

The New Frontier: Critical Minerals & the Energy Transition

Multi-Client Study Prospectus



440 Cobia Dr, Ste 1704
Houston, Texas 77494
+1.281.506.8234
info@adi-analytics.com
www.adi-analytics.com

Outline

- ▶ **Study Prospectus**

- ▶ About ADI

ADI is offering a multi-client study covering strategic questions on the role of critical minerals in the energy transition

1

Energy transition-related clean energy technologies will have a huge impact on critical minerals demand

- Critical minerals demand for clean energy technologies such as electric vehicles (EVs), battery storage, and renewable power generation is ...
- ... expected to grow rapidly over the next two decades aligned with the emission reduction goals adopted by several countries.
- For example, by 2040, demand for copper and rare earth elements (REEs) will rise by 40% each, nickel and cobalt by 60-70% each, and lithium by 90%.

2

Managing critical minerals supply is crucial for the growth and application of clean energy technologies

- Critical minerals are metals and non-metals vital for the economy and whose supply may be disrupted due to ...
- ... various factors such as supply scarcity, geopolitical risk, environmental factors, recycling potential, and trade policy.
- Supply of these critical minerals is under scrutiny as mine production growth of critical minerals since 2016 is not keeping pace with growing demand and can soon lead to scarcities.

3

Critical minerals offer a distinct set of challenges which need to be addressed in a timely manner

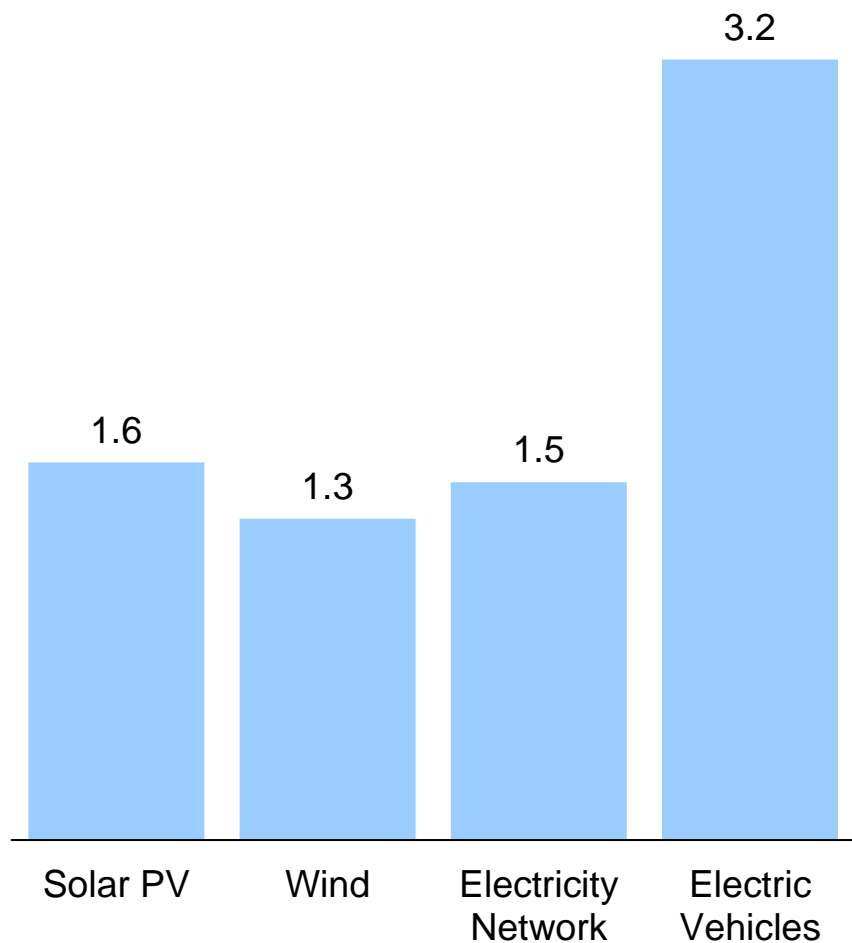
- Some of the factors that will have a high impact on creating conditions conducive to critical minerals availability and reliable supply growth include ...
- ... supply security and predictability, ensuring adequate investment via vertical integration, international collaboration ...
- ... and supply chain transparency, mining technology innovation, and acceleration of greenfield mining projects.

