CANADA'S CRITICAL MINERALS STRATEGY: DISCUSSION PAPER

OPPORTUNITIES FROM EXPLORATION TO RECYCLING:

Powering the green and digital economy for Canada and the world

Canada

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FOREWORD BY THE MINISTER

Let me begin with a simple fact — mining is one of Canada's most important economic sectors.

Canada currently produces 60 minerals and metals at 200 mines and 6,500 sand, gravel and stone quarries across the country.

This country is home to almost half of the world's publicly listed mining and mineral exploration companies, with a presence in more than 100 countries. With a combined market capitalization of $520 billion.

Now, our mining industry — indeed our country — is faced with a generational opportunity: critical minerals.

Simply put, there is no energy transition without critical minerals, and this is why critical mineral supply chain resilience is an increasing priority for advanced economies.

And because of this we are seeing projections for significantly increased demand for several of these minerals, overwhelming current supply.

In fact, the World Bank forecasts a 500 percent increase is required — by 2050 — in production of minerals like cobalt just to feed the clean energy transition to batteries.

And for minerals such as lithium and graphite, demand could increase by as much as 4,000 percent. With this increased demand comes the risk that, without sufficient supply, critical minerals could become the bottleneck, rather than an enabler, in the energy transition.

At the same time as these projections for increased demand, geopolitical uncertainty has magnified the precariousness of existing sources of minerals and metals.

Governments around the world have begun to assess their vulnerability to supply shocks for commodities they cannot sufficiently source inside their own borders but on which their economies depend.

It is in this context that the Government of Canada views the development of our critical minerals value chain as a generational opportunity for our country.

Every stage of the critical minerals value chain presents an opportunity for Canada: exploration, mining, processing, manufacturing and advanced manufacturing, and recycling. Moreover, these opportunities exist in every region of the country.

That's why our government has committed to develop a Critical Minerals Strategy, backed by nearly $4 billion in Budget 2022 — a strategy that will address the entire value chain.

To kick off the public consultations on the strategy, we are looking for input on this discussion paper that sets out guiding principles as well as five key outcomes:

- Economic growth and competitiveness;
- Environmental protection and climate action;
- Enhanced security and partnership with allies;
- Advancing reconciliation; and,
- Advancing diversity and inclusion.

I look forward to working with Indigenous Peoples, provinces, territories, industry and stakeholders to finalize a strategy that will create good jobs for Canadians, grow our economy and further Canada's standing on the world stage.

Jonathan Wilkinson,
Minister of Natural Resources

OVERVIEW

VISION

Canada's Critical Minerals Strategy will boost the supply of critical minerals to grow domestic and global value chains for the green and digital economy.

Critical minerals are essential inputs for renewable energy and clean technology applications, such as advanced batteries, permanent magnets, solar panels, wind turbines, and small modular reactors, as well as advanced manufacturing applications, including defence and security technologies, semiconductors and consumer electronics, and critical infrastructure.

Global demand for critical minerals and the manufactured products they go into is forecast to increase significantly in the coming decades to enable transition to a green and digital economy. Production and processing of many critical minerals are geographically concentrated, making supply vulnerable to economic, geopolitical, environmental, and other risks.

Growing Canada's supply of critical minerals and the products they make possible presents a generational opportunity. To fully seize this opportunity, we must address the entire supply chain, including exploration, mining, processing, manufacturing, and recycling, and ensure value is added at each stage.

By growing and building our expertise at each point in the critical minerals supply chain, Canada can grow its economy in almost every province and territory; fight climate change at home and around the world; and improve the resilience of our supply chain and those of our allies to future disruptions. Importantly, this must be done in a way that advances the Government of Canada's commitment to reconciliation with Indigenous peoples.

The Critical Minerals Strategy will empower businesses, workers, and communities across Canada to seize this opportunity.

OBJECTIVES

The Strategy will address five core objectives:

- **support economic growth and competitiveness;**
- **promote climate action and environmental protection;**
- **enhance global security and partnerships with allies;**
- **advance Indigenous reconciliation; and**
- **foster diverse and inclusive workforces and communities.**

The purpose of this paper is to solicit your views on the Government's approach to achieving these objectives. The Strategy will complement the pan-Canadian vision, principles, and strategic directions of the Canadian Minerals and Metals Plan (CMMP), developed with provinces and territories, industry, and Indigenous business representatives working to build a stronger, more competitive mining sector.

The consultation period will take place from June 14 to September 15, 2022. The Strategy will be published in Fall 2022.

CRITICAL MINERALS IN CANADA

There is no global definition of critical minerals. Critical minerals are country-specific, and their "criticality" can change with time based on supply and demand, technological development, and shifting societal needs. Canada as well as a host of other countries have critical minerals lists that are used to guide investment and prioritize decision-making to support critical minerals projects and supply chains. While these country-specific lists differ in their composition, there is a shared view that critical minerals

- have few or no substitutes,
- are strategic and somewhat limited commodities, and
- are increasingly concentrated in terms of extraction and, even more, in terms of processing location.

Although critical minerals lists may differ among countries, owing to a variety of factors, there is significant overlap between jurisdictions. For example, many critical minerals on Canada's list mirror the lists developed by the U.S., European Union and Japan.

Building Blocks

Critical minerals are the building blocks for the green and digital economy. They are used in a wide range of essential products, from mobile phones to solar panels, and from electric vehicle batteries to medical and healthcare applications. Without critical minerals, there is no energy transition for Canada and the world. By investing in critical minerals today, we are building a sustainable industrial base throughout the critical minerals supply chain for generations to come.

Growth in these applications is expected to boost world demand for many critical minerals. According to the International Energy Agency, the total market size of the critical minerals needed to transition to clean energy could increase nearly sevenfold between 2020 and 2030. The North American zero-emission vehicle (ZEV) market alone is estimated to reach $174 billion by 2030, creating more than 220,000 jobs in mining, processing, and manufacturing.

Canada's List of Critical Minerals

Canada has a list of minerals it considers to be "critical." Developed in consultation with provincial, territorial, and industry experts, the list provides greater certainty and predictability to investors, developers, and trading partners on Canada's priorities and capabilities to produce critical minerals.

To be deemed a "critical mineral" in Canada, it must be

- essential to Canada's economic security and its supply is threatened; or,
- required for Canada's transition to a low-carbon economy; or
- a sustainable source of highly strategic critical minerals for our partners and allies.

Canada's list of critical minerals currently consists of 31 minerals. The list is reviewed and, if necessary, revised every three years.

Canada already produces over 60 minerals and metals, is a leading global producer of many critical minerals, including nickel, potash, aluminum, and uranium, and has the potential to supply more to both domestic and international markets.

