

**Mineralizing the Road to Canada's Green Future;**

*Jurisdictional considerations surrounding critical mineral extraction and production for Electric Vehicle Batteries in Canada*

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## **Abstract**

This research paper investigates the critical mineral landscape in Canada with a focus on lithium (Li), nickel (Ni), and cobalt (Co), all integral to lithium-ion battery technologies and essential for the global energy transition, particularly in the context of electric vehicle (EV) adoption. Drawing upon data from the *Atlas of Canada's Critical Mineral Interactive Map* and *Natural Resource Canada's Survey of Mineral Exploration, Deposit Appraisal, and Mine Complex Development Expenditures*, this study evaluates critical mineral and exploration activities across Canadian jurisdictions. The research identifies Ontario and Quebec as priority provinces, due to their dominance in critical mineral activity and sustained investment in mineral exploration and development. A jurisdictional and regulatory review highlights disparities in mining taxation, exploration assistance, environmental policy, and reclamation requirements between Ontario and Quebec. While Ontario adopts a business-friendly approach with low mining taxation rates and generous tax incentives, Quebec prioritizes more stringent environmental assessments and sustainable development initiatives. This paper underscores the importance of government policy in ensuring the sustainable development of critical minerals in Canada as we strive to fuel the emerging technologies of a decarbonized world.

## **1.0 Introduction**

As part of the ongoing global transition to a low-carbon future, the Canadian federal government has committed to achieving net-zero emissions by the year 2050 (Government of Canada, 2023). Currently, within Canada, more than 80% of greenhouse gas emissions within transportation, residential and industrial sectors are related to energy generation and end-use (ECCC, 2023). Therefore, eliminating greenhouse gas emissions while meeting current and

future energy demand will require a transformative shift away from fossil fuel-based energy toward low-carbon alternatives throughout Canada.

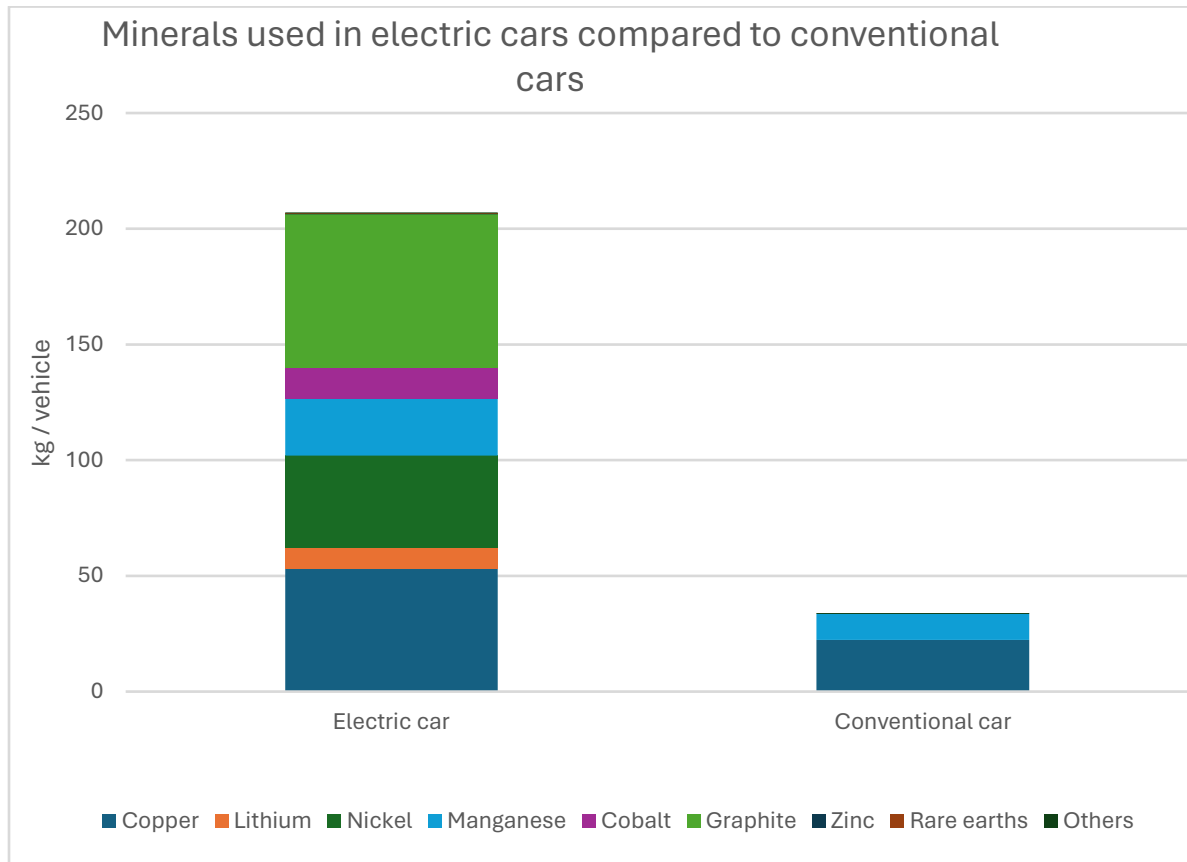
Carbon neutrality targets, as currently set by the Canadian government, rely heavily on accelerated uptake and deployment of low-carbon energy and energy storage technologies (Srivastava & Kumar, 2022). Net-zero trajectories, such as Canada's, involve rapid deployment and adoption of technologies which can generate, store, and utilize low-carbon energy. Therefore, not only will governments, such as Canada, need to deploy enough non-emitting energy sources to replace fossil fuel reliance within present-day electrical grids, but they will also need to expand grid capacity substantially in order to meet the growing energy demands of the new electrified economy (Wang et al., 2023). The Canadian Energy Regulator's most recent report on Canada's energy future predicts that, under a net-zero scenario, electricity use will more than double by 2050 as Canadians transition away from fossil fuel-consuming technologies to electric alternatives, such as electric vehicles and heat pumps (CER, 2023). Facilitating such an unprecedented and rapid expansion of electrical grid capacity is no small feat; the International Energy Agency recently estimated that global electricity transmission and distribution grids will need to expand by approximately 2 million kilometres annually through 2030 if the world is to remain on a feasible net-zero trajectory (IEA, 2023b).

Construction of the extensive infrastructure needed to generate, store, and utilize the low-carbon energy required to meet current and future energy demands is immense and requires extensive quantities of raw minerals (Kalt et al., 2022), many of which have are classified as 'critical' within countries like Canada due to their high economic importance and significant supply challenges (NRCan, 2022). Transitioning away from fossil fuels toward alternative energy sources is expected to have a profound impact on global primary material demand, as

sustainable technologies have larger material requirements per unit of energy than their fossil-fuel-based counterparts (Cairns et al., 2021; Deetman et al., 2021; Hund et al., 2023). In fact, a 2018 study found that the global energy transition could increase total material demand by 200-900% in the electricity sector and 350-700% in the transportation sector between 2015 and 2050, depending on the rate of decarbonization (Valero et al., 2018). This is because many minerals which are not apart of conventional fuels, including copper, nickel, cobalt, and rare earth elements, are essential components of many pivotal sustainable technologies, such as renewable energy systems and electric vehicles (EVs). Due to the presently low rates of recovery and recycling for many critical minerals, the vast majority of future supply will need to come from virgin materials, necessitating an inevitable expansion of mining activity (Agusdinata et al., 2022).

With road transportation accounting for ~20% of total greenhouse gas emissions in Canada in the last decade (ECCC, 2023), EVs are expected to play key role in decarbonizing the Canadian economy (Agusdinata et al., 2022; Gadd et al., 2023). Presently, the Canadian government has set ambitious national targets for light-duty zero-emission vehicle deployment, aiming to achieve zero-emission sales shares of 20% by 2026, 60% by 2030, and 100% by 2035 (Transport Canada, 2024). Such policies will undoubtedly be accompanied by increased demand for critical minerals as EVs carry an average material footprint over six times the mass of their conventionally fueled counterparts, utilizing at least 8 minerals deemed 'critical' by the Canadian government (Figure 1; IEA, 2021; NRCan, 2022). Of particular note is the material demand which will be required by emerging EV battery supply chains within Canada (IEA, 2021). It has been estimated, for instance, that Canada would need to open 15 more mines in order to meet the mineral demand of just four EV battery manufacturing factories, such as the *Stellantis-LGES*,

*Powerco-Volkswagen*, and *Northvolt* factories, recently announced by Canadian governments (Mining Association of Canada, 2024).



