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FROM MINERAL EXPLORATION TO ADVANCED MANUFACTURING: DEVELOPING VALUE CHAINS FOR CRITICAL MINERALS IN CANADA

Report of the Standing Committee on Natural Resources

James Maloney, Chair

**JUNE 2021
43rd PARLIAMENT, 2nd SESSION**

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NOTICE TO READER

Reports from committees presented to the House of Commons

Presenting a report to the House is the way a committee makes public its findings and recommendations on a particular topic. Substantive reports on a subject-matter study usually contain a synopsis of the testimony heard, the recommendations made by the committee, as well as the reasons for those recommendations.

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THE STANDING COMMITTEE ON NATURAL RESOURCES

has the honour to present its

SIXTH REPORT

Pursuant to its mandate under Standing Order 108(2), the committee has studied critical minerals and associated value chains in Canada and has agreed to report the following:

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SUMMARY

Critical minerals are essential components of many new technologies, from low-greenhouse gas energy sources to electric vehicles to advances in cutting-edge sectors such as medicine, electronics, aerospace and defence. Canada possesses vast reserves of critical minerals. Some of these minerals, such as aluminum, cobalt, copper, graphite, nickel and uranium, are mined or produced in Canada today. Others, such as rare earth elements, lithium and vanadium, are currently being explored or projects are under development.

Considering that the demand for critical minerals is growing strongly around the world, developing this mineral potential is an economic opportunity for Canada's mining industry. Securing a supply of critical minerals is especially important because access to these resources is not entirely stable and production is concentrated in a few countries, notably China. To reduce this dependence on foreign markets and to position itself on global markets, the Canadian mining industry can leverage its high environmental, social and governance standards and significant involvement of Indigenous communities. Canada could also pursue a "continental" approach to guarantee a supply of critical minerals in cooperation with the provinces and territories, as well as the United States. While some challenges remain, including the exploration and evaluation of Canada's critical mineral potential, infrastructure in remote and Northern regions and investment-related risks, Canada has the ability to sustainably and responsibly develop the critical minerals sector and take advantage of opportunities to reuse and recycle these resources.

In addition to developing its domestic critical minerals production capacity and supply chains, Canada could also process critical minerals to turn them into value-added products and thus create its own value chains, in sectors such as renewable and low-greenhouse gas energy, batteries and computer chips for electric vehicles and batteries for energy storage. This report presents ways the federal government could support the development of the critical minerals industry and its associated value chains and identifies potential solutions. These solutions include developing a value-added critical minerals strategy for Canada; supporting the development of intermediate processing capacity; focusing on industries that help reduce greenhouse gas emissions; and building expertise and training a skilled workforce.

LIST OF RECOMMENDATIONS

As a result of their deliberations committees may make recommendations which they include in their reports for the consideration of the House of Commons or the Government. Recommendations related to this study are listed below.

Recommendation 1

That the Government of Canada work with the provincial and territorial governments, Indigenous communities and governments, the mining industry and research and education institutions to develop a strategic vision for developing Canada’s critical minerals industry by:

- **formulating a strategy for harnessing critical minerals in Canada, with clear priorities and stable and predictable funding for its implementation;**
- **coordinating the efforts of the sector’s various stakeholders by capitalizing on the strengths and assets of each province and territory in order to bring mineral resources together with technical and technological capacity;**
- **assessing the benefits of establishing an office of critical minerals within the Government of Canada, made up of multidisciplinary experts who would work on developing critical mineral supply and value chains;**
- **collaborating with key international partners, including the United States, by building on the Canada–United States Joint Action Plan on Critical Minerals Collaboration; and**
- **assessing the potential to establish a critical minerals strategic reserve in Canada to attract and meet the needs of Canadian value-added processing companies.**

Recommendation 2

That the Government of Canada renew its support for the Canadian mining sector so that it can take advantage of the many opportunities offered by developing critical minerals and recognize their unique contribution to advanced technologies and the energy transition by:

- **increasing its capacity to carry out geoscience work, including effectively evaluating mineral resources and including critical mineral potential in the decision-making processes for infrastructure, land management and conservation in close cooperation with the provincial and territorial governments and Indigenous communities;**
- **expanding the scope of financial and tax measures, such as the Mineral Exploration Tax Credit and the flow-through share system, to spur investment in critical mineral exploration projects; and**
- **investing in transportation and communication infrastructure in remote and Northern regions to improve access to mineral resources, taking into account economic and environmental factors and the priorities of local communities.**

Recommendation 3

That the Government of Canada work with the provincial and territorial governments, Indigenous communities and governments, the mining industry and research and education institutions to promote responsible, sustainable and inclusive development of Canada’s critical minerals sector by:

- **supporting research on critical minerals, including the development of research infrastructure and technological innovation platforms;**
- **encouraging initiatives to develop mining and mineral processing activities that reduce the sector’s environmental impact, including waste recovery and mineral recycling, and ensuring that the regulatory framework allows it;**
- **launching a roadmap for the integration of renewable and low-greenhouse gas energy into off-grid mine energy systems in remote and Northern regions, taking into account reliability and cost;**
- **fostering the implementation of best practices for electrifying mining operations;**
- **offering critical mineral training programs and supporting initiatives to diversify the mining sector’s workforce; and**

- **supporting meaningful consultations and partnerships with Indigenous communities in developing critical mineral projects, taking into account project impacts and accommodation measures that may be needed, sharing of economic benefits and access to training and employment.**

Recommendation 4

That the Government of Canada work with the provincial and territorial governments, Indigenous communities and governments, the mining industry and research and education institutions to support the development of value-added processing in Canada in order to increase the number of markets for critical minerals in the country and build a domestic industry and domestic expertise by:

- **helping set up demonstration facilities for promising value-added product manufacturing, ensuring no duplication with provincial facilities; and**
- **assessing the possibility of expanding the scope of financial and tax measures, such as the Mineral Exploration Tax Credit and the flow-through share system, to support the development of value-added critical mineral processing.**

Recommendation 5

That the Government of Canada support industries that help decarbonize the Canadian economy by:

- **developing a strategic and coordinated approach to electrifying transportation in Canada, including dedicating budgets to building a Canadian electric vehicle battery industry and ensuring access to an adequate domestic supply of the critical minerals needed for their manufacture;**
- **implementing public procurement policies that favour the purchase and use of technologies that help reduce greenhouse gas emissions, including the electrification of its vehicle fleet;**
- **assessing the possibility of using existing mechanisms, such as the Canada Infrastructure Bank, to fund transportation electrification projects; and**

- **offering labour force training programs in the new, leading-edge manufacturing sectors, and easing the transition of expertise from other industries that make use of similar skillsets.**



FROM MINERAL EXPLORATION TO ADVANCED MANUFACTURING: DEVELOPING VALUE CHAINS FOR CRITICAL MINERALS IN CANADA

INTRODUCTION

In February 2021, the House of Commons Standing Committee on Natural Resources (the committee) decided to undertake a study on critical minerals and associated value chains in order to make recommendations to the Government of Canada to help this industry reach its full potential in Canada.

Over the course of six meetings, the committee heard testimony from a wide range of experts on the role critical minerals play in manufacturing numerous cutting-edge technologies and supporting the energy transition; the economic, environmental and supply issues relating to critical minerals in Canada; the development of value chains associated with critical minerals in Canada; and the current challenges to fully realizing the sector's potential. The committee is pleased to present its final report, which summarizes the findings of its study and makes recommendations to the Government of Canada.

CRITICAL MINERALS: RESOURCES FOR A TRANSFORMING ECONOMY

A number of recent technological advances, in fields such as low-greenhouse gas (GHG) emissions energy¹ and electric vehicles and in high-technology sectors such as medicine, electronics, aerospace and defence, all depend on a more traditional industry—mining.² These leading-edge technologies are often made up of several types of minerals, including some critical minerals that are needed for these transforming industries.

1 According to the [International Energy Agency](#), low-emissions energy sources include solar, wind, traditional use of biomass, modern bioenergy, hydro, other renewables and nuclear, and can also include natural gas, oil, and coal with the condition that they are equipped with carbon capture utilisation and storage technologies.

2 House of Commons Standing Committee on Natural Resources [RNNR], *Evidence*, 2nd Session, 43rd Parliament [*Evidence*]: [Jan London](#) (Executive Director, Canadian Critical Minerals and Materials Alliance); and [Karim Zaghbi](#) (Strategic Advisor, Investissement Québec).



The committee learned that some critical minerals are produced by only a handful of countries. Canada has reserves of these minerals, but few deposits are currently being mined.³ Growing global demand for critical minerals gives Canada an opportunity to develop a domestic critical minerals industry and associated value chains. The jobs and economic benefits of such an industry could be a key part of the economic recovery from the COVID-19 pandemic.⁴ As outlined in this report, a number of witnesses painted a portrait of the current situation in Canada and suggested measures that governments should take to enable Canada’s mineral exploration and development, mineral processing and advanced manufacturing sectors to expand and take advantage of the global need for critical minerals.⁵

Strategic Importance of Critical Minerals

The term “mineral” includes non-metallic and metallic minerals (also known as metals). Minerals are considered “critical” based on various criteria: their role in the modern economy, including in the manufacture of advanced technologies, such as those needed for the energy transition; their supply, which is limited and concentrated in a few countries; and their importance to energy and national security.⁶

Canada produces over 60 minerals, including some critical minerals.⁷ [Jeff Labonté](#), Assistant Deputy Minister of the Lands and Minerals Sector at Natural Resources Canada, explained that Canada is “the only nation in the western hemisphere with all the minerals and metals needed to produce advanced batteries for electric vehicles.”

3 RNNR, *Evidence*: [London](#) (Canadian Critical Minerals and Materials Alliance).

4 RNNR, *Evidence*: [Dale Austin](#) (Head, Government Relations, Cameco Corporation).

5 In Canada, the provinces have legislative jurisdiction over non-renewable natural resources, including mineral resources. Some exceptions apply to uranium mines, which are subject to both provincial mining laws of general application and to federal regulatory requirements. Mining operations by federal Crown corporations, on federal lands or in offshore areas are also under federal jurisdiction. However, the federal government can support the mining industry in a number of ways, such as research and development, labour force training, the international and interprovincial aspects of mineral resource management and certain environmental regulations.

6 RNNR, *Evidence*: [Austin](#) (Cameco Corporation); [Robert Fung](#) (Chairman, Torngat Metals Ltd.); [Raphael J. Heffron](#) (Professor, Global Energy Law and Sustainability, Jean Monnet Professor in the Just Transition, As an individual); [Jeffrey B. Kucharski](#) (Professor, Royal Roads University, As an individual); [London](#) (Canadian Critical Minerals and Materials Alliance); [Nigel Steward](#) (Head, Group Technical – Processing, Rio Tinto); and [Zaghib](#) (Investissement Québec).

7 RNNR, *Evidence*: [Jeff Labonté](#) (Assistant Deputy Minister, Lands and Minerals Sector, Department of Natural Resources [NRCan]).

These minerals include copper, cobalt, rare earth elements, graphite, lithium, manganese and nickel.⁸ These resources are found in multiple regions of the country.

In March 2021, the Government of Canada published a [list of 31 critical minerals](#) that are found in Canada, including some that are already being mined. This list is reproduced in Figure 1. These minerals have strategic value for Canada because they are essential to the country’s economic security, necessary for the transition to a low-GHG economy and crucial to Canada’s economic partners as a sustainable source of minerals. Other countries have also made lists of critical minerals for their economy, including Australia, South Korea, the United States (U.S.), Japan and the European Union.⁹ For example, the U.S. lists 35 minerals deemed critical for similar reasons to those cited by Canada, except for the addition of national security concerns.¹⁰

Figure 1—List of Canada’s Critical Minerals (2021)

- Aluminum
- Antimony
- Bismuth
- Cesium
- Chromium
- Cobalt
- Copper
- Fluorspar
- Gallium
- Germanium
- Graphite
- Helium
- Indium
- Lithium
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Niobium
- Platinum group metals
- Potash
- Rare earth elements
- Scandium
- Tantalum
- Tellurium
- Tin
- Titanium
- Tungsten
- Uranium
- Vanadium
- Zinc

Source: Figure from Natural Resources Canada, [Critical Minerals—Canada’s list of critical minerals](#).