Early Prioritization

Given the urgent need to develop Canada's critical minerals supply chains, our research suggests that early efforts should focus on the following **six** minerals: lithium, graphite, nickel, cobalt, copper, and rare-earth elements.[1]

These minerals have been selected because they offer the greatest economic growth and employment opportunities across the country, including for Indigenous peoples, along the entire value chain (exploration, mining, processing, manufacturing, and recycling). In addition, these six minerals support the manufacture of value-added products, including clean technologies, information/communication technology, and advanced manufacturing.

Opportunities also exist to ramp up production and processing of additional minerals for industrial value chains that are strategic to Canada and its partners and that will attract foreign direct investment (FDI), thus helping to create more stable global supply chains. This includes minerals like vanadium, gallium, titanium, scandium, magnesium, tellurium, zinc, niobium, and germanium.

By increasing the supply and processing of these minerals, Canada can work with it allies to manufacture products we need, such as military optics, semi-conductors, prosthetic limbs, ultrasound machines, solar panels and wind turbines.

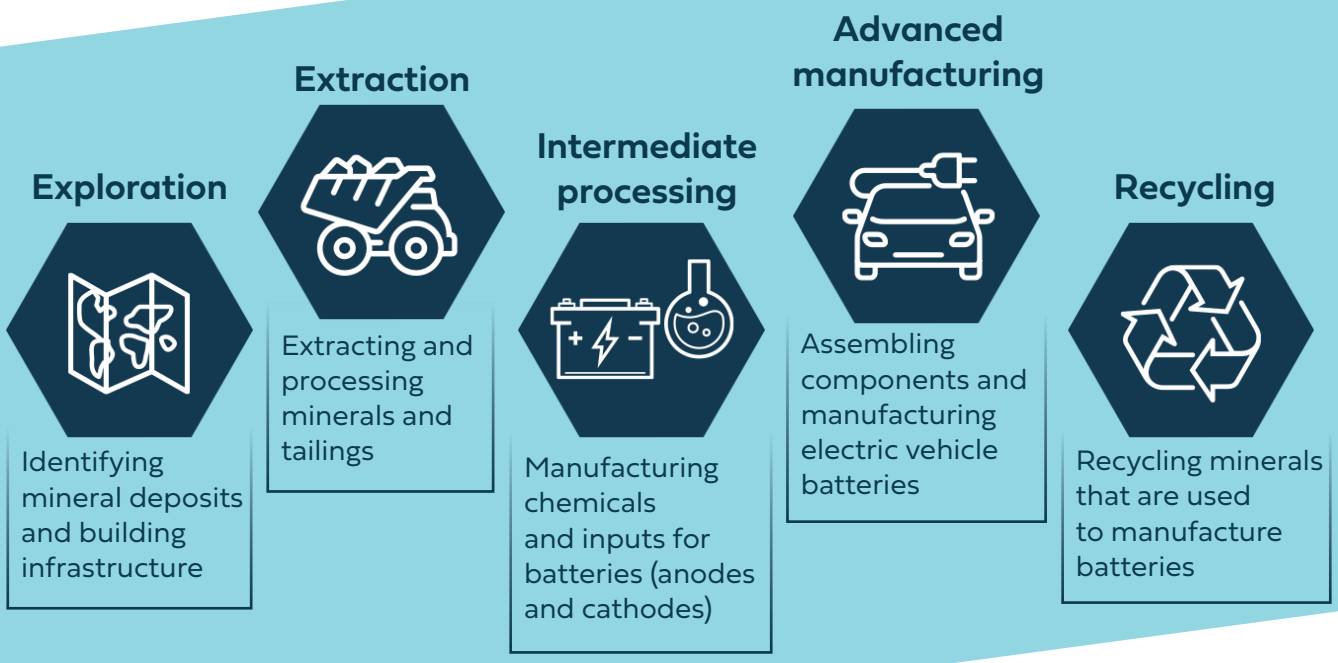
At the same time, Canada will work to strengthen and consolidate Canada's existing position as a strong, sustainable producer of potash, uranium, and aluminum, all minerals that are critical to the global economy. Whether it is opportunities in low-carbon energy and electrification, healthcare, green buildings, or food security, these minerals are central to Canada's trading relationships and strategic global position.

[1] The International Energy Agency (IEA) projects the market for critical minerals needed for clean technologies alone, like copper, cobalt, manganese, and rare earth elements (REEs), will grow almost sevenfold from 2020 to 2030 to attain a projected global market of USD 400 billion for these energy minerals by 2040.

THE VALUE CHAIN: FROM EXPLORATION TO RECYCLING

Building on the success of Canada's *Mines to Mobility* approach—which has attracted major investments in the manufacturing of zero-emission vehicles—the Strategy plans to pursue an *Exploration to Recycling* approach to critical minerals. This goes beyond the foundation established from *Mines to Mobility*, to building capacity at each stage of the value chain, from exploration to recycling, and everything in between (Appendix C).

The value chain for critical minerals includes five segments. An illustrative example of a battery manufacturing value chain is included below.



A value chain is the set of activities that adds value (e.g., product or process innovation) at each stage of the production and delivery of a quality product to a customer, and which maximizes a company's competitive advantage. A supply chain, which is a related concept, is concerned with securing access and the logistics and organizations involved in getting the product to market.

The production and processing of many critical minerals are presently geographically concentrated, making supply chains vulnerable to several risks. Recent global events, such as Russia's invasion of Ukraine, highlight the geopolitical fragility of critical minerals supply and the need for Canada's partners and allies to diversify sources and reduce import dependency as demand forecasts outpace mineral supply and investment plans.

Canada can grow and connect domestically mined and processed minerals to Canadian manufacturing with greater opportunities in the areas of:

- Clean technologies—energy transmission systems, permanent magnets, wind turbines, panels, advanced batteries, hydrogen fuel cells, and small modular reactors;

- Semiconductors and information and communication technologies;

- Advanced manufacturing inputs and materials—ceramics, high value-added metals, electronic materials, composites, polymers, and biomaterials.

By focusing on the entire value chain, Canada can ensure maximum economic benefits for Canadians, while mitigating supply chain risks.

This focus on the value chain will further advance Canada's circular economy. The global transition to a green and digital economy is expected to increase the volume of embedded material and end-of-life clean and digital technologies. The Strategy will incorporate circular solutions to close material loops, retain access to post-consumer resources through robust recycling infrastructure and secondary markets, and encourage the recovery of critical minerals from mining and industrial waste streams, which will further cement Canada's innovative leadership in this area. This will ensure that Canada retains the benefits from the extraction of its critical minerals for decades to come, capitalizing on an increasingly important segment of the critical minerals industry that remains largely untapped.

An important element of the Strategy is to capitalize on and advance Canada's ESG credentials along the value chain. ESG considerations are becoming increasingly prominent in business and investment decisions, especially for automotive sector firms as they transition away from combustion engines and toward increased production of electric vehicles. It matters that the carbon emissions of the end product are minimized, but markets are also increasingly demanding sustainability along the entire value chain, including extraction, production, and hiring practices. Public awareness can also impact firms' reputations and, consequently, their path to profitability, based on observances and opinions in social media, NGOs, and academia.