**Figure 1:** Comparison of mineral requirements between electric vehicles (EVs) and conventional internal-combustion engine alternatives. Excludes steel and aluminum. Values for vehicles encompass the entire vehicle, including batteries, motors, and glider. Electric car intensities are based on a 75 kWh NMC 622 cathode and graphite-based anode (IEA, 2021).

To properly assess the anticipated future mineral demand associated with EV battery production, it is important to first consider the various prevalent battery technologies and their respective mineral components. As of 2022, lithium cobalt oxide, known as mature cathode chemistry, prevails as the primary battery technology of consumer electronics (Houache et al.,

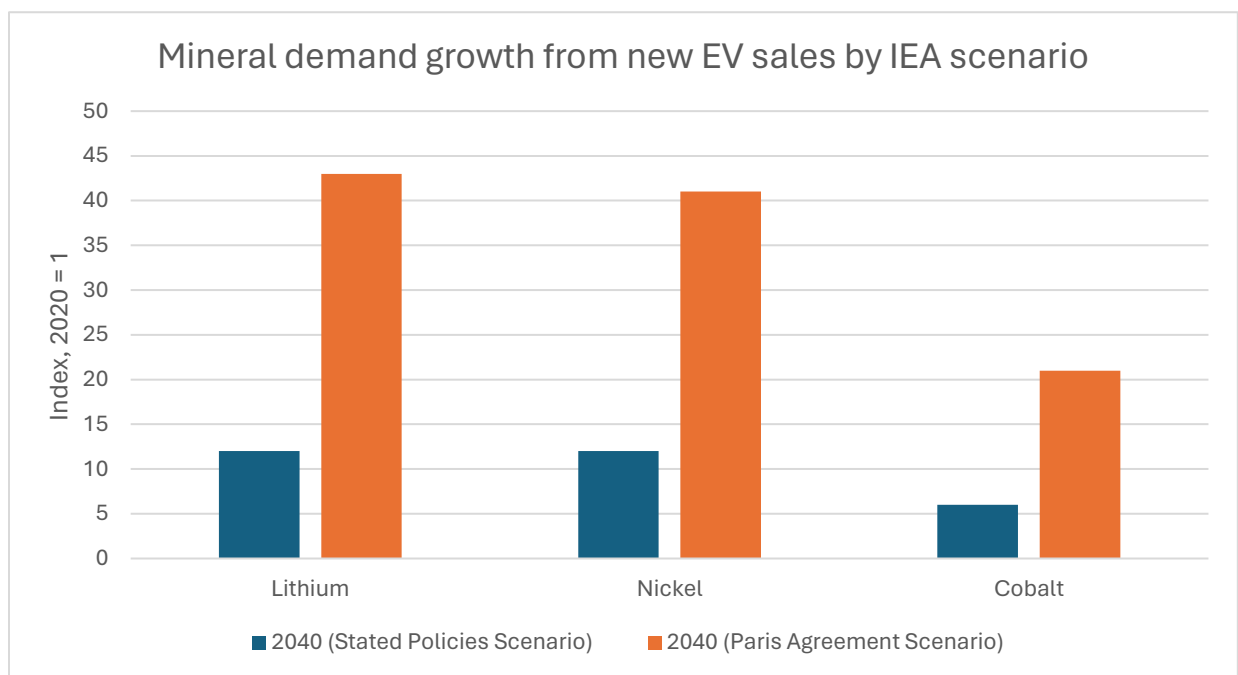
2022). However, due to concerns about its long-term structural stability, this technology is largely unsuitable for broader, larger-scale applications (Houache et al., 2022). Other cathode chemistries such as lithium nickel manganese cobalt oxide (NMC), lithium iron phosphate (LFP), lithium nickel cobalt aluminum oxide (NCA), and spinal lithium manganese oxide (LMO) have emerged as dominant battery technologies in industrial-scale implementations, particularly in electric vehicles, due to their stable crystal structure, abundant supply, and favorable economics (Houache et al., 2022; IEA, 2023a; Tracy, 2022).

In 2022, NMC was the dominant form of battery chemistry overall, representing around 60% of all batteries purchased that year (IEA, 2023a). LFP and NCA were the next two dominant battery technologies, with market shares of ~30% and ~8%, respectively (IEA, 2023a). With lithium-based batteries expected to continue to control the EV and plug-in hybrid EV markets in the coming decades, mining and processing of the critical minerals needed to produce lithium batteries will need to increase rapidly in order to keep pace with demand associated with increased projected adoption (Barman et al., 2023; IEA, 2023a).

Lithium (Li), nickel (Ni), and cobalt (Co) are all essential components of modern-day EV battery technologies, particularly within NCA and NMC battery cells (Table 1; Czerwinski, 2022). In modelling scenarios where warming targets set under the Paris Agreement are met, new EV sales are estimated to increase demand for Li, Ni and Co by 43, 41 and 20 times, respectively by 2040, compared to 2020 levels (Figure 2; IEA, 2021). Achieving such an expansion of production capacity for these minerals will be no easy feat, as recent studies have identified Li, Ni and Co as posing particular risk for bottlenecking future EV battery supply chains (Barman et al., 2023; Bongartz et al., 2021).

**Table 1:** Essential elements for the Li-ion battery sector (adapted from Czerwinski, 2022)Czerwinski, 2022)Czerwinski, 2022)Czerwinski, 2022)Czerwinski, 2022).

Element	Battery Component
Nickel	NCA, NMC cathode <sup>1</sup>
Cobalt	NCA, NMC cathode <sup>1</sup>
Lithium	All cathodes, electrolyte



**Figure 2:** Modeled increase in demand for lithium, nickel, and cobalt from new EV sales by 2040 in scenarios where present-day EV-related policies are upheld and remain constant (Stated Policies Scenario; blue) and where global Paris Agreement climate targets are met (Paris Agreement Scenario; orange). The y-axis is indexed to 2020 values, with the value at 1 representing the baseline value in 2020 (IEA, 2021).

<sup>1</sup> Cathode active materials: NCA – lithium nickel cobalt aluminium oxide (LiNiCoAlO<sub>2</sub>); NMC – lithium nickel cobalt manganese oxide (LiNiCoMnO<sub>2</sub>)

Extracting vast amounts of critical minerals to support the EV battery supply chain presents moral dilemma for global sustainability aspirations. On the one hand, the rapid expansion of mining activity is an unavoidable prerequisite for supporting the broad electrification and decarbonization of our transportation networks, which will be necessary if we wish to meet established climate targets and mitigate the many negative impacts of anthropogenic climate change (Bellard et al., 2012; Keeley & Syphard, 2016; Kompas et al., 2018; McMichael et al., 2006; Silva et al., 2017; Ulibarri et al., 2022). On the other hand, the rapid expansion of mineral production required to support electrified transportation carries with it many social and environmental concerns (Agusdinata et al., 2022; Dou et al., 2023). Pollution, ecological degradation, biodiversity loss, and environmental damage are inevitable challenges associated with mineral extraction industries, with over half of ore mining currently occurring within 20km of protected natural areas (Dou et al., 2023; Sonter et al., 2018). Studies indicate that the environmental costs of extracting legacy minerals like copper, iron, gold, and bauxite amount to billions of dollars annually, with these negative externalities disproportionately affecting local populations long after mining operations cease (Dou et al., 2023; Tost et al., 2020). The negative social impacts of critical mineral mining are also glaringly evident, as notoriously exemplified by the numerous human rights violations observed in the Democratic Republic of Congo's cobalt industry (Prause, 2020). While environmental impact assessments and policies can mitigate such negative effects, they can prolong project timelines, increase costs, and heighten operational risks associated with opening and operating mines (Söderholm et al., 2015). Though the rapid expansion of mineral production capacity is most easily achieved with minimal regulatory oversight, this approach may lead to ecological and social harm (Agusdinata et al., 2022).

