economics	**NPV,** $ M	243	545	1,000
	Operating margin, %	29	40	50
	IRR, %	21	25	20
	Payback, years	4	4	4.5
Additional impact metrics	**Government revenue (tax)[1],** $ M	50	-	-
	Direct jobs, #	200	-	175

Key Observations

- Spherical graphite business case is **attractive with ~$243M NPV** for a non-integrated project
- Business case assumes a **processing capacity of 50 ktpa** – a sixth of with Tanzania's projected production of over 300 ktpa
- It relies on **sourcing graphite concentrate from mines in the southern region of Tanzania** and processing them into mid-high grade coated and uncoated spherical graphite
- It assumes **production in a SEZ** implying a **10-year tax break**, which **is essential for global competitiveness** given incentives other governments are providing
- **Higher profitability** can be achieved by **integrating with mines** to reduce COGS or optimizing CAPEX costs through higher efficiency vs. projections (20% cost premium and 10% discount rate are applied)

1. NPV, Assuming no additional equity and 10% discount rate | 2. Assumes 10-year tax break which is unlocked by operating in a special economic zone

Source: Nouveau Monde Feasibility Study, Greenroc Strategic Minerals feasibility study

Spherical graphite: Business case key assumptions

High-level assumptions

- The opportunity **assumes building a 50,000tpa spherical graphite processing plan in Mwanza** to be near the graphite mining region and in the Special Economic Zones (SEZ) in order to take advantage of the 10-year tax holiday[1]

Opportunity setup assumptions	Tanzania opportunity	GR	NMG
Average unit price (market price)			
• **Spherical graphite,** $/tonne	7,500	7,500	9,051
Volume (based on Ngualla mine output)			
• **Concentrate,** '000 tonnes p.a.	85	80	61
• **Spherical graphite, '000 tonnes p.a.**	50	39	42
Ramp up volume (share of metal output)			
• **Year 1 ramp up,** %	50	-	42
• **Year 2 ramp up,** %	75	-	94
• **Year 3 ramp up,** %	100	-	100
Global average OPEX & CAPEX			
• **Tanzania cost premium[2],** %	20	n/a	n/a
• **COGS,** $/tonne	1,800	1,100	2,135
• **Processing cost**, $/tonne	2,334	2,211	2,260
• **Capex,** $ M	343	240	243

Opportunity setup assumptions	Tanzania opportunity	GR	NMG
Project start yr, yr	2030	TBD	2026
Project timeline, yrs	25	22	25
Discount rate, %	10%	8%	8%
Corporate tax, %	30%	22%	32%
Tax holiday, yrs	10	n/a	n/a

1. Special economic zone incentive given by the government for companies that export at least 80% of their locally produced end-products
2. This is additional Tanzania premium applied to higher range of global processing cost as well as the CAPEX (volume-based CAPEX which is half of the total)

Source: Nouveau Monde Feasibility Study, Greenroc Strategic Minerals feasibility study

For spherical graphite production to be viable in Tanzania, four things must hold true in the future

1 Graphite will remain a relevant input for anode materials in the short to medium term

- Silicon is an emerging alternative to graphite driven by its ability to hold 10 times as many lithium-ions by weight
- Historically, small quantities of silicon are combined with graphite in anode material. However, new technologies with higher shares of silicon are in early development
- Despite this, graphite is projected to remain the dominant anode material

High likelihood

2 70% of Tanzania's graphite falls into the premium range which fetches a higher market price

Premium range

Basket composition – Epanko Mine, Tanzania

Flake Size	Size (Microns)	Price[1]	Share of Basket
Jumbo	>300	$2,300	21.6%
Larger	180 – 300	$1,300	28.6%
Medium	106 – 180	$950	23.6%
Small	>75	$750	10.4%
Fine	<75	$550	15.8%
Weighted Average		**$1,258**	

High likelihood

3 Geopolitical conflicts and shifts in trade patterns increase the demand for graphite from alternative suppliers, presenting an opportunity for Tanzania to take advantage of.

Medium likelihood

And / Or

4 The abundance of low-grade, small flake size graphite in China is driving more investment into higher quality graphite sources outside the country, and Tanzania is well-positioned to supply these.

Medium likelihood

1. The pricing comes from the feasibility reports for Epanko from 2014 and 2020, but existing pricing information indicates that the distribution of basket prices still holds true

Source: Epanko Mine Feasibility Study

There are several actions that can be considered to unlock spherical graphite production

Core elements	Now	Next	Later
1 **Financing**	Create **financing avenues for downstream production** through government support & private sector incentives or regulations	**Develop structured incentives** that promote domestic value addition to direct larger volumes of graphite towards local processing plants	**Incentivize graphite importation** from other regional producers to increase volumes and economic value
2 **Technology (IP) and other partnership**	**Identify and attract international players** who have the intellectual property and capital **Support mining players to create partnerships to consolidate volumes** to improve viability to production	**Develop intellectual property** through R&D to enable higher share of value to be kept in Tanzania	**Facilitate local R&D partnerships** between international firms and local institutions **Negotiate knowledge-sharing agreements** with international tech providers
3 **Capability**	Identify **specific capability and training needs, and design programs by working** with educational institutions (e.g., universities)	**Establish training programs** for students in chemical and mineral processing engineering among other relevant skills	**Established advanced skill programs,** e.g.., PHD training to drive research and development
4 **Infrastructure architecture planning**	Create **reliable transmission lines for energy**, based on need and geography for value addition	**Improve road networks** in southern region of Tanzania	**Develop graphite processing zones** which benefit from targeted infrastructure

Source: Expert interviews

Landscape of global players for potential partnerships in spherical graphite production

☐ Emerging global players

Countries	Description	Potential partners	Considerations
 **Chinese players**	China dominates spherical graphite production with **9 of the top 10 producers and >95% of global supply**	BTR; KAIJIN 凯金; SHINZOM; 尚太科技 SHANGTAITECH; 璞泰来 PUTAILAI; 杉杉股份 Shanshan	⊕ Have **deep technical expertise, large global operations and high capital reserves** ⊕ BTR has 10% equity in Evolution Energy, the company behind Chilalo Graphite Project lowering barriers to investment in Tanzania ⊖ Investment from Chinese players may limit off taking in the EU and US as there is **growing demand to diversify away from Chinese production**
 **South Korean players**	South Korea is an **emerging** spherical graphite **producing country driven by Posco**, a top 10 producer	posco	⊕ Large and growing anode material manufacturer **and large supplier for EU battery manufacturing companies** ⊕ Posco Group has 20% equity in the Mahenge Graphite Mine, the largest planned graphite project in Tanzania ⊖ Posco Group has **slowed investment in production facilities outside of North America** in 2024 which may translate to limited investment appetite for Tanzania
 **Canadian players**	Canada has a **few early-stage spherical graphite producers**	GRAPHEX; FOCUS GRAPHITE ADVANCED MATERIALS; NMG NOUVEAU MONDE GRAPHITE	⊕ **Preferential offtake in North American markets** which is a large demand centre ⊕ In **early stages of becoming global players** which may create potential for investment ⊖ Canadian players are still producing small quantities of spherical graphite which **might limit their ability to invest globally**
 **Australian Players**	Australian players are in the **early stages of vertically integrating** their upstream activities	SYRAH TECHNOLOGIES; RENASCOR RESOURCES	⊕ Australian **companies have experience with upstream operation in Tanzania** which may make additional investment Africa, including Syrah resources operating the largest active mine in Africa ⊖ Australian players are still producing small quantities of spherical graphite which **might limit their ability to invest globally**

Source: Press search, company websites, expert interviews, Technology metals research

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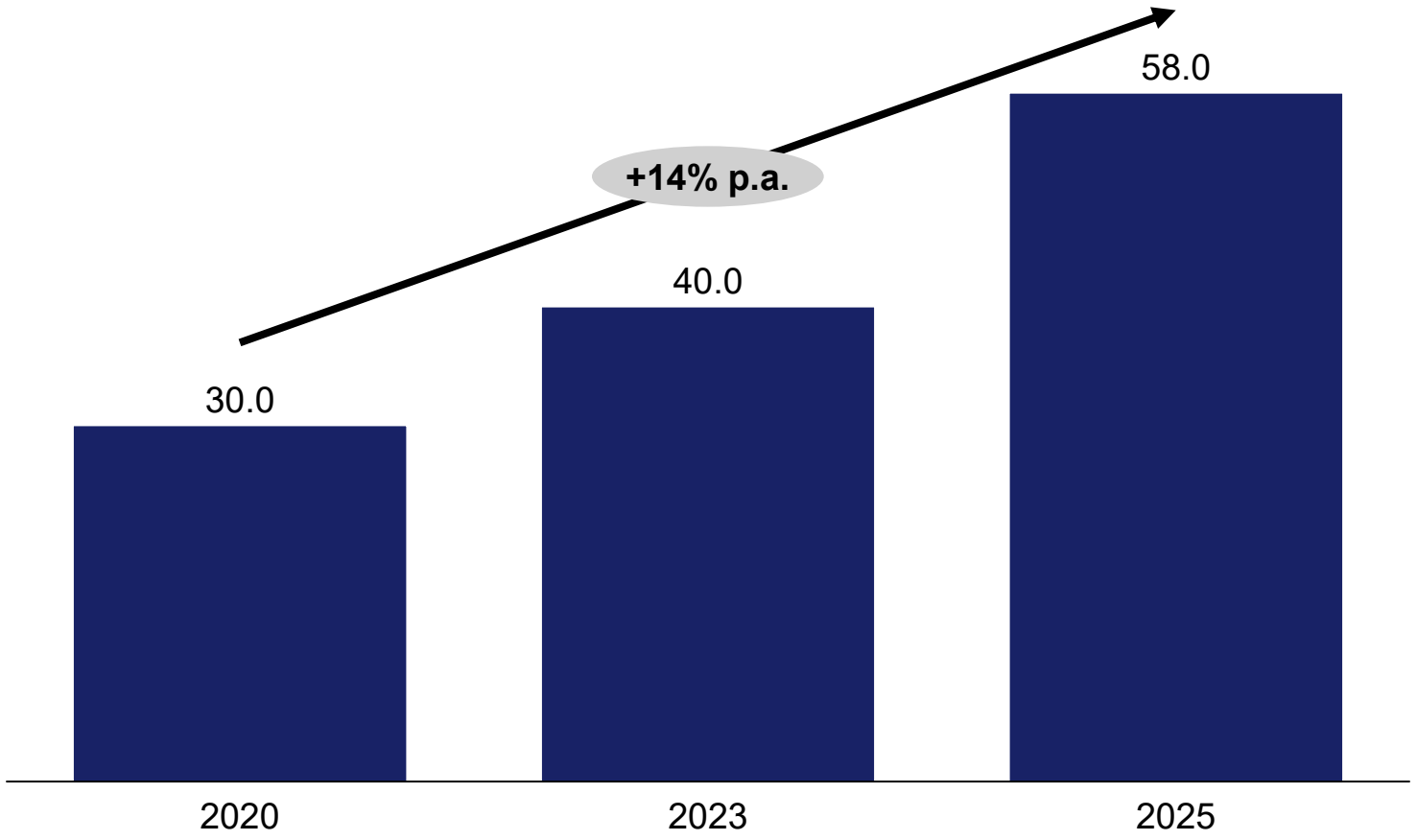
Over the past 5 years, rare earth elements demand has grown significantly

Global Nd-Pr REE demand, ‘000 tonnes p.a.



Source: Peak Resources limited, press search

Key insights

Global demand of Nd-Pr has increased by >14% over the past 5 years

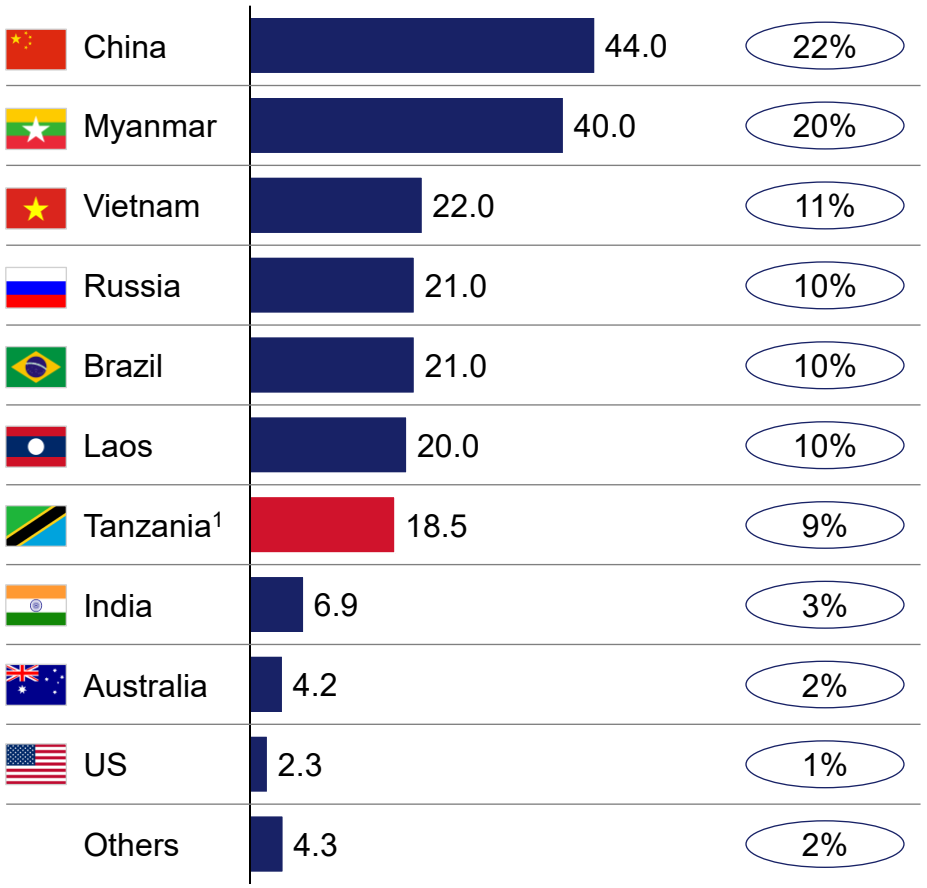
This demand is highly driven by the global energy transition

- Nd-Pr are primarily used to produce permanent magnets, which critical for EV battery efficiency, wind turbines, etc.

Growth of demand is expected to continue as the global energy transition continues

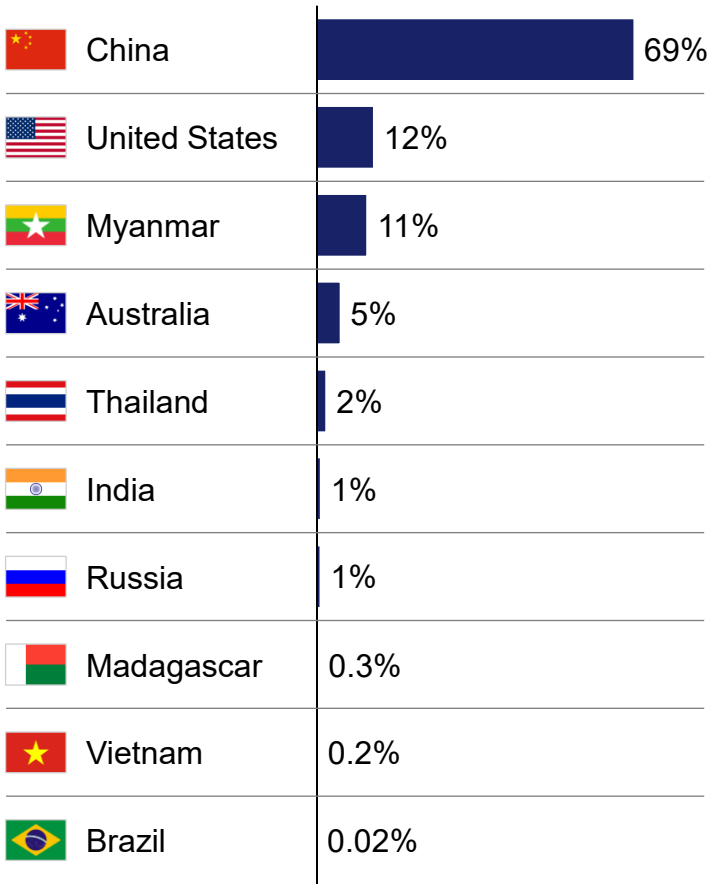
China and Myanmar have >40% of the global reserves; Tanzania holds 9%, but has no active production

Global REE reserves, M tonnes



Share of global

Rare earth mine production by country, % of global production, 2023



1. Tanzania data is gathered from press search

Source: USGS, Argus, press search

Key insights

China and Myanmar have >40% of the global reserves and ~80% of annual production

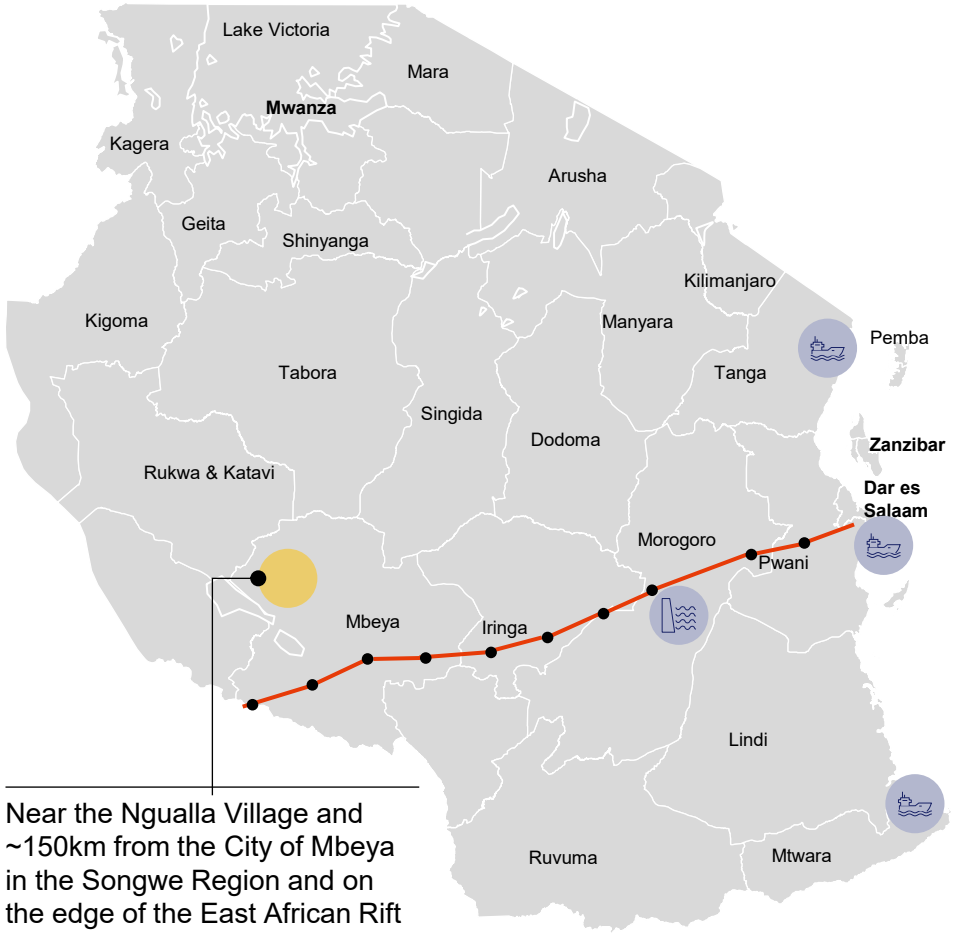
- China has contributed approximately 2/3rd of the global production
- **Similar, REE processing is concentrated in China** (e.g., Myanmar exports almost all concentrates to China)
- Myanmar has mostly HREEs which are significantly more valuable than other reserves