CANADA'S OPPORTUNITY AND OBJECTIVES

The generational opportunity presented by critical minerals is defined by five core objectives, which, if achieved, will indicate that Canada has successfully seized the opportunity before it. These five objectives are

Support economic growth and competitiveness, measured by:

- Jobs—Sustained and increased jobs in the critical minerals exploration, mining, processing, manufacturing, and recycling sectors
- Trade—Increased exports of processed materials and value-added goods
- Value—Developing, expanding, and consolidating Canadian value chains for critical minerals
- Growth—Anticipated increase in value-added and GDP growth (e.g., global market share), as well as regional economic development, including in rural, remote, and Indigenous communities

Promote climate action and environmental protection, measured by:

- Footprints—nature and biodiversity, such as through limiting the environmental footprint of mines and supporting environmental stewardship
- GHGs—Reduction of greenhouse gas emissions through the deployment of clean technologies and low-emission sources of energy and fuel in the mining process, in line with Canada's Emissions Reduction Plan
- Diverted Waste—Reduction of waste from critical minerals production (e.g., reducing mine tailings, recycling wastewater) and associated products (e.g., through enhanced recycling capabilities)

Enhance global security and partnership with allies, measured by:

- Cooperation agreements—Protecting critical supply chains among trading partners and like-minded nations, using bilateral agreements and multilateral forums
- Investment—Protecting Canadian assets while encouraging foreign direct investment
- Best practices—Working with international partners to strengthen best practices in Environmental, Social, and Governance (ESG), protection of human rights, and Indigenous rights

Canada's Competitive Advantage

- World class mineral resource wealth
- Long-standing mining expertise
- Extensive technology and mining capabilities
- Abundant clean energy resources
- Strong environmental, social, and governance (ESG) credentials

Advance Indigenous reconciliation, demonstrated by:

- Economic reconciliation—Economic participation in jobs, businesses, and equity, such as advancing priorities related to the Arctic and Northern Policy Framework and the implementation of the Truth and Reconciliation Commission's Calls to Action
- Rights—Protecting Indigenous rights and implementing UNDRIP
- Engagement—Meaningful and early engagement of Indigenous governments and organizations from project conception to development and oversight

Foster diverse and inclusive workforces and communities, measured by:

- Diversity and inclusion in the workforce - particularly women, youth, LGBTQ+, Indigenous peoples, recent immigrants, Black and racialized communities, and persons with disabilities
- Advancement of human rights abroad through Responsible Business Conduct Abroad: Canada's Strategy for the Future
- Leveraging existing government initiatives, such as the Youth Employment Strategy, the Centre on Diversity and Inclusion, and the Rural Economic Development Strategy

STRATEGY FOCUS AREAS AND INITIATIVES

The Strategy's core federal initiative is the Critical Minerals Centre for Excellence at Natural Resources Canada, which leads the development and coordination of Canada's policies and programs on critical minerals, in collaboration with industry, provincial, territorial, Indigenous, non-governmental, and international partners.

To achieve its objectives, the Strategy is being built on six focus areas for federal initiatives and investment.

DRIVE RESEARCH, INNOVATION, AND EXPLORATION

Locating critical minerals in Canada's vast landmass is a complex endeavour. It requires advanced geoscience capabilities, including geological mapping, geophysical surveying, and scientific assessments and data. To extract and process critical minerals sustainably, we need innovative technologies and industrial practices that optimize efficiency, cost competitiveness, and environmental stewardship.

Through a robust network of research and development (R&D) labs, Canada has the science, technologies, and tools to be a leader in the sustainable development of critical minerals. The federal government will build upon private sector investment to advance technological innovation and environmental performance in Canada's critical minerals sector and associated industries. Budget commitments from 2021 and 2022 cover different aspects of the value chain, from exploration to processing and refining, through to more advanced products:

- $79.2 million for public geoscience and exploration to better assess and identify mineral deposits;
- A 30% Critical Mineral Exploration Tax Credit for targeted critical minerals (i.e., nickel, lithium, cobalt, graphite, copper, rare-earth elements, vanadium, tellurium, gallium, scandium, titanium, magnesium, zinc, platinum group metals, and uranium);
- $47.7 million for targeted critical mineral R&D through Canada's research labs;
- $144.4 million for critical mineral research and development, and the deployment of technologies and materials to support critical mineral value chains.

Discussion Questions

- **What are priority areas for research programs (academia, industry, governments)?**
- **What more should be done to drive critical mineral exploration and innovation?**

ACCELERATE PROJECT DEVELOPMENT

Most mining and industrial development projects require large investments with high risk and slow return. For example, it can take 5 to 25 years for a mining project to become operational, with no revenue until production starts. Domestic projects are also subject to rigorous regulatory assessments to meet Canada's reputable ESG standards.

To advance our transition to a net-zero economy, the federal government is providing financial and administrative support to accelerate the development of strategic projects in critical mineral mining, processing, manufacturing, and recycling. This includes leveraging the resources and expertise of our trade and national business development organizations such as the Business Development Bank of Canada, Export Development Canada, and the Canadian Commercial Corporation. It also means capitalizing on existing programs such as the Strategic Innovation Fund, which is already making significant investments in the electric vehicle market.

We will also ensure alignment with provincial and territorial partners, while respecting the environment and Indigenous rights, which will allow these projects to develop in a more robust manner.

These core endowments in critical minerals value chains will reinforce and strengthen existing programs that seek to create new job opportunities and attract foreign direct investment in Canada's critical minerals sector and associated industries. Furthermore, the meaningful participation of Indigenous peoples and organizations in regulatory processes is integral to ensuring that projects advance and that rights are upheld. Federal support for regulatory processes will reinforce partnerships and strive to ensure that meaningful participation and engagement occur throughout all phases of project approvals. Budget 2021 and 2022 proposed the following initiatives:

- $1.5 billion ($1 billion in new funding, $500 million from existing funds) over six years, starting in 2024–25, for the Strategic Innovation Fund to support critical minerals projects, with prioritization given to manufacturing, processing, and recycling applications.
- $40 million to support northern regulatory processes in reviewing and permitting critical minerals projects; and
- $21.5 million to support the Critical Minerals Centre of Excellence (CMCE) to develop federal policies and programs on critical minerals and to assist project developers in navigating regulatory processes and federal support measures.[2]

Discussion Questions

- **How can we streamline the regulatory processes to better facilitate project development?**

BUILD SUSTAINABLE INFRASTRUCTURE

Canada has a strong base of critical minerals that are in high demand globally. Advancing strategic infrastructure investments to enable development of critical mineral resources will help foster sustained growth and the establishment of supply chains, while securing Canada's place in the growing global critical minerals industry. Although Canada's critical minerals sector has tremendous opportunities and potential, it is underexplored and critical mineral deposits are often located in areas with challenging terrain and limited access to enabling infrastructure such as roads, clean energy, or grid connectivity. This infrastructure deficit has been an obstacle to attracting investment while posing challenges to local communities. It increases development costs and potential project risks, particularly with rising inflationary pressures and increased challenges facing global supply chains.