Given that the expanded extraction of critical minerals presents both opportunities and challenges to long-term Canadian EV- and sustainability-related objectives, policymakers must strive to ensure that Canadians reap the benefits of critical mineral production in facilitating EV battery production while mitigating potential adverse impacts of mining operation and expansion. Recent literature underscores the considerable challenge facing policymakers and mineral producers in achieving sustainable extraction of critical minerals through systemic approaches, production strategies, policy frameworks, and incentives (Dou et al., 2023). Mining operations in Canada must be able to extract, refine and produce critical minerals in a manner that not only keeps pace with anticipated demand of a decarbonizing economy, but is also both environmentally and socially sustainable. Successfully ensuring the sustainable development of these resources is essential for the future of Canadian critical mineral development. However, achieving this goal without inadvertently impeding the necessary expansion of critical mineral development requires careful implementation, considering all levels of government policy and regulation.

As a stable democracy with access to low-carbon electricity, vast natural resources and a long history of mining, as well as strong environmental and social governance policy, Canada is well positioned to meet demands imposed by increased EV and related battery adoption in the years to come. In fact, Canada was recently ranked first of 30 nations reviewed in *BloombergNEF's Global Lithium-Ion Battery Supply Chain Ranking* for its perceived ability to build a secure, reliable, and sustainable Li-ion battery supply chain (BNEF, 2024). Canada possesses rich natural reserves of the critical minerals required to construct EV batteries; we currently produce more than 60 minerals deemed essential to achieve global net-zero ambitions, including Li, Co, and class-1 battery-grade Ni needed for EV manufacturing (NRCan, 2022a;

Ryu et al., 2021). Additionally, Canada is home to robust nickel and copper mining industries, activities which, globally, produce ~60% and ~30% of global cobalt supply as a by-product, respectively (Barman et al., 2023; NRCan, 2022b).

However, despite being home to a vast wealth of the very mineral building blocks required to support economy-wide decarbonization efforts such as EV battery manufacturing, it remains uncertain whether countries such as Canada will be able to sufficiently ramp up production and refinement efforts needed to support the rapid decarbonization of its domestic economy. Some scholars have speculated that it is unlikely that present day climate targets will be met in the desired timeframes, citing lack of coherent mineral policy, long and burdensome approval processes and anti-mining litigation as major barriers impeding timely progress (Hammond & Brady, 2022). It is therefore imperative that the different levels of government within Canada strike a balance between increasing extraction and refining capabilities and socially and environmentally responsible practices. Understanding how existing regulatory frameworks address these concerns across different jurisdictions is essential in achieving sustainable and accelerated critical mineral extraction in Canada.

Under the Canadian constitution (*Constitution Act*, 1982), provinces and territories have authority over mining activities and mineral rights within their borders. This decentralized governance structure grants both federal and provincial/territorial governments regulatory powers over mining in Canada. Provinces, Yukon, and the Northwest Territories primarily oversee exploration, development, extraction, and mine site management. However, the federal government maintains jurisdiction in areas such as the nuclear fuel cycle, mineral activities involving federal Crown corporations, federal lands, offshore areas, Indigenous rights, trade and commerce, and environmental matters such as fisheries (Abdel-Barr & MacMillan, 2023). Thus,

deposits of critical minerals are found within areas of differing governmental authority, which means that the policy approach and sustainability practices related to critical mineral production can vary significantly from one jurisdiction to another, despite all being located within Canada.

Therefore, in order to adequately assess Canada's capacity to sustainably source critical minerals to support emerging EV supply chains, it is important to first identify which subnational jurisdictions will be extracting the mineral resources on which EVs rely. Accurately doing so requires discerning which type of EV battery technology is likely to be utilized, which minerals they require and identifying which Canadian jurisdictions are best positioned to meet the future material demand of mass EV adoption. From there, it is possible to comparatively assess the practices of the subject jurisdictions to analyze their present capacity to increase critical mineral production in a way that is environmentally sustainable. Such an analysis of Canadian jurisdiction in the context of critical minerals supporting EV battery supply chains is presently lacking in contemporary literature.

To sustainably meet the increased demand driven by EV battery manufacturing, governments must ensure that their jurisdictions attract mineral exploration and development investment while effectively mitigating environmental impacts throughout the entire mining lifecycle. To do so, governments must ensure that they offer competitive taxation regimes to encourage investment (Maloney, 2021; Russell et al., 2010), are able to support exploration of new and untapped critical mineral reserves (Gadd et al., 2023; Maloney, 2021), that environmental impacts associated with mining development and operation are accounted for and minimized (IEA, 2021; Javed et al., 2024; Söderholm et al., 2015), and that the land is appropriately remediated once mining work has ceased (Kabir et al., 2015; Steenhof, 2015). Taxation regimes, exploration assistance policies, and environmental approval and reclamation

requirements are key policy dimensions for examining jurisdictions' ability to balance economic competitiveness with environmental responsibility.

This Major Research Project seeks to examine the governance and regulatory environment surrounding forecasted upstream supply chain pressures associated with deployment of EV battery technologies in Canada. This research is intended to aid policymakers in examining and understanding jurisdictional and intergovernmental challenges associated with responsibly scaling timely extraction and production of critical minerals required to facilitate Canada's present and future EV -related policy agendas. This research also endeavours to shed light on existing policies within relevant jurisdictions and their compatibility with broader Canadian sustainability and decarbonization agendas.

## **2.0 Design and Methodology**

### *2.1 Determination of focus minerals*

For the purpose of this research project, Li, Ni and Co were chosen as critical minerals of interest. These minerals were chosen due to their necessity in popular Li-ion battery technologies as well as their high level of projected battery-related demand increase associated with the projected increase in EV adoption worldwide as well as the energy transition more broadly. Additionally, Li, Ni and Co represent three (3) of the six (6) critical minerals prioritized by the federal government in the *Canadian Critical Minerals Strategy* due to their significant potential to drive Canadian economic growth in key economic sectors, such as EV batteries (NRCan, 2022).

## *2.2 Evaluation of critical mineral and exploration activity across Canada*

To examine the extent of present critical mineral activity across Canada, data from the *Atlas of Canada's Critical Mineral Interactive Map* was referenced (Atlas of Canada, 2023a). This public mapping data provides information on advanced critical mineral projects, active critical mineral mines and processing facilities across Canada. The application provides geographic and commodity-specific data on critical mineral developments in Canada, all of which possess or utilize viable critical mineral reserves, where viability is supported by either preliminary economic assessment or general feasibility studies (Atlas of Canada, 2023b). Using this data, activities involving exploration, mining and/or processing of this paper's chosen focus minerals (Li, Ni and Co) were isolated and compared across jurisdictions to determine the scope of present-day activities across Canada specifically relating to these minerals. Focus jurisdictions were selected based on their relative abundance of projects involving all the three chosen critical minerals of interest.

Natural Resource Canada's *Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures* was similarly consulted to compare the scope of exploration and development activities across Canadian jurisdictions (NRCan, 2024). Specifically, this survey presents data relating to exploration and development expenses incurred by mining industries across Canadian jurisdictions from 2015 to 2023. The pre-production costs included in this dataset include expenses associated with mineral exploration, deposit appraisal and on-site mine complex development. This data was referenced to infer the size of mineral exploration economies within Canadian provinces and territories and to compare activity over time across jurisdictions. Jurisdictions were screened for sustained investment in mineral exploration and pre-production activities over time to serve as an indicator for long-term mineral exploration and

development activity, a trait essential for the expansion and ramp-up of critical mineral production needed to meet projected demand associated with the energy transition.

### *2.3 Jurisdictional comparison and regulatory review*

Based on the analysis of critical mineral activity and mining development expenditure data, Ontario and Quebec were selected as priority jurisdictions for further analysis. For the comparative analysis, policy categories of mining taxation, mineral exploration assistance, environmental assessment and reclamation requirements were identified. These categories were selected due to their high degree of relevance to mineral development and its environmental implications as indicated in the literature (Atlin & Gibson, 2017; Carvalho, 2017; Dance, 2015; Gadd et al., 2023; IEA, 2021; Javed et al., 2024; Kabir et al., 2015; Lima et al., 2016; Maloney, 2021; Marques, 2016; McDowall, 2021; Mosquera Valderrama, 2021; Russell et al., 2010; Söderholm et al., 2015; Steenhof, 2015; Tremblay & Hogan, 2016). Additionally, these policy themes are prevalent in the strategic critical mineral policies published by both Ontario and Quebec (Government of Ontario, 2022; Government of Quebec, 2020).