Tanzania's reserve account for ~9% of the global reserves

Due to **REE's scarcity**, countries are also looking for alternative sourcing, to prevent dependence on China

Tanzania has identified significant deposits of Nd-Pr with plans to start mining in 2025

Prospect mine | Hydro power plant | Export ports



Near the Ngualla Village and ~150km from the City of Mbeya in the Songwe Region and on the edge of the East African Rift Valley

Ngualla Rare Earths Project

Reserve	**18.5 M tonnes** grading **4.8% REO** (1.02% Nd-Pr)
Mining	**Open pit** with low strip ratio of 1.77
Planned production	**37.2K tonnes** per annum of concentrate (45% total REO grade)

Remark

High quality: Average ores range between 1-3%, while Ngualla is estimated to be 4.5% of oxides and 1.02% Nd-Pr

Significant investment: $320 M required to construct mine, mill, concentrator, and associated infrastructure

Centralized extraction: Project contains 100% of Tanzania's reserve – which contains 9% of global serves

Source: TMIC 2024, Peak Rare Earths 2024, Mining Review Africa

5 potential intermediate and end use products have been identified for REEs

	REE metals	Permanent magnets	Catalysts	Glass additive	Metallurgy
Opportunity	• Separation and refining of rare earth oxides to create individual rare earth elements • $320-400M annual revenue potential	• Permanent magnets are high magnetic strength assets	• Produce catalysts, which are substances that accelerate chemical reactions	• Input to glass to impact specific optical properties	• Produce enhanced metal and alloy products
End uses (not exhaustive)	• Permanent magnets • Catalysts • Metallurgy	• Electric motors • Wind turbine generators • MRI scanners • Electronic devices	• Petroleum refining processes • Rubber production • Automotive catalytic converters	• Optical lenses • Laser materials • X-ray machinery • Color changing glassware	• Magnesium alloys • High strength steel • Corrosion resistant alloys
Approach (not exhaustive)	• Set up an REE separation plant with potential to collaborate with upstream players to develop an integrated plant	• Set up a manufacturing plant to transform alloys into magnets	• Set up a processing plant to incorporate REE's (including Nd-Pr's, cerium, lanthanum etc.) and other additives into catalysts	• Set up a manufacturing plant to incorporate REE oxides into glass melts to form new glass products	• Set up a manufacturing plant to produce REE alloyed metals like steel or copper
Requirements (not exhaustive)	• Intellectual property on REE separation • Dedicated chemical processing plants	• Intellectual property on REE separation • Advanced metallurgy • Magnetization equipment	• Input materials • Dedicated energy infrastructure	• Glass production capabilities	• Intellectual property on REE metallurgy • Dedicated energy infrastructure

1. Billet and slabs

While five value addition opportunities were assessed, only REE metals convinced as a future opportunity (1/2)

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A REE metals	B Permanent magnets	C Catalysts[1]
Market dynamics		Current global demand ~$5B, expected to grow by 5 – 10 % Pa Limited local and regional demand	Growing due to EV transitions (90% of REE metals value) Limited local and regional demand	Very limited local and regional demand (for use of REEs in these products) <10% in value of the global demand of REEs
Competitive landscape		Highly controlled by China controlling ~70% of production	Highly controlled by China (>50% of production)	The US and China control >50% of the market
Share of priority mineral		100%	>90%	>4%
Avail-ability of inputs	Raw materials	Sulfuric acid (H_2SO_4), hydrochloric acid (HCl), nitric acid (HNO_3) and are used, which are mostly imported Consumes water up to 200 m3/t metal	To make permanent magnets, other REEs like Terbium are used, which aren't yet found in Tanzania Moreover, Iron and Boron are utilized to make the magnet	Catalyst Coating like platinum, palladium, and rhodium needed, which are imported Other include ceramics substrates, which are also imported
	Energy	High energy intensive and may require	High energy intensive	Energy intensive in making catalyst materials (Pt, Pd & Rh)
	Capabilities or skills	Highly advanced and requires higher capability and training	Highly advanced and requires higher capability and training (esp. in metallurgy)	Highly advanced and may require higher training (e.g., materials science, chemical Eng.)
	Physical Infrastructure	Some infrastructure improvements may be required since it may require to be transported using rail system	Some infrastructure improvements may be required since it may require to be transported using rail system	May require infrastructure for moving and transporting
	Technology (IP)	←	High technology and IP requirements due advanced processes involved →	
Policy and regulatory landscape		China has had strong regulation for high production and local value addition controlling REE metals	China has had strong regulation for high production of permanent magnets	Major producers like the US have regulations requiring catalytic convertors[1]

1. While catalysts such as catalytic convertors are valued at >$100 B, they also have other major raw materials outside of Nd-Pr

Source: Press search, USGS, Trading Economics, MDPI global magnets market, Shanghai Metals market, Characterization quantification and recovery of REEs, Analysis of Rare Earth Elements in Rock and Mineral Samples 2024, Druic sustainability, Britannica, Regulations in catalytic convertor, World integrated Trade, TC Magnet manufacturers, US department of Energy, Press search

While five value addition opportunities were assessed, only REE metals convinced as a future opportunity (1/2)

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		D Glass additive	E Metallurgy
Market dynamics		Very limited local and regional demand (for use of REEs in these products) <10% in value of the global demand of REEs	
Competitive landscape		Significantly controlled by the US, Australia and Japan Is less controlled by single country/player	
Share of priority mineral		100%	>90%
Availability of inputs	Raw materials	Silica (SiO_2), soda ash (Na_2CO_3), limestone ($CaCO_3$), Boron and Manganese oxide Some of the minerals can be locally mined	Iron (Fe), boron (B), cobalt (Co), and dysprosium (Dy) may be required, which can be locally sourced (Iron and Cobalt
	Energy	Significant energy consumption of the glass manufacturing processes	High energy intensive due to metallurgy applications (e.g., melting and casting processes)
	Capabilities or skills	May require significant skills and capability, in producing	Highly advanced and requires higher capability and training (esp. in metallurgy)
	Physical Infrastructure	May require infrastructure limited infrastructure changes, as glass typically transports through trucks	Some infrastructure improvements may be required since it may require to be transported using rail system
	Technology (IP)	There may be some IPs (e.g., environmental compliance tech, oxide integration)	There may be some IPs (e.g., electrolysis process)
Policy and regulatory landscape		N/A	N/A

Source: Press search, USGS, Trading Economics, MDPI global magnets market, Shanghai Metals market, Characterization quantification and recovery of REEs, Analysis of Rare Earth Elements in Rock and Mineral Samples 2024, Druic sustainability, Britannica, Regulations in catalytic convertor, World integrated Trade, TC Magnet manufacturers, US department of Energy, Press search

REE (Nd-Pr) metals: Nd-Pr metals are an attractive opportunity with an estimated NPV $368.9M, and IRR 22%

Business Case Outputs			Benchmark, (*unique integrated set-up*)[1]
Capacity	**Nd-Pr metal volume,** '000 tonnes/year	**3.6**	**1.8**
Revenue	**Annual Revenue,** avg. $ M/year	**~390**	
Cost	**COGS, avg. $ M/year**	**~142**	
	Processing cost, avg. $ M/year	**~89.4**	**62.6**
	CAPEX, total $ M	**~462**	**295.5**
Project economics	**NPV,** $ M	**368.9**	**627**
	Operating margin, %	**39**	**75**
	IRR, %	**22**	**38**
	Payback, years	**3.7**	
Additional impact metrics	**Cumulative government** revenue (tax), $ M	**~59.1**	
	Direct jobs, total #	**~290**	

Key Observations

- The REE (Nd-Pr) metals opportunity is **attractive, with an NPV of $368.9M and an IRR of 22%.** This opportunity aims to use the REE concentrate from the Ngualla mine in the Songwe Region and manufacture REE (Nd-Pr) metals[2]
- The business case assumes production in a SEs to benefit from the 10-year tax holiday incentive
- Although **Tanzania's economics appears lower** compared to the benchmark, **it meets industry standards** (IRR between 18 – 25%)[3]
- The **benchmark**, Rainbow's project in South Africa, is unique due to its **integrated operations and higher-than-industry-standard profitability**, driven by low OPEX
- **Integrating backwards to the mine could improve economics** and also enable access to another nearby mine (Panda Hill), but **SEZ incentives** would need to be **geographically expanded**[4]

1. Rainbow REE Phalaborwa project is among the world's most profitable projects globally due to the low OPEX associated with gypsum waste being used as a raw material limiting traditional hard rock mining which lowers OPEX | 2. The Ngualla mine is a rare earth development mine by Peak Rare Earths located near the Ngualla Village, which also plans to beneficiate the extraction of 45% TREO concentrate | 3. Special economic zones are industrial zones which benefit manufacturers with incentives like a 10-year tax holiday, for companies that export at least 80% of their locally produced products | 4. Ngualla mine is >650kms from Dar es Salaam, while Panda Hill is >800kms from Dar es Salaam

Source: Peak Rare Earths, Expert input, Rainbow REE metals, Mountain pass REE, PWC, press search

REE (Nd-Pr) metals: Business case key assumptions

Details follow

High-level assumptions

- The opportunity **assumes building an REE (Nd-Pr) separation plant** in TZ sourcing concentrates from the Ngualla
- This opportunity **is assumed to be developed in Dar es Salaam**, where the Special Economic Zones (SEZ) are located, gaining a 10-year tax holiday incentive to be globally[1]

Opportunity setup assumptions	Tanzania opportunity	RAINBOW RARE EARTHS
Average unit price (market price)		
• **Nd-Pr metal,** $/tonne	111,250	111,250
• **REE concentrate,** $/tonne	3,500	
Volume (based on Ngualla mine output)		
• **Concentrate,** '000 tonnes p.a.	37.2	
– **Share of TREO[2],** % of concentrate	45	
– **Share of Nd-Pr[2],** % of concentrate	9.6	29
Ramp up volume (share of metal output)		
• **Year 1 ramp up,** %	50%	
• **Year 2 ramp up,** %	80%	
• **Year 3 ramp up,** %	100%	
• **Processing cost,** '000 $/tonne		33.9
– **Lower range**	20	
– **Higher range**	27	

Opportunity setup assumptions	Tanzania opportunity	RAINBOW RARE EARTHS
CAPEX (using Rainbow as proxy)[3]		
• **Vol. based (50%),** '000 $/tonne of separated REE	160	
• **Fixed CAPEX (50%),** $	147,000	
Tanzania Processing OPEX & CAPEX		
• **Tanzania cost premium[4],** %	20	
• **Processing cost,** '000 $/tonne	26.2	
• **Vol. based CAPEX (50%),** '000 $/tonne of separated REE	284.1	
• **Tanzania CAPEX premium (35%),** '000 $	30.23	
Other assumptions		
• **Project start yr,** yr	2029	
• **Project timeline,** yrs	17	16
• **Discount rate,** %	10%	10%
• **Corporate tax,** %	30%	
• **Tax holiday,** yrs[1]	10	

1.Special economic zone incentive given by the government for companies that export at least 80% of their locally produced end-products | 2. Nd-Pr metal represents 1.02% of the ore, which contains 4.8% Total Rare Earth Oxides (TREO). After concentration, TREO increases to 45%, and applying the same ore ratio, Nd-Pr concentration reaches 9.6% of the final concentrate | 3. Assuming that half of the CAPEX is fixed (despite volume of REE output) and the remaining half will be dependent on the volume output of separated REE metal | 4. This is additional Tanzania premium applied to higher range of global processing cost as well as the CAPEX (volume-based CAPEX which is half of the total)

Source: Peak Rare Earths, Expert input, Rainbow REE (Nd-Pr) metals, Mountain pass REE, PWC, press search

Rainbow REE Phalaborwa project is among the world's most profitable projects due to significantly low OPEX operating conditions

The **Rainbow REE Phalaborwa project benefits from unique OPEX advantages** through backward integration, readily available raw materials, and existing infrastructure…

Backward integration

The Phalaborwa project reprocesses 50+ years of gypsum waste from phosphoric acid production, avoiding traditional hard rock mining and significantly reducing CAPEX and OPEX

Easily accessible and partially processed inputs

REEs are already in 'cracked' form due to sulphuric acid used to make phosphoric acid, eliminating complex initial steps and enabling a 75% operating margin[1]

Strong existing infrastructure

Available high-voltage switchyards, workshops, labs, and tanks reduce capital needs and speed up time to production

…alongside **additional environmental benefits and strategic partnerships**

Environmental and sustainability gains

The project remediates old gypsum stacks, redepositing clean material on lined sites built to IFC standards, aligning with green mining practices.

Innovative technology and partnerships

Partnership with K-Tech enables more efficient, environmentally friendly REE separation with fewer processing steps and less hazardous reagent use.

1. Because they've gone through acid attack (sulfuric acid digestion), the REEs are no longer in their original, tightly bound mineral lattice. Instead, they are in a more reactive form — often as soluble sulphates or adsorbed ions — that can be more easily extracted compared to hard-rock ore.

Landscape of potential global players for REE (Nd-Pr) metals production

Rare Earth metals (Nd-Pr) production global players

☐ Emerging global players

Countries	Description	Potential partners	Considerations
 **Chinese players**	**China has multiple players** and currently control up to 90% the global REE (Nd-Pr) separation & processing	Guangdong Rare Earth Industrial Group Co. Ltd. China Northern Rare Earth (Group) High-Tech Company Limited China Rare Earth Group	⊕ **Have deep technical expertise**, with mature technologies and processes, and contain **integrated supply chains and global networks** ⊕ Chinese player owns 19% of Peak REE (the company behind the Ngualla project), **already being invested in its success** ⊖ More **reliance on Chinese technology and expertise**, as the world is moving toward diversification
 **North American players**	North American **players in US and Canada** are limited, with a most being emerging players	MP MATERIALS neo Performance Materials Rare Element UCORE USA Rare Earth	⊕ **Access to innovative and advanced tech** ⊖ **Potentially higher cost involved** with premium technology
 **RoW players**	**Australian and Japanese players** are the major players globally with are in the **early stages of vertically integrating** their upstream activities	Lynas Rare Earths TOYOTA TSUSHO Shin-Etsu RAINBOW RARE EARTHS 三德	⊕ Enables **diversification of global ties**, including with players like Rainbow, that has regional experience (e.g., in South Africa) ⊖ Productions in the Rest of the World (RoW) are **fragmented**, as new players are entering the market with innovative technology
 **European players**	Countries like **Norway, France and UK** have very few players with separation technology	grupa azoty MKANGO SOLVAY REEtec	⊕ Allows Tanzania to **leverage from experience in other adjacent expertise** (e.g., chemical processing) ⊕ Strong focus on **quality & sustainability standards**, while providing access to the EU market ⊖ Productions in EU are also **limited in scale**, as players are entering the market with innovative technology

Source: Ress search, company websites, expert interviews, Technology metals research

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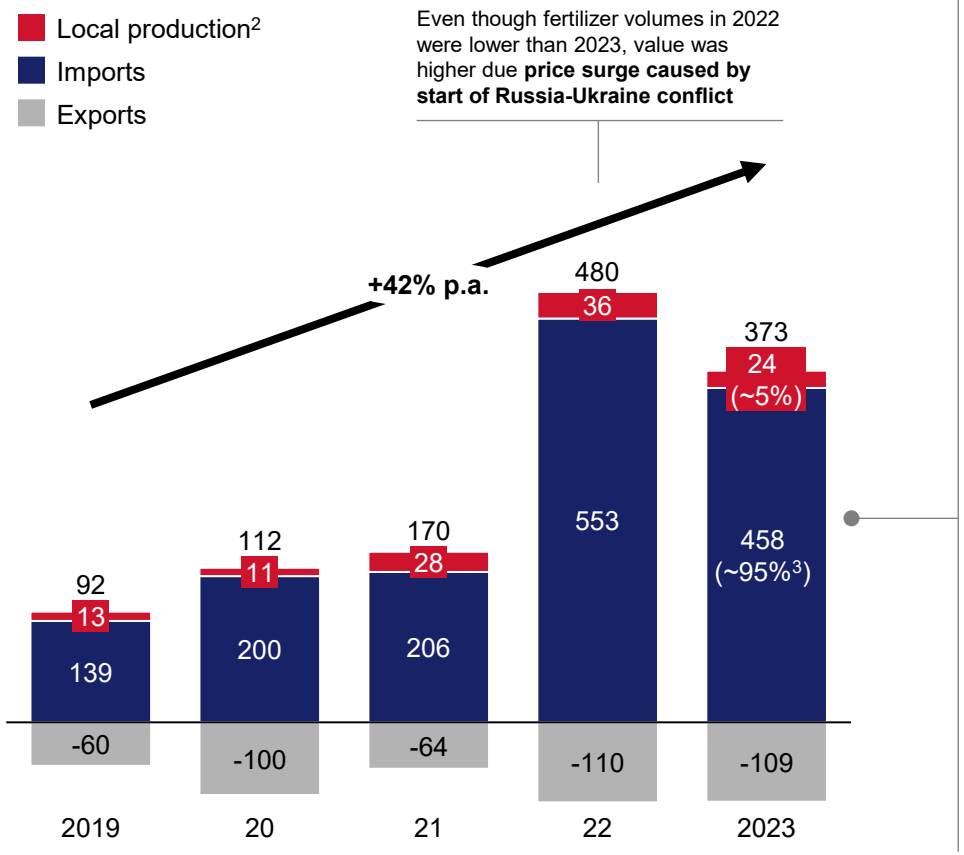
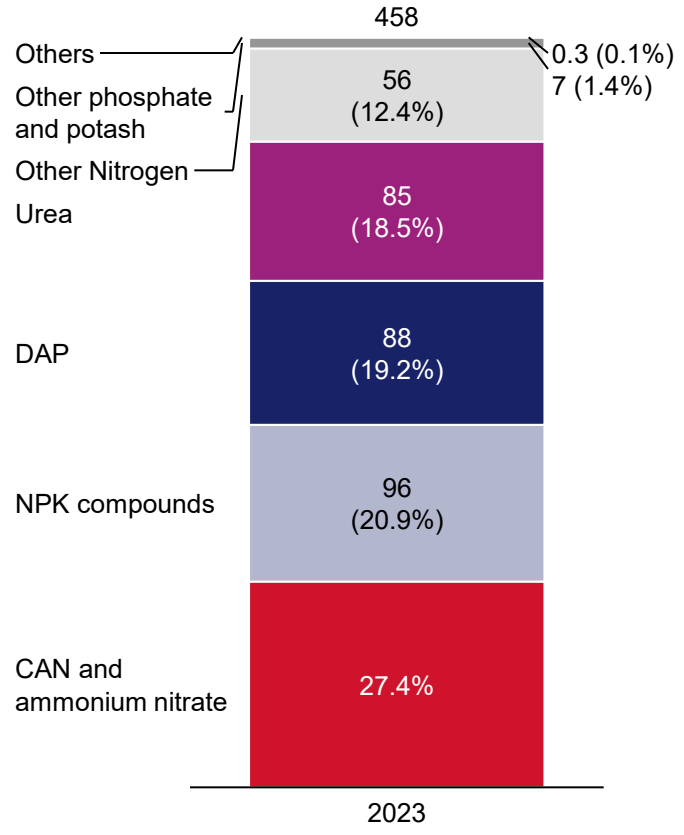
Tanzania imports ~95% of its fertilizer with DAP and NPK accounting for ~40%

Tanzania fertilizer consumption, by fertilizer type, import vs local production % share ($, M)[1]



Imported fertilizer by fertilizer type, % share ($, M - 2023)



1. Consumption = local production + import - export
2. Local production value is calculated assuming unit price equivalent to import prices
3. Percentage share of imported fertilizer that is consumed in Tanzania i.e., percentage contribution of import minus exports
4. Others include MAP, MOP, SOP, etc.,

Source: Trade map, AfricaFertilizer

XXX Details next

Insights

Fertilizer consumption has increased by ~42%, with imports accounting for **>90% of fertilizers consumed in 2023**

The primary fertilizers used in Tanzania include Urea, CAN, NPK, DAP, and others.