ADI Multi-Client Study

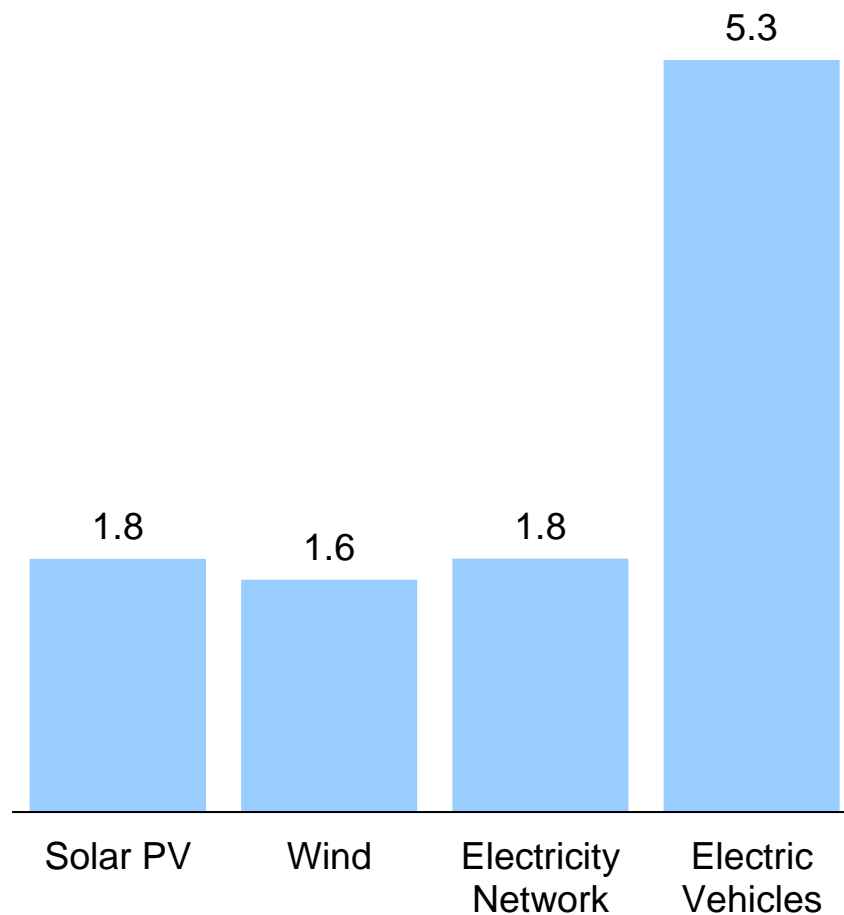
- In light of these dynamics, ADI is launching a multi-client study focused on a comprehensive assessment and forecast of critical minerals supply and demand through 2030.
- This multi-client study builds on ADI's extensive research and deep expertise in metals, minerals, mining, and mineral processing and will be based on in-depth primary and secondary research and mineral supply and demand modeling.

Clean energy technologies such as electric vehicles and clean power generation will grow dramatically over the next decade ...

Clean Energy Technologies Growth Index
(2030 BAU, 2019=1)



Clean Energy Technologies Growth Index
(2030 SDS, 2019=1)



Note: BAU is business as usual and SDS is sustainable development scenario

Source: IEA, ADI

... Driving demand for critical minerals whose necessity and applications across clean energy technologies vary widely

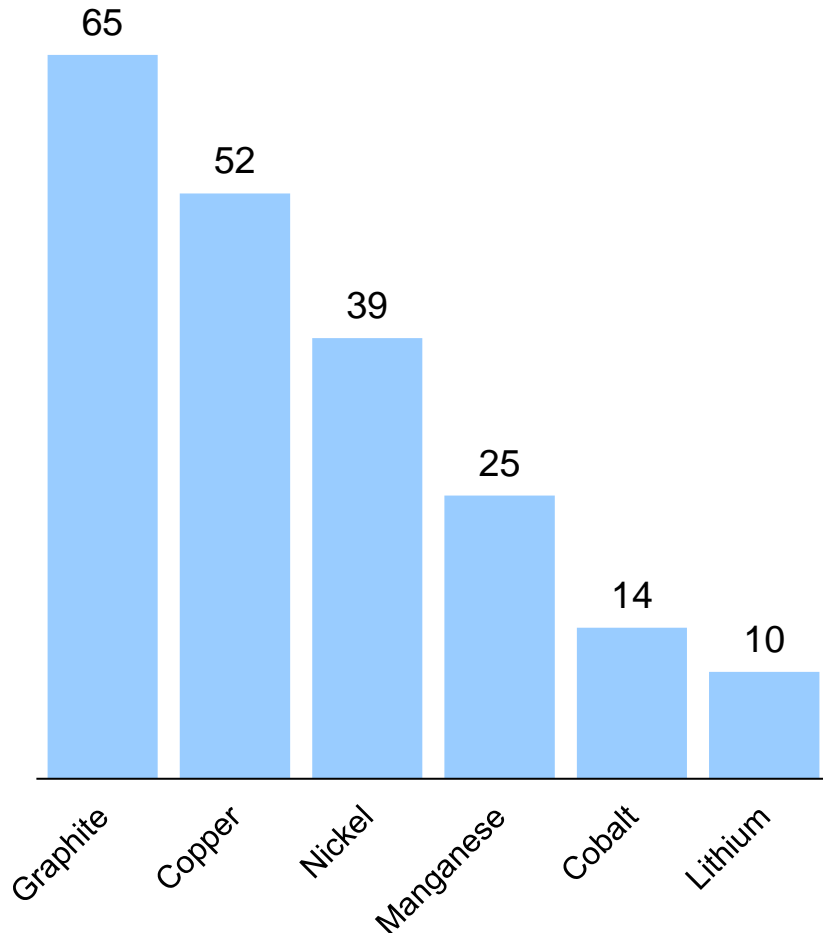
Critical Mineral Needs for Clean Energy Technologies