The committee heard that Canada already produces some critical minerals, but that production levels vary widely depending on the mineral. For example, Canada is an important producer of such critical minerals as aluminum, cobalt, copper, graphite, nickel and uranium. However, other “emerging” minerals are at an early or advanced stage of exploration. This is true of lithium, for which a number of exploration projects

8 RNNR, *Evidence*: [Simon Moores](#) (Managing Director, Benchmark Mineral Intelligence).

9 RNNR, *Evidence*: [Labonté](#) (NRCan); and [Zaghib](#) (Investissement Québec).

10 RNNR, *Evidence*: [Zaghib](#) (Investissement Québec).



are underway.¹¹ Canada does not yet produce rare earth elements, but it has significant known reserves, and some mining companies have launched exploration projects.¹² The committee learned of several projects at a more advanced stage of development, including the BlackRock Metals Inc. vanadium project and the Torngat Metals Ltd. rare earth elements project in Quebec. However, [Ian London](#), Executive Director of the Canadian Critical Minerals and Materials Alliance, noted the following:

Despite Canada's vast resource wealth, our critical materials remain largely undeveloped and not strategically leveraged, primarily because of the lack of understanding of their significant climate, national security and economic benefits.

Multiple Uses and Growing Global Demand

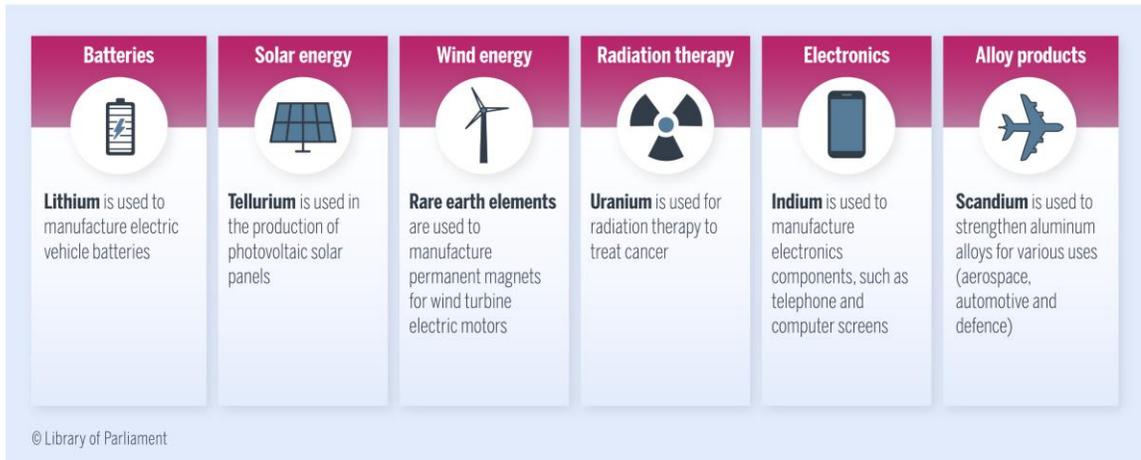
A number of witnesses told the committee about the multiple uses of critical minerals in manufacturing cutting-edge technologies.¹³ As shown in Figure 2, these minerals are used in technologies from sectors such as energy production and storage, medicine, electronics, defence, aerospace and automobile manufacturing. The minerals used in these technologies may vary with the model, size and use of the product. For example, many types of batteries are used in electric vehicles, each with a different composition.

11 RNNR, *Evidence*: [Grand Chief Abel Bosum](#) (Cree Nation Government); [Donald S. Bubar](#) (President and Chief Executive Officer, Avalon Advanced Materials Inc.); and [Liz Lappin](#) (President, Battery Metals Association of Canada).

12 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.).

13 RNNR, *Evidence*: [Austin](#) (Cameco Corporation); [Ilan Bahar](#) (Managing Director and Co-Head, Global Metals and Mining, BMO Capital Markets); [Bosum](#) (Cree Nation Government); [Bubar](#) (Avalon Advanced Materials Inc.); [Fung](#) (Torngat Metals Ltd.); [Labonté](#) (NRCan); [London](#) (Canadian Critical Minerals and Materials Alliance); [Juan Merlini](#) (Head, Sales and Marketing, Vale Canada Limited); [Steward](#) (Rio Tinto); and [Zaghib](#) (Investissement Québec).

Figure 2—Example Uses of Critical Minerals



Source: Figure prepared by the Library of Parliament.

Increased use of advanced technologies, notably in the energy sector and the electrification of transportation, will spur global demand for critical minerals.

Jeff Labonté provided forecasts from the World Bank:

For example, the World Bank has predicted a 500% increase by 2050 in the production of such minerals as graphite, lithium and cobalt just to feed the clean energy transition alone. The World Bank also estimates that over three billion tonnes of minerals and metals will be needed to deploy the clean energy needed for the world’s transition to a lower-carbon future.

Simon Moores, Managing Director of Benchmark Mineral Intelligence, stated that demand for critical minerals is “growing at a pace that no one alive has seen. This is an order of magnitude over ten years that could be anywhere from a four to ten times demand change within that time period, depending on the battery raw material that you’re looking for.” In addition, Jeffrey B. Kucharski, Professor at Royal Roads University, pointed out the following:

The Indo-Pacific region, driven by continued economic and population growth, will lead global demand for energy and critical minerals in the coming decades. According to the International Energy Agency, the region will account for approximately 60% of a [sic] global growth in energy demand by 2040, which will require more than \$1 trillion U.S. in annual energy infrastructure investment.

Leading-edge technologies that are made of numerous minerals and enable advances such as GHG-free electricity and transportation electrification are under development around the world. Statistics from Bloomberg New Energy Finance outlined by



[Daniel Breton](#), President and Chief Executive Officer of Electric Mobility Canada, show that the rise of electric vehicles (electric cars, light and heavy trucks, and buses) will be “exponential” over the coming years. [Mr. Breton](#) noted that global annual sales of new electric vehicles “are expected to reach 8.5 million in 2025 and 26 million by 2030. New EV sales should grow from 2.7% in 2020 to 28% in 2030, and 58% in 2040.”

Accordingly, soaring global demand for critical minerals presents new opportunities for producer countries, but also supply and environmental challenges.

To produce various technologies, countries are seeking to secure their supply of critical minerals by either procuring resources abroad or developing domestic production when these minerals are available within their borders. The committee learned that some critical mineral supply chains are dominated by a few countries. This control over production levels can create market instability, with periods of shortages as well as large surpluses that can lead to price volatility and pose supply and demand risks.¹⁴

[Jeffrey B. Kucharski](#) explained the situation to the committee:

We need to recognize there are risks to the stability and security of strategic resource supply chains. In the case of critical minerals, limited global supplies, the digital revolution and decarbonization efforts are driving resource scarcity and thus competition to secure uninterrupted access to CRMs [Critical Raw Minerals]. The principal risk is disruption of supplies, whether through shortages, embargoes, trade wars, conflicts or, as seen more recently, global pandemics.

Unstable Supply Dominated by a Small Number of Countries

Concentrated production by one or a few countries can increase the risk that other countries, including Canada, will not have access to a stable and predictable supply of these minerals. The committee heard that this situation creates “uncertainty” and that many countries often rely on precarious sources of supply.¹⁵

A number of witnesses emphasized the major role that China currently plays in producing the global supply of critical minerals. [Pierre Gratton](#), President and Chief Executive Officer of the Mining Association of Canada, said that China has “monopoly-like control over critical minerals production and distribution, rendering the rest of the world reliant on procurement and creating a level of risk that deters investors

14 RNNR, *Evidence*: [Nancy Concepcion](#) (Executive Manager, Global Product Marketing Manager, Vale Canada Limited); [Moores](#) (Benchmark Mineral Intelligence); and [Steward](#) (Rio Tinto).

15 RNNR, *Evidence*: [Ken S. Coates](#) (Johnson-Shoyama Graduate School of Public Policy, University of Saskatchewan, As an individual); and [Pierre Gratton](#) (President and Chief Executive Officer, Mining Association of Canada).

from entering these markets.” [Robert Fung](#), Chairman of Torngat Metals Ltd., pointed out that “China supplies in excess of 80% of world demand” for rare earth elements. In addition, [Jamie Deith](#), Chief Executive Officer of Eagle Graphite Corporation, related the difficulties his graphite mining business in British Columbia experienced in finding potential investors to expand its operations, as “[s]upply chains... seemed mostly content with heavy reliance on a single nation,” namely, China.

China can also use this market concentration for certain critical minerals as “a tool of economic leverage” or as “political leverage against countries with whom it has disagreements,” explained [Jeffrey B. Kucharski](#), recalling China’s decision to stop supplying rare earth elements to Japan in 2010. He also [stated](#) that

[n]ot only can critical minerals be used as a tool for political leverage, but also demand itself within China is going to reduce the supply of critical minerals from the country going forward. It's that much more important that we here in Canada, working with our partners and allies, develop these supply chains so that our industries, including the defence industry and the clean energy sector, are not starved of these important materials, which would put in jeopardy our industries here at home.

[Pierre Gratton](#) noted that Canada’s private sector could be at a disadvantage when competing against state-owned enterprises that invest for strategic reasons. With regards to China, Mr. Gratton stated:

Our sector has a complicated relationship with China. They're the largest consumer of minerals and metals. Our industry is enjoying buoyant commodity prices more or less across the board right now, and it's largely because China's economy has rebounded, but it's also true that they don't play by our rules when it comes to investing in the mining business. They're not a market-based economy. They're state-run enterprises and they invest for strategic reasons. We have members that compete with them around the world, and it's hard to compete with them. I've heard many stories from many of our members of just how tricky that is, because in other parts of the world it's a government-to-government relationship that they engage in, whereas we're the private sector trying to compete using private sector rules.

China is also investing abroad, as [Simon Moores](#) explained:

The way China does it is that it goes in and either owns part of the mine or takes over a company, or it does long-term contracts in supplier states. The one thing China does do is it goes to other countries and puts money into the ground and therefore it guarantees the raw materials for its own economy.

While some witnesses expressed concerns about foreign investment in the Canadian mining sector, others said that some foreign companies have an entrepreneurial spirit



and are open to working with Canadian businesses.¹⁶ [Jeffrey B. Kucharski](#) suggested that the federal government’s list of 31 critical minerals could serve as a “filter” for reviewing applications for investments in critical industries.

Developing a Canadian and Continental Supply Chain

To reduce this dependence on foreign markets, [Jeffrey B. Kucharski](#) believes that “[d]eveloping a viable supply chain for critical minerals in Canada will be the first priority.” He also added that “[a]ccess to critical mineral resources is a national security question for many countries and is increasingly vital to economic growth, peace and security.” A number of factors could enable Canada’s mining industry to effectively position itself in the eyes of consumers and on global markets, including its high environmental, social and governance (ESG) standards.¹⁷ However, some witnesses stated that the competition is often from countries that sometimes disregard ESG standards, which enables them to keep their cost of production lower.¹⁸ For instance, [Ken S. Coates](#), of the University of Saskatchewan, made the following remarks:

We also have to address, in Canada, that we’re not alone in this game and that there are many supply options, particularly in the developing world. Those areas have more complex issues and sometimes less favourable environments for human rights protections, environmental protections and what have you.

Other witnesses suggested a “continental” approach to securing a supply of critical minerals. Such an approach would entail cooperation between the provinces and territories, but also with the U.S.¹⁹ [Dale Austin](#), Head of Government Relations at Cameco Corporation, and [Jeff Labonté](#) mentioned the work already underway under the [Joint Action Plan on Critical Minerals Collaboration](#) between Canada and the U.S. [Mr. Austin](#) described the strategy as follows:

A continental approach to improving critical mineral security, minimizing the effects of state-owned players in the critical minerals space and ensuring the future competitiveness of Canadian and U.S. minerals industries should assist in attracting

16 RNNR, *Evidence*: [Bubar](#) (Avalon Advanced Materials Inc.); [Deith](#) (Eagle Graphite Corporation); and [Moores](#) (Benchmark Mineral Intelligence).

17 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); [London](#) (Canadian Critical Minerals and Materials Alliance); and [Zaghib](#) (Investissement Québec).

18 RNNR, *Evidence*: [Coates](#) (As an individual); and [Deith](#) (Eagle Graphite Corporation).

19 RNNR, *Evidence*: [Austin](#) (Cameco Corporation); [Roderick G. Eggert](#) (Professor, Colorado School of Mines, As an individual); and [Zaghib](#) (Investissement Québec).

investment to Canadian exploration and mining projects, and spur job creation and economic growth post-pandemic.

According to [Roderick G. Eggert](#), Professor at the Colorado School of Mines, this cooperation between Canada and the U.S. could also encompass labour force training, research and mining waste recovery.

Benefits and Growth Opportunities

Higher demand for critical minerals could boost economic growth and create jobs in Canada's mining and mineral processing sector. This sector is already a significant contributor to the Canadian economy.²⁰ [Lisa McDonald](#), Executive Director of the Prospectors and Developers Association of Canada, presented the following data:

Mineral exploration and mining form a cornerstone of our economy, employing over 700,000 Canadians and contributing in excess of \$100 billion to our GDP in 2020. It is the largest private sector industrial employer of Indigenous people on a proportional basis in Canada, and a key partner of Indigenous businesses from coast to coast to coast.