40% of imported fertilizers are phosphate and potash based (DAP, NPK, others[4]) amounting to ~$191 M (out of ~$458 M total fertilizer imports)

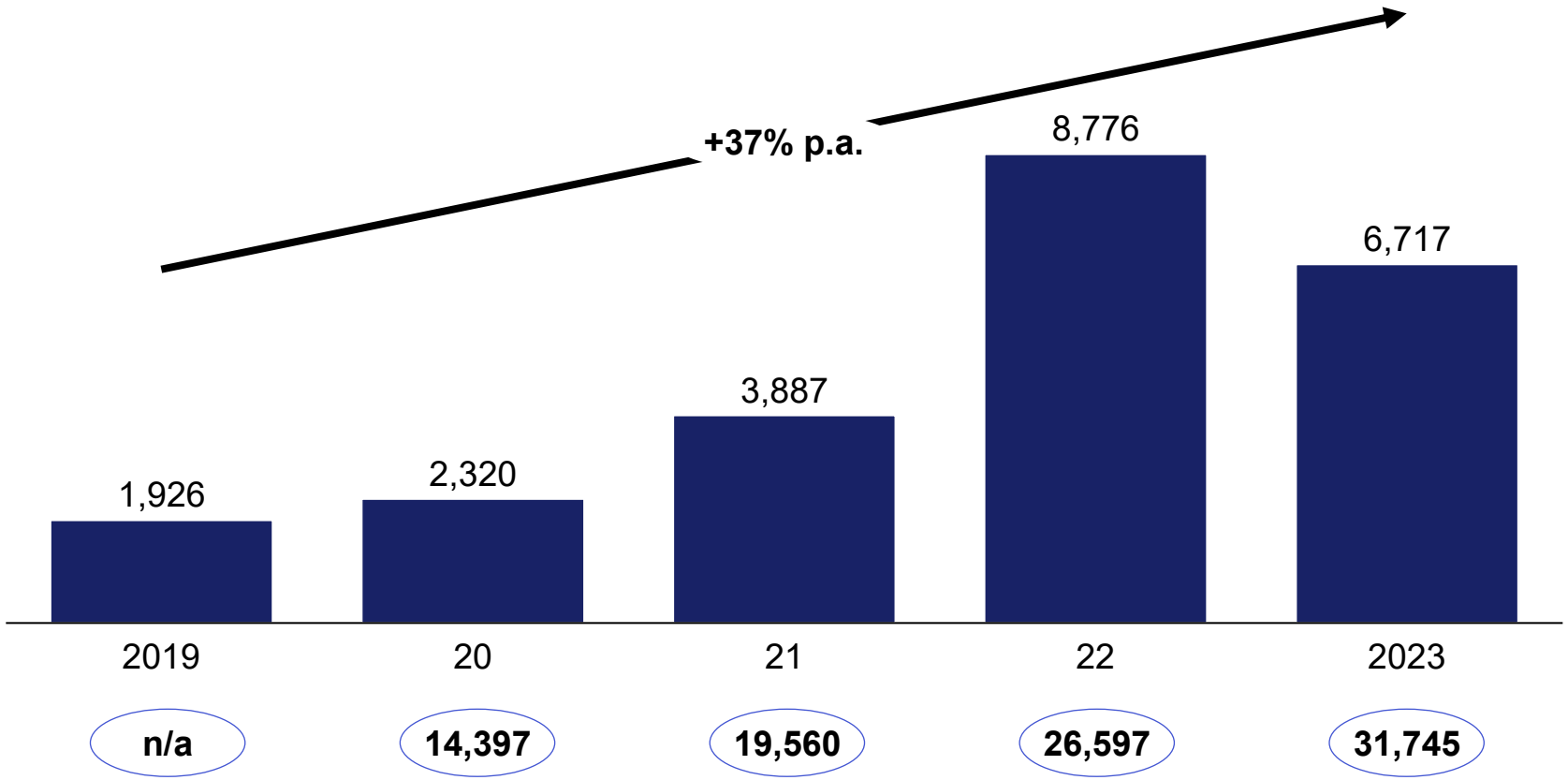
A **Phosphate** is found in phosphate ore

B **Potash** is found in potash ore

Tanzania's phosphate production grew 37% p.a. between 2019-2023

xx Volume, tonnes

Phosphate ore production value, $ M[1]



1. Conversion rate of $0.00039 to 1 TZS used

Source: Tanzania Ministry of Minerals, press search

Insights

- The **value of Tanzania's phosphate production has grown by 37%** p.a. from 2019 to 2023
- The **primary use of phosphate** is producing phosphate-based fertilizers (e.g., Minjingu Phosphate Rock (MPR) fertilizer)
- Despite fast volume growth, production would need to be scaled further to meet local demands

7 potential intermediate and end use products have been identified for phosphate and potash

	DAP[1]	NPK compounds[2]	Phosphoric acid	SSP[3]	TSP[4]	MAP[5]	NPS[6]
Opportunity	• Fertilizer made with ammonia	• Fertilizer made with ammonia and potash	• Phosphate rock processed with sulfuric acid. It is an input to most fertilizers	• Fertilizer made with sulfuric acid	• Fertilizer made with phosphoric acid	• Fertilizer made with ammonia	• Fertilizer made with ammonia and sulfur
End uses (not exhaustive)	All identified opportunities are end use products						
Approach (not exhaustive)	• Set up a fertilizer production plant, potentially vertically integrated with upstream activities or using locally produced phosphate and potash (for NPK fertilizer), for local and regional use		• Set up a processing plant to react phosphate rock with sulfuric acid		• Set up a fertilizer production plant, potentially vertically integrated with upstream activities or using locally produced phosphate, for local and regional use		
Requirements (not exhaustive)	• Scaled availability of potash		• Scaled availability of Phosphate • Availability of input materials, in particular sulfuric acid and ammonia • Cost competitive transportation infrastructure				

1. Diammonium phosphate | 2. Nitrogen Phosphorous Potassium | 3. Single Superphosphate | 4. Triple Superphosphate | 5. Monoammonium phosphate | 6. Nitrogen Phosphate Sulphur

Out of possible phosphate products, DAP and NPK fertilizers emerge as a potential opportunity for Tanzania (1/2)

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A DAP	B NPK compounds[2]	C Phosphoric acid
Market dynamics	Demand	Tanzania imports ~$54 M (2023)[3] Remaining EAC and Zambia imports ~$182 M (2023)	Tanzania imports ~$94 M (2023) Remaining EAC imports ~$170 M (2023)	Tanzania imports ~$400k (2023) Remaining EAC import ~$30 M (2023)
	Supply	No local production	Existing limited production but only blending of other imported fertilizers (e.g., DAP,MOP)	No local production
Competitive landscape		Existing export activity - re-exports $33.9 M (22% of imported) to Burundi, Zambia	The top 5 countries accounted for over 80% of NPK exports by volume in 2019[3]	Morocco controls 49% global trade
		Top 5 countries control >90% of global export –Tanzania sources >50% DAP from Morocco[1]		
Share of priority mineral		65%	6% - 30%	54-60%
Availability of inputs	Raw materials	Ammonia and phosphoric acid are not locally available Ammonia could be produced from Tanzania's natural gas reserves, dependent on realization of planned projects	Ammonia, phosphoric acid and potassium chloride not locally available	Sulfuric acid is not available locally Sulfuric acid could be sourced from local metal smelters, as it's produced as a bi-product
	Energy	Moderate energy intensity		
	Capabilities or skills	Limited expertise in chemical processing, which are not difficult to develop		
	Physical Infrastructure	Moderate infrastructure development required to ensure sustainable water supply		
	Technology (IP)	Limited technology availability but are widely accessible and not restricted by proprietary IPs		
Policy and regulatory landscape		Supportive policy framework with no major regulatory barriers		

1. Morocco, China, Saudi Arabia, Russia, and the US | 2. Includes different types of NPK compounds e.g., NK | 3. Net imports

Source: Trade map, Fertilizer Statistics Overview Tanzania 2024

Out of possible phosphate products, DAP and NPK fertilizers emerge as a potential opportunity for Tanzania (2/2)

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		D SSP	E TSP	F MAP	G NPS
Market dynamics	Demand	Supersulphates1 having an import value of ~$1.1 M in 2020 for Tanzania Remaining EAC imports ~$600k (2023)		Tanzania imports ~$2 M (2023) Remaining EAC import $1.6 M (2023)	N/A2
	Supply	No local production		No local production	Existing local production but not end to end – only blending
Competitive landscape		Fragmented market (notably Egypt, India, and China)		Controlled by global players	Relatively new product – controlled by Morocco
		Top 5 countries control >90% of global export –Tanzania sources >50% DAP from Morocco[3]			
Share of priority mineral		12%	46%	50-56%	5-20%
Availability of inputs	Raw materials	Sulfuric acid is not available locally Sulfuric acid could be sourced from local metal smelters, as it's produced as a bi-product	Phosphoric acid is not available locally Phosphoric acid could be produced depending on availability of sulfuric acid	Ammonia and phosphoric acid are not locally available Ammonia could be produced from Tanzania's natural gas reserves, dependent on realization of planned projects	Ammonia, sulfuric acid and phosphoric acid are not locally available
	Energy	Moderate energy intensity			
	Capabilities or skills	Limited expertise in chemical processing, which are not difficult to develop			
	Physical Infrastructure	Moderate infrastructure development required to ensure sustainable water supply			
	Technology (IP)	Limited technology availability but are widely accessible and not restricted by proprietary IPs			
Policy and regulatory landscape		Supportive policy framework with no major regulatory barriers			

1. Morocco, China, Saudi Arabia, Russia, and the US

Source: Trade map, Fertilizer Statistics Overview Tanzania 2024

DAP/NPK Fertilizers: Potential for an NPV of up to $73.6M and an IRR of 15%, assuming a 10% interest rate and 5-year tax break

Business Case Outputs		Scenario 1 (15% discount rate, no tax break)	Scenario 2 (10% discount rate, no tax break)	Scenario 3 (10% discount rate, 5yr. tax break)
Capacity	**DAP & NPK**, '000 tonnes/yr.	**200**	Same as scenario 1	
Revenue	**Annual Revenue,** avg. $ M	**128.4**		
Cost	**COGS,** avg. $ M/year	**64.1**		
	Processing, avg. $ M/yr.	**16.2**		
	CAPEX, total $ M	**214**		
Project economics	**NPV**, $ M	**-26.8**	**34.2**	**73.6**
	Operating margin, %	**38%**	Same as scenario 1	
	IRR, %	**12**	**12**	**15**
	Payback, years	**6**	**6**	**5**
Additional impact metrics	**Government revenue (tax),** $ M	**83.4**	**114**	**106.8**
	Number of jobs, #	**250**		

Key Observations

- The most attractive scenarios for DAP and NPK fertilizer opportunities **has an NPV of ~$73.6M and 15% IRR**
- Economic viability of business case depends on
  - **Scale:** The industry is a capital-intensive industry and needs to reach a minimum scale of ~200k to be economically viable
  - **Preferential terms:** Incentives and low cost of capital are required, e.g., a 5-year tax break and/or 10% cost of capital
- Business case assumes 200ktonnes p.a. capacity which would be sufficient to meet domestic demand (200-220 '000 tonnes p.a for phosphate & potash-based fertilizer).
- However, **further exploration of phosphate** is required to **scale production beyond**

Source: Expert input, trade map, PWC, company reports, press search

DAP/NPK Fertilizers: Business case key assumptions

High-level assumptions

- Commercial fertilizer processing plant which could **process both DAP and NPK in the same facility**
- Assumes a non-integrated plant **starting operations in 2030** (mid-Horizon 2) and operating **until 2047**, **utilizing 5M tonnes of proven phosphate reserves**

Opportunity setup assumptions

Average unit price (market price)	
• **NPK,** $/tonne	657
• **DAP,** $/tonne	679
Raw material volume	
• **NPK total raw materials input**[1], '000 tonnes p.a.	116
– **Phosphate rock,** '000 tonnes p.a.	58(50%)
– **Potassium chloride ,** '000 tonnes p.a.	30 (26%)
– **Ammonia,** '000 tonnes p.a.	22 (19%)
– **Sulphur,** '000 tonnes p.a.	6 (5%)
• **DAP total raw materials input**[2]**,** '000 tonnes p.a.	176
– **Phosphate rock,** '000 tonnes p.a.	148(84%)
– **Potash** , '000 tonnes p.a	22 (13%)
– **Sulphur ,** '000 tonnes p.a	6 (3%)
Ramp up volume (share of output)	
• **Year 1 ramp up,** %	50%
• **Year 1 ramp up,** %	80%
• **Year 1 ramp up,** %	100%

Global average CAPEX	
• **CAPEX,** $/tonne	1000
Tanzania Processing OPEX & CAPEX	
• **Tanzania cost premium,** %	20
• **Processing cost**[3]**,** $/tonne	168
• **CAPEX**[4]**,** $/tonne	1070
Other assumptions	
• **Project start yr,** yr	2030
• **Project timeline,** yrs	18
• **Corporate tax,** %	30
• **Discount rate**	
– **Scenario 1,** %	15
– **Scenario 2 & 3,** %	10
• **Tax holiday,** yrs	
– **Scenario 1 & 2,** %	N/a
– **Scenario 3,** %	5 yrs.

1. This is assuming the 18% of nitrogen, 18% of phosphate, 18% of potassium and 6% of sulphur. This may change the compositions of nitrogen, phosphate and potassium may go up to 18% each of the total NPK volume | 2. This is assuming 46% of phosphate, 18% of Nitrogen and 6% of sulphur used as raw material composition. This may also look different based on the different inputs | 3. Used India as proxy and multiplied by 3 to contextualize to Tanzania | 4. 20% additional Tanzania cost premium applied to only 35% of the CAPEX, since 65% of the CAPEX is machinery and equipment, which wouldn't have specific Tanzania premium

Source::Expert input, trade map, PWC, company reports, press search

For local NPK and DAP production, Tanzania may need to secure raw materials, incentivize production, and support cost reducing initiatives

Dimension	What we need to believe
Incentives	Targeted subsidies and tax **incentives to make domestic fertilizer production more attractive** than imports
Cost competitiveness	There is **sufficient local and regional demand** (e.g., at least 200,000 tonnes annually, with potential to scale up to 1M tonnes for DAP/MAP, NPK production) to justify investment in local production Local production in Tanzania would achieve **cost competitiveness with major players like Morocco, leveraging lower transport costs to regional markets** as a key advantage for export viability **Co-production of DAP and NPK fertilizers** would be undertaken as it uses shared infrastructure and enables economies of scale
Priority mineral production	Tanzania would have **sufficient good quality phosphate production to meet the threshold fertilizer production** volume(i.e., existing reserves (e.g., Panda Hills) would be tapped into to ramp up production) There are **unexplored potash resources** that, if confirmed, could provide a domestic source of potassium for NPK fertilizers
Raw material sourcing	**Sulfuric acid and ammonia production could be localized,** and it would be logistically viable to source it, reducing dependence on imports • Sulfuric acid can be sourced **from metal smelters close to production lines or produced from Tanzania's natural gas** • **Ammonia production from domestic natural gas reserves** (e.g., Mtwara project) would ensure a secure nitrogen supply