	Copper	REEs	Manganese	Nickel	Cobalt	Graphite	Lithium
Solar PV	High	Low	Low	Low	Low	Low	Low
Wind	High	High	High	Moderate	Low	Low	Low
Nuclear	Moderate	Low	Moderate	Moderate	Low	Low	Low
Electricity networks	High	Low	Low	Low	Low	Low	Low
EVs	High	High	High	High	High	High	High
Battery storage	High	High	High	High	High	High	High

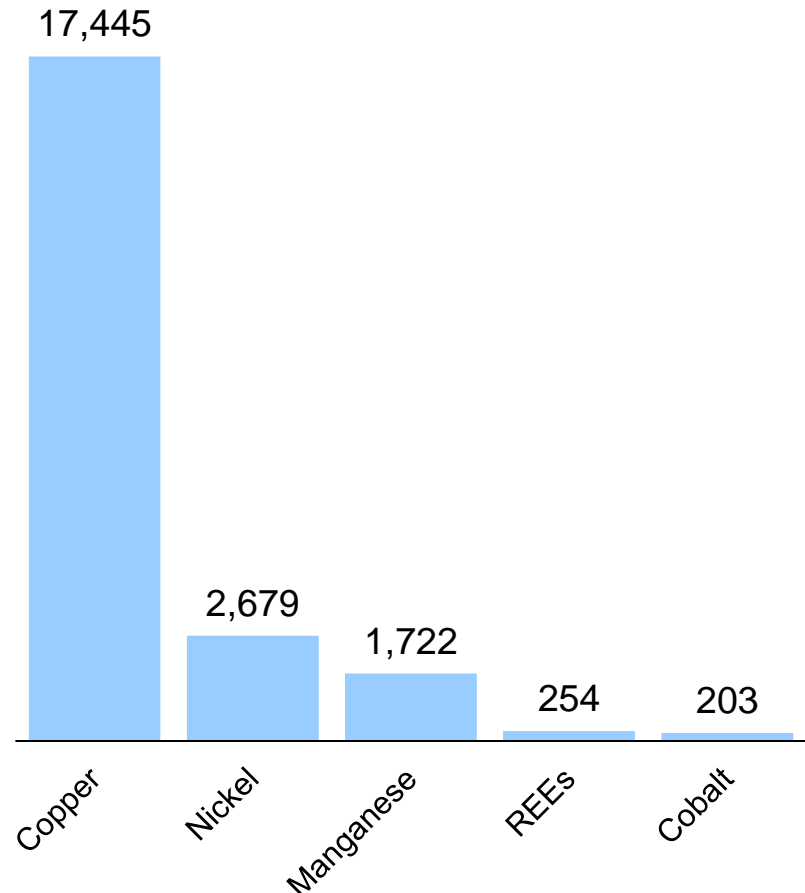
● High
 ● Moderate
 ● Low

Application of some critical minerals such as copper, nickel, and manganese is vital in both EVs and power generation ...

Critical Minerals Usage in Electric Vehicle
(Kg Per Vehicle, 2020)



Critical Minerals Usage in Power Generation
(Kg Per MW, 2020)