The [Saskatchewan Mining Association](#) informed the committee that Indigenous people make up 21% of the province's mine employees and that the mining sector is also "the largest customer of Indigenous-owned businesses in Saskatchewan, annually purchasing over \$650 M in goods and services."

Multiple witnesses stated that Canada's mining sector has many advantages that could enable it to become a major supplier of critical minerals for advanced manufacturing, including those used in the energy sector and transportation electrification. These advantages include the abundance of mineral resources in Canada, the potential for new discoveries, recognized expertise and a skilled workforce, the safety of mining operations, technology (automation and electrification), the availability of low-GHG and renewable energy, an effective and rigorous governance framework, and a stable and predictable geopolitical environment.²¹

20 RNNR, *Evidence*: [Austin](#) (Cameco Corporation); [Bahar](#) (BMO Capital Markets); [Lisa McDonald](#) (Executive Director, Prospectors and Developers Association of Canada); and Natural Resources Canada, [10 Key Facts on Canada's Minerals Sector](#), 2020.

21 RNNR, *Evidence*: [Bahar](#) (BMO Capital Markets); [Bubar](#) (Avalon Advanced Materials Inc.); [Gratton](#) (Mining Association of Canada); [Samson Hartland](#) (Executive Director, Yukon Chamber of Mines); [Sarah Houde](#) (President and Chief Executive Officer, Propulsion Québec); [Labonté](#) (NRCan); [Lappin](#) (Battery Metals Association of Canada); [McDonald](#) (Prospectors and Developers Association of Canada); [Moore](#) (Benchmark Mineral Intelligence); and [Steward](#) (Rio Tinto).



[Pierre Gratton](#) pointed out that the Mining Association of Canada’s [Towards Sustainable Mining](#) initiative is spurring mining companies in Canada to adopt practices that are sustainable in environmental, social and governance terms and reinforcing “confidence that when it comes to world-leading sustainable mining practices, Canadian mining is a leader.” Mining company representatives also told the committee that these principles have been or will be integrated into their mining practices, enabling companies operating in Canada to stand out on the global stage.²²

Significant Involvement of Indigenous Communities and Governments

“We’re the population that’s here to stay even after the mine is closed. It’s in our interest to see not only the short-term impact but the long-term impact.”

[Grand Chief Abel Bosum](#)

The Canadian mining sector operates mainly in remote regions and has a major impact on the communities in these regions. This is particularly true of many Indigenous communities across Canada. A number of critical minerals projects are located within Indigenous traditional territories. [Grand Chief Abel Bosum](#) of the Cree Nation Government outlined the various lithium mining projects underway on the traditional territory. He remarked that his region could “actually become the battery of the north,” meaning that it could provide minerals that are vital to battery production.

Consulting Indigenous communities and governments that may be affected by a mining project is a fundamental part of project development. This requirement is rooted in the duty of governments in Canada to consult and, if necessary, accommodate Indigenous peoples if a project could adversely affect potential or established Aboriginal or treaty rights.²³ [Samson Hartland](#), Executive Director of the Yukon Chamber of Mines, explained that this consultation must be “effective and meaningful.” [Nigel Steward](#), Head of Group Technical—Processing at Rio Tinto, stated that “building trust with all of the stakeholders involved” makes projects easier to complete, in part because it results in obtaining permits more quickly. This relationship of trust and cooperation with Indigenous

22 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); [Merlini](#) (Vale Canada Limited); and [Steward](#) (Rio Tinto).

23 RNNR, *Evidence*: [Coates](#) (As an individual).

communities and governments is critical to mining in Canada.²⁴ [Grand Chief Abel Bosum](#) summarized his perspective as follows: “the full recognition of Indigenous rights is not a threat to development. Instead, it is the necessary condition for orderly and sustainable development to take place.” In addition, [Ken S. Coates](#) rejected some preconceived notions about mining projects being delayed by Indigenous communities.

According to [Professor Coates](#), delays are in fact the result of “the regulatory burden and the time to development,” which also add cost. Other witnesses endorsed this argument, pointing out that delays are more likely to be caused by the complexity of project assessment processes, which may be split among different levels of government. [Pierre Gratton](#) mentioned that “the timelines that it takes to get mines through both federal and provincial processes present a real risk to our ability to take advantage of this opportunity.” Some witnesses said that timelines for obtaining a permit in Canada range from three years to ten years, and even up to 15 years in some cases.²⁵

[Grand Chief Abel Bosum](#) explained that the “Cree Nation of Eeyou Istchee has spent many decades struggling with both the province and the federal government to secure acknowledgements of [its] Indigenous rights and [its] treaty rights.” He told the committee that the *James Bay and Northern Quebec Agreement*, signed in 1975, is the treaty that enabled the Nation to “gradually expand the role and the jurisdiction of [its] communities within [its] traditional territory, while at the same time improving the living conditions of [its] people.” Under the treaty, any natural resource development project must go through the social and environmental impact assessment process that it sets out and must be socially acceptable to the community. Consultations must take place very early in the process, at the exploration stage, which encourages knowledge and information sharing and helps build trust between the parties.²⁶ Once a project is approved, in addition to environmental monitoring, community members can obtain employment, training, contract grants and financial benefits. The “Grande Alliance,” signed in 2020 by the Cree Nation and the Quebec government, aims to implement some of the requirements of the treaty and to help strike a balance between developing and protecting the traditional territory.²⁷

A number of agreements have been signed between mining companies and Indigenous communities and governments in Canada to address the impacts and benefits of mining

24 RNNR, *Evidence*: [Austin](#) (Cameco Corporation).

25 RNNR, *Evidence*: [Coates](#) (As an individual); [Jamie Deith](#) (Chief Executive Officer, Eagle Graphite Corporation); [Gratton](#) (Mining Association of Canada); and [Hartland](#) (Yukon Chamber of Mines).

26 RNNR, *Evidence*: [Grand Chief Abel Bosum](#) (Cree Nation Government).

27 RNNR, *Evidence*: [Bosum](#) (Cree Nation Government).



projects, including revenue sharing and Indigenous communities' involvement in projects.²⁸ While there are still many challenges to be overcome in order to foster an increased and meaningful participation of Indigenous communities, sustainable and responsible development of critical minerals could be an opportunity to enable this kind of cooperation and ensure the benefits are shared.²⁹ [Donald S. Bubar](#), President and Chief Executive Officer of Avalon Advanced Materials Inc., argued that “new critical minerals supply chains offer a tremendous opportunity for active involvement by Indigenous communities in the north in building these new supply chains.” [Dale Austin](#) added that the “critical minerals sector in Canada must recognize the importance of Indigenous partnerships for future success.”

Challenges to Canada's Mining Industry

The Canadian mining sector faces multiple economic and environmental challenges. The COVID-19 pandemic has also affected the entire sector, disrupting operations and reducing production capacity, and even forcing some mines to close to prevent the spread of the virus.³⁰ The evidence heard during this study shed light on the current situation and the challenges relating to exploration and mining operations that the critical minerals sector must address.

Identifying the Potential of Critical Minerals

Multiple witnesses underscored the importance of properly ascertaining the availability of critical minerals in Canada and their potential for exploitation.³¹ Critical minerals are often more difficult to discover, are located in remote regions to which access is limited and consist of smaller-scale deposits containing small concentrations of mineral.³² [Jovette Godbout](#), Executive Director of the Research Institute of Mines and the Environment, noted that Canada's critical minerals sector remains undeveloped because the industry does not have the financial resources to support research in this area.

28 RNNR, *Evidence*: [Sean Cleary](#) (Chairman and Chief Executive Officer, BlackRock Metals Inc.); and [Coates](#) (As an individual).

29 RNNR, *Evidence*: [Cleary](#) (BlackRock Metals Inc.).

30 RNNR, *Evidence*: [Austin](#) (Cameco Corporation).

31 RNNR, *Evidence*: [Labonté](#) (NRCan).

32 RNNR, *Evidence*: [Jeff Killeen](#) (Director, Policy and Programs, Prospectors and Developers Association of Canada); and [Steward](#) (Rio Tinto).

Federal programs such as the Geo-Mapping for Energy and Minerals (GEM) program and the Targeted Geoscience Initiative (TGI) currently provide a geoscience knowledge base for the mining industry.³³ However, [Jeff Killeen](#), Director of Policy and Programs at the Prospectors and Developers Association of Canada, explained that there is a genuine need for further geoscience work, through greater cooperation with the provinces, to better identify the most promising areas “for infrastructure to be developed that maybe can help to bring some of these smaller deposits together and create that upstream production potential that may be lacking right now.” Moreover, according to [Ken S. Coates](#), governments could play a larger role in identifying “no-go zones” where conflicts may arise, such as hunting grounds or cultural sites.

Lack of Infrastructure in Remote and Northern Regions

In Canada, exploration and mining provide economic benefits and create jobs in many communities, including those in remote and Northern regions.³⁴ [Lisa McDonald](#) told the committee that, although mineral exploration companies have spent more than \$15 billion over the past decade, “mineral exploration in our three territories dropped by 50% in 2020 versus the year prior, whereas spending in Ontario and Quebec actually increased over the same period.” Yet, as [Pierre Gratton](#) noted, the southern part of Canada has been mined for decades, and the potential for new “world-class” deposits lies in the North.

Some witnesses pointed out that the lack of infrastructure in remote and Northern regions, such as the road and highway network required to reach isolated resources, and the lengthy construction timelines for building it are limiting the expansion of mineral exploration in these regions.³⁵ [Samson Hartland](#) described an initiative jointly funded by the federal and Yukon governments and the industry that was launched three years ago: the [Yukon Resource Gateway Program](#). This project was designed to address the lack of infrastructure for resource access, but, according to [Mr. Hartland](#), “very little [has been] spent to date.” [Grand Chief Abel Bosum](#) said that, to address these challenges, the Cree Nation Government will “work together with the [Quebec] government to develop a 30-year infrastructure plan so that [its] people will know exactly what’s likely to happen.” This long-term plan would provide more certainty for natural resource development projects.

33 RNNR, *Evidence*: [Killeen](#) (Prospectors and Developers Association of Canada).

34 RNNR, *Evidence*: [McDonald](#) (Prospectors and Developers Association of Canada).

35 RNNR, *Evidence*: [Coates](#) (As an individual); [Gratton](#) (Mining Association of Canada); [Hartland](#) (Yukon Chamber of Mines); and [McDonald](#) (Prospectors and Developers Association of Canada).



Investment-Related Risks

Despite the prospect of new markets, the mining sector also faces economic challenges, including barriers to investment. First, the volatility of resource prices and especially the persistent weakness of prices can hold back investment in new mines.³⁶ These factors deter investment, as there is no “incentive price to bring on a new supply,” explained [Simon Moores](#). Likewise, [Nigel Steward](#) said that a key principle for Rio Tinto is not investing unless it knows it has “a mine with a long life and a low cost... [Otherwise] it wouldn’t survive during any trough in commodity prices.” To avoid this price volatility, Rio Tinto instead attempts to determine whether critical minerals can be found in existing deposits and extracted as by-products.

[Juan Merlini](#), Head of Sales and Marketing at Vale Canada Limited, explained that developing new deposits requires significant capital and a great deal of time may pass between discovery of a viable deposit and commercial production. Competition for capital among critical mineral mines in other countries was another issue cited.³⁷ [Pierre Gratton](#) reported that there has been “over the past decade a gradual decline in [Canada’s] percentage share of mineral exploration spending.” He also noted that Australia, one of Canada’s competitors, “has boosted its attractiveness” in part because it adopted a mining exploration tax credit targeting small minerals exploration companies in Australia.³⁸ Some witnesses pointed out that exploration is typically done by small companies and few projects go into production. [Lisa McDonald](#) made the following comments in this regard:

mineral exploration is a complex process with low odds of success. Only about one in 10,000 mineral claims reach an advanced exploration stage, and just one in 1,000 advanced-stage projects become mines. Junior exploration companies do the bulk of this high-risk capital-intensive work, and account for upwards of 70% of all mineral discoveries made in Canada. However, new discoveries in Canada are in decline, with grassroots exploration down by roughly 75% over the last decade.

36 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); and [Lappin](#) (Battery Metals Association of Canada).

37 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); and [Lappin](#) (Battery Metals Association of Canada).

38 The [Junior Minerals Exploration Incentive](#) (JMEI) “encourages investment in small minerals exploration companies that carry out greenfields mineral exploration in Australia. The scheme allows these companies to convert a portion of their tax losses into credits that may be passed onto investors of newly issued shares as either a franking credit or refundable tax offset. This acts as an incentive to attract new investment”. Since the start of the incentive in 2018, about A\$100 million were allocated. On 5 May 2021, the Australian Government [announced](#) that it will invest an additional A\$100 million over four years to extend the JMEI to the end of June 2025.