Source: Expert inputs, press search

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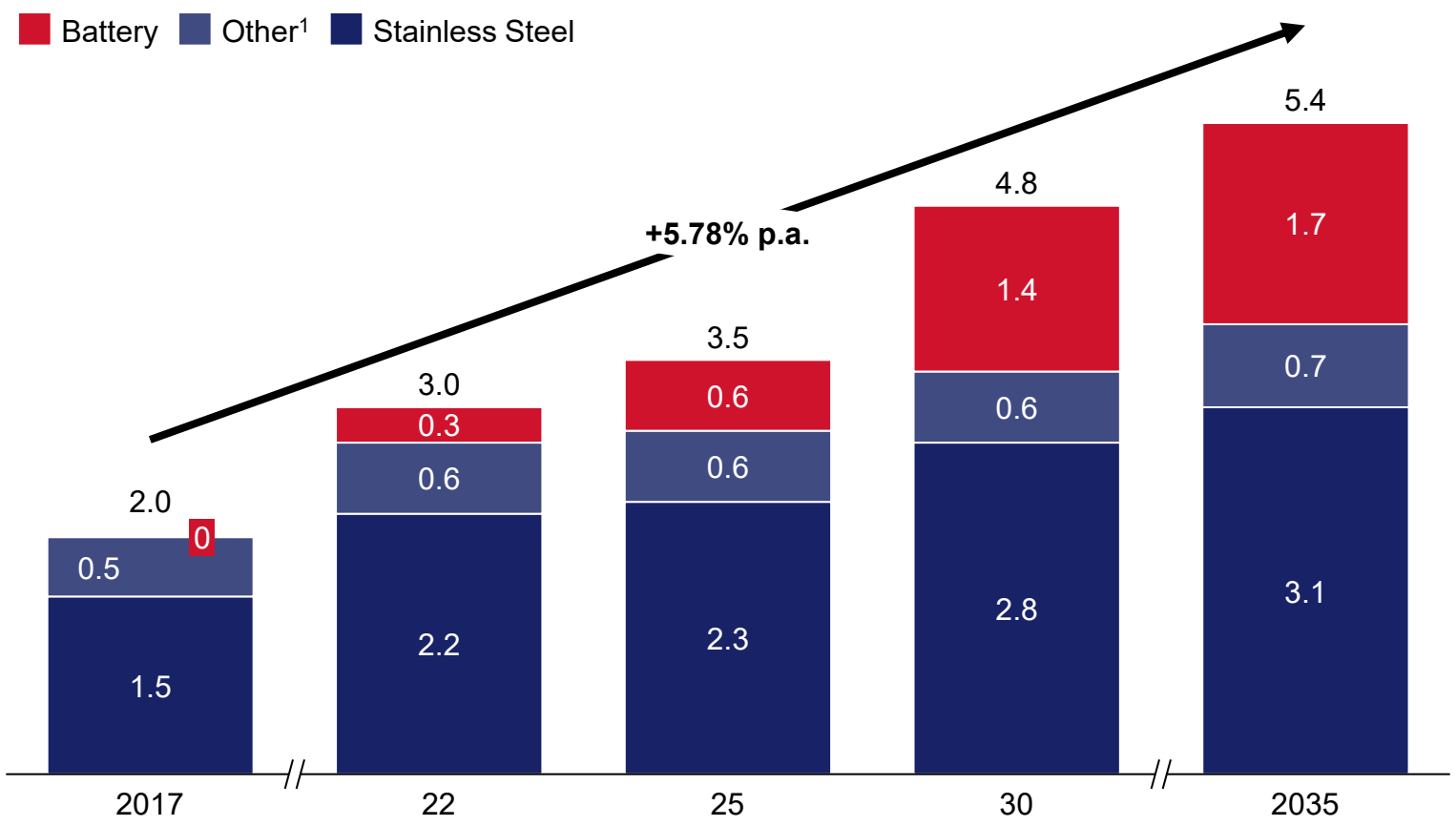
Nickel demand is expected to increase through 2035 driven by significant growth in batteries and positive contribution from stainless steel

BASE CASE3

Primary Nickel Demand[2], M tonnes



XX Total CAGR

CAGR

	2017-22	2022-35	2035-50
	9%	5%	1%
Battery	n/a	14%	-2%
Other[1]	2%	2%	2%
Stainless Steel	8%	3%	1%

Slowdown of battery demand growth driven by **high recycling rates** and increased **uptake of battery compositions that do not contain nickel** (e.g LFP)

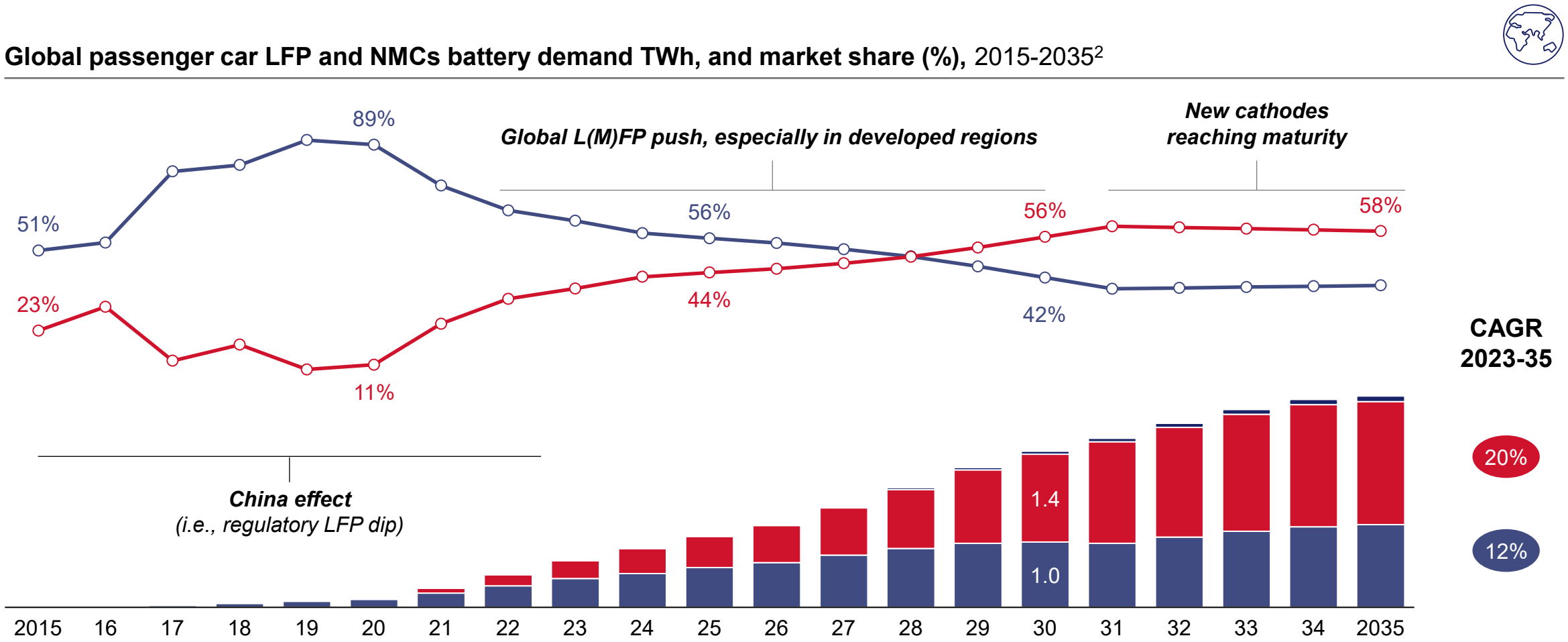
1. Includes Alloy Steels, Foundry, Non-Ferrous Alloys, Plating, etc. | 2. Battery scrap assumptions: 12 Year lifetime (smoothen over 3 years), Collection rate of 95%, Manufacturing yield of 90%; Stainless Steel scrap assumptions: 12 Year lifetime, Collection rate of obsolete (70%), prompt (90%), home(98%) | 3. ~60% penetration of EVs in 2035 (of which ~5pps. PHEV), Ni-based CAM in batteries represent ~47% of total GWh in 2035, Battery scrap:12 Year lifetime, Collection Rate of 95%, Manufacturing yield of 90%

Source: Minespans, USGS

Battery demand is expected to increase globally, but demand is expected to shift to non-nickel-based chemistries such as LFP

2024 Q3

Global passenger car LFP and NMCs battery demand TWh, and market share (%), 2015-2035[2]



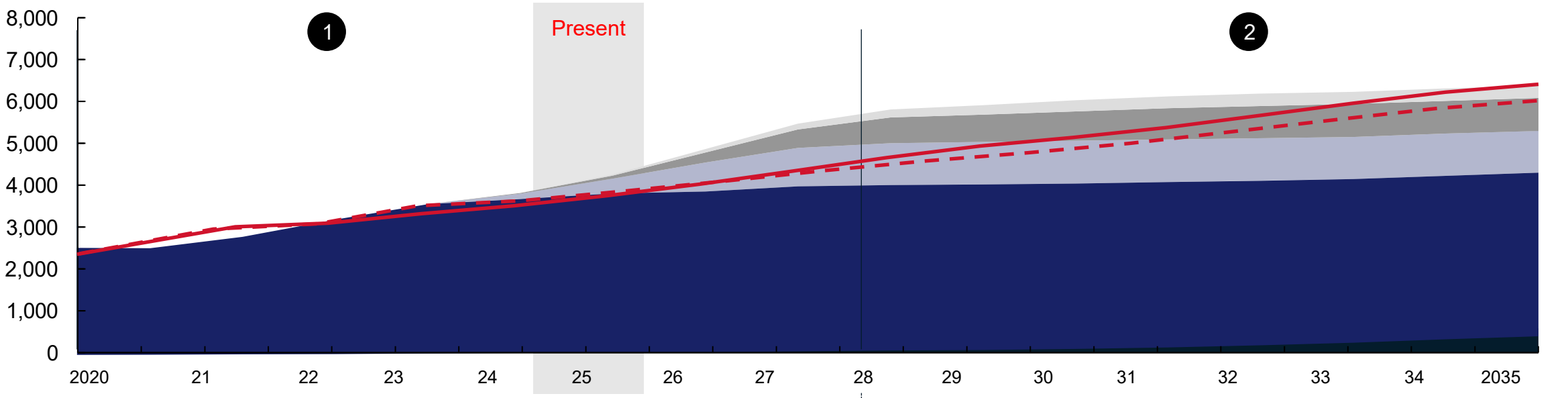
1. LMO, LMNO included
2. Demand is based on EV production location. SSBs are excluded from demand. Chemistry split based on regional end user preferences

Source: McKinsey Battery Insights

Rapidly ramped up production has led to an oversupply that could last at least until 2030 even if demand accelerates

Demand[1]: Further Acceleration, Current Trajectory Supply[2]: Recycling, Low case, Base Case, High Case, Full Potential

Refined nickel supply capacity and demand, kt nickel



1	**Demand**	Demand picks up due to increase in EV battery demand and constant stainless steel growth
	Supply	Many operations coming online, particularly in Indonesia

2	**Demand**	Strong growth of EV demand with stable stainless steel demand
	Supply	Based on current announcements, supply depends on less feasible projects, recycling will pick up by 2035

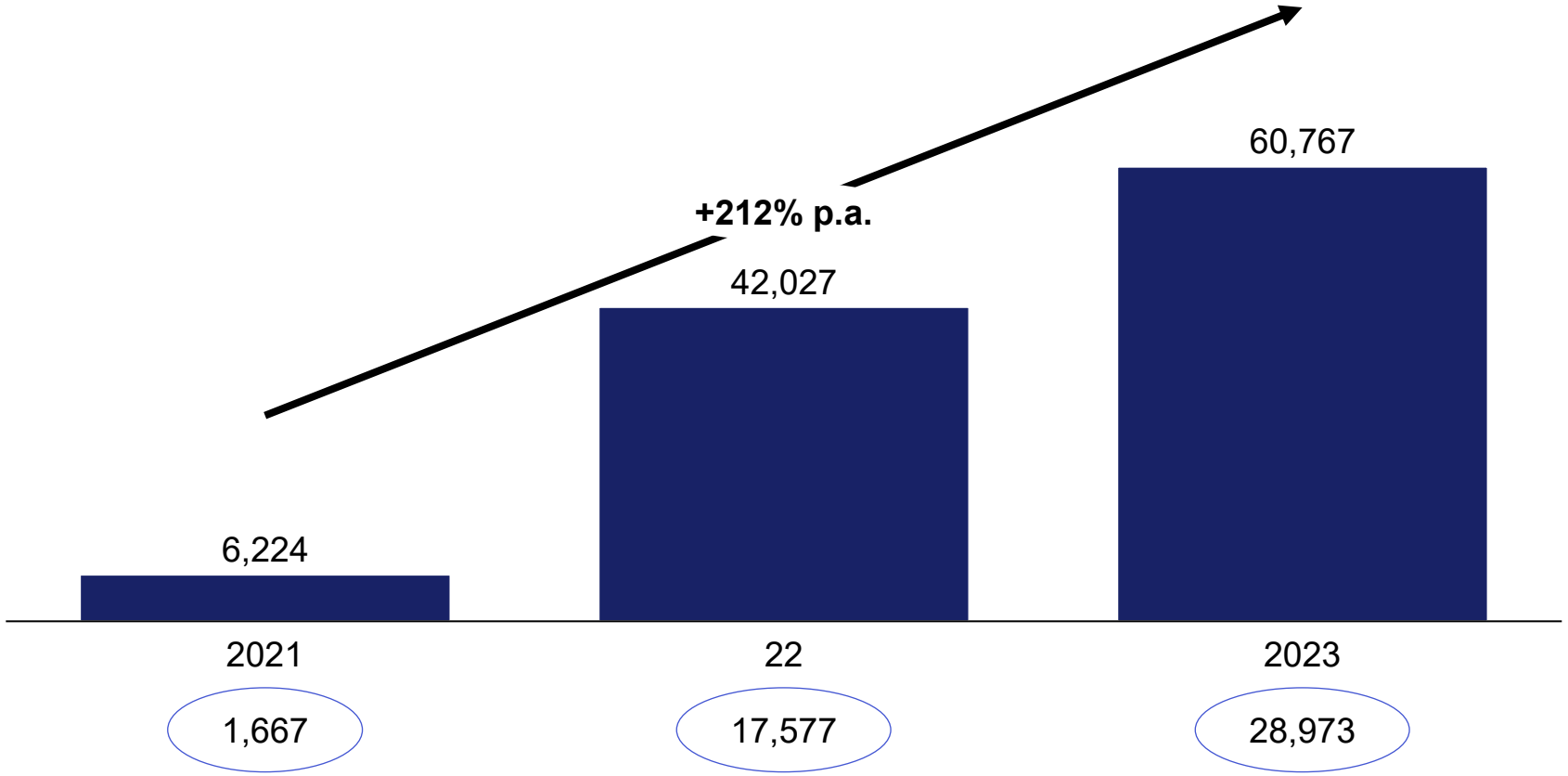
1. Demand –Current trajectory: Base stainless-steel demand, base automotive demand with base chemistry; Further acceleration: High stainless-steel demand, aggressive automotive demand with base chemistry
2. Supply - Low case: Current operations; Base case: Advanced projects; High case: Projects in construction or feasibility confirmed: Full potential: Feasibility not confirmed

Source: MineSpans

Nickel production volumes in Tanzania are rapidly growing, however production levels remain low on a global level

xx Value, 000' $[1]

Tanzania's nickel production volume, tonnes



1. Conversion rate of $0.00039 to 1 TZS used

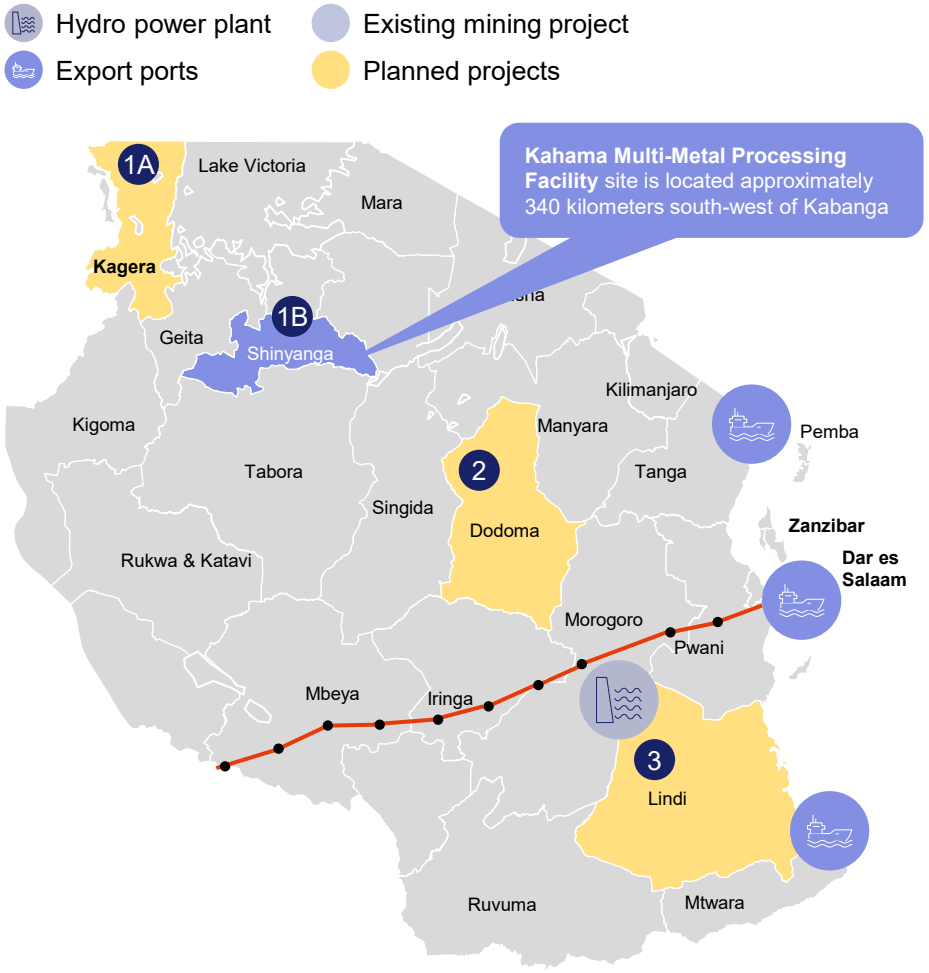
Source: Tanzania Ministry of Minerals, Press search

Insights

- While nickel production **increased significantly at >200% p.a. from 2021 to 2023** to reach ~60k tonnes in 2023, significant growth is required to become a relevant global supplier
- Tanzania currently produces low volumes of nickel with **less than 0.002% of global production**
- Nickel produced in Tanzania is primarily **exported to China with ~$20 M** to total exports in 2023

Kabanga is a flagship nickel project set to strengthen Tanzania's supply position and unlock opportunities for producing battery-grade nickel

ILLUSTRATIVE **NON-EXHAUSTIVE**



1 **Kabanga Nickel Project** (Kagera)

Status: Feasibility study ongoing

58M tonnes of high-grade nickel sulfide resource with 2.62% nickel content (1.86M tonnes nickel equivalent)

2 **Haneti Project** (Dodoma)
Status: Development paused

3 **Ntaka Hill Nickel Project** (Lindi)

Status: Under exploration

Further exploration could yield additional nickels reserves (e.g., Tanzania has 1.5M tonnes of laterite ores)

Insights

LIFEZONE METALS

A Mining

- Kabanga project is a joint venture between **Lifezone Metals and the Tanzanian government**
- Set to boost Tanzania's **nickel production to 40,000 tonnes/year**
- Kabanga is reported to begin production in 2025-2026, however concerns of oversupply may postpone start dates with some **experts projecting a delay until 2028**

B Value addition

- $500M energy-efficient **mine-to-metal processing plant** planned in Kahama to produce **battery-grade nickel**, copper, and cobalt
- Utilizes **Hydromet Technology** for lower environmental impact and energy intensity
- Proven through successful **nickel cathode production** tests
- MoU signed with Jogmec to **secure offtake** of cleaner metals for **Japan's battery industry**