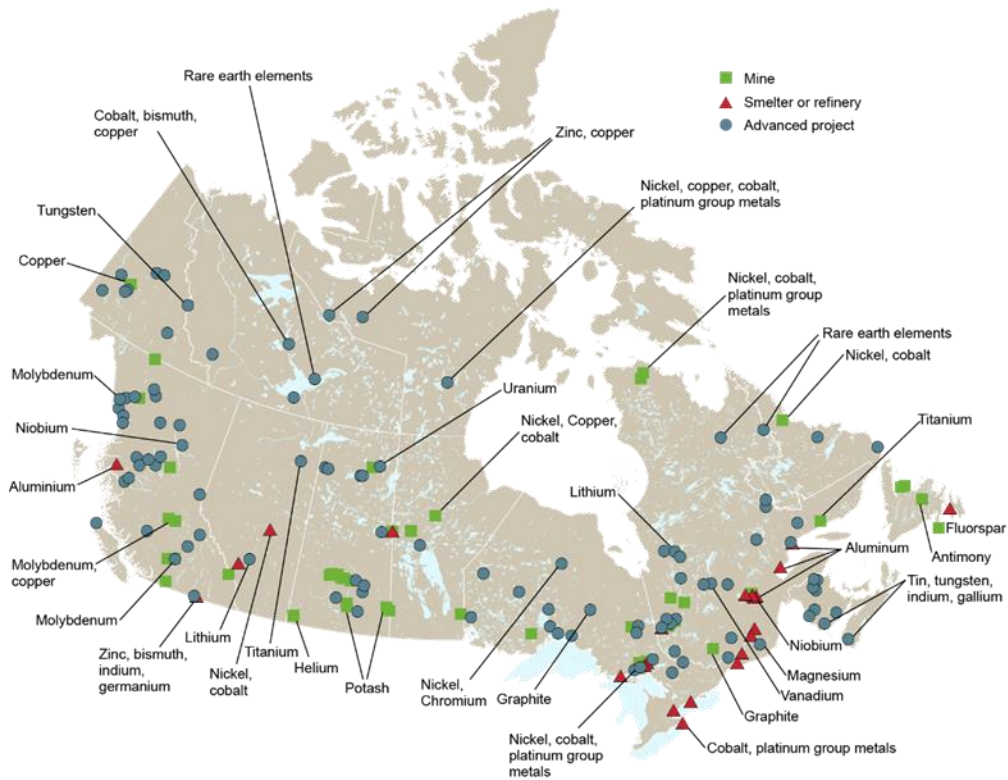
For both Ontario and Quebec, provincial legislation pertaining to mining operations, taxation, and environmental assessment, as well as strategic critical mineral plans, were reviewed and compared. Specifically, the *Ontario Mining Act* (1990), *Ontario Mining Tax Act* (1990), *Environmental Assessment Act* (1990), and *Critical Minerals Strategy* (Government of Ontario, 2022) were examined for Ontario. Similarly, for Quebec, the *Quebec Mining Act* (2024), *Quebec Mining Tax Act* (2011), *Environmental Quality Act* (2024), and the *Quebec Plan for the Development of Critical and Strategic Minerals* (Government of Quebec, 2020) were reviewed.

Regulations and policies were then compared and contrasted to determine where legislation and policy overlapped and differed between the chosen jurisdictions. This comparative analysis provided insights into the regulatory frameworks governing mineral development and related environmental protection in Ontario and Quebec.

### **3.0 Results and Discussion**

#### *3.1 Overview of Critical Mineral Activity Across Canadian Jurisdictions*

Canada is a nation privileged with a large endowment of critical-mineral-rich regions from coast to coast (to coast), with critical mineral activity present in all provinces and territories with the exception of Prince Edward Island (Figure 3; Figure 4; Atlas of Canada, 2023a; NRCan, 2022a). As of 2023, there are 47 active mines, 26 active processing facilities (including refineries, smelters, and electric arc furnaces), and 151 ongoing projects dedicated to critical minerals across Canada (Atlas of Canada, 2023a).



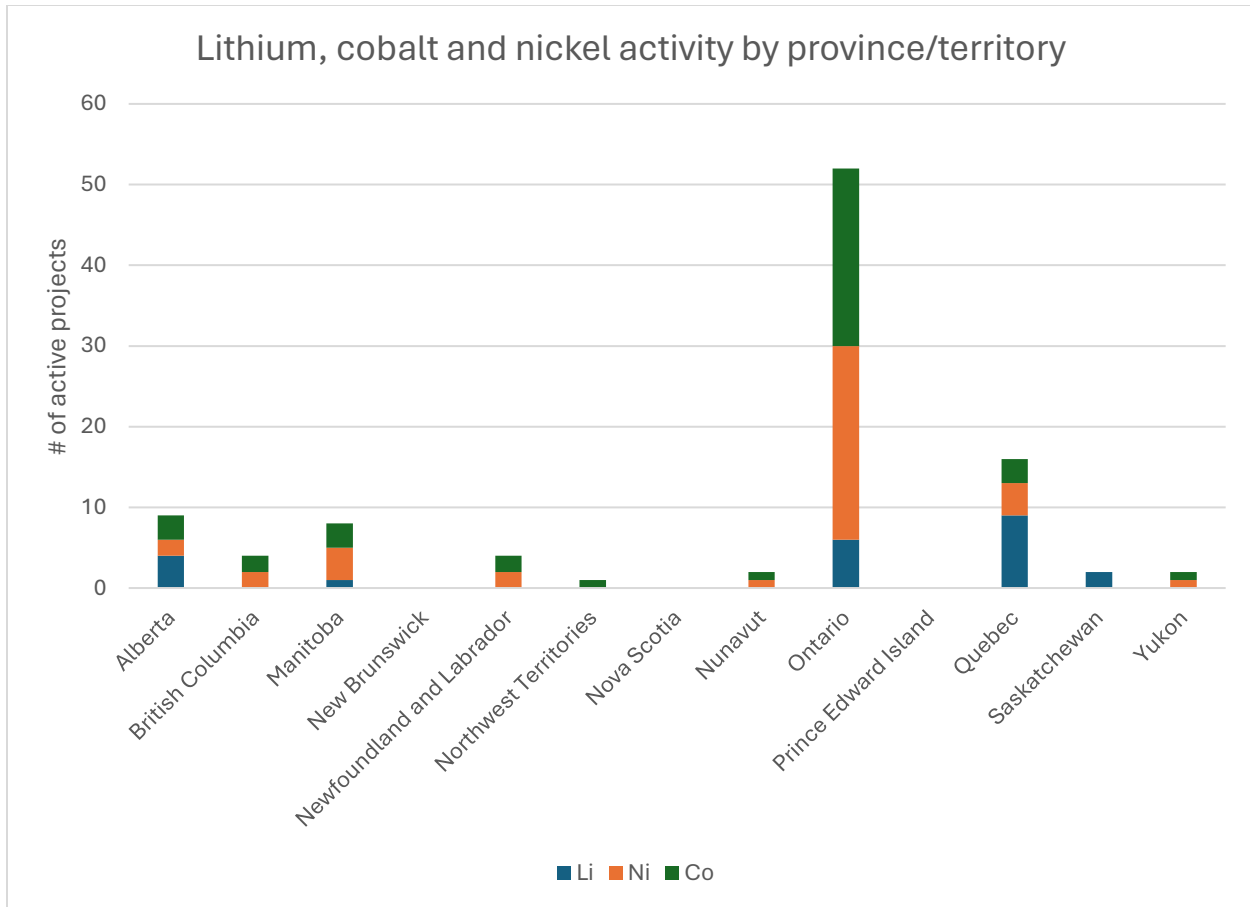
**Figure 3:** Critical mineral opportunities across Canada (NRCan, 2022a).

Despite the widespread availability of critical mineral resources across nearly all regions of Canada, present-day activity, particularly pertaining to major EV battery-related components such as Li, Ni and Co, varies significantly from jurisdiction to jurisdiction (Figure 4; Atlas of Canada, 2023a).

The lion's share of present-day critical mineral activity in Canada, perhaps unsurprisingly, is concentrated within its three most populous provinces: Ontario, Quebec and British Columbia. These three provinces are currently home to over 71% of Canadian critical mineral activity, boasting shares of approximately 35%, 24% and 13%, respectively (Atlas of Canada, 2023a).