[2] This amount represents $10.9 million from Budget 2021 and $10.6 million from Budget 2022.

The federal government is supporting the development of Canada's critical minerals sector through investments in sustainable energy and transportation infrastructure to support the supply chains that are needed to get critical mineral products to market. These investments will support Canadian trade and economic development by addressing gaps in enabling infrastructure to unlock priority mineral deposits, while considering potential multi-user benefits and Canada's goals related to environmental protection, climate adaptation, and Indigenous reconciliation.

- Up to $1.5 billion for infrastructure development for critical mineral supply chains, with a focus on priority deposits, was proposed in Budget 2022.
- The ability to partner with the Canada Infrastructure Bank for revenue-generating infrastructure projects, particularly by drawing on their $5 billion clean power priority investment area and $5 billion trade and transportation priority investment area.

Discussion Questions

- **What regional infrastructure gaps must be addressed (e.g., transportation and clean energy) to enable the sustainable development of Canada's critical mineral resources?**

ADVANCE INDIGENOUS RECONCILIATION

Indigenous peoples are the stewards, rights holders, and in many cases, title-holders to the land upon which natural resources are located. The success of Canadian critical mineral development must be based on respect for Indigenous and treaty rights, and meaningful engagement, partnership, collaboration and inclusion of First Nations, the Métis Nation, and Inuit.

Engagement in the CMMP highlighted that Indigenous peoples experience significant systemic barriers that limit their meaningful participation in the mining sector and the natural resource sectors more broadly. Barriers commonly cited by Indigenous peoples include economic, business, and community skills capacity gaps; varying levels of industry commitment to provide meaningful economic opportunities to Indigenous communities; access to competitive capital for equity participation; and the need to equip and upskill Indigenous workers for participation in the resource sectors of the future.

The Final Report of the National Inquiry into Missing and Murdered Indigenous Women and Girls also found that there are higher levels of violence and harassment by transient workers toward Indigenous peoples and women, and that Indigenous women face significant barriers to participating in the extractive economy. To reduce gaps and advance community participation in natural resource sectors, engagement and partnership-building must be early and ongoing and must respect and reflect diverse Indigenous interests.

The federal government is striving to advance economic reconciliation by advocating for and supporting the meaningful participation of Indigenous peoples and businesses in critical mineral projects, including regulatory processes and value chains. The implementation of the Strategy will be informed by the United Nations Declaration on the Rights of Indigenous Peoples and the development of a National Benefits-Sharing Framework.

- $103.4 million was provided in Budget 2022 to advance economic reconciliation in the natural resource sector, including at least $25 million to support Indigenous participation in the Critical Minerals Strategy through early engagement and community capacity building.

Discussion Questions

- **How can Indigenous governments and organizations, communities, and individuals partner and participate in critical mineral value chains (including regulatory processes)? How can government and non-Indigenous industry proponents support this effort?**

GROW A DIVERSE WORKFORCE AND PROSPEROUS COMMUNITIES

Developing Canada's critical minerals and associated value chains will create new economic opportunities in regions and communities across the country. Moreover, as lower-emission industries come online, workers from other extractive sectors, like oil and gas, will be able to use their transferable skills to secure high-quality jobs in critical mineral exploration, extraction, processing, manufacturing, and recycling.

NRCan will leverage other federal skills and training initiatives to help institutions and employers train and reskill people, and help the workforce grow and meet demand driven by critical minerals. This includes collaborating with other federal partners on key Budget initiatives such as the Community Workforce Development Program and the Sectoral Workforce Solutions Program, as well as long-standing Indigenous labour market programs such as the Skills and Partnership Fund and the Indigenous Skills and Employment Training Program. To ensure a regional approach for communities, the federal government will leverage the expertise of Regional Development Agencies and initiatives related to rural economic development. In addition, developing the skills needed to fully realize the opportunities available in the critical minerals sector will require partnerships with several other stakeholders including provinces and territories, universities, colleges, and specialized training institutions.

The Mining Industry Human Resources Council forecasts over 25% of the current mining workforce will retire by 2029 and between 79,680 and 113,130 new workers will need to be hired before 2030. Skills requirements in mining will continue to change as a result of new technologies in the workplace.

Canada is committed to a just transition to and creating sustainable jobs for a net-zero emissions future. We want to help workers and communities thrive in the new economy, while fostering a diverse industrial sector that includes Indigenous peoples, women, Black Canadians, people with disabilities, LGBTQ2+ individuals, and other racialized Canadians.

Discussion Questions

- **How do we leverage critical minerals investment into more diverse skills training, employment, and regional outcomes, including for local, rural, and Indigenous communities?**

STRENGTHEN GLOBAL LEADERSHIP AND SECURITY

The geographic concentration of critical mineral production in few countries overseas raises the risk of supply chain disruption. As a trusted supplier of responsibly sourced mineral and metal products, Canada is well positioned to be a leader in the responsible, inclusive, and sustainable production of critical minerals and resilient value chains. We have a role to play in powering the green and digital economy, both at home and around the world.

Since January 2020, Canada has formalized bilateral cooperation with the U.S., the EU, and Japan, and is actively engaging with additional allies like Australia, the UK, and Korea. Canada needs to deliver on its growing number of bilateral commitments and engagements without compromising its ability to deliver on domestically focused programs and priorities.

The Strategy will work to ensure that international engagement activities related to critical minerals align with the Government of Canada's strategic objectives. This includes strategic consideration of broader geopolitical and industrial priorities for Canada's international engagements to advance secure critical minerals supply chains, including the consideration of any potential gaps and regional priorities.

There is growing interest to pursue collective action to secure critical mineral value chains across the globe. Canada is engaged in bilateral and multilateral cooperation on critical minerals with several international partners, including the United States, the European Union, and Japan. We are leveraging our international partnerships to align policies and regulatory approaches, improve global ESG standards, address technical challenges through joint R&D, and encourage new investment opportunities in Canada.

- $70 million for global partnerships to promote Canadian mining leadership, such as promoting ESG standards and supporting bilateral and multilateral critical minerals commitments, was proposed in Budget 2022.
- Continue to enhance Canada's reputation abroad, through Canada's new Responsible Business Conduct (RBC) Strategy which was launched in April 2022, by strengthening the global RBC ecosystem. This includes contributing to a rules-based international system that advances Canada's values, integrating RBC in bilateral and multilateral agreement and engagements, as well as fostering an enabling environment for RBC.

Discussion Questions

- **How might the Government work with its partners and stakeholders so that greater value is placed on high ESG standards throughout the value chain?**

CONCLUSION AND NEXT STEPS

Our approach to critical minerals builds on extensive public and Indigenous consultations for the CMMP, as well as multi-stakeholder evidence and recommendations from the February 2022 report of the House of Commons Standing Committee on Natural Resources, *From Mineral Exploration to Advanced Manufacturing: Developing Value Chains for Critical Minerals* in Canada and the March 2022 report of the House of Commons Standing Committee on Industry and Technology, *The Neo Lithium Acquisition: Canada's National Security Review Process in Action*.