Source: Press search, TMIC magazine

4 potential intermediate and end use products have been identified for nickel

	Matte	Nickel Sulphate	Nickel Metal	EV Battery Cell Production
Opportunity 	• Produce nickel matte, which is an intermediate product in the refining process with 30-70% nickel content	• Produce nickel sulphate which is a soluble metal salt compound	• Produce nickel metal which is a high purity metallic nickel	• Producing lithium-ion batteries for use in electric vehicles
End uses (not exhaustive) 	• Nickel Sulphate • Nickel Metal	• Lithium-ion batteries • Electroplating catalysts • Specialty chemicals	• Stainless steel • Nickel based alloys • Plating • Batteries	• Electric vehicles
Approach (not exhaustive) 	• Establish a nickel refinery plant • Partner with companies with existing plans to build nickel refineries	• Build a processing plant to react cobalt oxide or metal with sulfuric acid	• Establish a refinery that converts cobalt ore to refined metal • Partner with companies with existing plans to build nickel refineries	• Build a giga-factory for production of batteries
Requirements (not exhaustive) 	• High quantities of energy for smelting	• Construct processing plant • Source input materials, especially sulfuric acid	• High quantities of energy for refining process	• Access to input materials for anodes and cathodes • Intellectual property and expertise

Nickel sulphate and nickel metal emerge as a potential opportunity for Tanzania

Summary of assessment by product

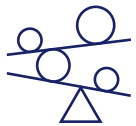
Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Nickel sulphate	B Nickel metal[1]	C Matte	D EV battery cell production[2]
Market dynamics	Demand	$1.5 B of global trade (2023) Limited local and regional demand	$14 B of global trade (2023) Limited local and regional demand	$8 B of global trade (2023) Limited local and regional demand	Growing global demand for EV batteries; NMC expected to still account for ~40% of li-ion batteries by 20353 Limited local and regional demand
	Supply	No local production			
Competitive landscape		Over 70% of nickel sulfate production takes place in China		Indonesia supplies 93% of China's matte imports in 2023 (which accounts 35% of global imports)	Top 2 players hold 50% of the market
		Tanzania's high grade Sulfide ore would make it cost competitive, but Indonesian battery-grade nickel capacity may double by 2027			
Share of priority mineral		22%	99%	30 – 80%	Not applicable
Availability of inputs	Raw materials	Sulfuric acid or ammonia for leaching needed which Tanzania currently only imports	Required hydrogen gas is not locally available	Fluxes (limestone, silica) and coal for smelting - available in Tanzania	Requires cobalt, manganese, lithium, graphite which are available in Tanzania in their raw forms, but processed materials would need to be imported
	Energy	High energy intensity through commonly used pyrometallurgical methods			High intensity, but does not necessarily require a dedicated power plant
	Capabilities or skills	Advanced skills required for nickel smelting and chemical engineering			Highly advanced skills required in battery cell production
	Physical Infrastructure	Some infrastructure development including power supply, water treatment and logistics			Very significant infrastructure development, e.g., building a giga factory
	Technology (IP)	IP and technology for producing nickel sulphate, metal and matte are not strictly proprietary			High-tech battery IP is tightly controlled
Policy and regulatory landscape		Supportive policy framework with no major regulatory barriers			Tax incentives in US, EU and China which are key demand centres

1. Represents powder, briquettes, cathode and pellets | 2. Lithium-ion battery cells (NMC) | 3. Lithium-ion accumulators (excl. spent) import data from trade map

Source: The world nickel factbook 2024, expert inputs, press search, Nickel memo Bhuwalka Olivetti, trade map

While nickel metal and nickel sulfate have potential, Tanzania should "wait and see" as short-term market dynamics make viability uncertain

Dimension	Description	What we need to believe
Price collapse & profit margins shrink 	• **Nickel prices crashed** from $48,000/tonnes (Mar 2022) to $16,000/tonnes (Mar 2024) due to Indonesia's supply surge • Major players like BHP, IGO, and First Quantum in Western Australia are already **cutting production and closing mines** • Philippines **potentially adding more supply** by restricting raw ore exports for domestic refining	• Indonesia would **limit the amount of product supplied** which helps regulate the market • The supply **projections are overestimated** and that planned probable projects are not realized
Weak demand & market shifts 	• **LFP batteries are replacing nickel-based NMC batteries** in low-range EVs • **Lower than expected EV adoption** is muting overall battery demand • **Evolving geopolitical dynamics** are influencing global demand centers (e.g., the U.S. explores diversified supply chains beyond China)	• **Market for NMC batteries would remain large enough** given shifts towards battery compositions that do not contain nickel • **New momentum in EV uptake** driving up overall battery demand • **Slower than expected improvement of LFP cell chemistry** slowing transition away from NMC

Source: Expert inputs, press research

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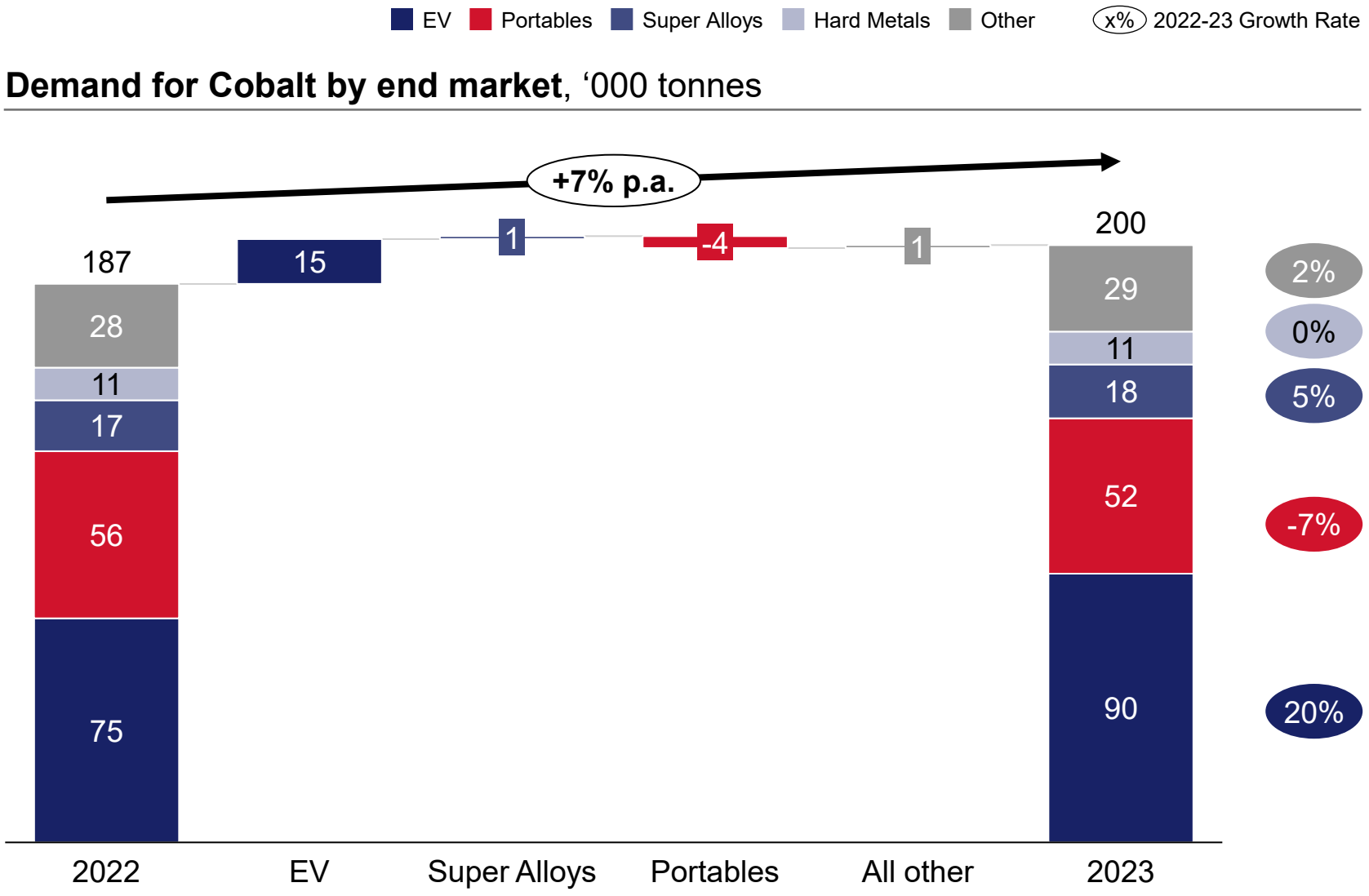
Demand for cobalt is driven by electric vehicles and portables batteries and supper alloys

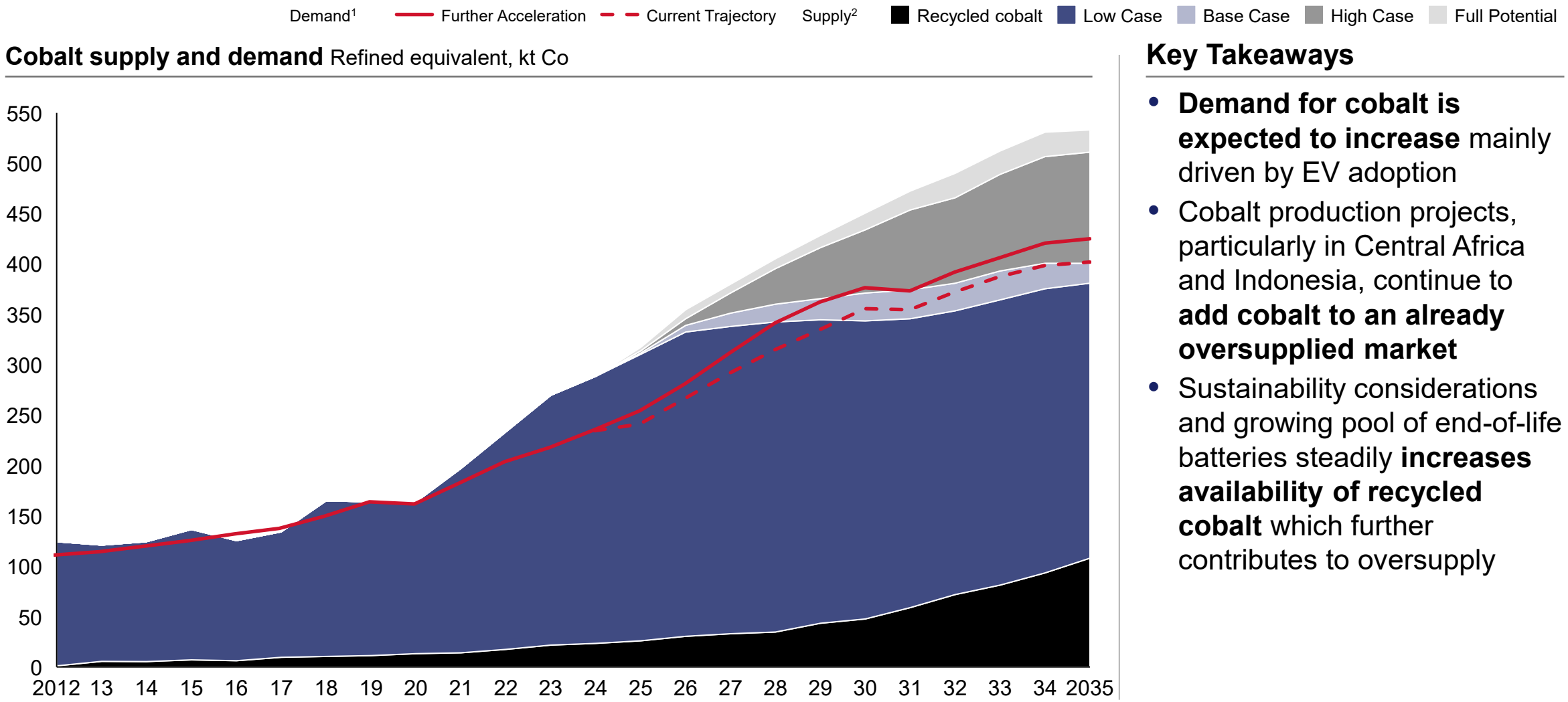


Insights

- **EV batteries** contribute **45% of cobalt demand** and **contributes ~90% of growth** year on year form 2022-23
- **Demand for portable batteries is shrinking** driven by longer battery shelf lives and longer sales cycles for electronic devices
- **Superalloys are ~9% of total market** with limited growth and high barriers of entry driven by cobalt superalloys being a niche market

Source: Cobalt Institute Cobalt Market Reports 2022 & 2023

Cobalt demand will grow over the next decade, however current and planned supply will exceed demand



Cobalt supply and demand Refined equivalent, kt Co

Key Takeaways

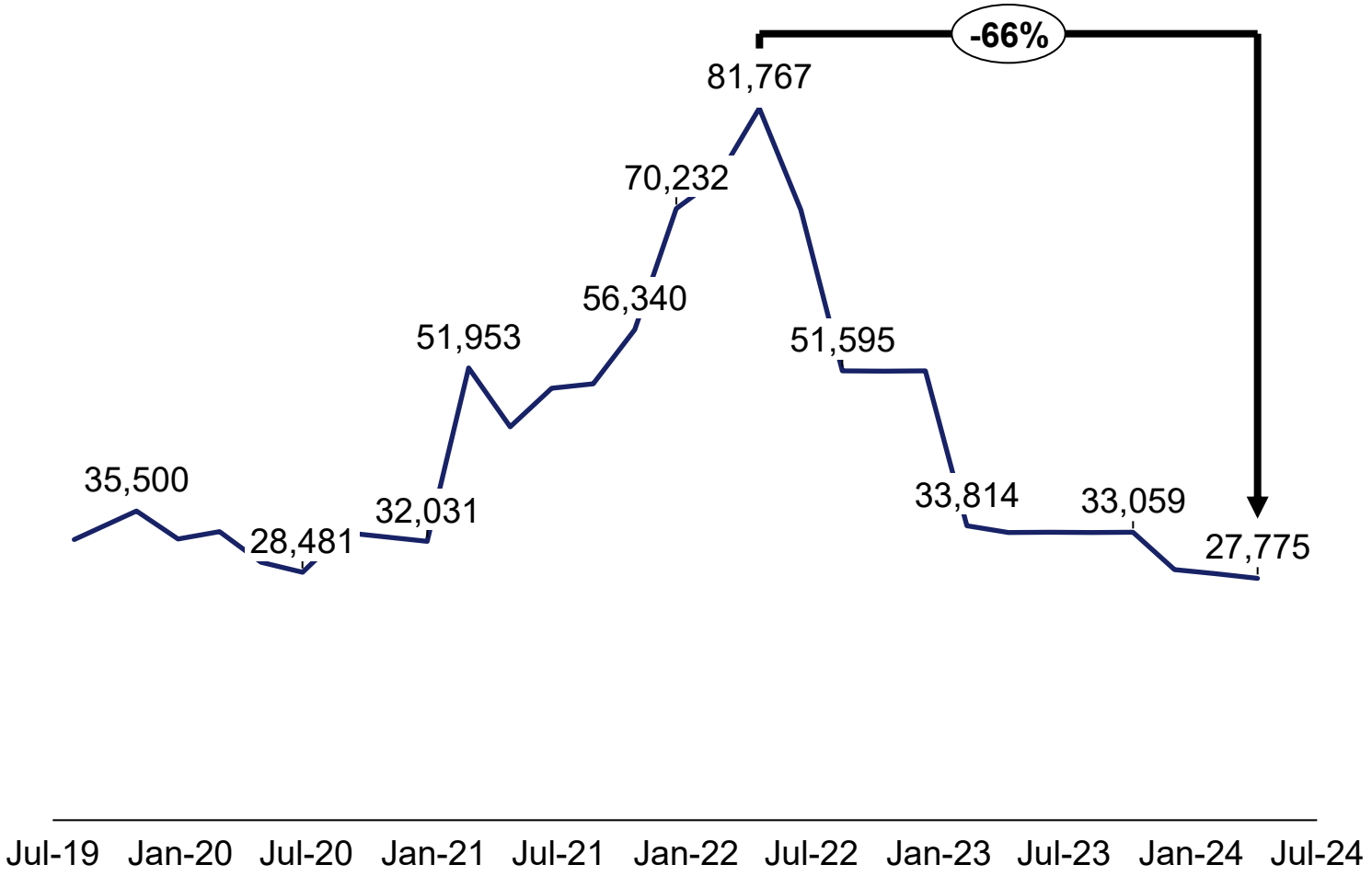
- **Demand for cobalt is expected to increase** mainly driven by EV adoption
- Cobalt production projects, particularly in Central Africa and Indonesia, continue to **add cobalt to an already oversupplied market**
- Sustainability considerations and growing pool of end-of-life batteries steadily **increases availability of recycled cobalt** which further contributes to oversupply

1. Demand – Current trajectory: Base stainless steel demand, base automotive demand with base chemistry; Further acceleration: High stainless steel demand, aggressive automotive demand with base chemistry
2. Supply - Low case: Current operations; Base case: Advanced projects; High case: Projects in construction or feasibility confirmed: Full potential: Feasibility not confirmed

Source: MineSpans

Market price of cobalt has been declining from 2022 driven by oversupply from Indonesia and DRC

Price of cobalt worldwide, $ per metric tonne



Source: Statista Cobalt Price Globally

Key Takeaways

- Market prices increased from 2020 to **reach an all time high in March 2022** driven by **supply chain disruptions** from the COVID-19 Pandemic
- Market prices have been **declining from mid-2022 driven by increased production** from the DRC and Indonesia
- **Expected increase in supply** will result in **further market price decline**
- Despite this, **cobalt is a by-product of nickel or copper mining,** and the **market prices of these primary metals play a more significant role** in determining the feasibility of a mining project

Tanzania does not currently produce cobalt, however the Kabanga-Kahama project is expected to make it a relevant global supplier

ILLUSTRATIVE **NON-EXHAUSTIVE**

Kabanga Nickel Mine

Output	Cobalt-Nickel (Cu-Ni) alloys
Mining	Underground mine with large deposit
Planned production	2,500 tonnes
Proposed start date	2025 / 2026 (delay expected)

1. Benchmark: 2024 Production

Source: TanzaniaInvest, Press Releases, TMIC, BHP, NPR

Key Considerations

- **Tanzania does not currently produce cobalt,** however the Kabanga nickel mine is expected to produce **cobalt as a bi-product**
- The Kabanga Nickel mine has planned production of **2,500 tonnes** of cobalt per year which would make it the **12th largest Cobalt producer contributing 0.9% of global supply**
- The **Kahama refinery,** which is integrated to the Kabanga mine**, has received licensing for cobalt metal**
- Kabanga is reported to begin production in 2025 -2026, however concerns of oversupply may postpone start dates with some **experts projecting 2028 commencement of mining**