When specifically examining minerals, such as Li, Ni and Co, related to EV battery manufacturing, the discrepancy between Canadian jurisdictions becomes even more striking. Ontario, for instance, is home to 27% of all Li-related activity, 60% of Ni-related activity, and 58% of Co-related activity within Canada (Atlas of Canada, 2023a). Quebec is second to Ontario in all areas except for Li, representing 41% of Li-related activity, 10% of Ni-related activity, and 8% of Co-related activity across Canada (Atlas of Canada, 2023a). Combined, Ontario and Quebec contribute to 68% of all Canadian activity related to Li, Ni, and Co, with Ontario alone representing a staggering 52% of the Canadian total (Figure 4; Atlas of Canada, 2023a).

As present-day critical mineral powerhouses among Canadian provinces and territories, housing over two-thirds of contemporary mining, processing, and active projects related to Li, Ni, and Co, it appears highly probable that critical mineral production in Canada will remain dominated by Ontario and Quebec for the foreseeable future. These provinces enjoy a significant advantage as established critical mineral production continues to forge relevant supply chains, supportive industries, and related infrastructure, all of which will catalyze the ongoing expansion of critical mineral sectors within their boundaries. Moreover, both provinces possess vast untapped critical mineral potential and are actively promoting and incentivizing exploration, extraction, and production of these minerals in their remote regions (Government of Ontario, 2022; Government of Quebec, 2020). This concerted effort suggests that Ontario and Quebec will likely maintain their leading positions in critical mineral production in the years ahead and will continue to be important contributors to the upstream Canadian EV battery supply chain.



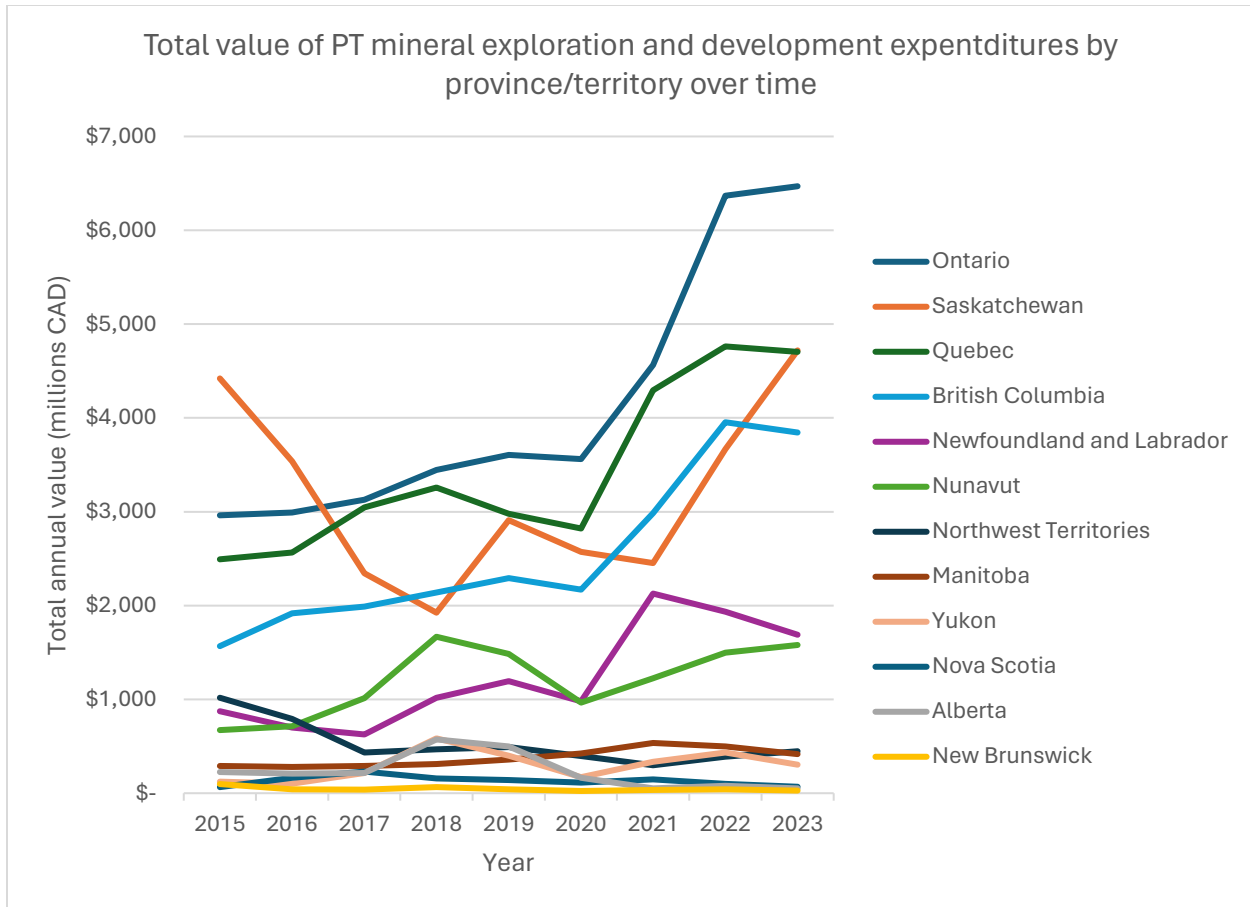
**Figure 4:** Active operations related to the exploration, mining and/or processing of lithium, nickel and cobalt across Canada as of 2023 (Atlas of Canada, 2023).

### 3.2 Analysis of Mining Exploration and Development Spending Across Canadian Jurisdictions

When examining trends in annual exploration and development expenditures across Canada, similar trends of concentrated dominance emerge. Since 2017, Ontario exploration and development spending has outpaced that of all other Canadian jurisdictions (Figure 5; NRCan, 2024). Meanwhile, Quebec rates of exploration and development have closely trailed those made in Ontario over the same period, ranking second among Canadian jurisdictions until it was narrowly surpassed by Saskatchewan in 2023, following a notable surge in spending within Saskatchewan in recent years. Notably, while other Canadian jurisdictions have experienced

either significant volatility or relative spending stagnation over the years, both Ontario and Quebec have experienced sustained growth in exploration and development expenditures. Between 2015 and 2023, both provinces saw impressive overall spending growth in exploration and development of approximately 118% in Ontario and 89% in Quebec (Figure 5; NRCan, 2024). Moreover, the pace of growth in exploration and development expenditures within these provinces appears to be accelerating, as over 80% of the growth experienced since 2015 has occurred since 2020 (NRCan, 2024).

While this data does not specifically depict exploration and development related to Li, Ni and Co or critical minerals in general, it does offer valuable context for understanding the relative size and vitality of mineral exploration economies within Canada. Moreover, it suggests that both Ontario and Quebec possess active and expanding mineral exploration sectors within their borders, sectors which are essential for facilitating the expansion of critical mineral extraction and production within Canada.



**Figure 5:** Comparison of total annual exploration and development expenditures by Canadian provinces and territories between 2015 and 2023. Data illustrated here encompasses expenditures associated with exploration, deposit appraisal, and mine complex development processes (NRCan, 2024).

### 3.3 Jurisdictional Comparison of Mining Regulations and Policy

This section of the research will delve into the regulatory and policy regimes of Ontario and Quebec, the two chosen jurisdictions for this research. This section will begin with a comparison of general tax regimes surrounding mineral operations, and will proceed to compare programs and policies aimed at encouraging exploration and discovery of new critical mineral deposits, environmental policy, and mine reclamation requirements.

### 3.3.1 Mining Tax Regime

Both Ontario and Quebec implement taxation schemes that levy taxes on the profits generated by mining operations within their jurisdictions while offering annual deductions or allowances to mitigate reported profits. A summary of taxation frameworks employed by both jurisdictions can be found in Table 2.

**Table 2:** Summary of general mining taxation structures in Ontario and Quebec (Ontario Mining Tax Act, 1990; Quebec Mining Tax Act, 2011).