The Strategy is intended to be forward-looking, long-term, and iterative. As such, engagement with PTs, Indigenous organizations, and key industry stakeholders will continue on an ongoing basis with opportunities to adjust the Strategy moving forward.

In addition to this document, several of our strategic partnerships and engagement forums will inform the implementation of the Canadian strategy over the long term:

- Federal-Provincial-Territorial (FPT) Task Team on Critical Minerals and Battery Value Chains
- Critical Minerals Indigenous Engagement Strategy
- Northern Regulatory Process Engagement
- Regional Energy and Resource Tables
- Industry Critical Minerals Roundtables
- Canada-U.S. Joint Action Plan on Critical Minerals Collaboration
- Critical Minerals Working Group under the Canada-Japan Energy Policy Dialogue
- Canada-EU Strategic Partnership on Raw Materials

The current consultation period will take place from June 14 to September 15, 2022. You may email submissions to NRCan's Critical Minerals Centre of Excellence at cmce-cemc@nrcan-rncan.gc.ca. The final Strategy will be published in Fall 2022.

APPENDIX A: COMPILATION OF DISCUSSION QUESTIONS

Prioritization and Areas of Focus

- Do you concur that the value chains identified and their associated minerals offer Canada the greatest opportunities for economic growth?
- Are the six areas of focus and their associated objectives the right ones to help Canada achieve its vision on critical minerals for domestic and global value chains?

Drive Research, Innovation, and Exploration

- What are priority areas for research programs (academia, industry, governments)?
- What more should be done to drive critical mineral exploration and innovation?

Accelerate Project Development

- How can we streamline the regulatory processes to better facilitate project development?

Build Sustainable Infrastructure

- What regional infrastructure gaps must be addressed (e.g., transportation and clean energy) to enable the sustainable development of Canada's critical mineral resources?

Advance Indigenous Reconciliation

- How can Indigenous governments and organizations, communities, and individuals partner and participate in critical mineral value chains (including regulatory processes)? How can government and non-Indigenous industry proponents support this effort?

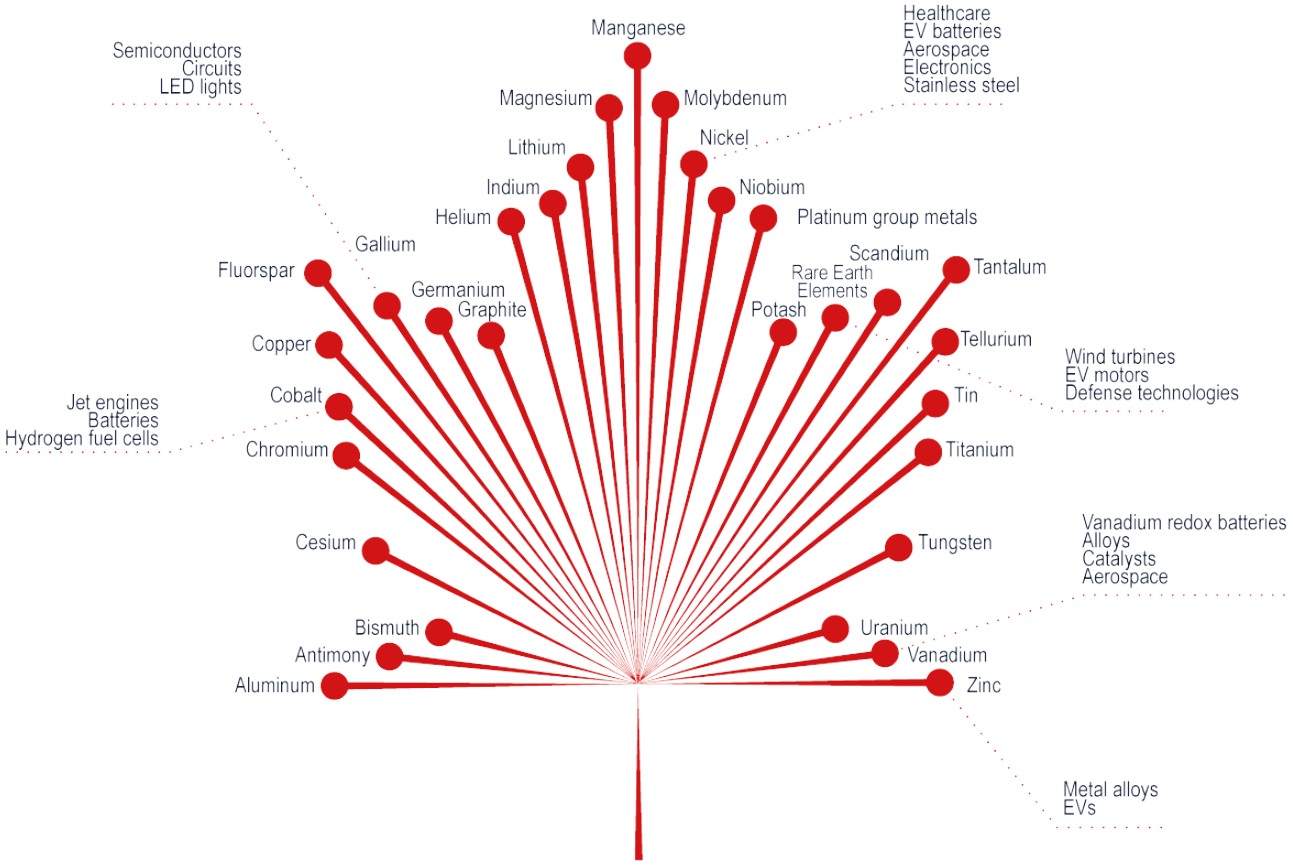
Grow a Diverse Workforce and Prosperous Communities

- How do we leverage critical minerals investment into more diverse skills training, employment, and regional outcomes, including for local, rural and Indigenous communities?

Strengthen Global Leadership and Security

- How might the Government work with its partners and stakeholders so that greater value is placed on high ESG standards throughout the value chain?