Moreover, [Sean Cleary](#), Chairman and Chief Executive Officer of BlackRock Metals Inc., remarked that critical mineral projects “are not well followed by the capital markets [and] ha[ve] to be financed privately and with public-private partnerships.” The committee heard that more government support is needed to encourage investment in critical mineral exploration.³⁹ For example, the scope of Canada’s Mineral Exploration Tax Credit (METC) and flow-through share system⁴⁰ could be expanded or revised to reflect the specific circumstances of mining companies that are exploring new deposits of critical minerals, “including the fact that they can be more challenging to discover, and they can be of smaller scale”, according to [Jeff Killeen](#). [Liz Lappin](#), President of the Battery Metals Association of Canada, said that incentive measures or tax advantages could help attract capital to Canada for projects that have been “validated.”

Other witnesses said that emerging mineral mining should start at a smaller scale.⁴¹ [Donald S. Bubar](#) argued that it is “best to start out at a more modest scale and make sure your process flow sheet works” and then gradually scale up production.

Path Toward Sustainable and Responsible Development

Multiple witnesses asserted that Canada’s critical minerals sector will be vital to achieving the Government of Canada’s GHG emissions reduction target for 2030 and the goal of net-zero emissions by 2050.⁴² The Canadian mining industry’s goals are consistent with those of the federal government and the Paris Agreement.⁴³

As noted above, the critical minerals sector makes a key contribution to manufacturing the advanced technologies that will enable a transition to a low-GHG economy. To realize the environmental benefits of using these technologies, such as solar panels, wind turbines and batteries for energy storage or electric vehicles, the environmental

39 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.); [Killeen](#) (Prospectors and Developers Association of Canada); [Gratton](#) (Mining Association of Canada); and [Lappin](#) (Battery Metals Association of Canada).

40 According to Natural Resources Canada, “the [Mineral Exploration Tax Credit](#) is a 15% non-refundable tax credit on [eligible exploration expenses](#). Investors can apply it against the federal income tax that would otherwise be payable for the taxation year in which the investment was made.” Also, “a [flow-through share](#) allows a principal business corporation to obtain financing for expenditures on mineral exploration and development in Canada.”

41 RNNR, *Evidence*: [Bubar](#) (Avalon Advanced Materials Inc.); and [Lappin](#) (Battery Metals Association of Canada).

42 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); and [Steward](#) (Rio Tinto).

43 RNNR, *Evidence*: [Samantha Espley](#) (President, Canadian Institute of Mining, Metallurgy and Petroleum [CIM]); and [Steward](#) (Head, Group Technical—Processing, Rio Tinto).



footprint across the life cycle of the mines and production of the technologies, including mineral extraction processes, must be taken into account.⁴⁴

Mining and mineral processing can be water and energy intensive, and some toxic mining effluent may be released into soil and water. The committee learned that the mining industry could improve its environmental performance and better manage resources by using more renewable and low-GHG energy, electrifying its mining vehicle fleet and increasing recycling and reuse of some minerals.⁴⁵

An important element in the continued sustainability of the critical minerals sector life cycle is the final decommissioning and restoration of mines and mineral processing facilities. It is important that the costs of cleaning up these sites not fall on Canadians. As [Dr. Raphael J. Heffron](#) told the committee, a common practice is to require companies to set aside funds to prevent, "...a company's disappearing in some type of bankruptcy and not fulfilling its decommissioning obligation."

Increased Use of Renewable and Low-GHG Electricity

The mining sector can reduce its GHG emissions by using more renewable and low-GHG electricity. Some mines already have access to this kind of electricity, including hydroelectricity and wind and solar power, which are available in many parts of Canada.⁴⁶ As a result, some Canadian mining operations have the lowest GHG emissions in the world, including certain nickel mines in Ontario and aluminum production and its scandium oxide by-products in Quebec.⁴⁷ However, Canada's mining industry is mainly situated in remote regions that are not connected to the country's electrical grids.⁴⁸ [Pierre Gratton](#) made the following comments:

Off-grid remote mines are virtually exclusively reliant on diesel fuel for power and haul-fleet operations for the time being. With very limited and currently uneconomic options to displace diesel, the competitiveness and longevity of these operations under the proposed clean fuel regulations and the projected \$170 per tonne carbon price will erode.

44 RNNR, *Evidence*: [Cleary](#) (BlackRock Metals Inc.); [Roderick G. Eggert](#) (Professor, Colorado School of Mines, As an individual); [Moore](#) (Benchmark Mineral Intelligence); and [Steward](#) (Rio Tinto).

45 RNNR, *Evidence*: [Christian G. Brosseau](#) (Vice-President, Investment, Strategic Capital, Energy and Environment, Fonds de solidarité des travailleurs du Québec); and [Merlini](#) (Vale Canada Limited).

46 RNNR, *Evidence*: [Houde](#) (Propulsion Québec); and [Zaghib](#) (Investissement Québec).

47 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); and [Steward](#) (Rio Tinto).

48 RNNR, *Evidence*: [Gratton](#) (Mining Association of Canada); and [Hartland](#) (Yukon Chamber of Mines).

While he supports carbon pricing, [Pierre Gratton](#) suggested that this measure should come with government support. His colleague [Brendan Marshall](#), Vice-President, Economic and Northern Affairs, at the Mining Association of Canada, argued that it is important “to be sensitive that a one-size-fits-all solution isn’t apportioned equally in all shapes and sizes.”

Other economic factors, such as the cost of some low-GHG energy sources, could also hamper this energy transition. [Jeffrey B. Kucharski](#) stated that “there could be some tax provisions provided to this industry to help reduce the costs of energy, should that be a significant factor or a barrier to its development.” Still, innovative projects are moving forward in Canada, such as BlackRock Metals’ use of hydrogen in its mining and metallurgy operations. [Sean Cleary](#) explained that BlackRock Metals “is a commercial hydrogen user and early adopter. It is uniquely designed to use grey hydrogen and is enabled for the conversion to green hydrogen once it is commercially available.”

The electrification of mining operations could also reduce the industry’s GHG emissions. [Samantha Espley](#), President of the Canadian Institute of Mining, Metallurgy and Petroleum, explained to the committee that her organization has developed global mining guidelines that encourage the use of battery electric vehicles in underground mining in order to promote “green mining” and a “green economy.” However, [Jamie Deith](#) said that his graphite mine is “amenable to becoming an all-electric operation [only] once haul vehicle technology advances far enough.”

Increased Use of Mining Waste and Recycling

The mining industry is using new methods for extracting critical minerals that have potential and could reduce mining’s environmental impact. Besides ore extraction, critical minerals can be obtained by other means, such as oil field brines, tailings from closed mines or by-products of existing mines that are currently considered waste.⁴⁹

Recovering minerals from wastes and tailings that would otherwise be worthless offers a number of benefits, as it amounts to extracting all possible value from deposits that have already been mined. Termed “full-value mining” by [Nigel Steward](#), using this waste creates economic value and could reduce the sector’s environmental footprint. [Ian London](#) told the committee that China is already active in extracting from secondary sources and the country’s rare earth elements “actually came out of their biggest, richest deposits [as] an off-product from iron ore mining.”

49 RNNR, *Evidence*: [Bubar](#) (Avalon Advanced Materials Inc.); and [Steward](#) (Rio Tinto).



In Canada, these extraction methods could also deliver economic and environmental benefits. According to [Donald S. Bubar](#), “[m]any of these sites now offer opportunities to go back and create a new plan, reprocess the tailings that track critical minerals, and fully remediate the long-term environmental liability while you do it.” A number of issues must nonetheless be resolved to make these methods viable: access to closed mining sites, management of a mine’s environmental liabilities, the financial assurance bonding requirements for companies and new mining technologies that reduce the amount of waste generated.⁵⁰

In addition, [Jeff Labonté](#) pointed to the potential for the mining sector to develop a “circular economy” that would involve the use of mining waste and mineral recycling. [Mr. Labonté](#) informed the committee that the Department of Natural Resources is working with its provincial and territorial counterparts to determine “where that value can be extracted from recycling activities” and has research programs currently examining how to extract the critical mineral value from some of the tailings that are currently being produced by mining operations. As [Nigel Steward](#) noted, it is crucial to consider the life cycle of a mine when issuing its operating permit; the environmental impact must be considered “in a holistic way.”

FROM THE DEVELOPMENT OF CRITICAL MINERALS TO VALUE-ADDED PROCESSING

The committee heard that, in addition to developing its domestic capacity to produce critical minerals and the associated supply chains, Canada could also transform critical minerals into value-added products, thus creating its own value chains. Such an industry would create wealth in Canada by giving rise to Canadian secondary (or intermediate) and tertiary processing companies, developing domestic expertise in critical mineral processing and advanced manufacturing, creating skilled, well-paid jobs and reducing the country’s dependence on foreign supplies of value-added products and cutting-edge technologies.⁵¹

A number of value chains can be developed from critical minerals: some low-GHG energy production technologies (such as wind turbines, photovoltaic solar panels and nuclear energy), batteries and computer chips for electric vehicles, energy storage

50 RNNR, *Evidence*: [Bubar](#) (Avalon Advanced Materials Inc.).

51 RNNR, *Evidence*: [Austin](#) (Cameco Corporation); [Daniel Breton](#) (Electric Mobility Canada); [Deith](#) (Eagle Graphite Corporation); [Labonté](#) (NRCan); and [London](#) (Canadian Critical Minerals and Materials Alliance).

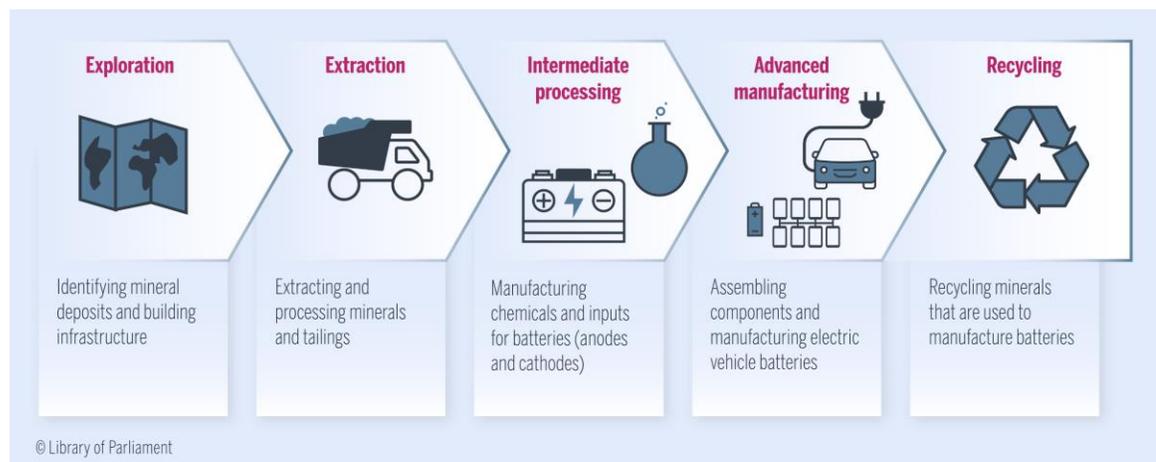
batteries and various uses of critical minerals in many other leading-edge sectors such as medicine, electronics, aerospace and defence.

From Mines to Mobility: Battery Manufacturing

Multiple witnesses cited the value chain for manufacturing batteries for electric vehicles as a way of decarbonizing the Canadian and global economies by electrifying transportation.⁵² This value chain could be significant for Canada, as it possesses all the minerals needed to make these batteries.⁵³ However, some links in this chain do not currently exist in Canada.

A number of witnesses referenced the concept of “mines to mobility” to describe all the links in the battery manufacturing value chain.⁵⁴ As shown in Figure 3, the value chain is separated into the many steps required to make batteries, with some variations.

Figure 3—The Battery Manufacturing Value Chain



Source: Figure prepared by the Library of Parliament.

This series of activities must be carried out by different sectors with different expertise in order to provide the market with a value-added product, such as batteries for electric

52 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada); [Brosseau](#) (Fonds de solidarité des travailleurs du Québec); [Deith](#) (Eagle Graphite Corporation); [Houde](#) (Propulsion Québec); [Lappin](#) (Battery Metals Association of Canada); [Moores](#) (Benchmark Mineral Intelligence); and [Zaghib](#) (Investissement Québec).