Policy Type	Jurisdiction	
	<i>Ontario</i>	<i>Quebec</i>
General tax regime	10% levy on annual profits exceeding \$500,000 (reduced to 5% for remote mines) <sup>2</sup>	Operators pay the higher of: - 1-4% of the mine's output value <sup>3</sup> - 16-28% on annual profits, depending on profit margin
Processing allowance	8-20% of costs related to mineral processing, depending on location within Canada	10-20% of costs related to mineral processing, depending on location within Quebec <sup>4</sup>
Exploration allowance	100% of annual exploration expenses	100% of annual exploration expenditures, including exploration-related environmental studies and community consultation expenses (increased to 125% for mines in northern Quebec)
Development allowance	100% of development expenses	100% of pre-production development expenses
Depreciation allowance	Calculated at a rate of 15-30% per year for mining and transportation-related assets	Calculated at a rate of 30%/year for mining assets purchased after March 31, 2010
Consultation allowance		50% of community consultation expenses, unrelated to those incurred during exploration

<sup>2</sup> New mines are exempt from paying tax (up to a maximum of \$10 million) for the first 3 years of production (extended to 10 years for remote mines).

<sup>3</sup> Operators pay 1% on the first \$80 million of mine output, and 4% thereafter.

<sup>4</sup> Allowance is capped at either 75% of gross annual mine earnings or 30% of the mine output value for a given year, whichever is higher.

Environmental studies allowance		50% of expenses related to conducting environmental studies, unrelated to those incurred during exploration
Critical mineral development allowance		100% of costs associated with sampling and testing ore bodies for the presence of select critical minerals (up to a maximum of \$31.25 million)

In Ontario, the mining taxation rate ranks among the lowest in Canada, requiring operators to pay a mere 10% tax on annual profits exceeding \$500,000 (Ontario Mining Tax Act, 1990). This rate is lowered further to just 5% on annual profits for mines designated as remote by the Ministry of Northern Development and Mines (MNDM; Ontario Mining Tax Act, 1990). Mining companies can further reduce their payable tax by deducting 8-20% of costs associated with processing mined resources, depending on the type and location of the refining facility within Canada, as well as 100% of expenditures related to exploration and development activities (Ontario Mining Tax Act, 1990). Additionally, Ontario grants an exemption period for new mines, exempting new mines from paying tax for the first three years of production up to a maximum of \$10 million. This grace period extends to a remarkable 10 years for mines deemed ‘remote’ by the MNDM. Additional annual reductions in profits are permitted for asset depreciation, including those related to the transportation of mined goods (Ontario Mining Tax Act, 1990).

In contrast, Quebec employs a taxation regime that appears more nuanced and progressive. Operators in Quebec are required to pay the higher of either: (1) 1-4% of the mine’s total value of mineral output, or (2) 16-28% of the mine’s annual profits, reflecting a progressive taxation rate that escalates with the size of the mine’s profit margin (Quebec Mining Tax Act, 2011). Similar to Ontario, Quebec allows for the annual deduction of 100% of costs incurred by

mine operators for exploration and development of new mining entities, with the allowance increasing to 125% for mines located in Northern Quebec. Deductions related to exploration and development also include expenses related to environmental studies and community consultation, both of which are seemingly absent from the exploration and development section of the Ontario framework. Quebec also offers comparable rates of depreciation for mining-related assets, though some transportation-related assets, such as mineral transportation vehicles, are excluded from the Quebec framework. Notably, the Quebec taxation framework includes additional allowances which are absent from Ontario's tax framework, such as the ability for companies to deduct 50% of annual costs associated with community consultation and environmental study efforts (excluding costs incurred during exploration), as well as the option to deduct 100% of costs linked to sampling and testing ore bodies for the presence of critical minerals (Ontario Mining Tax Act, 1990).

Taxation frameworks in both provinces have positive and negative implications for promoting sustainable development of critical minerals within their regions. Ontario's approach for example appears to be very business-friendly, offering low taxation rates on industry profits and generous tax holidays for new mines which can extend up to a decade after a new mine is opened. This type of landscape is highly attractive for mining companies seeking to invest in Canadian regions, positioning Ontario as a pseudo tax haven for mining companies aiming to minimize tax burdens. Research has shown that changes in government taxation regimes significantly impact the presence of mining firms within jurisdictions, with tax increases negatively affecting both overall mining firm activity and share prices of mining corporations (Russell et al., 2010). Historically in Canada, increases in mining-related taxation have resulted in subsequent declines in industry investment (Russell et al., 2010). Furthermore, literature

emphasizes the need for governments to design tax incentives to attract sustainable investment to facilitate domestic resource mobilization (Mosquera Valderrama, 2021). Therefore, Ontario's business-friendly approach is an effective tool in promoting mineral-related investment within the province, and is likely a large factor as to why Ontario is home to most of Canada's critical mineral activity (Figure 4), as well as why the province continues to outpace other Canadian jurisdictions in overall mineral exploration and mine development spending (Figure 5; Atlas of Canada, 2023a; NRCan, 2024).

Ontario's approach does have some drawbacks, however, particularly with respect to incentivizing environmental studies and meaningful community (including Indigenous) involvement in mining projects. Also, Ontario fails to specifically target critical mineral extraction through its taxation policy. Unlike Quebec, Ontario does not include consultation or environmental assessment as costs that are deductible under its exploration and development allowances, instead only allowing for deductions related to mine complex development, such as mine shaft construction (Government of Ontario, 2023b). Additionally, taxation policy has been shown to be effective in incentivising certain activities or sectors, such as through the administration of preferential tax measures favouring development in specific regions or targeting strategic mineral resources (Mosquera Valderrama, 2021). This lack of financial incentive to conduct consultation and environmental studies is compounded by the fact that Ontario has fairly relaxed rules and regulations surrounding community consultation and environmental assessment during the mineral exploration phase of mining projects, requiring only that mining operators notify surface rights holders if the surface of a claimed area is not owned by the crown and that excavation or drilling holes are filled after exploration is complete (MNDM, 2018; Ontario Mining Tax Act, 1990). With respect to Indigenous consultation,

Ontario merely ‘recommends’ that mining companies consult with local Indigenous communities, while Ontario’s MNDM is required to provide Indigenous communities with copies of the exploration plans submitted to the government by the mining company (Ontario Mining Act, 1990). The absence of financial incentives for conducting consultation and environmental studies, coupled with relatively relaxed rules and regulations surrounding community consultation and environmental assessment during the mineral exploration phase of mining projects, raises questions about the extent to which Ontario mining companies engage in such practices, the answers to which rely solely on the internal corporate policies of individual mining organizations.

Quebec’s government also provides a tax allowance for the costs associated with extracting and sampling new mineral deposits in exploration for strategic critical minerals, such as Li, Ni, and Co, a measure which is not present in the Ontario regime. This approach prioritizes, through simple tax policy, the exploration for minerals required for the broader energy transition, rather than supporting the continued search for precious metal deposits within Canada which dominate the market today. Providing tax incentives to encourage the targeting of specific resources has been shown to be an effective tool in promoting increased activity in strategic areas (Mosquera Valderrama, 2021), and can serve as an important catalyst for future Quebec critical mineral development, particularly in a sector where many legacy minerals remain financially more enticing (Kerr, 2023). Ontario’s policy regime, alternatively, promotes the exploration and development of critical minerals through grants issued through *Critical Mineral Innovation Fund* (which will be discussed in the next section). However, the literature suggests that issuing tax credits or incentives is typically preferred, particularly pertaining to research and development, over general government grants due its flexibility and the wider array

of options it presents to the private sector (McDowall, 2021). Tax credits also allow governments to financially support specific activities without needing to select specific projects or run competitions to allocate funds (McDowall, 2021).

To best ensure the sustainable development of critical mineral mining operations over the multiple decades that many mines are in production there must be mechanisms to encourage the ongoing assessment of environmental impacts associated with mining as well as ongoing consultation with adjacent communities (Atlin & Gibson, 2017). Quebec's tax regime allows for this, allowing companies to, on an annual basis, discount costs associated with environmental studies and consultation (Quebec Mining Tax Act, 2011). Though such practices are not necessarily mandated by the Quebec government (besides in initial environmental assessment requirements which will be discussed later), they are incentivized, as mining companies can engage in such practices as companies in order to reduce the overall tax burden imposed on them by the provincial government.