5 potential intermediate and end use products have been identified for cobalt

	Cobalt Sulphate	Cobalt Metal	Cobalt Based Super Alloys	EV Battery Cell	Electronics Battery Cells
Opportunity 	Produce cobalt sulphate which is a soluble metal salt compound	Produce cobalt metal which is a refined form of cobalt metal	Produce superalloys which are temperature resistant, durable materials used in industrial processes	Produce lithium-ion batteries for use in electric vehicles	Produce lithium-ion batteries for use in portable devices like phones, laptops, etc.
End uses (not exhaustive) 	Animal feeds Industrial uses including electroplating, driers, etc. Pigments	Batteries Magnets Superalloys Cutting tools	Aerospace and gas turbines Power generation Chemical and biomedical equipment	Electric vehicles	Portable electronics
Approach (not exhaustive) 	Creating processing plant to react cobalt oxide or metal with sulfuric acid	Establish a refinery that converts cobalt ore to refined metal	Establish a factory with high temperature equipment and castings	← Build a giga-factory for production of battery cells →	
Requirements (not exhaustive) 	Source input materials, especially sulfuric acid	High quantities of energy	High quantities of energy Input materials including chromium, tungsten, iron, etc.,	← • Access to input materials for anodes and cathodes • Intellectual property and expertise →	

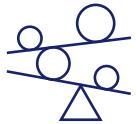
Cobalt sulphate and metal emerge as feasible downstream opportunities for Tanzania

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Cobalt Sulphate	B Cobalt Metal	C Cobalt Based super alloys	D EV Battery Cell	D Electronics Batteries Cell
Market dynamics	Demand	~$3.5 B market, growth driven by EV market, limited local and regional demand	$16 B market, growth driven by EV market, limited local and regional demand	$3 B market, 5% CAGR driven by aerospace industry, limited local and regional demand	$68B market, growth driven by energy transition, limited local and regional demand	>$14B, short-term decline but expected to recover by 2030, limited local and regional demand
	Supply	Planned production of cobalt metal which can be processed into sulphate	Planned production, however market is oversupplied	No current or planned local production	No current or planned local production	No current or planned local production
Competitive landscape		Top 5 global producers control >50% of the market	Top 5 global producers control >50% of the market with China refining >75%	Consolidated, niche market – players tend to have full alloy range	Top 2 players hold 50% of the market	Top 3 players control 80% of the market
Share of priority mineral		100%	99.9%	Up to 70%	<20%	
Avail-ability of inputs	Raw materials	Sulfuric acid and sodium hydroxide can be imported	No additional raw materials required	Requires several other minerals like chromium, tungsten, iron, etc.,	Requires cobalt, manganese, lithium, graphite which are available in Tanzania in their raw forms, but processed materials would need to be imported	
	Energy	Low energy intensity, processes are hydrometallurgical	High energy intensity of smelting	High energy intensity of vacuum induction melting	High energy required for cell production	
	Capabilities or skills	Limited advanced skills required	Limited advanced skills required	Limited advanced skills required	Advanced technical skills required	
	Physical Infrastructure	Requires hazardous material treatment	Some infrastructure development including power supply, water treatment and logistics		Very significant infrastructure development, e.g., building a giga factory	
	Technology (IP)	Publicly available	Publicly available		IP held by top players	
Policy and regulatory landscape		N/A	N/A	N/A	Tax incentives in US, EU and China which are key demand centers	N/A

Source: Cobalt Institute, Fortune Business Insights, Globe NewsWire, Market Research Future, FactMR, MMR, PromoMarket Report, Statista

In order for Cobalt downstream production to be viable in Tanzania, the global Nickel market needs to recover

Dimension	Description	What we need to believe
Nickel Market Recovery 	• **Tanzania's cobalt is primarily a by-product of nickel mining,** particularly from laterite and sulfide deposits. • Therefore, the economic incentive to extract cobalt depends heavily on the profitability of nickel operations. • **The current oversupplied nickel market reduces the economic feasibility** of mining projects, which in turn diminishes cobalt production.	• **Nickel prices will recover or stabilize** at a level that makes nickel mining economically attractive, thereby supporting cobalt by-product production.[1] • **Cobalt demand** (e.g., from EV batteries or industrial uses) **remains strong enough** to justify investment in processing and refining infrastructure, even when cobalt is not the primary target of mining operations.
Weak demand & market shifts 	• **LFP batteries are replacing cobalt-based NMC batteries** in low-range EVs • **Lower than expected EV adoption** is muting overall battery demand • **Evolving geopolitical dynamics** are influencing global demand centers (e.g., the U.S. explores diversified supply chains beyond China)	• **Market for NMC batteries would remain large enough** given shifts towards battery compositions that do not contain cobalt • **New momentum in EV uptake** driving up overall battery demand • **Slower than expected improvement of LFP cell chemistry** slowing transition away from NMC

1. This requires resolution of nickel oversupply. For details refer to deep dives on nickel.

Source: Expert inputs, press research

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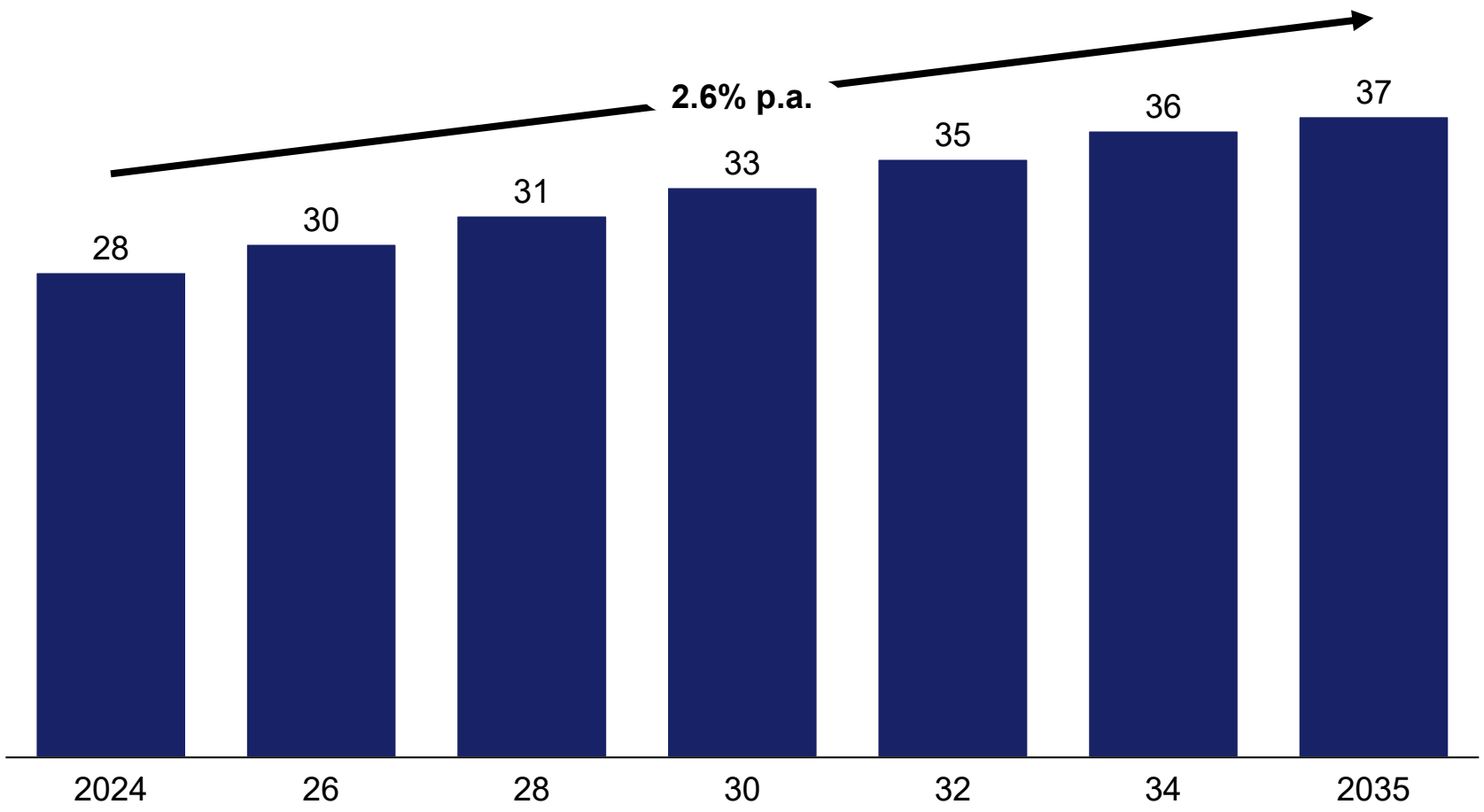
Copper demand forecast to grow at ~2.6% p.a. reaching 37M tonnes by 2035

BASE CASE

Global copper market demand, M tonnes



Source: MineSpans, International Copper Association

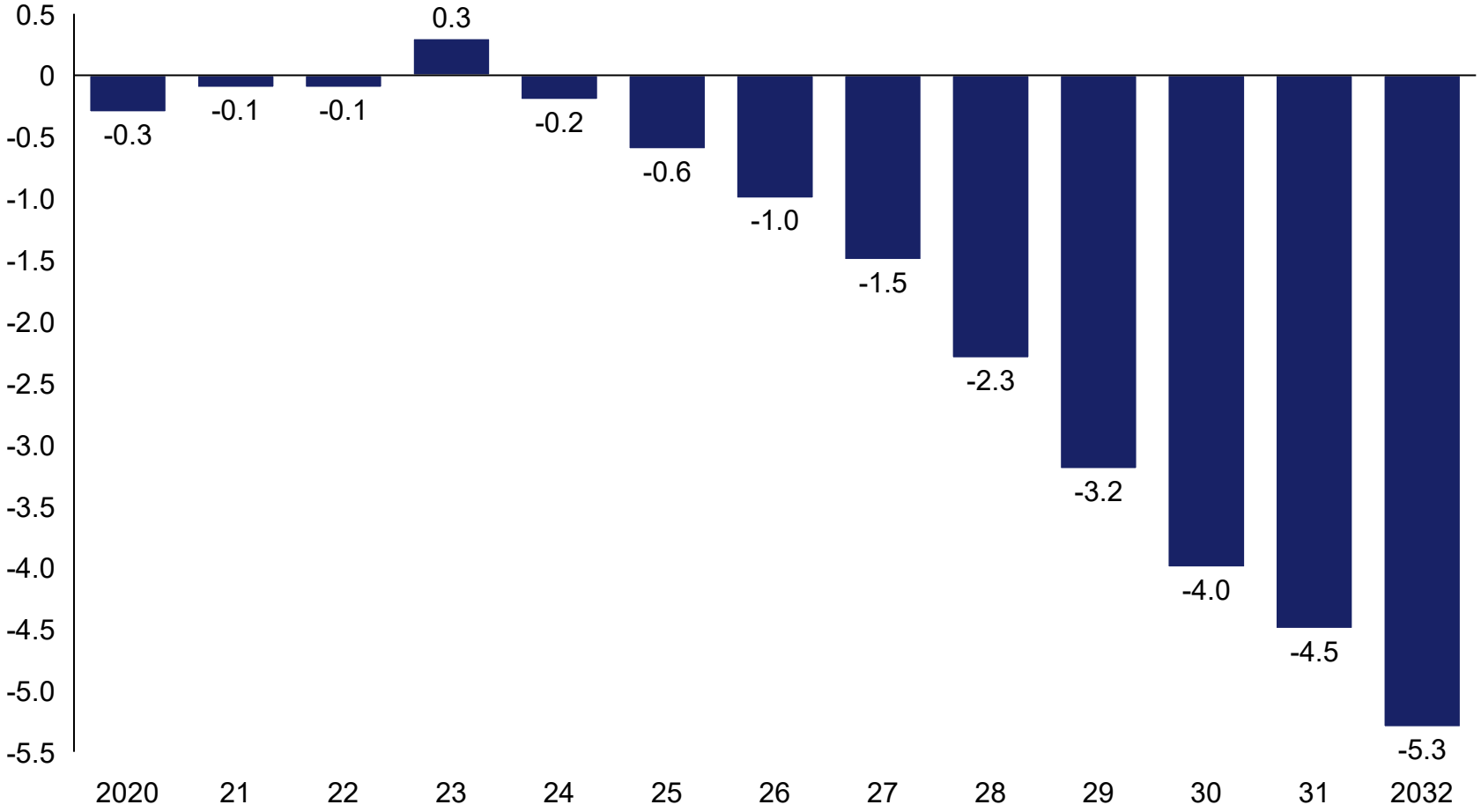
Key demand drivers

- **Energy:** Ongoing expansion of the grid in developing countries, modernization and upgrades, and shift towards renewables in developed countries
- **Transport electrification:** Strong growth of EVs with higher copper intensities than conventional ICE cars outweighs expected slowdown of ICE vehicle production
- **Machinery**: Demand growth in line with overall industrial GDP expectations

Global copper market balance is expected to be tighten and could reach -5.3M tonnes by 2032

BASE CASE

Global copper market balance (supply – demand), M tonnes



Source: MineSpans

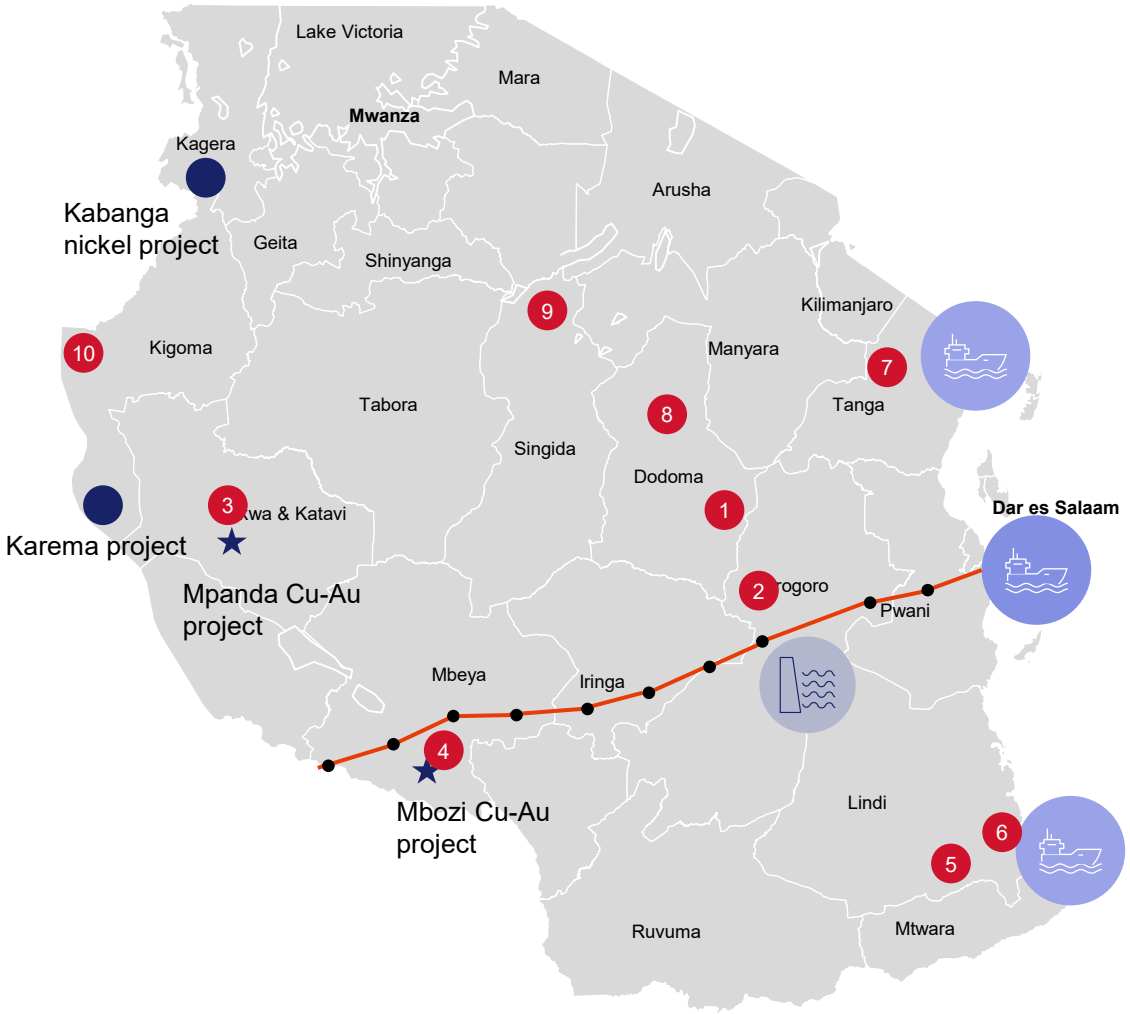
Remarks

- Global **demand growth for copper is expected to outpace supply by 2025**, driven by the increasing need for copper in modern applications (e.g., batteries, energy infrastructure)
- Copper market deficit is expected to **expand in the late 2020s** due to a **weak copper project development pipeline**
- Sufficient copper has been discovered to close deficit
- However, **secondary copper supply** could limit the overall deficit

Tanzania has various deposits of copper across the country, but only a few of them have active mines

ILLUSTRATIVE NON-EXHAUSTIVE

Deposits | Prospect mine | Active Mine | Hydro power plant | Export ports



Copper occurrences/ deposits

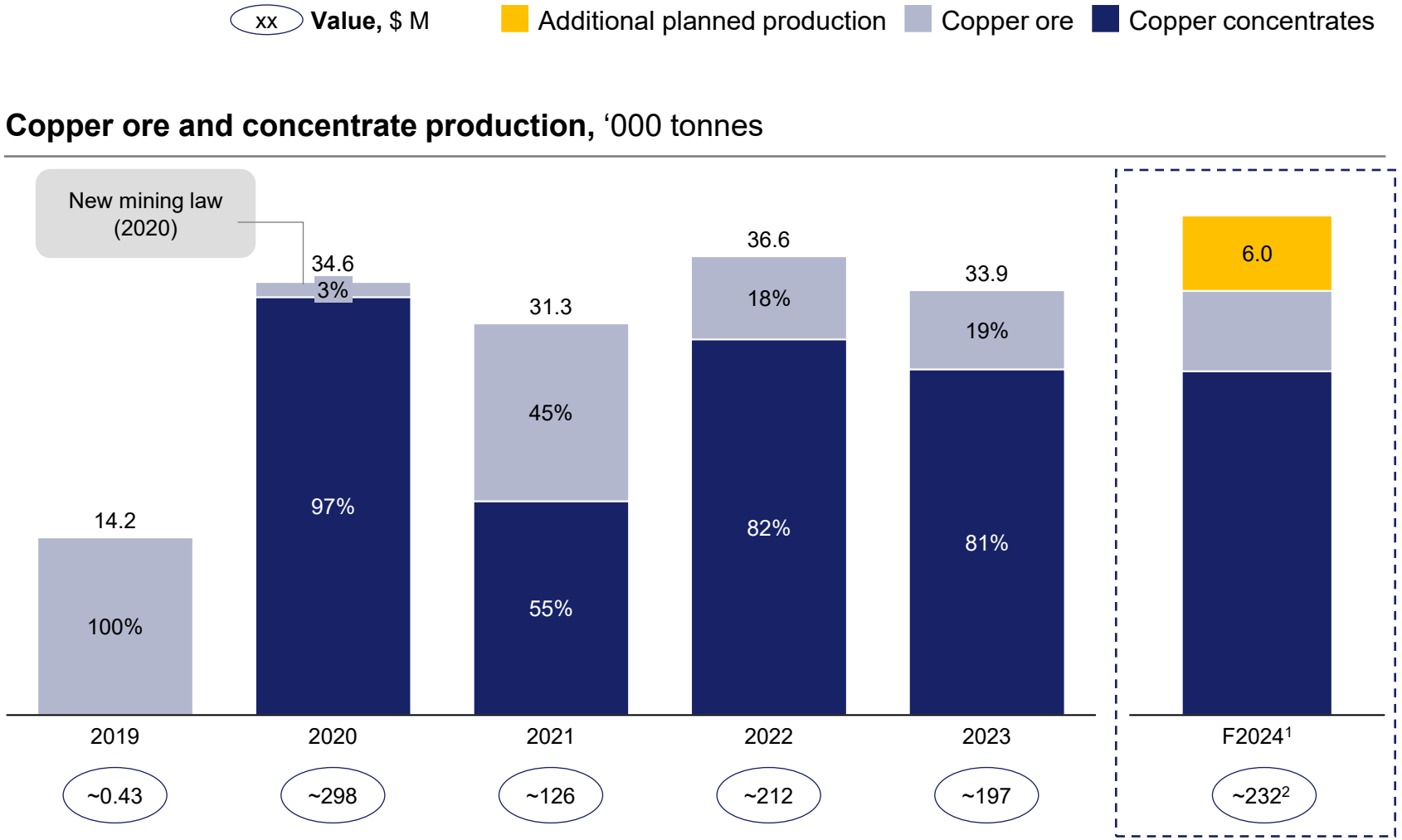
1. Mpwapwa
2. Kilosa
3. Mpanda
4. Mbeya
5. Lukoe-Ruangwa
6. Kikombe-Lindi
7. Mzundu-Handeni
8. Mlunga-Kilosa
9. Ibaga-Singida
10. Kagwe-Kigoma

