Canada's Critical Minerals Capacity

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Issue

Canada lacks the production, recycling capacity, regulation and supply chain to increase the output of critical minerals, which will need to be overcome to meet the growing global demand for electric vehicle (EV) batteries and solar panels.

Background

Canada's Current Situation Surrounding Critical Minerals

Critical minerals have become a vital part of Canadians' everyday lives. Over the coming years, Canada will need to increase its production to maintain its current global market share, as it lacks the necessary output, recycling capacity, regulations and supply chain to boost the production of critical minerals. For instance, the world has long been reluctant to innovate when it comes to recycling, the very essence of renewable energy sources. Such negative issues run directly contrary to what renewable energy products, such as EV batteries and solar energy, strive toward. However, the problems of recycling critical minerals from end-of-life EV batteries and solar panels are no longer a technical constraint, but rather a lack of governance initiatives. The lack of governance capability persists in areas of regulatory barriers that hinder Canada's ability to extract critical minerals efficiently and safely. This undercapacity within our governance system stems from the federal and provincial jurisdictional overlap and their ineffectiveness in managing their relationships with Indigenous communities. Despite recycling and regulatory inefficiencies, Canada has managed to maintain its prominence within the global critical mineral supply chain as a key supplier of many essential critical minerals. Canada's role is crucial for the United States' consumerism and military equipment production. Thus, the goal for Canada should be to help create a robust recycling system that draws in end-of-life EV batteries and solar panels from global markets, while simultaneously streamlining governance structures to reduce bureaucratic hurdles and improve regulatory efficiency in the mining sector. Through these changes, Canada can further grow its global market share of critical minerals in renewable energies that are continuing to grow in demand.

Recycling EV Batteries

Canada has an abundance of five of the seven critical minerals that are found in EV batteries: graphite, nickel, copper, cobalt and lithium. Canada ranks eleventh in graphite production, sixth in nickel, twelfth in copper and fourth in cobalt. Canada also ranks among the top 10 countries in terms of reserves of graphite, nickel, cobalt and lithium (see Table 1). Global EV demand is expected to increase significantly over the next 25 years; by 2050, new EV sales are projected to reach 62 million (Wood Mackenzie 2021). To meet its part in this increase in demand, Canada has two options: either increase the mining of critical minerals or recycling capacity of EV batteries.

Table 1: Critical Mineral Reserves and Production

Critical Mineral	Canadian Reserves	Percent of World Reserves	Canadian Production	Percent of World Production	Canada's 2050 EV Market Share
Graphite	5,900,000	2.11%	4,261	0.27%	8,586
Nickel	2,200,200	1.69%	158,668	5.06%	90,907
Copper	7,600,000	0.76%	480,000	2.18%	27,055
Cobalt	220,000	1.93%	5,099	2.22%	10,996
Lithium	3,200,000	3.05%	3,400	1.89%	7,026.67

Source: Natural Resources Canada (2025).

To maintain Canada's current global market share of mining production, graphite production will need to increase from 4,261 tons to 8,586 tons by 2050 for just EVs, a 102 percent increase. Cobalt and lithium will need 216 percent and 207 percent of current production to go toward EVs to maintain global market share by 2050. Nickel and copper require 57 percent and six percent of current production respectively to be used in EVs by 2050 to maintain market share (see Table 1). This increase, given our current regulatory framework, will be difficult to achieve. Withdrawal rates for nickel, copper and cobalt are at 7.21 percent, 6.32 percent and 2.32 percent, respectively. This indicates that, with current reserves, nickel will last only 13.86 years, copper 15.82 years and lithium 43.1 years (see Table 1). EV battery recycling is, therefore, vital to sustain Canada's current position in the global market share.

Canada has four EV battery recycling plants. When recycled, EV batteries can reuse 95 percent of their critical minerals (Bergevin-Chammah 2024). The United States is projected to have the capacity to recycle 1,293,000 EV batteries annually (International Council on Clean Transportation 2023). The United States is producing 1,390,000 EVs annually as of 2023 (Our World in Data 2025). This is a 97,000 battery difference that needs to be met, and Canada can fill this void. By increasing battery recycling plants, Canada can meet its own demand while also filling the global void in recycling EV batteries, thereby maintaining its current market share in the production of critical minerals such as graphite, nickel, copper, cobalt and lithium.

Recycling Solar Panels

Looking at data collected in the United States, end-of-life solar panel collection rates are estimated to be approximately 10 percent (Lee et al. 2024). Such wastefulness has been tolerated due to the technical limitations in efficiently extracting critical mineral resources from the panels themselves. However, the use of thermal treatment and gravimetric separation has enabled the efficient extraction of silicon dioxide, silver, lead, tin and indium from end-of-life solar panels (Mukwevho et al. 2025). For instance, most solar panels can be treated through gravimetric separation, resulting in an intact target component and optimal pre-concentration yield of silver and indium (91.42 percent and 94.25 percent for crystalline panels and 96.10 percent for copper indium selenide panels) (Savvilotidou and Gidarakos 2020). "Overall, it is believed that the mitigation of metal losses during the pre-processing stage of waste panels can substantially contribute to an economically viable secondary production of silver or indium" (ibid.). "Based on these findings, recycling can save more than 3,900 tonnes of silver and 120 tons of indium by 2050" (ibid.). However, with annual indium production likely to exceed 2,000 tons per year by 2050 (Werner, Mudd and Jowitt 2015, 217), utilizing recycling techniques alone is insufficient, and new mining extraction techniques are necessary to increase extraction efficiency.