APPENDIX B: CANADIAN CRITICAL MINERALS AND SAMPLE USES

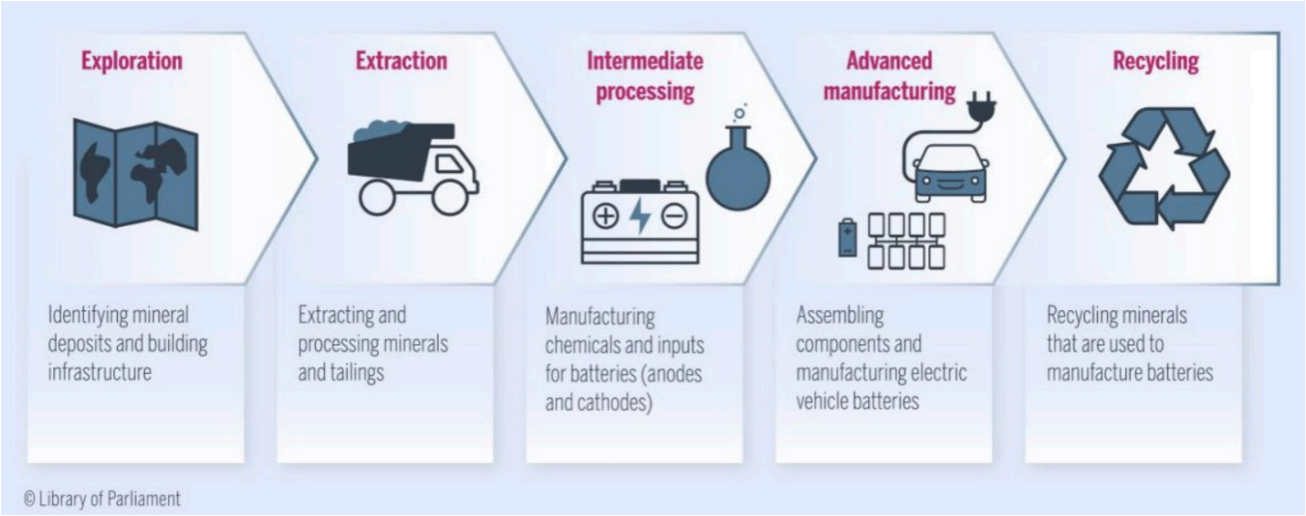


APPENDIX C: BUILDING CANADIAN VALUE CHAINS

An Exploration to Recycling approach to critical minerals refers to building capacity at each stage of the value chain, from exploration to recycling, and everything in between. A value chain is the set of activities that adds value (e.g., product or process innovation) at each stage of the production and delivery of a quality product to a customer, and which maximizes a company's competitive advantage. A supply chain, which is a related concept, is concerned with the logistics and organizations involved in getting the product to market.

Due to factors like geopolitical risks, ESG and cost considerations, many companies are increasingly prioritizing vertical integration, and having as much of the value chain located in close geographic proximity to their primary operations. An EV manufacturer, for example, will benefit if all stages of battery production occur relatively close to its plant, with transparent and trusted suppliers, operating in a stable economic and political climate.

The value chain for critical minerals includes five segments:



Upstream—Exploration

Mineral exploration is the search for materials in the earth's crust that occur in concentrations and quantities high enough to be extracted and processed for profit. Exploration covers a wide range of activities, including reconnaissance surveys (e.g., aerial photography, geophysical surveys), prospecting and ground surveys, sampling, project engineering, and feasibility studies.

Companies are actively exploring for critical minerals and developing critical minerals projects in Canada.

From 2010 to 2020, a total of $66.4 billion was invested on critical minerals exploration and development projects in Canada, accounting for 45% of total spending. However, except for base metals and uranium, critical minerals, especially battery minerals, account for a small but recently growing share of total exploration spending.

The federal, provincial, and territorial governments support mineral exploration by providing geoscience in the form of geological maps, regional geophysical surveys, and other scientific information. The Geological Survey of Canada (GSC) manages a number of national geoscience research initiatives that support critical mineral exploration, including the Geo-Mapping for Energy and Minerals-GeoNorth program and the Targeted Geoscience Initiative.

The Government of Canada can improve its geoscience capacity by combining and overlaying geological potential with economic feasibility, ESG priorities, and infrastructure data at an early stage to identify the exploration projects that offer the greatest benefits and lowest risks. Better data, platforms for large-scale data analysis and visualization, and predictive tools deployed as early as possible in the mining cycle would also facilitate project planning, improve investor confidence, and create efficiencies in the regulatory and permitting processes.

Upstream—Mining (or Extraction)

Mining is the process of extracting minerals and/or other useful materials from the earth. The two primary modes of mining are surface and underground mining, with the former being more common. While specific operations may differ depending on the characteristics of the deposit or ore body, they generally involve the use of heavy machinery for drilling, blasting, loading, and hauling the minerals away for processing.

With approximately 200 active mines across the country, Canada is a major producer of critical minerals. It is the global leader in the production of potash and ranks among the top five global producers for aluminum, indium, niobium, platinum group metals, titanium concentrate, and uranium.

The mining sector is also the second-largest private sector employer of Indigenous peoples in Canada and provides skills and employment training, contracting opportunities, job guarantees, and community investments.

Mining is typically very capital-intensive, and new mines can take anywhere from 5 to 25 years to become operational. Mining companies, particularly junior companies, face the challenge of raising the private investment required to reach the production stage. In rural, Northern, and remote regions, infrastructure gaps also hamper mineral development. To boost or develop new mine production, and to do so in a cost-effective and environmentally responsible way, the Government of Canada will look for opportunities to partner with the private sector in financing new projects, support building the necessary infrastructure for priority deposits, advance innovation to improve efficiency and environmental performance, strengthen Indigenous engagement, and streamline regulatory and permitting processes.

Midstream—Processing, Refining, and Metallurgy (e.g., semi-finished inputs and materials)

Metallurgy refers to the study of metals and alloys, and specifically, the science of turning them into forms suitable for practical use. There are three steps in extracting metals from their ores or “waste rock”: mineral processing, chemical extraction, and refining. The processing stage treats the ore to eliminate as much of the waste portion as possible, and includes two main steps: comminution (e.g., crushing and grinding), and separation. Chemical extraction often uses high-temperature processes, such as smelting or aqueous solutions, to process these valuable metal-bearing solids and transform them into intermediate compounds that are refined to their elemental or metallic state.

Canada has a long tradition in copper, zinc, and nickel mining, smelting, and processing. Mining of these metals in Canada comes mostly from sulphide deposits, which produce concentrates, either for exports or for processing within Canada into intermediate or refined metal products. Base metals refineries are key sources of minor metals deemed critical, including germanium, indium, and tellurium. Canada is also a producer of refined cobalt. Cobalt is produced primarily as a co-product of nickel mining and processing.

For many critical minerals such as lithium, Canada has no domestic refined production. However, several companies are investing in innovative refining technologies to extract lithium from deposits. Canada has significant rare earth resources and advanced projects and is developing a first-of-its-kind processing and separation facility in Saskatchewan.

The Government can focus on building Canada's midstream capacity to produce the materials and value-added products needed for clean technologies, such as lithium, graphite, nickel, cobalt, copper, and rare-earth elements. This will connect upstream and downstream components, and allow Canada to build new production capacity, capture more value, expand economic benefits and jobs in Canada, attract investment, and boost our domestic capabilities, all while helping to meet growing global demand.