53 RNNR, *Evidence*: [Labonté](#) (NRCan).

54 RNNR, *Evidence*: [Bahar](#) (BMO Capital Markets); [Labonté](#) (NRCan); and [Lappin](#) (Battery Metals Association of Canada).



vehicles.⁵⁵ These activities include mineral exploration, extraction and processing (such as smelting and refining⁵⁶), the transformation of these elements into products that can be used to make batteries (chemicals, anodes, cathodes) and the assembly of the battery components into a finished product.⁵⁷ While still in the developmental stages, recycling the minerals used to manufacture batteries is the final phase in the battery life cycle and would create a “circular economy” in this industry.⁵⁸ According to multiple witnesses, developing this kind of value chain could create many business opportunities for Canadian companies, support Canada’s economic and national security and foster the adoption of technologies that reduce GHG emissions.⁵⁹

In some parts of the world, the battery manufacturing industry is growing rapidly. [Simon Moores](#) told the committee that a number of battery “megafactories” or “gigafactories” have been built in China and Europe in recent years, allowing for large-scale, low-cost production. [Mr. Moores](#) also pointed out that a number of countries are investing significant resources in their battery production chains and that China will account for 67% of global battery capacity by 2030, compared with 18% for the European Union and 12% for North America. The European Union has also launched a battery strategy and announced €3 billion in funding to support research and innovation in the field of electric vehicle batteries at every link in the value chain.⁶⁰

Batteries and electric vehicles will be a very large global market in the years and decades to come.⁶¹ On this point, [Nancy Concepcion](#), Executive Manager and Global Product Marketing Manager at Vale Canada Limited, offered the following assessment:

the EV industry has clearly passed a point of no return for the auto industry. Over \$300 billion has been invested into the development of EV models, and battery producers have contributed roughly \$130 billion of investment...

55 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); and [Labonté](#) (NRCan).

56 According to the [Canadian Minerals and Metals Plan](#), “Smelting and refining are among the downstream mineral processing activities that add value to mined products.”

57 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.); [Labonté](#) (NRCan).

58 RNNR, *Evidence*: [Brosseau](#) (Fonds de solidarité des travailleurs du Québec); [Labonté](#) (NRCan); and [Zaghib](#) (Investissement Québec).

59 RNNR, *Evidence*: [Brosseau](#) (Fonds de solidarité des travailleurs du Québec); [Lappin](#) (Battery Metals Association of Canada); and [Moores](#) (Benchmark Mineral Intelligence).

60 RNNR, *Evidence*: [Moores](#) (Benchmark Mineral Intelligence).

61 RNNR, *Evidence*: [Concepcion](#) (Vale Canada Limited); [Deith](#) (Eagle Graphite Corporation); and [Moores](#) (Benchmark Mineral Intelligence).

Some witnesses asserted that, if Canada becomes a significant and reliable supplier of critical minerals, it would draw businesses that process these minerals and make various technologies to the country.⁶² Others emphasized that creating an ecosystem to expand manufacturing of these technologies will first require stimulating demand for these products in Canada.⁶³

An Opportunity for Canada Despite Current Challenges

“We have the raw materials. We should not be selling them and then buying back processed products.”

Ian London

The committee heard that many benefits could be garnered from developing value chains associated with critical minerals in Canada, but that some challenges will need to be overcome to do so. The evidence heard during this study revealed some of the current gaps in the industrial ecosystem required to develop a value-added critical minerals industry in Canada.

A Weak Link in the Value Chain: Intermediate Processing

Between mining and technology manufacturing are intermediate processing stages to refine the ore and make the value-added products needed in advanced manufacturing. This work may include processing minerals through smelting and refining, transforming refined minerals into chemicals and inputs such as cathodes, anodes and oxides, which are used in cutting-edge technologies, such as batteries in electric vehicles (see Figure 3).⁶⁴

A number of witnesses pointed to this “intermediate” (or secondary, or downstream) processing as a key part of the value chains associated with critical minerals that remains undeveloped in Canada.⁶⁵ Jamie Deith reported on the situation in the graphite industry:

62 RNNR, *Evidence*: Concepcion (Vale Canada Limited); and Fung (Torngat Metals Ltd.).

63 RNNR, *Evidence*: Concepcion (Vale Canada Limited); and Labonté (NRCan).

64 RNNR, *Evidence*: Dan Blondal (Chief Executive Officer, Nano One Materials Corp.); and MoORES (Benchmark Mineral Intelligence).

65 RNNR, *Evidence*: Blondal (Nano One Materials Corp.); Bubar (Avalon Advanced Materials Inc.); Deith (Eagle Graphite Corporation); Fung (Torngat Metals Ltd.); Simon Thibault (Director, Regulation and Public Policy, Propulsion Québec); and Zaghib (Investissement Québec).



“At the moment, there is no further processing domestically that we can sell to, so there is no value-added processor that we could sell to.” Furthermore, [Karim Zaghieb](#), Strategic Advisor to Investissement Québec, explained that Canada does not make the machinery required to do this processing, so it has to buy it from other countries, such as China or Japan.

To remedy this situation, a number of witnesses argued that the priority should be developing the value-added critical minerals ecosystem and making the machinery required for these processes, two missing components that prevent processing from occurring in Canada.⁶⁶ This processing is also lacking in sectors other than emerging critical minerals. [Nigel Steward](#) cited the aluminum industry as a sector where the production capacity for high-value-added products is underdeveloped in Canada because this work must be done close to customers, which are mainly in the United States. Some witnesses suggested that governments play a role in supporting the development of critical minerals processing facilities domestically, as these projects require large amounts of capital, which can discourage some industry players from investing in Canada.⁶⁷

Yet the various links in value chains are well developed in Europe and Asia, and a number of countries have opened up a lead in the value-added critical minerals sector.⁶⁸ This has occurred even though some of them have few or no primary resources.⁶⁹ This is not true of China, which has the resources, including some in significant quantities, and also dominates the processing industry at every stage of the value chains.⁷⁰ According to Bloomberg New Energy Finance data presented by [Daniel Breton](#), “China presently controls 80% of the refining” of the materials needed to produce electric vehicles, electronics, gas vehicles and military equipment, and “77% of the world’s battery-cell manufacturing capacity.” This figure grows to 96% for Asia as a whole if the battery production capacity of South Korea and Japan is included. [Jamie Deith](#) offered the following example:

In the extreme case of natural graphite for lithium-ion batteries, fully 100% of the intermediate-stage processing was taking place in China, and still is. This positioning is

66 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); [Bubar](#) (Avalon Advanced Materials Inc.); [Fung](#) (Torngat Metals Ltd.); [Lappin](#) (Battery Metals Association of Canada); and [Zaghieb](#) (Investissement Québec).

67 RNNR, *Evidence*: [Deith](#) (Eagle Graphite Corporation); and [Zaghieb](#) (Investissement Québec).

68 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); [Cleary](#) (BlackRock Metals Inc.); and [Deith](#) (Eagle Graphite Corporation).

69 RNNR, *Evidence*: [Deith](#) (Eagle Graphite Corporation); and [Houde](#) (Propulsion Québec).

70 RNNR, *Evidence*: [Concepcion](#) (Vale Canada Limited); and [Fung](#) (Torngat Metals Ltd.).

intentional. China has been investing in electric vehicles since at least 2009 and openly seeks global dominance in the sector.

Rare earth elements are another instance of China's market dominance: [Robert Fung](#) reported that it carries out 75% to 80% of all rare earth oxide production. Similarly, [Ian London](#) noted that China built a complete ecosystem for processing this mineral, from extracting the primary resource to making magnets to manufacturing commercial products that use electric motors (refrigerators, car engines and washing machines) and are purchased by Canadian consumers. However, [Simon Moores](#) pointed out the following:

Despite the common misnomer, only 23% of all battery raw materials are mined in China, but 80% of battery chemicals are refined there. Having huge midstream capacity ensures these key raw materials flow into China to be value-added. It also translates into creating trillions of dollars of value in downstream industries.

Despite the lead some countries have in this sector, Canada has a number of advantages to help it develop domestic value chains. First, the country has significant critical mineral reserves and a large supply of renewable and low-GHG electricity.⁷¹ Referencing the aluminum industry, [Robert Fung](#) said that the processes for turning some critical minerals, including rare earths, into value-added products can be energy-intensive. Having low-cost, low-GHG energy sources such as hydroelectricity is an asset for developing the industry.⁷² Indeed, Torngat Metals's rare earths project in Quebec will use environmentally "sustainable" mining powered as much as possible by wind energy.⁷³ Finally, another advantage Canada has for developing the varied activities of these value chains is proximity to primary resources and the associated logistical benefits.⁷⁴

Potential Solutions for Developing Value Chains in Canada

Despite the missing links in Canada, which include the intermediate processing of critical minerals and the capacity to produce advanced technologies using those minerals, Canada still has an opportunity to develop a critical minerals and value-added

71 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.).

72 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); [Breton](#) (Electric Mobility Canada); [Eggert](#) (As an individual); [Fung](#) (Torngat Metals Ltd.); and [Zaghib](#) (Investissement Québec).

73 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.).

74 RNNR, *Evidence*: [Bubar](#) (Avalon Advanced Materials Inc.); [Deith](#) (Eagle Graphite Corporation); and [Lappin](#) (Battery Metals Association of Canada).



processing sector.⁷⁵ [Sarah Houde](#), President and Chief Executive Officer of Propulsion Québec, described this opportunity as follows:

this is a unique chance to rebuild our economy on a new and promising foundation for the future by integrating best practices in circular environmental and social responsibility, particularly with respect to the recycling of these batteries and the development of industrial residues; we can also increase transparency, for example, by integrating the traceability of battery supply chains.

Witnesses offered the following suggestions to make the most of Canada's potential in the various industries that use critical minerals.

Develop a Canadian Value-Added Critical Minerals Strategy

To take full advantage of Canada's potential in the critical minerals sector, multiple witnesses proposed identifying the key factors for its development. These factors could include building a viable and integrated supply chain; creating a circular economy; ensuring GHG and source traceability; developing capacity and expertise; enacting the regulatory framework necessary for sustainable and effective resource management according to economic, environmental and social criteria; and developing government policies and programs to support the industry.⁷⁶

Some witnesses stated that a Canadian critical minerals strategy could set out the possibilities and identify what the industry needs to reach its potential.⁷⁷ Some industry stakeholders are already mobilizing to chart a path forward for the country. For example, [Ian London](#) said that the Industry Strategy Council "recently issued a report and has created a blueprint for implementation, a road map for how Canada can enable critical materials value chains to be developed."

Measures to facilitate and attract investment should also be considered to ensure the success of a coordinated and integrated strategy. Canada could draw on initiatives from other parts of the world that are leaders in this sector, as Australia did with its critical

75 RNNR, *Evidence*: [Houde](#) (Propulsion Québec); [Lappin](#) (Battery Metals Association of Canada); [London](#) (Canadian Critical Minerals and Materials Alliance); [Moore](#)s (Benchmark Mineral Intelligence); and [Zaghib](#) (Investissement Québec).

76 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); [Cleary](#) (BlackRock Metals Inc.); [Houde](#) (Propulsion Québec); [Kucharski](#) (As an individual); [Labonté](#) (NRCan); [London](#) (Canadian Critical Minerals and Materials Alliance); [Moore](#)s (Benchmark Mineral Intelligence); and [Zaghib](#) (Investissement Québec).

77 RNNR, *Evidence*: [Deith](#) (Eagle Graphite Corporation); [Fung](#) (Torngat Metals Ltd.); [Kucharski](#) (As an individual); [Lappin](#) (Battery Metals Association of Canada); and Brief submitted by the [Saskatchewan Mining Association](#).

minerals strategy⁷⁸ and its new government office specializing in critical minerals, which helps Australian businesses in the sector secure funding.⁷⁹ [Robert Fung](#) explained to the committee that “[a]ny small Australian company can go to this particular government office and it will assist them to get funding.” He further stated that “[t]he Australians have been moving very quickly to get their supply chain in place, as a competitor to Canada.”

Witnesses said it would also be appropriate to foster cooperation and partnerships between the sector’s various stakeholders, which could stimulate innovation and investment. These stakeholders include the federal, provincial and territorial governments, Indigenous communities and governments, academics, research institutions, technology and value-added product manufacturers and their customers.⁸⁰ Some witnesses even proposed a “pan-Canadian approach” that could harness the advantages of each Canadian region; some collaborations are already underway and could be brought to bear, including in the automobile industry.⁸¹

A “continental approach” involving the U.S. may also be necessary to compete with other regions that are major players in the sector, namely, Asia and Europe.⁸² The foundation for a collaborative framework is already in place with the creation of the [Roadmap for a Renewed U.S.–Canada Partnership](#), in which the countries’ leaders committed to working together

to build the necessary supply chains to make Canada and the United States global leaders in all aspects of battery development and production. To that end, the leaders agreed to strengthen the [Canada-U.S. Critical Minerals Action Plan](#) to target a net-zero industrial transformation, batteries for zero-emissions vehicles, and renewable energy storage.

[Roderick G. Eggert](#) proposed that cooperation between Canada and the U.S. could encompass the following:

78 In March 2019, the Australian government released a [critical minerals strategy](#) that targets actions in three key areas: promote investment into Australia’s critical minerals sector and downstream processing, provide incentives for innovation to lower costs and increase competitiveness and connect critical minerals projects with infrastructure development.

79 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.).