Regulatory Regime

Canada is currently facing a lack of an effective governance framework regarding regulations within the mining industry. For example, industry professionals have indicated that 83 percent of respondents in Manitoba, 69 percent in Nova Scotia and 56 percent in Ontario indicated that uncertainty around disputed land claims was a deterrent to investment, compared to only nine percent in Nevada and none in Utah (Mejía and Aliakbari 2023). Similarly, 89 percent of respondents in Nunavut, 84 percent in the Northwest Territories and 77 percent in Nova Scotia cited uncertainty over which areas would be protected and off-limits for mining exploration, compared to only 15 percent in South Australia and 22 percent in Nevada (ibid.). This problem is further exacerbated when

comparing Canadian provinces to other regions worldwide. For example, when focusing solely on policy factors, Ontario ranks eighteenth out of 62 jurisdictions in terms of mining investment potential, indicating significant room for improvement on the policy front (ibid.). Overall, the negative aspects surrounding investment in Canada's critical mineral industry can be summarized by environmental and administrative regulations, regulatory duplication and a lack of clarity regarding protected land (Green and Jackson 2016, 6).

Despite Canada's tighter restrictions on critical mineral mining, Indigenous communities continue to be affected. For example, "According to the Assembly of First Nations (AFN), more than 36% of First Nations communities are located less than 50 km from major mines in Canada," many of which are downstream from mining sites (Hipwell et al. 2002, 4). Additionally, 20 percent of water discharges are directed to groundwater in mineral mining cases and tailings ponds in metal ore mining (Atakhanova 2023, 6). Water treatment indicators before discharge are similar across mining sectors, with approximately 43 percent of water undergoing primary or mechanical treatment (ibid.). Most of the remaining water is released untreated, except in metal ore mining, where approximately six percent of the discharged water undergoes secondary or biological treatment (ibid.). Therefore, due to the proximity of many Indigenous communities to mining sites and the lack of adequate water treatment, these communities often face damaged and untreated water resources. Overall, the insufficient regulation of water use has created a disconnect between the Canadian government and Indigenous communities, hindering further cooperation in the mining sector.

Supply Chains

When it comes to global relations, Canada's vast resources enable the federal government to maintain its negotiation power with the United States, as the United States relies on Canadian imports to sustain American consumerism and military power. First, the US agricultural industry relies on Canadian potash and utilizes Canadian refining capabilities of germanium as part of the process for producing microchips and valuable medicine (Nassar, Alonso and Brainard 2020). Second, Canada's indium supply has been a lifeline for American importers shifting away from Chinese exports. Third, silver and zinc are heavily imported from Canada and Mexico, while nickel is primarily imported from Canada and Australia (ibid.). Third, Brazil and Canada together produce 98 percent of the global niobium supply, which is a crucial critical mineral in America's aerospace industry (ibid.). Ultimately, Canada's vast reserves of natural resources are crucial to the trade balance between Canada and the United States, particularly when examining beyond Canada's oil exports to the United States.

Recommendations

Canada should invest in EV battery and solar recycling. To date, Canada has invested CDN$52.5 billion into the electric vehicle supply chain. However, none of this money has been invested in EV battery recycling (Giswold 2024). The federal and provincial governments will need to work alongside each other to facilitate efficient investment. Currently, the country has invested CDN$52.5 billion, with 60 percent coming from the federal government and 40 percent from provincial governments (ibid.). Using new techniques on old tailings is a viable solution for increasing the indium supply. For example, New Brunswick indium mines indicate that the indium contained within the tailings of two sites alone contributes over 10 percent of the global estimates for indium in zinc processing wastes (Werner, Mudd and Jowitt 2015, 222). Similar to how Canada exchanges garbage with the United States, a process may be followed for recycling end-of-life solar panels and EV batteries, with Canada becoming the leader in recycling and the United States exporting its end-of-life EV batteries and solar panels to Canada. With a system of recycling cooperation between Canada and the United States, Canada will not only be able to preserve the critical mineral resources in solar panels and EV batteries but also create a new industry.

Canada should develop a centralized application process. To help streamline regulatory processes within Canada, all regulatory applications must be routed through either the federal or provincial governments. Therefore, this pathway requires a choice: provincial governments can relinquish their jurisdiction over critical minerals to the federal government or the federal government can allow provincial governments to gain greater autonomy regarding Indigenous affairs. Regardless of which pathway is chosen, it creates a centralized application process for critical mineral mining, reducing bureaucracy and duplication

within the application process. To ensure that water filtration is held to the highest standard, all critical mining sites must have water treatment stations that ensure that all water discharge undergoes primary filtration treatment. The goal is to ensure that all Indigenous communities' water resources are safe for drinking and able to sustain water-related ecosystems. In pursuit of the federal government's efforts to improve its relationship with Indigenous communities, all critical mineral mining sites within Canada should incorporate a royalty stream that allows Indigenous communities to gain a financial benefit from their traditional lands.

Canada should work with like-minded partners to strengthen supply chains. To bolster Canada's position in the global market, Canada should negotiate with Australia to establish a mutually beneficial relationship in the field of critical minerals. Through this partnership, neither country would directly compete, but instead expand their market share, allowing them to demand higher prices for critical minerals. To develop such an alliance, the Canadian government could offer its extensive expertise in electrical grid infrastructure to assist Australia in managing its electrical grid overload resulting from the surge in solar panel usage.

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