Key insights

- Tanzania has a mix of **active mining operations** and **exploration projects**
- **Most deposits** are in the **exploration or development stages**
- Tanzania also has both copper sulfide and copper oxide ores with ongoing efforts to develop new mining projects and enhance beneficiation facilities within the country

Source: Press search, expert interviews

Current copper supply of Tanzania is more than 30,000t out of which ~80% is concentrates



1. This is through the Kabanga Nickel Project, which is set to begin in 2025. This could be either in copper ore or copper concentrates
2. Assuming an average 2023 price of $5.8 k per ton

Source: Tanzania critical and strategic minerals Strategy, TMIC 2024, World Integrated Trade Solution

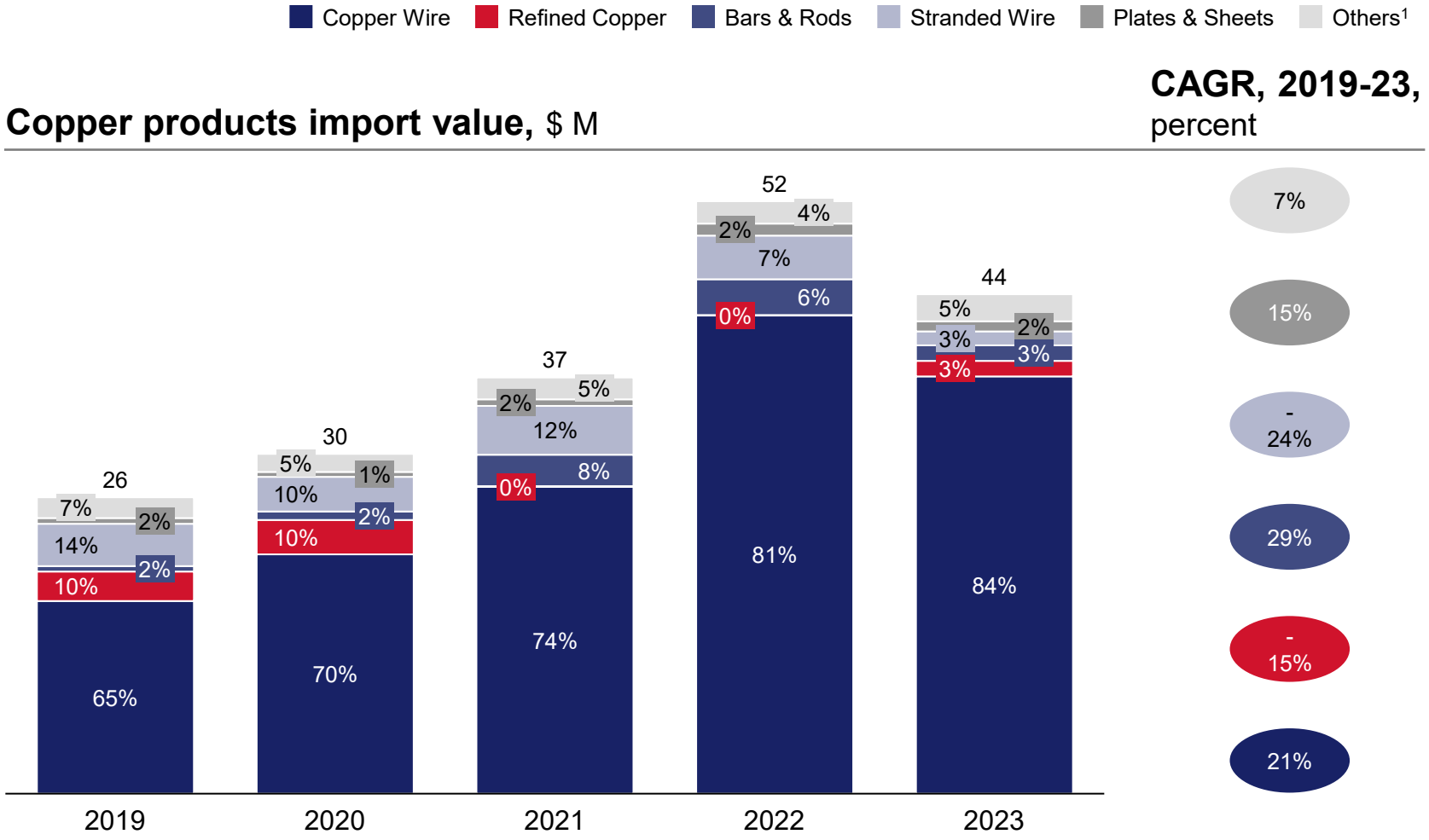
Key insights

Tanzania produces **significant quantities of copper ore and concentrates** (typically 25% of copper) which is mostly exported

Export destinations include **Singapore, Germany, India, and China**Since 2020, **Tanzania has produced more concentrates than ores,** which have higher copper share

This is likely due to the updated regulation in 2020, which required all players to include beneficiation as part of their framework arrangement with government

Despite having large deposits, Tanzania imports almost all of its locally used semi-finished and end-products of copper



1. Includes products such as: Kitchenware, Nails and tacks, Powders and Flakes. Waste and scrap, Master Alloys, Unrefined Copper, and Copper Foil

Source: Trade map

Key insights

- Tanzania **imports almost all of its locally used copper**, in the form of semi-finished and end-products
- **~80% of the imported products are copper wires**
- Tanzania also exports some share of the imported products to regional countries (e.g., Copper bars to Kenya)
- This **local demand volume significantly higher than local supply** (which was ~34kt)

6 potential intermediate and end use products have been identified for copper

	Copper cathode	Wires & Foils	Tubes	Bars	Plates & Sheets	Wire rods
Opportunity	Produce copper cathode which is a 99.9% pure rectangle plate of copper	Produce copper wires & foils which are wires or thin sheets of copper	Produce copper tubes which are round bars of copper	Produce copper bars which are solid copper strips	Produce copper plates & sheets which are flat sheets of copper metal	Produce copper cathode which are round bars of copper
End uses (not exhaustive)	Electrical applications (e.g., wires & cables) Construction (e.g., roofing, HVAC systems)	Roofing Cladding Industrial applications	Plumbing HVAC systems Industrial uses	Construction and manufacturing	Roofing Cladding Industrial applications	Electrical wires
Approach (not exhaustive)	Establish an electro-refining plant for copper	← Establish processing plants to refine copper and shape the materials through various castings →				
Requirements (not exhaustive)	← • Scaled production of copper • Skills and expertise required for production • Sufficient energy supply →					

Based on the criteria, two intermediary and end-products of copper emerge as potential opportunities for local value addition (1/2)

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		A Copper cathode (refined copper)	B Wires and foils	C Tubes
Market dynamics	Demand	>$1.8B demand in SSA[1]	>$100M demand in EAC and ~$35M demand in Tanzania	Limited demand in the region due to low processing capacity
	Supply	No current production, but there are plans to produce from Kabanga Project	No current and planned production, with full dependence on imports	
Competitive landscape		>40% of refined copper is produced by China	China and other major global players control significant share, including cost-competitive global exports; however, developing markets tend to have fragmented markets	
Share of priority mineral		~100%		
Avail-ability of inputs	Raw materials	Sulfuric acid (for leaching) and electrolytes (for refining), which are not locally available	Require different additives and metals (incl. copper cathodes) which are not locally available	
	Energy	Requires ~250kwh/ton electricity and requires >80GJ thermal energy	Require <50kwh/ton and need between 3-10GJ thermal energy	
	Capabilities or skills	Relevant skill sets are available regionally or can be developed with moderate effort		
	Physical Infrastructure	Improvements needed across rail, road and energy infrastructures		
	Technology (IP)	Refining processes can be proprietary technologies (electrolytic refining)	Requires some complex processes and tech IP based on desired output	Moderate to easy to manufacture with limited IP requirement
Policy and regulatory landscape		Local regulation supports value addition		

1. Sub-saharan Africa

Source: Trade map, USGS, Meteoree, TZ Ministry of Minerals, Energy Use in Copper, press search

Based on the criteria, two intermediary and end-products of copper emerge as potential opportunities for local value addition (2/2)

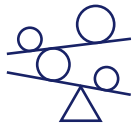
Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

Assessment criteria		D Bars	E Plates and sheets	F Wire rods
Market dynamics	Demand	Limited demand locally and regionally		
	Supply	No current production and planned production, with full dependence on imports		
Competitive landscape		China and other major global players control significant share, including cost-competitive global exports; however, developing markets tend to have fragmented markets		
Share of priority mineral		~100%		
Avail-ability of inputs	Raw materials	Require different additives and metals (incl. copper cathodes) which are not locally available		
	Energy	Require <50kwh/ton and need between 3-10GJ thermal energy		
	Capabilities or skills	Relevant skill sets are available regionally or can be developed with moderate effort		
	Physical Infrastructure	Improvements needed across rail, road and energy infrastructures		
	Technology (IP)	Moderate to easy to manufacture with limited tech IP requirement		
Policy and regulatory landscape		Local regulation supports value addition		

1. Sub-saharan Africa

Source: Trade map, USGS, Meteoree, TZ Ministry of Minerals, Energy Use in Copper, press search

In order for Copper production to be viable in Tanzania, the global Nickel market needs to recover

Dimension	Description	What we need to believe
Uncertainty around future supply gap 	• Many **existing copper smelters and refineries** are **not operating at full capacity** due to market or country-specific conditions • There is **uncertainty around future supply gaps** driven by complex market dynamics slowing investment in new projects as well as increased focus on recycling driven by consumer preferences or regulation	• Future copper demand is growing larger than expected (e.g., due to significantly faster grid build out)
High capex requires scale 	• **Capex** associated with building a new smelter could total **more than $1 B** – therefore, **>150kt p.a. capacity required** to be cost competitive • Smelting is typically a lower margin activity (0-10% EBIT margin[1]) due to high operating costs driven by large energy intensity and high labour and raw materials costs	• There is a **recovery in nickel market prices** leading to the **development of the Kabanga refinery** which can be leveraged for copper refining

1. Estimated based on selected companies/ standalone smelters; observed average from 2017-2021

Source: Expert inputs, press research

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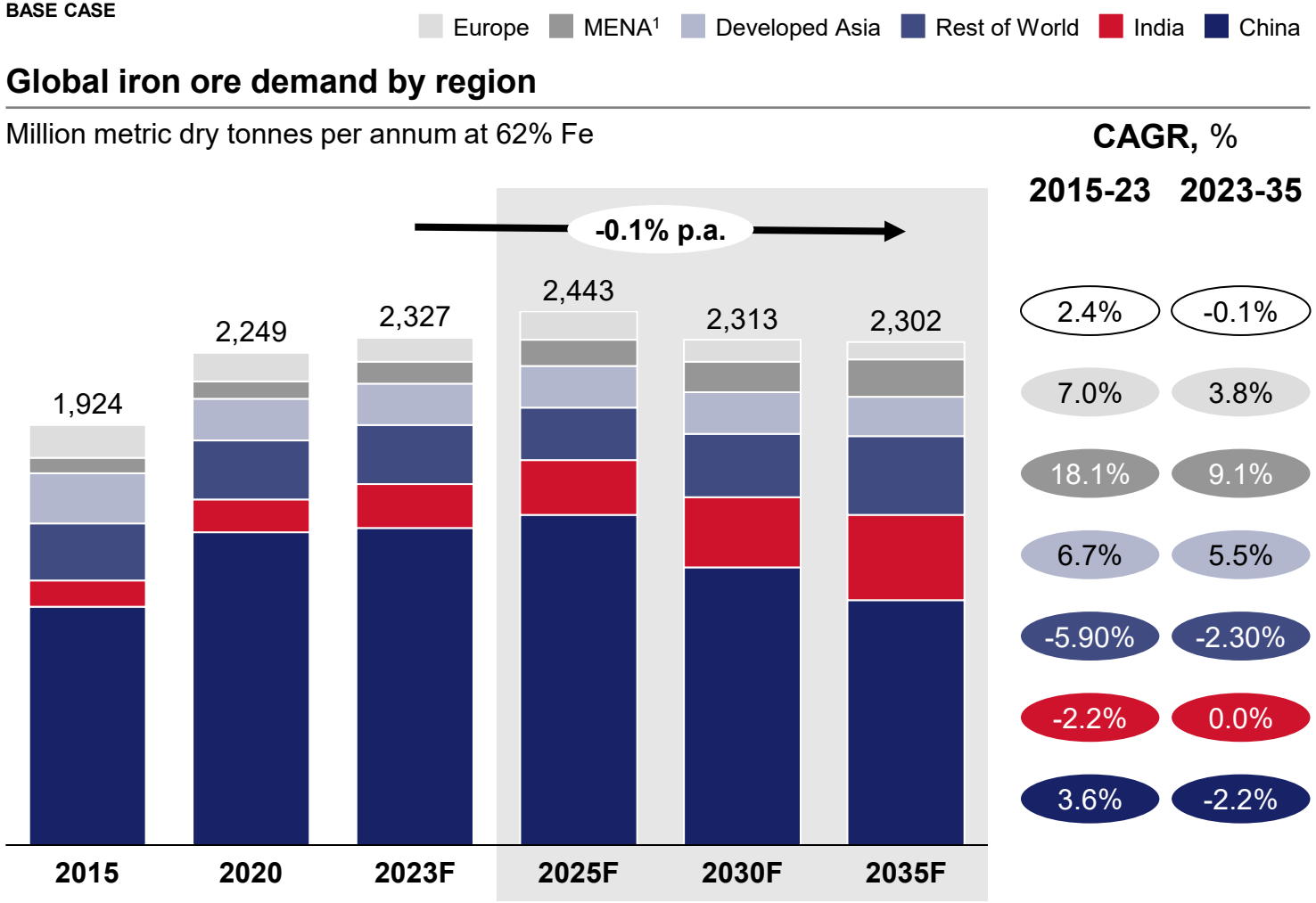
Global iron ore demand is expected to decline starting 2025 to 2035 mainly driven by reduced steel production in China

BASE CASE



1. Middle East and North Africa

Source: McKinsey GMI iron ore demand model, MineSpans, press search

Insights

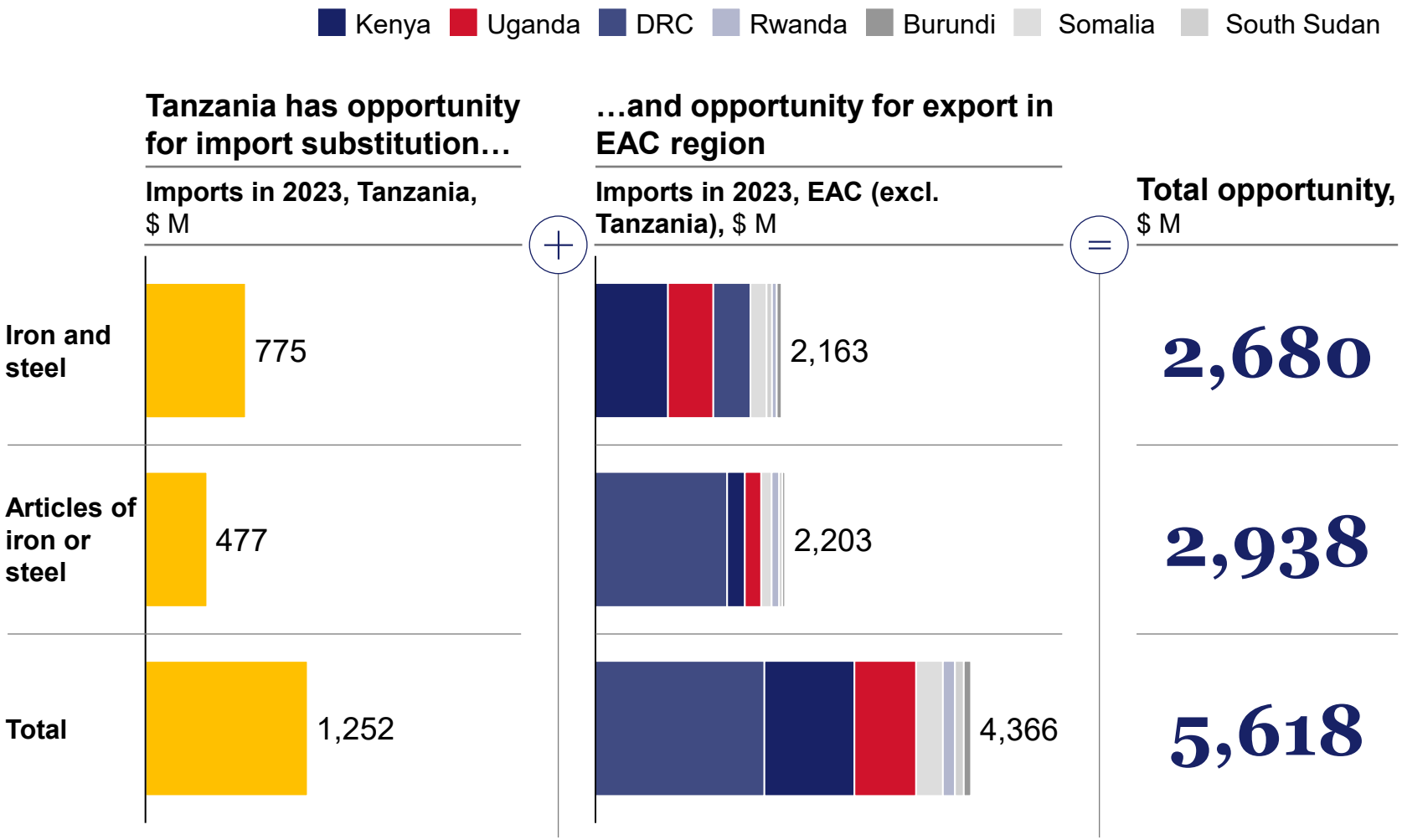
Global iron ore demand is expected to **fall at -0.1% CAGR by 2035 to 2,302 M tonnes,** mostly due to:

- China steel production decline
- Increase in scrap consumption

However**, India** is **expected to increase iron ore demand to meet expected increase in steel demand**, driven by the government investing in number of sectors (e.g., railways, industrial park)

MENA, Southeast Asia, Rest of World will also drive iron ore demand through increased steel demand driven by infrastructure growth

Iron is prioritized primarily due to strong demand, with ~$1.2B in imports substitution and ~$4.2B in EAC exports opportunities



Source: Trademap

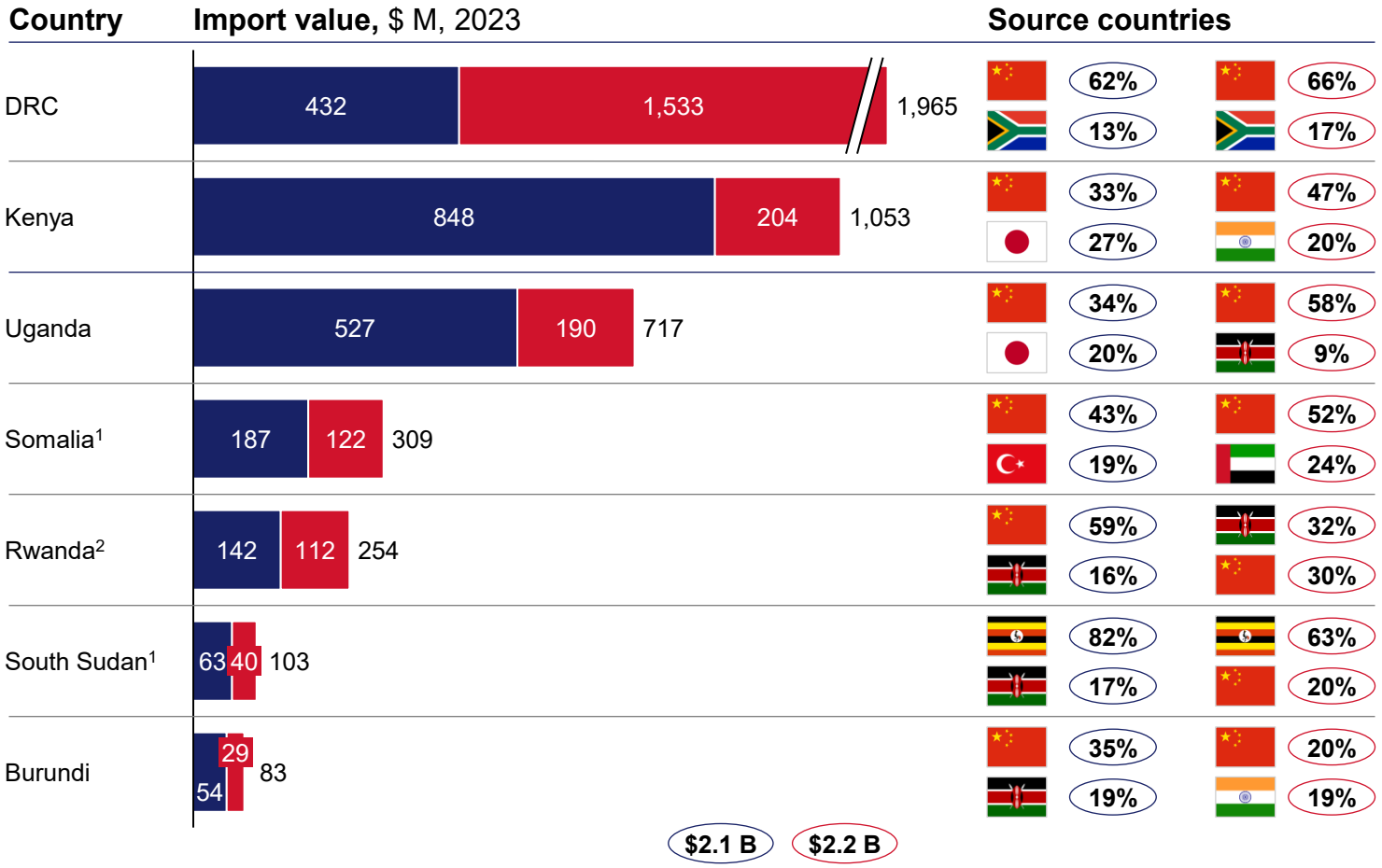
Remark

Iron and steel includes various **semi-finished and finished iron or steel products** including materials like pig iron, flat-rolled products, bars, wire and others

Articles of iron or steel refer to specialized **finished goods** made from iron or steel, such as pipes, tubes, and structural components, bots and others

Tanzania could play in the regional steel market with EAC importing ~$2.1 B iron and steel and ~$2.2 B articles of iron or steel

Iron and steel product breakdown for EAC countries is consistent with Tanzania's product breakdown



1. Based on mirror data, i.e., data reported by exporting countries | 2. 2022 values based on data availability

Source: Trade map, Trend Economy, press search

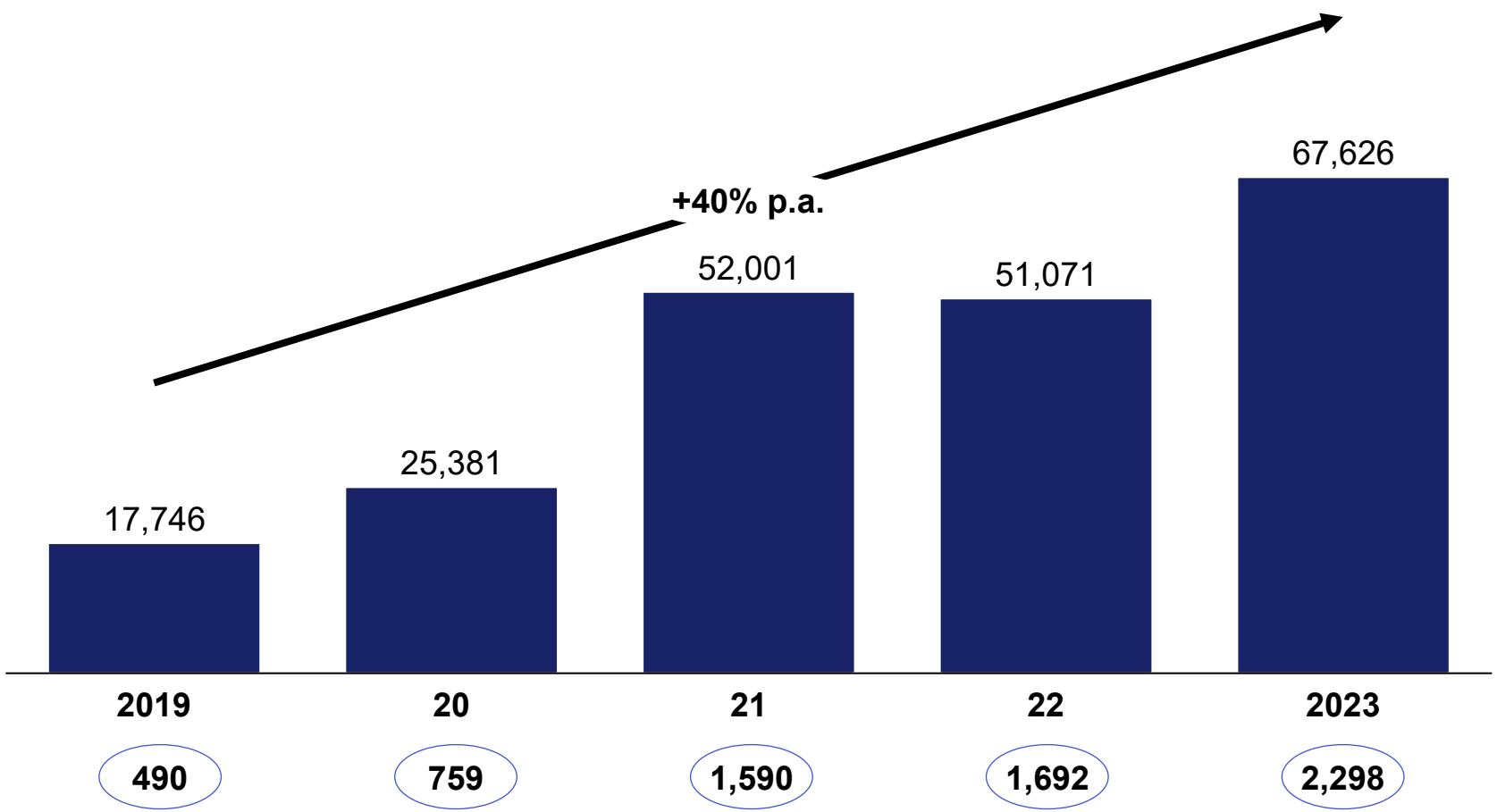
Remarks

- **DRC, Kenya and Uganda** offer the biggest opportunities for potential Tanzanian exports
- Globally, **China is the top exporter of iron and steel products to EAC countries** making up a significant portion
- Regionally, Kenya is the largest exporter of steel supplying $184B largely to neighboring countries like Uganda (38%), Tanzania (19%) and Rwanda (17%)
- Tanzania could **leverage its significant iron ore reserves** and **learn from Kenya's actions** to compete in the value-added steel products market. Kenya's competitiveness is driven by
  - **Establishment of major steel mills** like Devki Steel to boost production and **competitiveness through economies of scale**
  - Leveraging **EAC trade agreements** to ensure benefits from duty-free, quota-free access
  - Use of its **strategic positioning as EAC gateway** especially to landlocked countries,

Tanzania's iron ore production is growing rapidly but remains small, with minimal exports and domestic-focused consumption

xx Value, 000' $

Iron ore production volume, tonnes



Source: Tanzania Ministry of Minerals, Press search

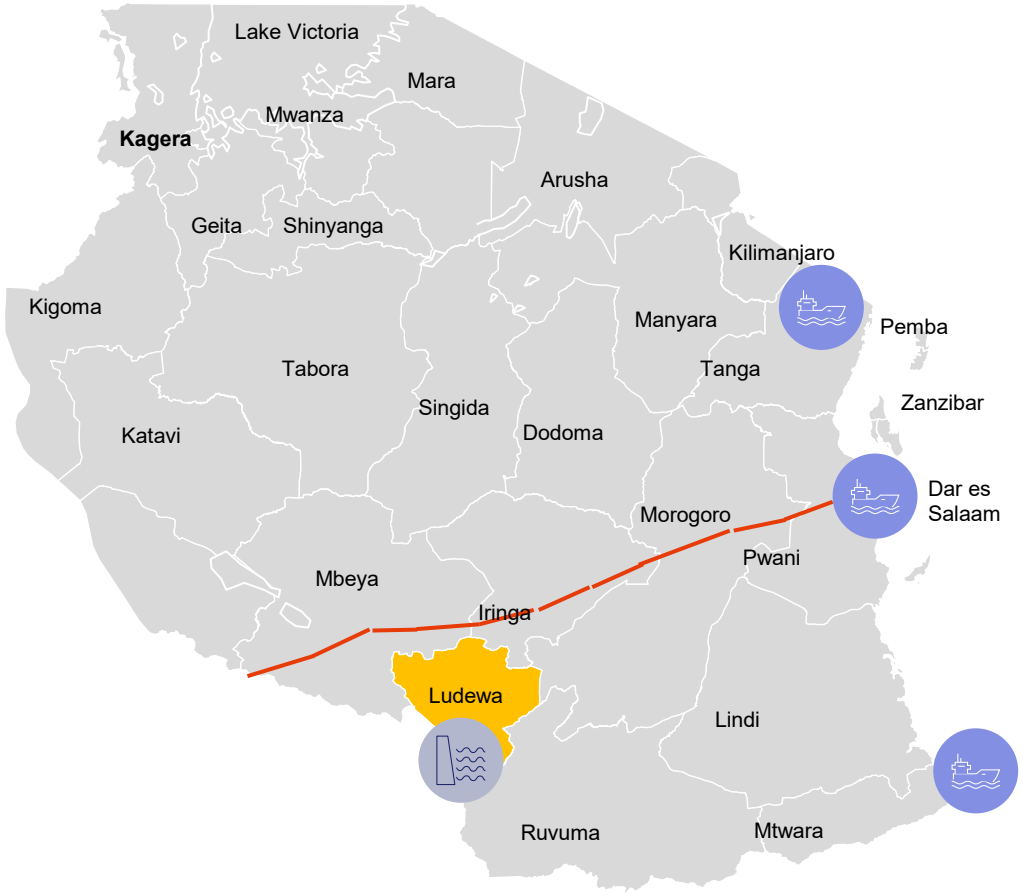
Insights

- Tanzania possesses significant iron ore reserves, though **production remains in its early stages**
- From 2019 to 2023, production grew to over 67.5K tonnes in 2023, **which is ~45% of regional steel demand**
- Majority of iron ore produced is **consumed domestically** for cement manufacturing with limited exports (~$10K exports in 2023)
- The significant increase from 2020 to 2021 was likely driven by Tanzania's post-COVID-19 economic recovery

The Liganga project aims to significantly boost Tanzania's iron ore production and establish a fully integrated steel mill

NON-EXHAUSTIVE

Deposits | Planned energy infrastructure | Export ports



Tanzania's iron reserves are in Liganga, the Uluguru Mountains, Mbabala near Lake Tanganyika, Karema, Manyoro Gondite, and Itewe**, with Liganga being the most significant deposit**

Liganga, located in Ludewa District, contains an estimated **126 million tonnes of iron ore reserves** and is part of an integrated project

Insights

The planned large integrated Project (Liganga and Mchuchuma integrated project) comprises of:

- **Liganga Iron Ore Mine:** Production capacity of 2.9 million tonnes /year of iron ore
- **Iron and Steel Complex:** Capacity of 1.1 million tonnes/year of finished products
- **600 MW coal-fired thermal power station to provide 250 MW to the Linganga project**

Despite the Liganga project being announced in 2011, it has experienced substantial delays due to financial, infrastructure, and other challenges

Source: Press search, Tanzanian critical and strategic minerals strategy

6 potential intermediate and end use products have been identified for iron

	Sections	Rebars	Wire rods & plates	Hot rolled coil	Pig iron	Semi-finished steel[1]
Opportunity	Pre-formed steel shapes used in construction	Manufacture rebars which are steel bars which anchor in concrete	Flat sheets of metal	Steel rolled at high temperatures (above 900°C) into wide, flat coils	Produce pig iron which is a smelted form of iron used in the production of steel	Produce intermediate stage steel products which require further processing
End uses (not exhaustive)	← Construction and manufacturing →				← Steel →	
Approach (not exhaustive)	← Develop integrated plants or rerolling / finishing mills or mini steel plants →				← Establish an integrated steel plant with blast furnaces, steelmaking, casting, and rolling milling capabilities →	
Requirements (not exhaustive)	← • Dedicated energy supply • Transportation infrastructure that can manage the weight of the products →					

1. Billet and slabs

The assessment identified 5 viable value addition opportunities for iron in Tanzania

Deprioritized opportunities | Prioritized opportunities | High / Favourable | Medium / Moderate | Low / Unfavourable

NON-EXHAUSTIVE

Assessment criteria		A Sections	B Rebars	C Wire rod	D Plates	E Hot rolled coil	F Pig iron	G Semi-finished steel[1]
Market dynamics	Demand	Tanzania imports ~$17 M (2023)	Tanzania imports ~$93 M (2023)		Tanzania imports ~$368 M (2023)		~$200k in Tanzania imports and ~$10 M in EAC imports, however there is potential to export outside of EAC	~$72 M in Tanzania imports and ~$234 M in EAC imports
	Supply	Remaining EAC imports ~$124 M (2023)	Remaining EAC imports ~$306 M (2023)			Remaining EAC imports ~$737 M (2023)		
Competitive landscape		Tanzania does not have scaled production of steel products. There are established steel mills in Kenya that produce a diverse array of products (e.g., Devki steel), however the country is still a net importer. Globally, it would be difficult to compete with players like China, which benefit from massive high-grade ore reserves and economies of scale						
Share of priority mineral		98-99%					92-95%	98-99%
Availability of inputs	Raw materials	Require imports of billets which are key inputsr			Require imports of Slabs which are key inputs		Inputs such as thermal coal, limestone and dolomite are widely available locally, while coking coal could be imported	Inputs such as limestone and dolomite are widely available locally Additives for alloying such as chromium, nickel, manganese could be imported or locally available (contingent on planned projects being realized)
	Energy	Do not require high volumes of energy as these are final steps in the production process			Highly energy intensive		Highly energy intensive and requires constant power but there's a planned power station to provide 250 MW to the Liganga project	
	Capabilities or skills	Limited local and regional talent, but developing the required capabilities is not difficult						
	Physical Infrastructure	Significant infrastructure development required to transport final steel products for shipment (e.g., a rail system)					On-site infrastructure, including transport roads is accounted for in the project plan[2]	Significant infrastructure development required to transport final steel products for shipment (e.g., a rail system)
	Technology (IP)	Widely available technology with no IP restrictions for standard processes						
Policy and regulatory landscape		Supportive policy framework with no major regulatory barriers						

1. Billet and slabs

Source: Press search, expert inputs

Three unlocks can help accelerate the development of Tanzania's steel manufacturing

Unlocks required to realize these opportunities:

1 Scale production of iron ore[1]

- Unlock upstream activities by availing financing, potentially through incentives, and improving infrastructure

2 Develop required infrastructure

- Improve transport networks to provide reliable and cost-effective movement of raw materials to production facilities and finished steel products to domestic and export markets
- Expand and stabilize energy infrastructure to ensure consistent, high-capacity power supply essential for energy-intensive iron and steel production processes.

3 Develop local capabilities to power the steel industry

- Develop technical partnerships with foreign steel manufacturers to transfer knowledge and improve domestic capability
- Strengthen institutional capacity by creating specialized training programs for local engineers and workers in metallurgical and mining engineering

1. Access to financing for steel production is an ongoing global concern due to declining demand from economic downturns.