80 RNNR, *Evidence*: [Houde](#) (Propulsion Québec); [Labonté](#) (NRCan); [Lappin](#) (Battery Metals Association of Canada); and [Merlini](#) (Vale Canada Limited).

81 RNNR, *Evidence*: [Houde](#) (Propulsion Québec); [Labonté](#) (NRCan); and [Moore](#)s (Benchmark Mineral Intelligence).

82 RNNR, *Evidence*: [Labonté](#) (NRCan).



information sharing and broad, forward-looking strategic analysis related to raw materials, university to university co-operative programs and exchanges for students and faculty [as well as] government-to-government collaborations to assess unconventional primary resources, the recovery potential of valuable materials from processed waste streams from both historical and ongoing mining, and the potential for circularizing material life cycles.

Support the Development of Intermediate Processing in Canada

Identified as the weakest link in Canada’s critical minerals value chain, the intermediate processing sector merits attention. [Simon Moores](#) argued that this sector, which sits between mining and advanced manufacturing, offers the “biggest leaps in value.” He gave the example of lithium-ion batteries, which make up 25% of the cost of an electric vehicle, but whose inputs—the minerals and chemicals used to make them—account for 80% of their cost.⁸³

A number of witnesses suggested that governments need to create incentives in order to develop an intermediate processing industry.⁸⁴ For example, according to [Samantha Espley](#), such incentives would support research and development work on new technologies and innovative new processing methods, including modular technologies that could be used by multiple companies. Some countries or regions have already set up supports for their industry. For instance, the European Union has its strategy and €3-billion investment to establish a battery value chain in its member countries, and Australia gives its critical minerals sector access to its A\$1.3-billion Modern Manufacturing Initiative, which is designed to help Australian manufacturers produce at scale and commercialize their products.⁸⁵ [Robert Fung](#) explained that this fund is accessible to Australia’s critical minerals manufacturing sector and suggested that Canada should adopt a similar approach.

Setting up demonstration-scale facilities could be another key to developing the value-added critical minerals processing industry. [Donald S. Bubar](#) laid out the following explanation:

This has been one of the key reasons that these supply chains have not yet been established in Canada. There’s a lack of downstream processing facilities needed to, first of all, do the piloting work to establish an efficient flow sheet that can make the product that’s needed in the market. In most cases, you have to be able to produce trial

83 RNNR, *Evidence*: [Moores](#) (Benchmark Mineral Intelligence).

84 RNNR, *Evidence*: [Concepcion](#) (Vale Canada Limited); [Merlini](#) (Vale Canada Limited); [Thibault](#) (Propulsion Québec); and [Zaghib](#) (Investissement Québec).

85 RNNR, *Evidence*: [Fung](#) (Torngat Metals Ltd.); and [Moores](#) (Benchmark Mineral Intelligence).

quantities of the product, show them to your customers and get them to verify that it will meet their required specifications.

The Saskatchewan Research Council is moving forward with a demonstration facility, but [Mr. Bubar](#) believes that “there’s still a role the federal government could play here in creating some more of these demonstration-scale pilot facilities for aspiring new producers to get access to in order to be able to prove their processes.”

In addition, developing a novel industry in Canada would mean starting fresh on a new foundation that takes account of economic, social and environmental factors.⁸⁶ [Dan Blondal](#), Chief Executive Officer of Nano One Materials Corp., said that Canada’s lack of a critical minerals processing industry is an opportunity to develop value chains that do not use “legacy” production methods that have a serious environmental impact and instead “to be a better technology and value chain leader.”

Focus on Industries that Decarbonize the Economy

To stimulate the supply of and demand for advanced technologies in Canada, especially those that produce low-GHG energy, the country must adopt a strategy to “decarbonize [the] economy.”⁸⁷ [Christian Brosseau](#), Vice-President of Investment, Strategic Capital, Energy and Environment, at the Fonds de solidarité des travailleurs du Québec, pointed out that this strategy should encompass not only technologies to electrify light vehicles, but also heavy transportation and industrial processes, which are “major GHG consumers and emitters.” This strategy could encourage projects such as one mentioned by [Sarah Houde](#) involving a prototype 100% electric truck, which will be tested next year at the Nouveau Monde Graphite mining site. Ms. Houde said this is a good example of “a 100% Canadian, locally manufactured, locally developed with Quebec expertise truck, which will be tested here and then could be exported around the world.”

An electrification strategy would also deliver environmental, social and economic benefits. It would boost locally produced low-GHG energy, reduce GHG emissions from other energy sources and reduce pollution that affects human health.⁸⁸ Regarding the economic and employment benefits, [Daniel Breton](#), President and Chief Executive Officer of Electric Mobility Canada, cited an analysis his organization did in 2020, which found the following:

86 RNNR, *Evidence*: [Blondal](#) (Nano One Materials Corp.); and [Houde](#) (Propulsion Québec).

87 RNNR, *Evidence*: [Brosseau](#) (Fonds de solidarité des travailleurs du Québec).

88 RNNR, *Evidence*: [Zaghib](#) (Investissement Québec).



a Canadian transportation electrification strategy modelled on those in British Columbia, Quebec or California could generate up to \$200 billion in revenue between 2021 and 2030, and create tens of thousands of new jobs.

Some witnesses discussed the challenges the industry faces in setting up this value chain in Canada. For instance, Canada’s mining sector may not be able to provide a sufficient supply of the minerals and inputs needed to produce leading-edge technologies such as batteries and charging infrastructure.⁸⁹ In those circumstances, the automobile industry might have to use foreign sources of supply to meet its needs.⁹⁰ To overcome this challenge, [Roderick G. Eggert](#) suggested “establishing public-private partnerships to incentivize and accelerate technology deployment and commercial activity in a specific, more narrowly defined, supply chain.”

Electrifying transportation could also result in higher demand for electricity across the country. However, some witnesses argued that this issue should not prevent the introduction of more electric vehicles or disrupt the supply or cost of electricity.⁹¹ Moreover, electric vehicles could open up new opportunities, including their potential to store energy, which could be useful in meeting demand during peak periods.⁹² [Karim Zaghib](#) pointed out that the transition to electric vehicles must be done in a way that does not “upset” consumers.

Develop Expertise and Train a Skilled Workforce

The value chains associated with critical minerals will require new expertise and training programs.⁹³ According to [Jovette Godbout](#), developing a critical and strategic minerals industry in Canada will increase the need for training at every link in the value chain:

There will definitely be a greater need for training for individuals who are going to work in our industry and help us develop the field, particularly in terms of clean technologies and processes to extract, treat, process and recycle these substances in an environmentally responsible manner.

89 RNNR, *Evidence*: [Brosseau](#) (Fonds de solidarité des travailleurs du Québec); [Breton](#) (Electric Mobility Canada); and [Merlini](#) (Vale Canada Limited).

90 RNNR, *Evidence*: [Merlini](#) (Vale Canada Limited).

91 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada); and [Deith](#) (Eagle Graphite Corporation).

92 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada).

93 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada); [Eggert](#) (As an individual); and [Lappin](#) (Battery Metals Association of Canada).

[Simon Moores](#) asserted that the priority is “building active capacity in the midstream of the supply chain and encouraging new minds to then tap into the supply chain.” It may also be possible to leverage expertise from other industries that make use of similar skills.⁹⁴ [Daniel Breton](#) pointed to workers at Ford, Chrysler and GM assembly plants in Canada, who “will be retooling and will be retrained so they can start assembling electric vehicles.” Electrifying transportation will provide a new set of jobs in a number of areas, including research, mining, sales, maintenance, infrastructure and materials recycling.⁹⁵ [Roderick G. Eggert](#) stated that training could focus on “the important inputs to commercial activities.” [Daniel Breton](#) argued that government assistance is needed to support workers looking to enter these new industries. Finally, some witnesses noted the work being done to foster a more diverse workforce—for example, by increasing the number of women and people from diverse backgrounds at mining companies by providing them with technical training and selecting them to serve on boards of directors.⁹⁶

CONCLUSION

In light of the testimony heard during this study, the committee believes that Canada has many of the assets required to develop an internationally competitive critical minerals industry. Rising global demand for advanced technologies gives Canada the opportunity to become a premier source of the minerals necessary for the energy transition and modern technologies and to develop its value-added processing industry.

To achieve these goals, Canada must catch up to other countries in developing a critical minerals supply chain and the associated value chains. Some challenges will need to be overcome, including ascertaining the availability of critical minerals in Canada, attracting the investments needed to develop Canada’s critical minerals sector, building the infrastructure the industry needs, reducing the environmental impact of mining and processing activities, creating a value-added critical minerals processing sector, and developing expertise and training a skilled workforce.

Lastly, Canada must focus on cooperation and partnerships between the critical minerals sector’s various stakeholders to ensure successful value chain integration. Of particular importance is the meaningful participation of Indigenous communities, which is a key to the success of Canada’s critical minerals industry.

94 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada).

95 RNNR, *Evidence*: [Breton](#) (Electric Mobility Canada); and [Moores](#) (Benchmark Mineral Intelligence).

96 RNNR, *Evidence*: [Merlini](#) (Vale Canada Limited); and [Steward](#) (Rio Tinto).

APPENDIX A LIST OF WITNESSES

The following table lists the witnesses who appeared before the committee at its meetings related to this report. Transcripts of all public meetings related to this report are available on the committee's [webpage for this study](#).

Organizations and Individuals	Date	Meeting
Canadian Critical Minerals and Materials Alliance Ian London, Executive Director	2021/02/19	12
Canadian Institute of Mining, Metallurgy and Petroleum Samantha Espley, President	2021/02/19	12
Department of Natural Resources Mark Boyland, Director Industry and Economics Analysis Division, Lands and Minerals Sector Andrew Ghattas, Director Policy and Economics Branch, Lands and Minerals Sector Photinie Koutsavlis, Director General Policy and Economics Branch, Lands and Minerals Sector Jeff Labonté, Assistant Deputy Minister Lands and Minerals Sector	2021/02/19	12
Mining Association of Canada Pierre Gratton, President and Chief Executive Officer Brendan Marshall, Vice-President Economic and Northern Affairs	2021/02/19	12
Prospectors and Developers Association of Canada Jeff Killeen, Director Policy and Programs Lisa McDonald, Executive Director	2021/02/19	12
Avalon Advanced Materials Inc. Donald S. Bubar, President and Chief Executive Officer	2021/02/22	13

Organizations and Individuals	Date	Meeting
Battery Metals Association of Canada Liz Lappin, President	2021/02/22	13
Benchmark Mineral Intelligence Simon Moores, Managing Director	2021/02/22	13
Eagle Graphite Corporation Jamie Deith, Chief Executive Officer	2021/02/22	13
Yukon Chamber of Mines Samson Hartland, Executive Director	2021/02/22	13
As an individual Dr. Ken Coates, Joynson-Shoyama Graduate School of Public Policy, University of Saskatchewan	2021/03/08	15
Cree Nation Government Grand Chief Abel Bosum	2021/03/08	15
Rio Tinto Dr. Nigel Steward, Head Group Technical - Processing	2021/03/08	15
BMO Capital Markets Ilan Bahar, Managing Director and Co-Head Global Metals and Mining	2021/03/12	16
Cameco Corporation Dale Austin, Head Government Relations	2021/03/12	16
Fonds de solidarité des travailleurs du Québec Christian G. Brosseau, Vice-President Investment, Strategic Capital, Energy and Environment	2021/03/12	16
Torngat Metals Ltd. Robert Fung, Chairman	2021/03/12	16
Vale Canada Limited Nancy Concepcion, Executive Manager, Global Product Marketing Manager Juan Merlini, Head Sales and Marketing	2021/03/12	16

Organizations and Individuals	Date	Meeting
As an individual	2021/03/26	18
Dr. Roderick G. Eggert, Professor Colorado School of Mines		
Dr. Raphael J. Heffron, Professor, University of Dundee, Global Energy Law and Sustainability, Jean Monnet Professor in the Just Transition		
Dr. Jeffrey B. Kucharski, Professor Royal Roads University		
Investissement Québec	2021/03/26	18
Dr. Karim Zaghbi, Strategic Advisor		
Research Institute of Mines and the Environment	2021/03/26	18
Dr. Jovette Godbout, Executive Director		
BlackRock Metals Inc.	2021/04/12	19
Sean Cleary, Chairman and Chief Executive Officer		
Electric Mobility Canada	2021/04/12	19
Daniel Breton, President and Chief Executive Officer		
Nano One Materials Corp.	2021/04/12	19
Dan Blondal, Chief Executive Officer		
Propulsion Québec	2021/04/12	19
Sarah Houde, President and Chief Executive Officer		
Simon Thibault, Director Regulation and Public Policy		

APPENDIX B LIST OF BRIEFS

The following is an alphabetical list of organizations and individuals who submitted briefs to the committee related to this report. For more information, please consult the committee's [webpage for this study](#).