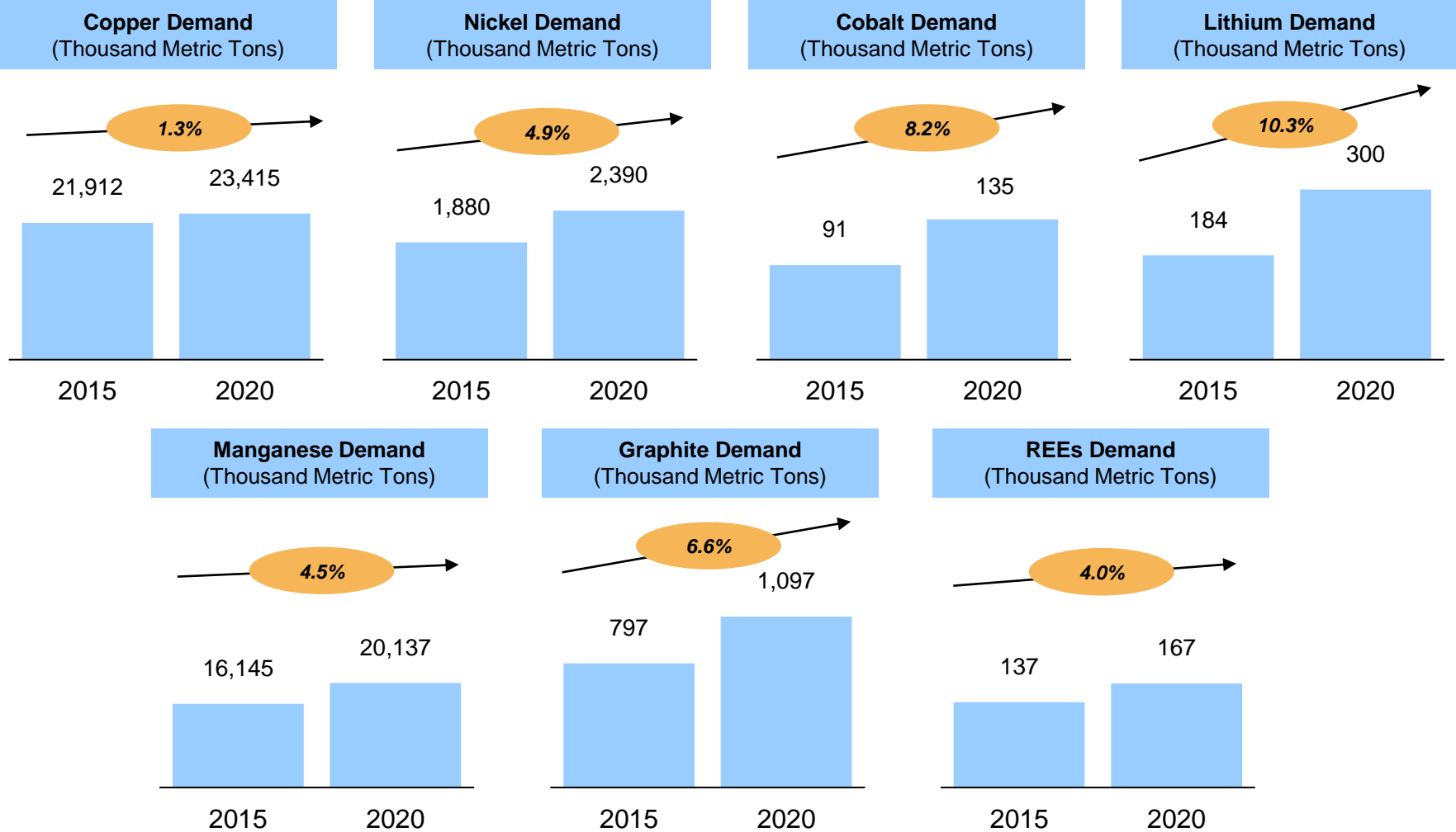
Note: Power generation includes wind, solar PV, nuclear, coal, and natural gas

... while the rapid growth of other clean energy technologies will increase the demand for many other critical minerals

Critical Mineral	Discussion
Copper	Copper is used in many clean energy technologies due to its high conductivity and malleability with most of it being used in wiring for electrical networks.
Nickel	Nickel is predominantly used in electric vehicles and geothermal wells due to its superior power density.
Cobalt	Cobalt is used almost exclusively in EVs due to its stabilizing effect. For example, lithium-ion batteries require cobalt to prevent corrosion.
Lithium	Lithium is exclusively used in EVs to store energy and supply power.
Manganese	Manganese is used mainly in car batteries due to its low cost, various natural ionic states, and capacity to hold and discharge electrons.
REEs	REEs find application in permanent magnets used in wind turbines and electric vehicle motors and are also used in high-tech devices for solar panels.
Graphite	Lithium-ion batteries use graphite anodes because they cope well with the flow of lithium ions during charging and discharging.