Downstream—Component Manufacturing and Clean, Digital, and Advanced Technology Production (e.g., ZEV manufacturing, aircraft, and semiconductors)

Once processed, the metals make their way into any number of products. Separated rare earth oxides that were converted into metals can be combined to create permanent magnets that are important components of EV motors and wind turbines. Minerals like lithium and cobalt undergo chemical processing for cathode and anode production, components which make their way into lithium-ion battery packs that are later integrated into end-use applications like EVs.

One of Canada's strengths is its automotive manufacturing base. Ontario represents one of the two largest automotive manufacturing jurisdictions in North America. It has the distinction of serving as Canadian headquarters for five global OEMs: Stellantis, Ford, General Motors, Honda, and Toyota. Together, these companies typically assemble about two million light vehicles each year at their Canadian plants. They are supplied by an ecosystem of nearly 700 parts suppliers across the country.

Working with provincial partners along with the private sector, the Government of Canada has made significant investments in attracting EV and battery manufacturing in both Ontario and Quebec. Canada can continue to build on these efforts to develop downstream capacity in the country for various commodities, which will help incentivize production further upstream, whether it is a new mine or a new processing facility.

Material Recovery and Recycling

Recycling relieves the pressure on primary supply, and can be a more cost-effective, environmentally friendly alternative to opening new mines. For example, the recycling of end-of-life lithium-ion batteries to recover valuable minerals can reduce primary supply requirements for these minerals by around 10%.

Currently, recycled mineral volumes are relatively minimal overall (there are exceptions like aluminum where volumes are higher), but the International Energy Agency forecasts they will become much more significant by 2040.

In Canada, critical minerals are also found in secondary and unconventional sources (e.g., mine tailings, brines in oil fields). Examples of current private sector recycling activities and R&D research include lithium-ion recycling; recovery of titanium and zircon from oil sands tailings; recycling of vanadium in the steel industry in the form of scrap steel; recovery of magnesium from asbestos tailings; and extraction of rare earth elements from recycled permanent magnets.

Natural Resources Canada's Mining Value from Waste Program is a multifaceted program that works on reprocessing existing tailings to remove the valuable minerals and metals important for clean technology and military applications.

Among the critical minerals essential for these priority supply chains, six hold significant potential for Canadian economic growth. These include:

Critical Minerals	Value Chains	Major Applications	Examples of Specific Products
Lithium	Clean technologies	Batteries, glassware, ceramics	Rechargeable batteries (phones, computers, cameras and EVs), hydrogen fuel storage, metal alloys (military ballistic armour, aircraft, bicycle, and train components), specialized glass and ceramics, drying and air conditioning systems.
Graphite	Clean technologies	Batteries, fuel cells for EVs	Metal foundry lubricants, vehicle brake linings, metal casting wear, crucibles, rechargeable battery anodes, EVs fuel cells, electrical motor components, frictionless materials, pencils
Nickel	Clean technologies	Stainless steel, solar panels, batteries	Metal alloys (steel, superalloys, non-ferrous alloys), jet and combustion engine components, rechargeable batteries (phones, computers, EVs), industrial manufacturing machines, construction beams, anti-corrosive pipes, cookware, medical implants, power plant components
Cobalt	Clean technologies	Batteries	Battery electrodes, metal alloys, turbine engines components, automobile airbags, catalysts in petroleum and chemical industries, drying agents for paints, varnishes and inks, magnets.

Critical Minerals	Value Chains	Major Applications	Examples of Specific Products
Copper	Clean technologies and advanced manufacturing	Electrical and electronics products	Power transmission lines, electrical building wiring, vehicle wiring, telecommunication wiring, electronic components.
Rare earth elements	Zero-emission vehicles	Permanent magnets for electricity generators and motors	Flat screens, touch screens, LED lights, permanent magnets, electronic components, EV drive trains, wind turbines, airplane components, vehicle components, speakers, steel manufacturing, battery anodes, chemical catalysts, glass manufacturing, specialized glass lenses.

While these minerals represent the greatest opportunity to fuel Canadian domestic manufacturing and will be the focus of most investment, many other minerals also present significant prospects for the future. Where critical minerals are not used solely for domestic manufacturing, there is value to be captured by increasing exports for allies and expanding domestic refining and processing and components manufacturing over the medium to long term. Examples of these minerals include:

Critical Minerals	Value Chains	Major Applications	Examples of Specific Products
Vanadium	Clean technologies and advanced manufacturing	Alloys, batteries	Metal alloys (steel), military armour plating, vehicle axles, piston rods and crankshafts, nuclear reactor components, manufacturing superconducting magnets, pigments for ceramics and glass.
Gallium	Information and communications	Semiconductors, optoelectronics	Electronic circuit boards, LED devices, semiconductors, specialized thermometers, barometer sensors, solar panels, blue-ray technology, pharmaceuticals
Titanium	Clean technologies	Defence applications, chemicals	Colour pigments in paint, plastics, and paper, metal alloys (aluminum, steel, molybdenum), military aircraft, spacecraft, missiles and rockets, non-corrosive pipes, ship and submarine hulls, medical implants, sunscreen.