Fonds de solidarité des travailleurs du Québec

Saskatchewan Mining Association

REQUEST FOR GOVERNMENT RESPONSE

Pursuant to Standing Order 109, the committee requests that the government table a comprehensive response to this Report.

A copy of the relevant *Minutes of Proceedings* ([Meetings Nos. 12, 13, 15, 16, 18, 19, 29, 30, 31 and 32](#)) is tabled.

Respectfully submitted,

James Maloney
Chair

Conservative Dissenting Report - FROM MINERAL EXPLORATION TO ADVANCED MANUFACTURING: DEVELOPING VALUE CHAINS FOR CRITICAL MINERALS IN CANADA

June 16th, 2021

Introduction:

This dissenting report represents the views of the Conservative Members of the Committee.

We appreciate the efforts of our Committee analysts in the drafting of the original report, *From Mineral Exploration to Advanced Manufacturing: Developing Value Chains for Critical Minerals in Canada*. That said, we feel that the main report neglects to include critical information and testimony from witnesses which would guide the federal government in making integral decisions which could affect the long-term prosperity of this rapidly growing sector.

We are of the opinion that witness testimony demonstrated serious shortfalls in current government legislation and strategies which are unnecessarily hindering the rapid development required to meet the growing global demand for critical minerals.

We would like to reiterate that we appreciate the work of the Members and staff of the Standing Committee on Natural Resource, however, we must provide a dissenting report as laid out below.

Recommendation 1:

Establish protections for critical Minerals to ensure national security is maintained.

It is the responsibility of the federal government to ensure adequate access to strategic critical minerals. Within the mining industry, this means ensuring key resources are not exploitable by hostile foreign state-owned entities, to the detriment of Canada's national security interests.

The Government of Canada needs to recognize that the market for numerous critical minerals is dominated by State-Owned Enterprises whose trade and security interests are, at times, counter to those of Canada and other liberal democracies. In effect, their dominance of the market for these thinly traded minerals makes them an effective cartel at setting the price for these minerals in the world market. The objective of these non-market entities is to maintain control of the value chain of these critical minerals – that is, the end products from their processing – where the bulk of economic value lies. There is also a strategic importance in controlling the high-tech production output that requires these critical elements.

Conservatives are calling for mechanisms to ensure that Canada does not become a low-cost commodity supplier to price-setting jurisdictions which are capturing the downstream value of technological applications and final product development. This could include ensuring that entities connected with state-owned enterprises are limited in their ability to take a strategically significant position in any of the critical mineral elements identified by Natural Resources Canada.

Conservatives recognize that critical mineral developments have failed in market economies over the past two decades because of price volatility. When the cartelized supply of these rare minerals is low, the price is high, resulting in the market price for the advanced products that required these minerals to be high. At this point in the commodity cycle, the impetus for starting new critical mineral mine developments in market-oriented economies becomes evident. Investors (and governments – either through direct investment, or through tax incentives like ‘Canadian Exploration Expenses’ or similar provincial equivalents, or through Mineral Tax Exemptions) expend significant resources in new mineral developments.

As pointed out in testimony, the expected time from discovery of a resource to mineral output can take ten years. Ten years is a long time in a commodity cycle. Due to the actual supply of the available material in the world market being somewhat opaque (as many state-owned enterprises recognize their interests are not well-served by disclosing what market-based firms are required to disclose), the mine developments in market-oriented economies falter as the pricing for the critical minerals finds its ebb in the marketplace. The project under development will be starved for capital, and often, the entity and investors backing the project face bankruptcy. As most of these developments occur in remote areas, the cost of commission and decommission is large –even when no project ensues. So the residual value of a mineral development that has been starved of development capital is usually significantly less (<20% of the funds that have been expended in its development).

The full cycle of what happens in market-oriented economies through the efforts of state-owned enterprises manipulating the world market price of critical minerals is the loss of billions of dollars of investment – some of which comes from individual, institutional, and corporate investors – and some of which is borne by governments – through tax incentives that did not result in a taxable outcome, or through direct provision of taxpayer funds by various governments to project developments.

Once the new entrant, market-oriented forthcoming supplies of critical minerals are interrupted in their development, the world market price for the critical minerals rises once again, as does the value of the finished goods that are dependent upon their provision.

The beneficiaries at all stages are the state-owned enterprises who have cornered the market, developed the supply chains, and often constrained supply of the critical elements further by purchasing development sites in the developing world.

Simon Moores of Benchmark Mineral Intelligence clearly stated that, “China has built dominance in the supply chain from more than a decade of investments.” He went on to say, “The way China does it is that it goes in and either owns part of the mine or takes over a company, or it does long-term contracts in supplier states. The one thing China does do is it goes to other countries and puts money into the ground and therefore it guarantees the raw materials for its own economy.”

Note that the investment benchmark in market-oriented economies – meeting a benchmark cost of capital – required for a project to proceed – is not obvious with state-owned enterprises which look at the value chain of the finished product from start to finish – that is, from

commodity extraction through to finished good production – from both an economic value added and a national security perspective.

With Canada’s growing reliance on critical minerals for the development of modern technology and our increasingly strained relationship with China, it is the federal government’s responsibility to Canadians to ensure standards are in place to protect our national security interests while fostering a positive investment environment for development of a critical minerals industry with our global partners.

Recommendation 2:

Revise Impact Assessment Act to cut red tape and eliminate disincentives.

The current approval processes in place imposes barriers and represent a serious financial risk for reputable mining companies to move forward with new projects to develop our abundant critical mineral deposits.

The federal government must work with the mining industry and the provinces/territories to create a cohesive environmental approval process to reduce legislative redundancies and reduce risks for companies caused by delayed approval processes. Often, these delays act as a disincentive to companies who wish to invest in the Canadian mining industry.

During their testimony, witnesses clearly stated that current government legislation seriously hinders the Canadian mining industry and their ability to grow and meet the ever-increasing global demand for critical minerals.

Pierre Gratton, President and CEO of the Mining Association of Canada, stated, “For the federal one, that involves an impact assessment, an environmental assessment, and that takes several years.” He went on to say that, “The timelines that it takes to get mines through both federal and provincial processes present a real risk to our ability to take advantage of this opportunity.”

These thoughts were echoed by witness Samson Hartland, Executive Director of the Yukon Chamber of Mines, when asked about whether federal government approval requirements would hinder our ability to meet our 3 year agreement under CUSMA; “We have an abundance of materials, as noted earlier, but if you were to go through the environmental assessment process to permit one of these mines to meet those demands, you're looking at anywhere from three to 10 years... I would put money on it and guarantee that it will go beyond that three-year window.” Jamie Dieth, President and CEO of Eagle Graphite Inc., also testified that 10 years is an accurate representation of how long the approval process takes.

For example, Sean Cleary, Chairman and Chief Executive Officer of BlackRock Metals Inc., discussed the approval process they underwent to receive authorization for their mine in Chibougamau and the metallurgical complex in Saguenay. He stated that they have invested over \$150 million dollars in the approval process, which has taken between 10 – 15 years to complete, and they still don’t expect to see shovels in the ground for another couple of years.

Canada must also learn from other market-oriented liberal democracies. Countries like Australia realized that they were falling behind and made significant legislative changes to speed up approval processes for projects while still maintaining exceptional environmental standards. The current government, however, has gone the opposite direction and has made it more difficult to get projects approved through unnecessarily excessive assessment practices.

Contrasting the importance of the strength of our environmental and accountability regime in Canada – which we need to maintain – is the lack of such standards with state-owned enterprises and non-market economies. James Dieth commented, “One of the advantages that China has over the rest of us is that it gets to play by a different set of rules. Sometimes those rules are environmental rules and sometimes they have to do with labour and safety. It would be best, in my view, if we and our allies could ensure that there’s some level of accountability for those actions, so basically levelling the playing field so that China doesn’t translate a lax regulatory structure into a cost advantage at the expense of our own industries.”

If the federal government maintains the status quo, Canada will not be able to take advantage of the growing market demand for critical minerals and we will miss out on the exceptional economic potential this industry could provide.

The regulatory burden serves as an overwhelming counterweight to any concerted action governments may take in assisting with project developments. Therefore, it should be quickly examined, and the regulatory process should be reduced to a manageable, transparent process within the next six months. There is no time to waste in reducing this regulatory overburden.

Recommendation 3:

Develop an integrated supply chain with international allies.

As the global demand for critical minerals increases, it is paramount that the federal government have well-established supply chains with our allies with whom we already have strong partnerships.

Currently, China controls the vast majority of the world’s critical mineral supply and associated value-add supply chains, and that share continues to grow. According to Simon Moores, by 2030 China will “hold the sway of this industrial power, accounting for 67% of the world’s battery capacity,” while Europe is projected to hold 18% of the capacity by 2030. Moore also stated that North America only holds 12%, which is a fraction of what it needs to meet the projected demand in this space. Pierre Gratton echoed these fears in his testimony, where he stated, “For decades, China has held monopoly-like control over critical minerals production and distribution, rendering the rest of the world reliant on procurement and creating a level of risk that deters investors from entering these markets.”

There is hope, however, for Canada to meet these critical demands if swift action is taken by the federal government and if we work with our partners to improve these value chains.

Gratton stated that, “An increasingly uncomfortable reliance upon China for many of these commodities has led Europe, the U.S., Canada, Australia and other allies to come together to

develop strategies and policy instruments to lessen this dependence.” We need to continue working with our international allies and develop a strategic plan to create a secure supply chain system among our countries.

If the federal government neglects to engage with our partners and turns a blind eye to learning from our allies’ legislative successes in this area, Canada will continue to fall behind and we will fail to see the economic benefits this industry holds. Instead, we will be reliant on other countries to provide us with these critical minerals and the processing they require to create value-added products, like batteries.

Recommendation 4

Coordinate with our allies to establish a dedicated supply stock of critical minerals, possibly through a physical storage and floor pricing mechanism for visibility and pricing purposes.

Canada is too small of a market to undertake this effort on its own, but it can play a key role with its longstanding leadership as the mining jurisdiction of choice in the world. Canada’s pre-eminent role as a financing jurisdiction for international mining is well understood. Although we are at the early stages of losing this historical leadership to Australia, acting quickly to solidify Canada’s leadership will be a strong signal.

Australia and Europe have already established critical mineral strategies to offset the dominance of the market that China has exerted. At the very least, Canada’s coordination needs to include the United States, and probably Mexico (through CUSMA), as the ongoing funding of a critical mineral supply may require backstopping developments with a price amelioration mechanism. In essence, a floor price to ensure the protection of critical mineral developments from manipulating price volatility – and which has held back developments, or caused the insolvency of several of these developments, due to non-transparent world market pricing mechanisms.

With a steady demand for critical minerals, it will lead to the requirements for further value-added development, including concentrations, and processing of the minerals, eventually leading to production of high value-added finished products.

Canada could fulfill the role of maintaining the physical supply and verification – much like Canadian corporate and financial parties perform in other non-critical minerals supply stockpiling.

Establishing a steady supply of these critical minerals will lead to more value-added opportunities, in conjunction with our trade partners. The constraints around dependence on consistent supply of minerals will be reduced, and opportunities building on the demand for these critical minerals will be less risky and less dependent upon foreign, state-owned enterprises manipulating the price and supply of these key minerals.

The value chain – for both the critical minerals and their strategic finished products – is solidified in the non-market, opaque state-owned enterprises. Obviously, their governments

benefit significantly from this strategy – economically, strategically, technologically, and they solidify their national security, at the expense of market-oriented liberal democracies.

As stated by Simon Moore of Benchmark Intelligence, “China has built dominance in the supply chain from more than a decade of investment. Despite the common misnomer, only 23% of all battery raw materials are mined in China, but 80% of battery chemicals are refined there. Having huge midstream capacity ensures these key raw materials flow into China to be value-added. It also translates into creating trillions of dollars in downstream industries.”

Canada needs to interrupt this negative feedback mechanism or we will be only a provider of cheaply-price raw material inputs to state-owned enterprises elsewhere, which will continue to concentrate market dominance of the technological supply chain associated with the development of advanced technology products.

Recommendation 5:

We strongly advise AGAINST any large investments on specific critical mineral downstream industry development.

Developing key points of value in the supply chain does not occur overnight. Other world jurisdictions are pursuing the same strategy. Australia is ahead of Canada in their development and implementation of such a strategy, and they are in the shadow of a large resource consumer (China) that represents much of the state-owned enterprise market manipulation in minerals. Canada should examine Australia’s approach to their efforts to development their critical mineral supply chain. However, Canada should also clearly recognize that its market advantage is its proximity to the other world leader in technology development, that requires critical minerals. Canada’s approach should advance in partnership with the U.S. (and possibly Mexico). Further, the European Union also has its own critical minerals development strategy, with which Canada should pursue a partnership.