### 3.3.2 Exploration Assistance

Supporting exploration and discovery of new critical mineral deposits within Canada is crucial for governments to ensure that mining companies can meet the mineral demand associated with widespread EV and EV battery adoption in society (Maloney, 2021). A 2021 report from Canada's *Standing Committee on Natural Resources* identified difficulty in discovering and accessing critical mineral deposits as a key challenge facing the Canadian mining industry (Maloney, 2021). Government-led exploration assistance typically involves providing financial support through grants and tax incentives, as well as through assisting with geoscientific research and mapping activities (Maloney, 2021). To aid in exploration, the *Canadian Standing Committee on Natural Resources* has called for an expansion of the scope of

financial and taxation measures offered to spur investment and help to account for the financial risks associated with discovering and developing new mineral reserves (Maloney, 2021).

In Ontario and Quebec, the mineral exploration assistance policy landscape includes tools to facilitate easy access to mineral reserve and geoscience information, support for research and development in mineral extraction, and various financial mechanisms to increase economic feasibility and reduce associated risks of critical mineral exploration. Table 3 summarizes policies supporting critical mineral exploration in Ontario and Quebec.

**Table 3:** Government-led exploration assistance measures in Ontario and Quebec (Government of Ontario, 2022; Government of Quebec, 2020).

Policy Type	Jurisdiction	
	<i>Ontario</i>	<i>Quebec</i>
Access to geoscience information	The Ontario Geologic Survey (OGS) provides free public geoscience data, maps, reports through online digital platforms	The système d'information géominière du Québec (SIGÉOM – Geomining Information System) provides free public geoscience and mineral reserve data through an online digital platform
Research and development	Ontario's Critical Minerals Innovation Fund (CMIF) allocates funds to support research and development projects related to critical mineral exploration	Quebec's consortium en exploration minérale (CONSOREM) carries out research projects which focus on the development of exploration tools to benefit the industry
Financial assistance	The Ontario Junior Exploration Program (OJEP) covers costs for mineral exploration and development projects	SOQUEM invests in companies pursuing mineral exploration, discovery and deposit appraisal in Quebec
	Ontario's Focused Flow-Through Share (OFFTS) tax credit helps to generate capital to support mineral exploration and development	SIDEX Ltd. Partnership – co-established by the Government of Quebec – provides financial investments to support mineral exploration companies in the province
	Ontario's Critical Mineral Innovation Fund allocates funds to support critical mineral exploration and extraction	Mineral Exploration Support Program for Critical and Strategic Minerals offers funding for projects aimed at assessing

		new critical mineral deposits within Quebec
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Both Ontario and Quebec prioritize facilitating access to comprehensive geoscience information through government-managed digital databases housing mineral and reserve data within their respective regions. Investing in public geoscience research has been found to be a significant economic driver for mineral exploration activities, with the benefits of public geoscience investment largely outweighing the original government expenditure (Gadd et al., 2023). Public geoscience programs are able to support industry by providing data in frontier exploration settings, which are either too high risk or otherwise costly for individual private actors to approach alone (Gadd et al., 2023).

In Ontario, the *Ontario Geological Survey* (OGS) provides high-quality geoscience information in the form of maps, reports and data through an intuitive digital platform. Additionally, the OGS offers assistance to mineral exploration projects through its chemical and physical analysis facilities and in-house expertise, resources which can be accessed by industry upon request (Geology Ontario, n.d.; Government of Ontario, 2022, 2024).

Similarly, the Quebec government facilitates access to public geoscience and mineral reserve data through the *système d'information géominière du Québec* (SIGÉOM), offering geoscience data and cartographic information via an online mapping interface (Government of Quebec, 2020; MNRF, n.d.). Both databases are incredibly robust, easily accessed over the internet, and host a wealth of useful geoscientific information such as bedrock geology surveys, maps of existing and abandoned mines, and electromagnetic assessments of unexplored territories, among other information (Geology Ontario, n.d.; MNRF, n.d.).

In terms of research and development in the critical mineral exploration space, the two provinces take different approaches. Ontario seeks to encourage innovation in mineral exploration by offering grant payments to companies and academic institutions conducting research related to mineral exploration-related technologies and novel approaches. In relation to critical minerals, Ontario offers grants and incentives through funds such as the *Critical Minerals Innovation Fund* (CMIF). The CMIF offers up to \$500,000 per project for projects that support research, development and commercialization of innovative technologies, techniques and processes related to critical mineral exploration, among other initiatives (Government of Ontario, 2022, 2023a). Quebec's research and development efforts, on the other hand, are spearheaded by specific research organizations such as the *consortium en exploration minérale* (CONSOREM), a think tank based out of the *Université du Québec à Chicoutimi*. CONSOREM focuses on developing exploration tools and methodologies to benefit the mining industry (Government of Quebec, 2020). It is widely accepted that government support for research and development is necessary in the mineral sector due to market failures associated with knowledge spill-overs which reduces the incentive for individual firms to conduct independent research and development (McDowall, 2021). Governments are able to successfully support research and development through grants, tax incentives, and public research firms, provided that the chosen support mechanism receives adequate funding (McDowall, 2021).

Within Canada, a substantial portion of mineral exploration is carried out by "junior" mining firms, a distinct category within the industry (Corbeil, 2020). Unlike their "senior" counterparts, junior companies do not operate mines, and therefore do not directly generate revenue from any mineral production. Instead, their primary goal is to profit by selling confirmed deposits to 'senior' companies, which can then develop the discovered assets. As one might

imagine, engaging in mineral exploration in this manner carries significant financial risk, as junior mining firms can be left on the hook for large unrecoverable costs should a reserve turn out to be unviable. In this context, financial incentives from governments can therefore prove to be instrumental in encouraging continued mineral exploration activity within a given jurisdiction; such incentives will be needed to support the EV battery industry of the future.

Ontario and Quebec offer financial support for critical mineral exploration work in different ways. Ontario offers direct financial payment to companies and relevant investors through the issuance of grants and tax credits. Ontario's CMIF, for instance, allocates funding for exploration projects that target critical minerals (Government of Ontario, 2023a). Ontario also has a dedicated program, the *Ontario Junior Exploration Program* (OJEP), that covers up to \$200,000 in eligible costs for mineral exploration and development projects within Ontario (Government of Ontario, 2022). Ontario's Focused Flow-Through Share (OFFTS) tax credit further incentivizes mineral exploration by allowing individual shareholders of mining companies to write off 5% of eligible Ontario exploration expenses. Through the OFFTS framework, these exploration expenses "flow-through" to the investor rather than resting with the company conducting the exploration (Government of Ontario, 2022; NRCan, 2023). Coupled with federal tax incentives, the Ontario government states that the OFFTS tax credit can reduce the after-tax cost of a \$1000 investment by as much as \$625 (Government of Ontario, 2022). This program has proven to be successful during its tenure; since 2011, a reported 60% of all new mines used OFFTS (Government of Ontario, 2022), though it is unclear how much of that is attributable to the provincial versus the federal governments flow-through tax credit regimes.

Quebec, conversely, offers financial support for mineral exploration endeavours primarily through investment in the projects themselves. the *société québécoise d'exploration*

*minière* (SOQUEM), a subsidiary of *Investissement Québec*, receives an annual budget from the government to develop projects and joint-ventures with junior exploration companies (Government of Quebec, 2020). Similarly, Quebec's SIDEX Limited Partnership was founded by the government with the mandate of investing in mineral exploration companies within Quebec (Government of Quebec, 2020; SIDEX, n.d.). Since its founding in 2001, SIDEX has funded hundreds of mining exploration projects in Quebec, including projects which specifically target Li, Ni and Co (SIDEX, n.d.). Targeting critical minerals in particular, Quebec operates the Mineral Exploration Support Program for Critical and Strategic Minerals, which covers 50% of eligible expenses up to \$400,000 for projects aimed at assessing new critical mineral deposits within Quebec (Government of Quebec, 2020).

When comparing the exploration assistance policies of Ontario and Quebec, several similarities and differences emerge. Both jurisdictions prioritize access to geoscience information through digital platforms, recognizing the importance of data accessibility in informing exploration activities. Additionally, both Ontario and Quebec demonstrate a commitment to supporting research and development in critical mineral exploration, albeit through different initiatives. However, there are differences in the specific financial assistance programs offered in each jurisdiction, with Ontario's programs like OJEP and OFFTS focusing on providing direct financial support to exploration activities, while Quebec's programs like SOQUEM and SIDEX offer financial investments as a means of fiscal support.