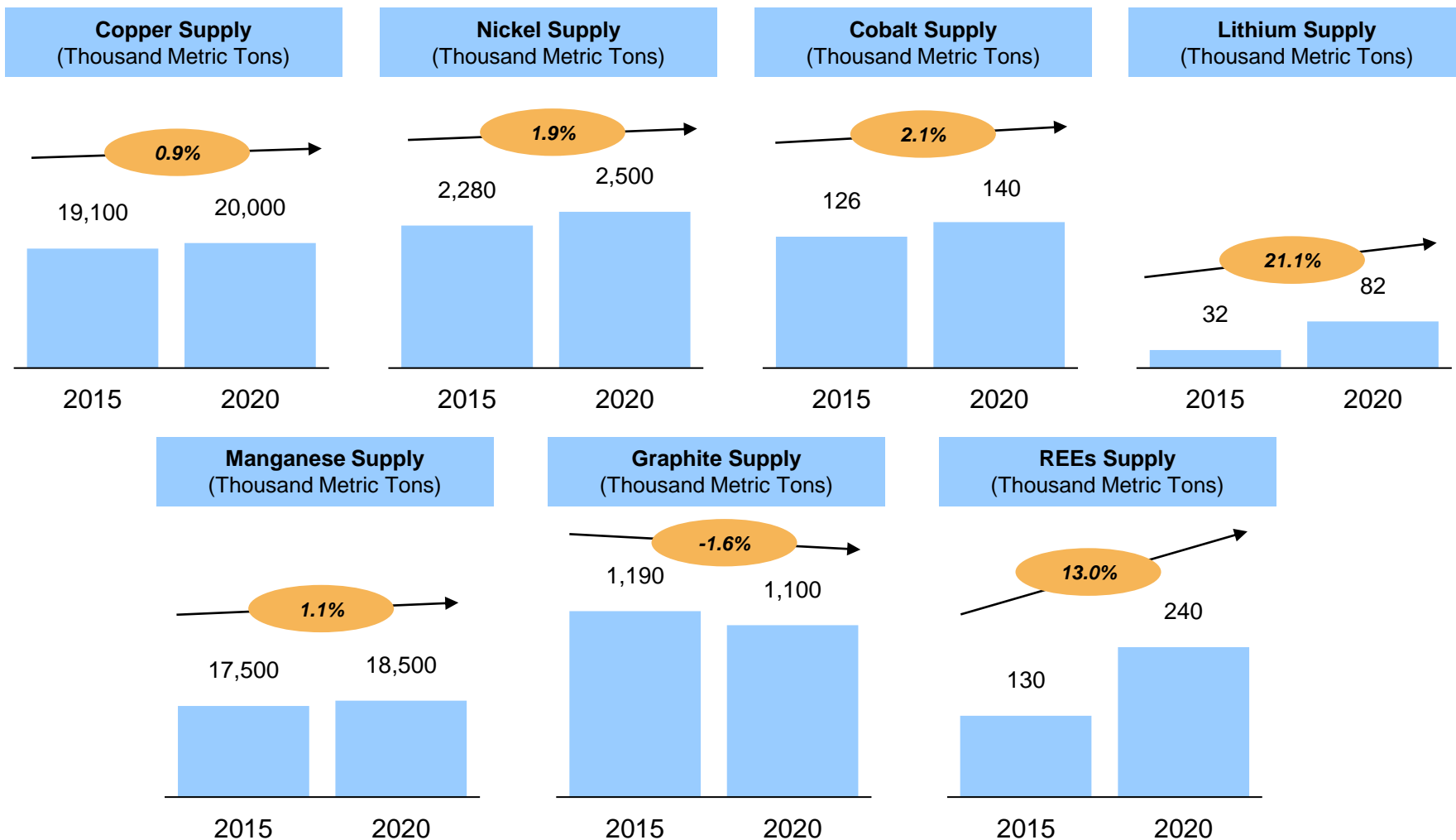
Demand for critical minerals has grown rapidly since 2015 as the emphasis for the energy transition grows ...

Critical Minerals Demand



... But supply growth has been slow except for lithium and REEs and will result in deficits barring further investments

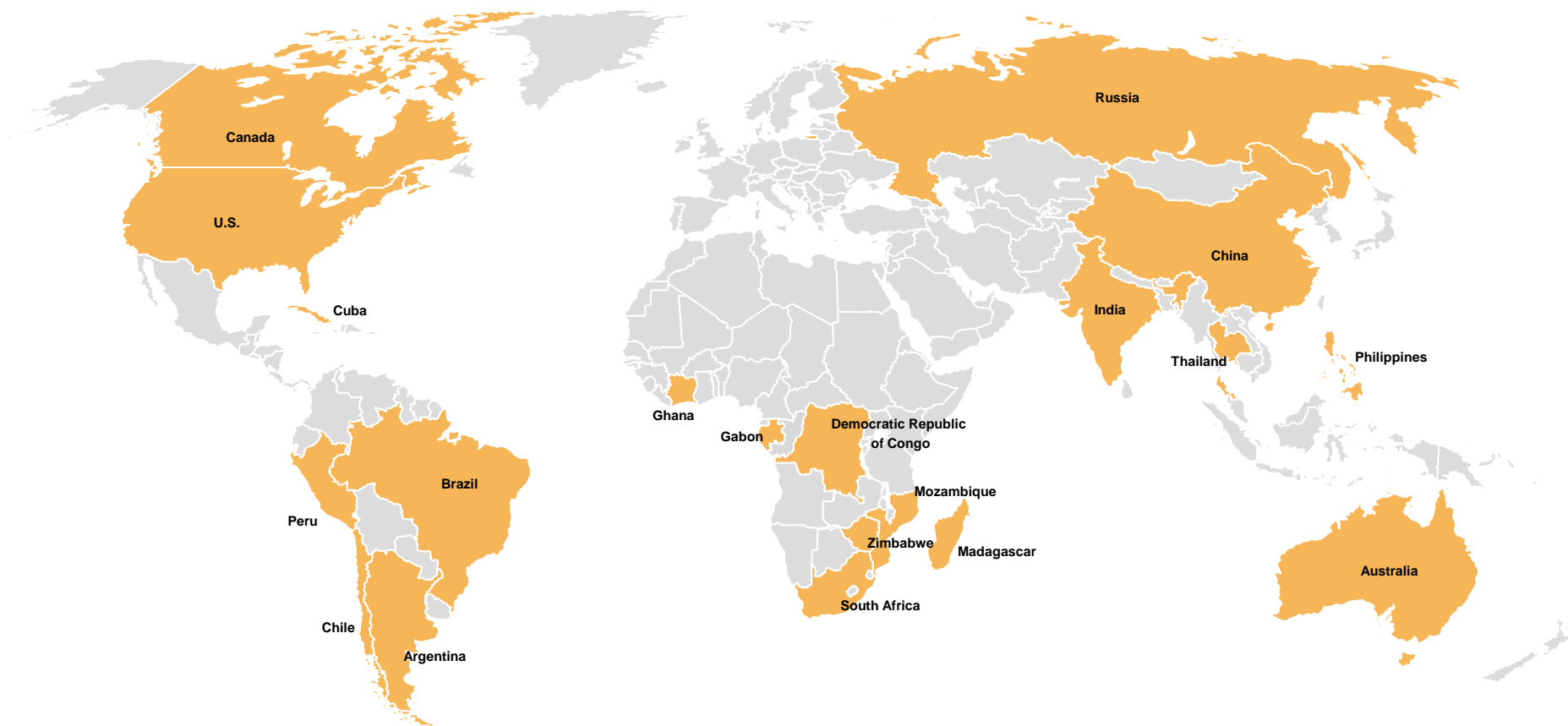
Critical Minerals Supply from Mine Production