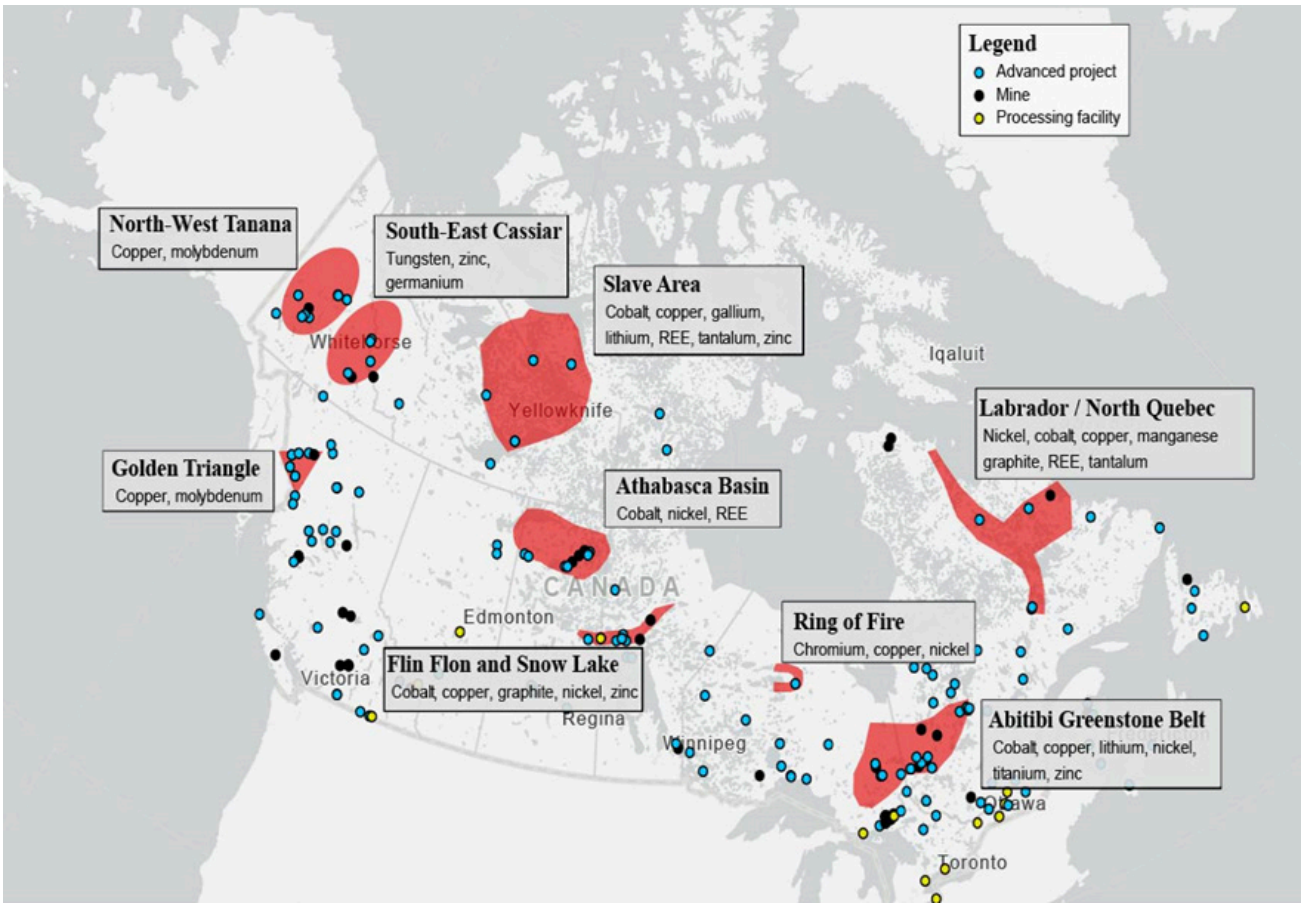
Critical Minerals	Value Chains	Major Applications	Examples of Specific Products
Scandium	Clean technologies and advanced manufacturing	Advanced alloys (aerospace & defence), fuel cells	Metal alloys (aluminum), commercial and military airplanes, rockets and vehicle components, high-end sports equipment, specialized light bulbs, solid oxide fuel cells, laser research.
Magnesium	Clean technologies and advanced manufacturing	Aluminum alloys	Aluminum alloys (airplane and automobile components), iron manufacturing, flares and fireworks, lightweight consumer goods (laptops, cameras, power tools), fertilizer, animal feed, pharmaceuticals
Tellurium	Clean technologies	Solar power, thermoelectric devices	Metal alloys (copper and steel), solar cells, semiconductors, CDs/DVDs, vulcanized rubber, chemical catalysts in oil refining.
Zinc	Clean technologies and advanced manufacturing	Galvanizing	Rust proofing, manufacturing of automobiles, paints, rubber, cosmetics, pharmaceuticals, plastics, inks, soaps, batteries, textiles, electronics, baby creams, sunscreen
Niobium	Clean technologies and advanced manufacturing	Construction, transportation	Metal alloys (steel), jet engines, rockets, construction beams, building girders, oil rigs and pipelines, superconducting magnets, MRI scanners, NMR equipment, eyeglasses.
Germanium	Information and communications, clean technologies and advanced manufacturing	Optical fibres, satellites, solar cells	Fibre-optic communication networks, camera and microscope lenses, infrared night vision systems, polymerization catalysts.

It is also important that Canada maintain its global market leadership where it is already a world leader in minerals like potash, uranium, and aluminum.

APPENDIX D: MAP OF CANADIAN CRITICAL MINERALS

Identifying and Developing Canada's Critical Mineral Rich Regions

Canada is endowed with enormous resource wealth and is home to a host of critical-mineral-rich regions. Preliminary analysis has identified eight prospective critical-mineral-rich regions based on their critical mineral potential and opportunities for projects development (APPENDIX C). Recognizing that these regions are at different stages of development and have differing needs, additional work and engagement with internal and external experts, provinces, and territories will be conducted to finalize a list of priority regions and further evaluate resource potential, current and potential projects, project needs/barriers, and economic potential in an effort to target finite resources under the Strategy.



APPENDIX E: PROVINCIAL AND TERRITORIAL STRATEGIES AND POLICIES

Critical minerals development is an area of interest for provincial and territorial partners. The Strategy advances the sector by ensuring shared benefits from complementary investment and addressing gaps not covered by regional initiatives. Several provinces have developed critical mineral strategies while others are in the process of developing policies or are actively promoting this sector.

- British Columbia
- Alberta
- Saskatchewan
- Manitoba
- Ontario
- Quebec
- New Brunswick
- Nova Scotia
- Newfoundland and Labrador
- Yukon
- Northwest Territories
- Nunavut

APPENDIX F: CANADA'S GLOBAL COOPERATION ON CRITICAL MINERALS

Canada is seeking to build more resilient critical mineral global supply chains by working with international partners to align policies, raise global economic, social, and governance (ESG) standards, advance joint research and development, and encourage new investment opportunities, among other priorities.

The Canada-U.S. Joint Action Plan on Critical Minerals was announced on 9 January 2020 to advance bilateral interest in securing supply chains for the critical minerals needed for strategic manufacturing sectors, including communication technology, aerospace and defence, and clean technology. The Action Plan is guiding cooperation between officials in areas such as industry engagement, innovation, defence supply chains, improving information sharing on mineral resources and potential, and cooperation in multilateral forums. Canada already supplies many of the minerals deemed critical by the United States. In 2020, bilateral mineral trade was valued at $95.6 billion, with 298 Canadian mining companies and a combined $40 billion in Canadian mining assets south of the border.

The Canada-EU Strategic Partnership on Raw Materials is the primary mechanism for engaging the European Commission and European Union Member States on Canada's critical mineral and battery value chains. The overarching objective of the partnership is to advance the value, security, and sustainability of trade and investment into the critical minerals and metals needed for the transition to a green and digital economy. Agreed areas of collaboration include the integration of raw materials value chains; science, technology, and innovation collaboration; and, collaboration in international forums to advance world-class ESG criteria and standards.

The Canada-Japan Sectoral Working Group on Critical Minerals aims to facilitate commercial engagement between Canadian and Japanese businesses across the critical mineral value chain; strengthen government-to-government information sharing; and encourage cooperation on international standard setting for critical minerals. It is part of the Canada-Japan Energy Policy Dialogue, where Japan is working to secure the critical mineral supply chains needed for its industrial base and broader green energy transition.

Through other multilateral engagements, Canada is pursuing collective action on critical minerals to support the global transition to green energy and more resilient supply chains. Notable multilateral organizations and initiatives include the G7/G20, the International Energy Agency (IEA), the World Bank, the International Renewable Energy Agency (IRENA), the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF), and the Energy Resource and Governance Initiative (ERGI).