Strategies are best exemplified by governments investing \$130 million in Nemaska Lithium, which included the development of a lithium mine and a lithium processing facility, using proprietary (first of its kind) processing technology. Along with all other investors, totaling approximately \$600 million, this investment was worth nothing by the end of 2020, as the market swings in the price of lithium (and other factors) pushed the company into bankruptcy. One issue we recognized is the development of “mission creep” as the development sought to become more ambitious in order to attract more capital, ultimately leading to its own demise as capital expenditures grew unsustainably.

As quoted by Liz Lappin, the President of the Battery Materials Association of Canada, regarding the failure of Nemaska, “We understand that the deposit there is strong but we also understand that the production of battery-grade materials is challenging and complex.”

When asked for his input on the reasons Nemaska went bankrupt, Don Bubar, President of Avalon Advanced Materials Inc., stated, “I followed the Nemaska story, and the mistake they made was they took a miner's approach and tried to make it too large scale too quickly. With

many of these operations, you're best to start out at a more modest scale, make sure your process flow sheet works, start with a small, modest amount of product to the market and then scale it up after time. If your plant doesn't work right from day one, then you're going bankrupt, if you build it too big.”

There are political reasons to make large investments, but the risks of committing taxpayer funds to speculative projects is the usual curse of unaccountably deploying ‘other people’s money’. At the end of the day, if the manager does not bear the same risk, or detriment as those who will lose their funds due to a project failure (in this case, the taxpayers), the accountability mechanism is faulty.

Therefore, any government should not be the direct investor in these project developments. Should any development warrant public support – beyond economic incentives – funds deployed into projects should only be managed through third parties with an adequate risk / reward accountability structure.

Conclusion:

This study should be a wake-up call for the federal government. It has been made abundantly clear that the overarching issue within this industry is the fact that the federal government has created a business environment where Canada will be unable to meet the growing global demand for critical minerals and, therefore, be reliant on other countries to meet our needs.

Canada will not be able to meet our climate and national security goals if the federal government does not take serious action to reduce approval periods and work with our allies to develop an adequate supply chain for value-added, high-technology products.

Bloc Québécois Dissenting Opinion

New technologies are playing an increasing role in Quebec's economy. Aerospace, telecommunications, the medical sector, transportation electrification and renewable energy are all high-growth sectors in which the supply of critical and strategic minerals (CSMs) is vital.

The Government of Quebec considers that critical minerals have importance in key economic sectors, present a high supply risk and have no commercially available substitutes. Strategic minerals are indispensable to implement Quebec's major policies. Quebec's CSMs include copper, tin, gallium, zinc, cobalt, graphite, lithium and nickel. CSMs play an important role in our daily lives and are found in cell phones, computers, rechargeable batteries, electric vehicles, medical imaging equipment and solar panels.

In the current economic context and considering the growing demand for CSMs, the House of Commons Standing Committee on Natural Resources undertook a study on critical minerals and associated value chains. The Bloc Québécois is keen for Quebec to become a world leader in the green economic recovery, develop an end-to-end supply chain within its borders for battery production and seize the strategic opportunity of transportation electrification. Securing the supply of critical minerals and reducing our dependence on foreign markets were addressed in this study. In this regard, we were excited to begin the committee's work to identify the challenges of developing CSMs and solutions to support the sector.

However, as we are seeing more and more, the federal government has a disturbing and unfortunate habit of wanting to interfere in the jurisdictions of Quebec and the provinces and of wanting to impose its way of doing things. The most striking example of this desire to intrude is of course health care. In the fall of 2020, the Quebec government released its own *Quebec Plan for the Development of Critical and Strategic Minerals*. The federal government, if not willing to help, should at least not interfere.

Many of the recommendations in the report clearly infringe on Quebec's jurisdiction over mineral exploration and development. That is the main reason why we cannot support the report nor every single one of its recommendations as an ensemble.

In 1982, the addition of section 92A to the *Constitution Act, 1867*, expanded the exclusive jurisdiction of Quebec and the provinces with respect to the exploration, development, conservation and management of non-renewable natural resources.

Parliament has some jurisdiction over natural resources, but it is limited. It can regulate natural resources on federally owned property, such as national parks, military bases and the sea that lies beyond the geographic boundaries of any province or territory. It can also regulate natural resources on First Nations reserves. Parliament can also make laws affecting natural resources using its jurisdiction over the regulation of interprovincial and

international trade and commerce, like taxation. It can also make laws for peace, order and good government.

In 1946, having decided that uranium was a strategic mineral, the federal government exercised its declaratory power to declare uranium to be for the advantage of Canada and federalized it under the *Atomic Energy Control Act*. Subsequently, all mines fell under the jurisdiction of the provinces, which have authority over the subsurface, except for uranium mines, which fell under federal jurisdiction.

The 1946 act reads as follows: All works and undertakings

(a) for the production, use and application of atomic energy,

(b) for research or investigation with respect to atomic energy, and

(c) for the production, refining or treatment of prescribed substances,

are declared to be for the general advantage of Canada.

These few words, “for the general advantage of Canada,” were akin to a constitutional amendment removing uranium from Quebec’s jurisdiction. This precedent must not be repeated for other critical minerals.

Canada has no business telling Quebec how it should conduct its affairs in its own jurisdiction. The federal government must also stop trying to impose wall-to-wall national strategies that do not take Quebec’s priorities and distinct nature into account. This hierarchical vision of the Canadian federation is paternalistic and contrary to the principle of asymmetrical federalism.

The federal government can play a role in promoting the electrification of transportation, which Quebec has been working on for over a decade.

Quebec has put in place bold policies on transportation electrification over the past decade, while the federal government had no strategy. Quebec has not received its fair share of infrastructure investment in the past. If the federal government wants to spend on the electrification industry, it must make sure its investments do not compete with the Quebec market and undermine Quebec’s efforts to develop this industry, particularly with respect to mineral processing and battery production. If programs are created, they must align with Quebec’s strategy. The federal government can still play a role in promoting the electrification of transportation. For example, if private industrial projects were to be announced in the battery field, there would be no reason for the federal government not to participate. Among other things, the federal government can:

- renew and enhance incentives for the purchase of zero-emission vehicles for low-income households, the replacement of older vehicles and the purchase of used vehicles;

- following the Bloc Québécois' proposal and the recommendation of the House of Commons Standing Committee on Environment and Sustainable Development, which conducted a study on zero-emission vehicles (ZEVs), and following the lead of British Columbia, Quebec and 11 U.S. states, develop regulations to require automakers to build and sell enough zero-emission vehicles to meet demand, thus accelerating the transition of the auto industry to ZEVs (zero-emission law with credit system);
- provide research incentives to develop the heavy-duty and commercial vehicle sector as well as purchase incentives;
- invest in research and development in Quebec research centres, particularly in the regions, in colleges and universities, to promote the acquisition and adaptation of green technologies to support our unique network of Quebec-owned SMEs;
- electrify the federal fleet and install charging stations in federal buildings, public areas and businesses, particularly in the regions; and
- incentivize the purchase of electric school buses and support fleet replacement by allowing companies to borrow at an advantageous rate and by covering interest costs for five years.

New Democratic Party's Supplementary Report
to
The Standing Committee on Natural Resources report
FROM MINERAL EXPLORATION TO ADVANCED MANUFACTURING: DEVELOPING VALUE CHAINS
FOR CRITICAL MINERALS IN CANADA

The New Democratic Party of Canada supports the development of Critical Minerals in Canada and agrees with the recommendations of this report. However, the report is incomplete as it fails to consider the closure, clean-up and rehabilitation of these mines and mineral processing facilities. This report recommends the expenditure of large amounts of public funds to support the development of this industry while not ensuring that the private sector benefactors of this expenditure take responsibility for any environmental liabilities created.

The issue of taxpayers being encumbered with the burden of cleaning-up abandoned/orphaned mine sites and mineral processing facilities is not new. In 1994 this committee reported to the House of Commons:

“The main issue raised by old mining sites, unlike current and future mines, is the issue of liability for funding site reclamation. The onus today is on the governments concerned and on the mining industry to assume joint or several liability for activities that were conducted at those sites, in some cases a long time ago.”ⁱ

The impact on Canadians of the negative environmental legacy of these operations goes beyond the monetary burden of financing the clean-up. The United Nations Environment Program notes the impacts of these abandoned/orphaned mines and mineral processing facilities include:

“... loss of productive land; loss or degradation of groundwater; pollution of surface water by sediment or salts; fish affected by contaminated sediments; changes in river regimes; air pollution from dust or toxic gases; risks of falls into shafts and pits; and landslides.”ⁱⁱ

In their 2002 report to Parliament the Commissioner of the Environment and Sustainable Development found:

“[h]undreds of thousands of tons of highly toxic chemicals such as arsenic and cyanide are found at northern abandoned mine sites. These chemicals, the result of past mining operations, have accumulated to hazardous levels. Indian and Northern Affairs Canada estimates that the cleanup and closure of these complex contaminated sites will cost Canadian taxpayers at least \$555 million. In many cases, longterm site management will be needed because complete and definitive cleanup will not be possible.”ⁱⁱⁱ

Unfortunately, the commissioner's figures were extremely low as the cost of cleaning-up Giant Mine in Yellowknife is approaching a \$1 billion. Other examples of the Canadian public having to clean-up environmental liabilities from private sector operations include the more than \$530

million (from all levels of government) spent cleaning Hamilton Harbour^{iv} and the \$1.7 billion to clean-up orphaned oil wells.^v

Arguments have been made that any requirement by the federal government that the private sector be responsible for its environmental liabilities would be an invasion of provincial jurisdiction. However, history and jurisprudence show the opposite to be true.

As Joseph F. Castrilli in his paper *Wanted: A Legal Regime to Clean Up Orphaned /Abandoned Mines in Canada* notes:

“federal legislative jurisdiction over mining and related activity derives from its constitutional powers over public property, taxation, seacoast and inland fisheries, Indian lands, and criminal law. Works situated wholly within a certain province that are declared by Parliament to be for the general advantage of Canada (the declaratory power), as well as peace, order, and good government, have been used to justify federal legislation relating to all aspects of the uranium industry.”^{vi}

The Canadian Constitution allows Parliament to spend or lend funds to any government, institution, or individual it wishes, for the purposes of its choosing, and may attach any conditions to such grants or loans—including conditions on matters it could not legislate directly.^{vii}

In its 1991 decision *Re Canada Assistance Plan* the Supreme Court of Canada found financial arrangements like the Canada Assistance Plan were constitutional as withholding federal monies to fund a matter within provincial jurisdiction does not result in regulation of that matter by the federal government. As such a federal department or agency could therefore act with respect to abandoned/orphaned mines and mineral processing operations through loans, grants, and other financial arrangements. In particular, it could impose conditions regarding cleanup standards for air, land, and water protection.^{viii}

In his testimony Dr. Raphael J. Heffron said:

“...there's what's classed as an energy reserve financial obligation where companies have to put money into a bank account so that there are funds there for decommissioning. Irrespective of that company's sale to another company, let's say here in the U.K., the practice has sometimes been that the company would go bankrupt before, or nearly at the end of, the life cycle of the particular mine, and then the obligation to clean up was left with the government.

More and more we see a financial reserve obligation where companies are forced to put in two hundred million three hundred million, or five hundred million—it depends on the size of the project—which should provide insulation from a company's disappearing in some type of bankruptcy and not fulfilling its decommissioning obligation.

The issue of decommissioning comes if Canada wants to expand this industry. If so, the industry is going to need that public support in five, 10, 15, 20 years if the critical minerals industry is to grow and to be relied upon.”

The New Democratic Party of Canada recommends that:

Prior to any mining or mineral processing project receiving federal assistance the private sector proponents show there is sufficient financial resources in place to close, clean-up and rehabilitate there operations so that no liability falls upon the Canadian people.

ⁱ Parliament, Standing Committee on Natural Resources, Lifting Canadian Mining Off the Rocks (December 1994)

ⁱⁱ United Nations Environment Programme, Division of Technology, Industry and Economics, Abandoned Mines - Problems, Issues and Policy Challenges for Decision Makers: Summary Report (June 2001)

ⁱⁱⁱ Commissioner of the Environment and Sustainable Development (CESD), Abandoned Mines in the North: Report to the House of Commons (Ottawa: CESD, 2002) at 1 [CESD Report I].

^{iv} <https://www.hamilton.ca/city-initiatives/our-harbour/budgets-and-fast-facts>

^v <https://www.cbc.ca/news/canada/calgary/federal-oil-and-gas-orphan-wells-program-1.5535943>

^{vi} Castrilli, Joseph F., Wanted: A Legal Regime to Clean Up Orphaned /Abandoned Mines in Canada, (2007)

^{vii} Peter W. Hogg, Constitutional Law of Canada, (Toronto: Carswell, 1998)

^{viii} Castrilli