Note: More than 50% of the global supply of lithium comes from non-mine production mainly from groundwater brine

Only 20 countries supply most of the critical minerals used in clean energy technologies amplifying geopolitical risks

Top Producers of Critical Minerals



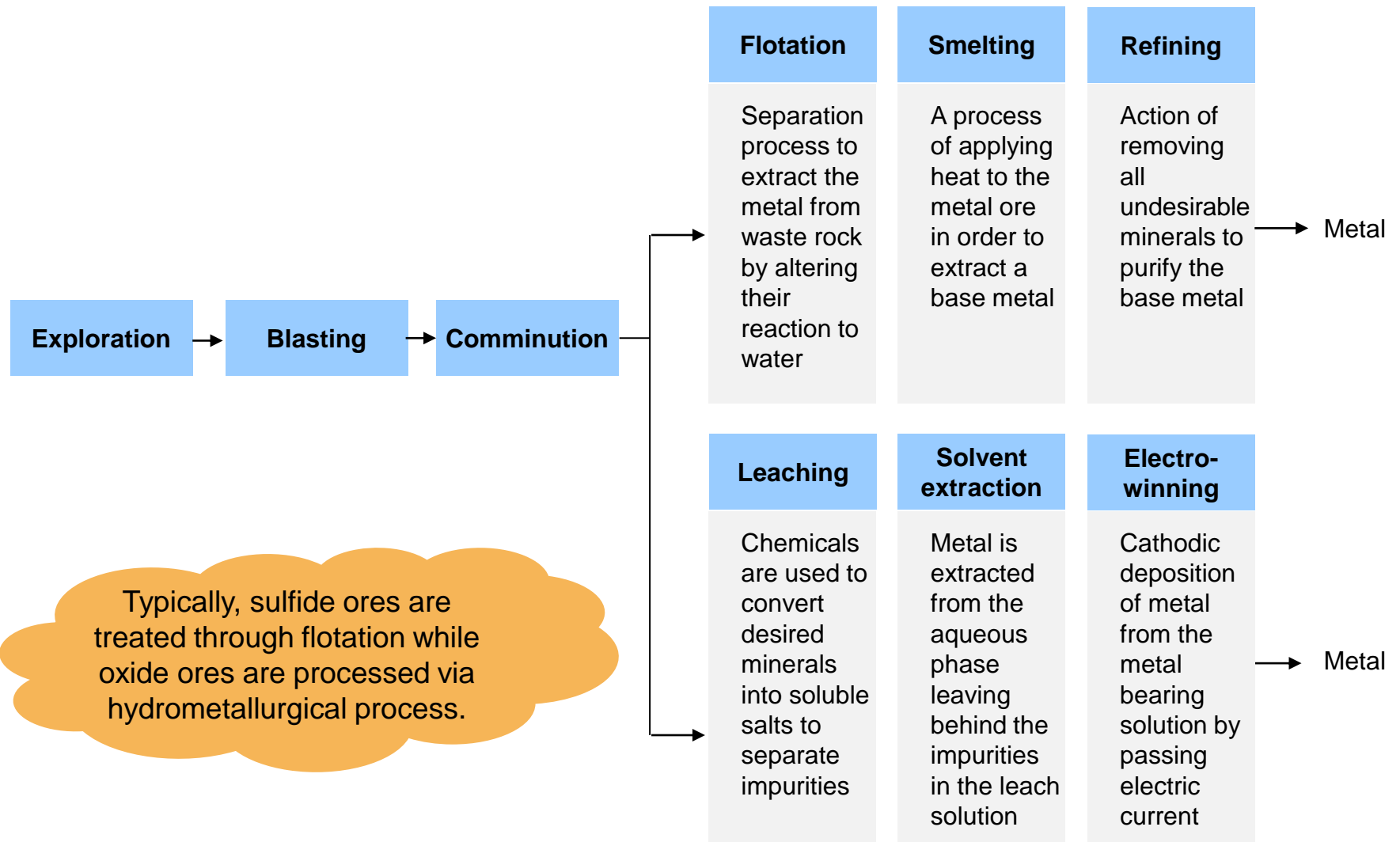
Government mining regulations and company-level ESG initiatives will drive sustainable mining operations practices going forward.

Countries such as China, Russia, and Australia are amongst the top five producers of multiple critical minerals

Top Five Producers by Type of Critical Mineral

	Copper	Nickel	Cobalt	Lithium	Manganese	Graphite	REEs
Chile	✓			✓			
Peru	✓						
China	✓	✓		✓	✓	✓	✓
Congo	✓		✓				
U.S.	✓	✓					
Russia		✓	✓				✓
Canada		✓					
Australia		✓	✓	✓	✓		✓
Philippines			✓				
Cuba			✓				
Argentina				✓			
Zimbabwe				✓			
Mozambique						✓	
Brazil						✓	✓
Madagascar						✓	
India						✓	
South Africa				✓	✓		
Gabon					✓		
Ghana					✓		
Thailand							✓

Critical mineral supply is also impacted by rising complexity of mineral ore processing and other operational issues



There are several strategic questions that need to be answered in critical mineral markets and their outlook through 2030

Strategic Questions

- What are the key demand scenarios for critical minerals?
- How competitive will it get to access supply of critical minerals? Who will be the emerging players?
- What are medium-/long-term implications of COVID-19 on critical minerals demand and supply?
- Which opportunities, risks, and competitive strategies should critical minerals users and suppliers consider?

A

Demand / supply

- What are the key critical minerals demand drivers and how will they change?
- What are the post-COVID demand drivers for critical minerals by region?
- How will critical minerals supply, capacity, and supply/demand balance change?

B

Infrastructure and technological investments

- What is the outlook and cost structure for new mining projects in key countries?
- Are mining operators making investments to drive up production?
- What are new mining and mineral processing technologies to optimize supply?

C

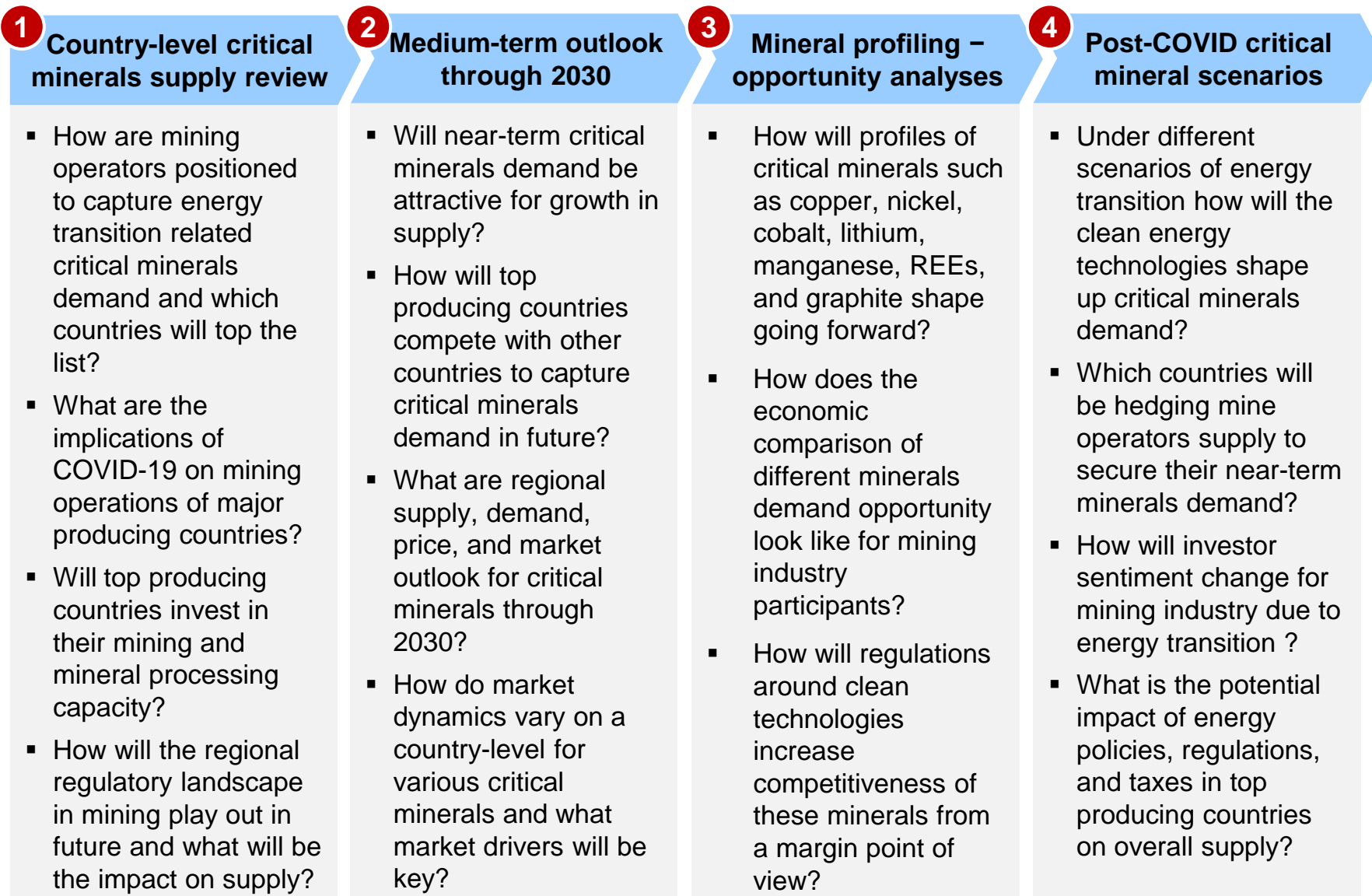
Regulations and implications

- Which policies and regulations will impact critical minerals?
- How should stakeholders position themselves for future supply?
- What are medium-/long-term risks and strategies in these markets?

... That will be addressed by ADI's multi-client study as reflected by its comprehensive table of contents

1	Executive Summary <i>Key conclusions, findings, and strategic implications with a review workshop and underlying data in spreadsheet format</i>	8	Deep Dive Profiles: Copper <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
2	Critical Minerals Market Drivers <i>Population / economic growth, EVs and clean energy outlook, regulations and policies on energy transition</i>	9	Deep Dive Profiles: Nickel <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
3	Critical Minerals Demand Outlook to 2030 <i>Forecasts for critical minerals demand through 2030 along with key enabling drivers and corresponding scenarios</i>	10	Deep Dive Profiles: Cobalt <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
4	Critical Minerals Supply Outlook to 2030 <i>Mining infrastructure and greenfield mining investments by country through 2030 in relevant energy transition scenarios</i>	11	Deep Dive Profiles: Lithium and Rare Earth Elements <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
5	Critical Minerals Supply Issues and Challenges <i>Ore quality assessment by country / mineral and key issues in supply landscape such as environmental regulations</i>	12	Deep Dive Profiles: Manganese <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
6	Technological Innovation in mining <i>Mining technology innovations including digital, analytics, and automation to optimize productivity and reduce costs</i>	13	Deep Dive Profiles: Graphite <i>Country-wise assessment for copper including supply-demand balances, prices, and regulations</i>
7	Cost, Economic, and Pricing Analyses <i>Existing and upcoming mining projects cost competitiveness including regional margins, breakeven, and price outlooks</i>	14	Strategic Implications and Opportunity Analysis <i>Findings and conclusions, strategic implications by segment, risks and mitigation strategies, and opportunity analyses</i>

In summary, ADI's independent, current, and unique study will answer key questions and provide actionable insights



Key deliverables of ADI's critical minerals study will include insightful outcomes and several materials

Outcomes	Deliverables
1 In-depth coverage of critical minerals market across top producing countries	Kick-off call ~150-page report
2 Critical minerals supply-demand balances through 2030	Interim update ~20-page executive summary, Q&A, and presentation
3 Mineral profiles for copper, nickel, cobalt, lithium, manganese, graphite, and REEs	Client workshop Spreadsheet data package
4 Economics and competitive landscape of critical minerals	Interactive conference call Analyst access

Contact Uday Turaga, +1.832.768.8806 or turaga@adi-analytics.com to purchase this study.

Outline

▶ Study Prospectus

▶ **About ADI**

ADI is a consulting firm serving oil & gas, energy, chemicals, and industrial clients with expertise, rigor, and passion



Over 150 clients – Fortune 500 brands, mid-sized firms, start-ups, and investors – engage ADI to shape decisions

Oil & Gas



Investors



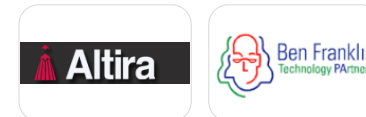
Start-ups



Chemicals



Industrials



Clients accelerate priorities with ADI's consulting services, subscription research, data analytics, and conferences

Consulting

Discover and capture opportunities, solve problems, and help businesses thrive amid uncertainty with ADI's market research and management consulting services



Research

Track markets with ADI's subscription research



Analytics

Inform workflows with ADI data, models, and analytics



Forums

Build a strategic view and network at our conferences



Stay ahead of the curve with market intelligence, forecasts, and analysis from ADI's subscription research services



Downstream Market Advisory [↗](#)

Monthly intel, oil prices, fuels supply & demand, capex, margins, downstream and refining insights



Gas Monetization Advisory [↗](#)

Review of natural gas to power, LNG, fuels (GTL), and chemicals costs, economics, and markets



LNG Analytics [↗](#)

LNG project benchmarking tool; global and NA small-scale LNG studies; and global LNG database



Energy Transition Advisory [↗](#)

Monthly energy transition deep dives, e.g., biofuels, hydrogen, low-carbon, CCS, flaring, biomaterials



Global CapEx Outlook [↗](#)

Quarterly forecast and analysis of global capital spending in E&P, midstream, refining, LNG, petchem



Global OpEx Outlook [↗](#)

Quarterly forecast and analysis of operating expenses in upstream, midstream, downstream, and LNG



ADI Analytics

OIL & GAS • ENERGY • CHEMICALS

440 Cobia Drive
Suite 1704
Houston, Texas 77494

+1.832.768.8806
info@adi-analytics.com
www.adi-analytics.com