Ontario's emphasis on direct financial support through programs like OJEP and OFFTS aligns with its goal of incentivizing exploration investment and activity. These programs provide tangible benefits to exploration companies, particularly junior and grassroots ventures, by mitigating financial risks associated with exploration endeavours. However such programs incur

significant direct cost to the provincial government/taxpayers and do not directly target exploration of critical minerals. The Ontario CMIF does provide funding for critical-mineral-related research, development and exploration; however, the fund targets a broad array of critical mineral projects and initiatives and has finite funding, barring continual re-investment into the fund by the provincial government.

In contrast, Quebec's exploration assistance policies showcase a strong emphasis on strategic investment. Financial resources, such as those provided by SOQUEM and SIDEX, reflect the province's strategic approach to supporting exploration companies through targeted investments, which can allow the province to make direct returns on partnered mineral exploration ventures and use these returns to help fuel further investment in the exploration space. Though both of these organizations target mineral exploration of all types, as government-led investment agencies, these funding bodies can potentially be leveraged in the future to incentivize the exploration for critical and strategic minerals within the province.

In light of these differing approaches, it becomes evident that Ontario and Quebec are both actively engaged in fostering mineral exploration, yet their strategies diverge in terms of direct financial support versus strategic investment. These distinctions underscore the multifaceted nature of mineral exploration incentives and highlight potential pathways for advancing the sustainable development of critical minerals in Canada.

### 3.3.3 Environmental Policy

Among the various fields related to mining examined for this research, environmental policy stands out as one where Ontario and Quebec exhibit the most significant differences. While both provinces emphasize the importance of strong environmental and social governance

frameworks in their pursuit of critical mineral development advancement and expansion (Government of Ontario, 2022; Government of Quebec, 2020), their policies convey contrasting approaches. Table 4 in this report provides a summary of the environmental policies examined in this context.

**Table 4:** Summary of environmental policy measures related to mining in Ontario and Quebec (Environmental Assessment Act, 1990; Environmental Quality Act, 2024; Ontario Mining Act, 1990; Government of Ontario, 2022; Government of Quebec, 2020; MNDM, 2012).

Policy Type	Jurisdiction	
	<i>Ontario</i>	<i>Quebec</i>
Environmental Assessment Requirements	<p>Mining projects are largely exempt from assessment under the <i>Environmental Assessment Act</i></p> <p>MNDM conducts environmental assessments on discretionary decisions related to surface rights, mining rights, asset allocation, and ministry-led rehabilitation efforts</p>	<p>All mining developments and activity, excluding low-impact exploration, are subject to Quebec’s environmental assessment and approval process under the <i>Environmental Quality Act</i></p>
Research and development		<p>The Quebec government funds a joint research program related to sustainable development in the mining sector</p>
Environmental and Social Governance (ESG) certification		<p>The Quebec government offers and facilitates access to the ÉCOLOGO® certification for mineral exploration</p>
		<p>Quebec Mining Association members are required to comply with the Towards Sustainable Mining Initiative’s self-reporting measures</p>

In Ontario, mining projects are not automatically required to undergo any environmental assessment. Under the Ontario government's provincial framework, private sector projects, such as those undertaken by the mining industry, are exempt from undergoing a formal environmental assessment process under sections 3(b), 3(c) and 3.0.1 of the *Environmental Assessment Act* (1990). However, construction of ancillary facilities, such as mining roads, transmission lines, or diesel generators, may trigger environmental assessment requirements under the *Environmental Assessment Act*. The issuance of mining claims, leases, and mine construction are subject to regulations under the Ontario Mining Act, which is overseen by the MNDM. Historically, many large mining operations within Ontario have voluntarily submitted to the Ontario Environmental Assessment process, however this voluntary screening was largely linked to similar requirements being mandated by the federal government's *Impact Assessment Act* (MineHutte, 2021), federal requirements which have since been lifted for all non-federally funded projects since a recent Supreme Court of Canada ruling in October of 2023, which deemed the *Impact Assessment Act* to be unconstitutional (SCC, 2023).

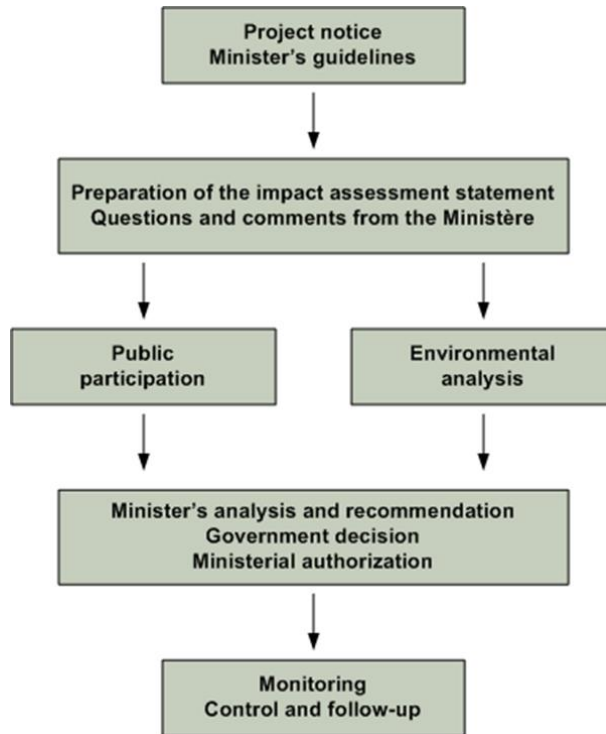
Since 2012, the MNDM has required class-based environmental assessment for some of its discretionary decision-making, such as decisions related to surface rights, mining rights, and the disposal of related assets (i.e., ore bodies), as well as ministry-led rehabilitative action (MNDM, 2012; Ontario Mining Act, 1990). It is important to note, however, that neither the acquisition of a mining claim nor a mining lease triggers environmental assessment under the Mining Act, as these are not left to the discretion of the MNDM (Ontario Mining Act, 1990). Generally speaking, in Ontario, unless otherwise specified under the Mining Act, mining rights are open for registration on all crown land (Ontario Mining Act, 1990). With the exception of established national and provincial parks, Indigenous reserves, and some lands in southern

Ontario, companies are able to stake a digital claim for virtually any parcel of land in the province provided they pay the required fee (Ontario Mining Act, 1990). The issuance of a claim is non-discretionary and requires no review by the provincial government; instead, it utilizes a self-service online model for claim issuance. Upon registration of a mining claim, provided it remains in good standing, the claim holder is granted exclusive rights to mineral exploration on the designated lands (Ontario Mining Act, 1990). If mineral resources are discovered within a claimed area, the mining operator can then convert a claim into a mining lease, which is a 21-year agreement granting exclusive rights to extract and dispose of minerals within the leased area without additional government review (Ontario Mining Act, 1990).

For mineral exploration activities, proponents are required to follow provincial standards which supposedly minimize the impacts to public health, safety and the environment (MNDM, 2018). However, these standards fail to contain any provisions related to important environmental considerations such as species at risk, natural habitat protection, re-vegetation, or local air quality (MNDM, 2018). The Provincial Standards for Early Exploration merely encourage mining operators to adopt industry best practices, such as those outlined in the Excellence in Environmental Stewardship for Responsible Exploration (E3) guideline published by the Prospectors & Developers Association of Canada (MNDM, 2018). However, compliance with these practices is not obligatory under provincial law.

In Quebec, on the other hand, the *Environmental Quality Act* dictates that all mining developments, including additions, alterations or modifications to existing mining developments, are subject to the provincial government's environmental assessment and review procedure (Environmental Quality Act, 2024). In Quebec, this process varies regionally. For projects situated in southern Quebec, potential operators are required to prepare and submit an

environment impact assessment statement. These statements typically include information related to project justification, alternative options for completion, considerations of biophysical and human environments, anticipated impacts, proposed mitigation measures, as well as emergency response and monitoring plans (Government of Quebec, 2024a). Specialists from the Ministry of the Environment, the Fight against Climate Change, Wildlife, and Parks (MEFACCWP), review the statement to ensure it adequately identifies and addresses potential environmental concerns. Next, the information presented in the proponent's impact assessment statement is made public for a 45-day period, during which the public has the opportunity to provide comments and request hearings. During this time, the MEFACCWP conducts an independent analysis of the project's environmental acceptability and justification for proceeding. Finally, if the project is approved, the mining operator is required to monitor its own compliance with imposed mitigation measures as well as conduct a follow-up plan to measure and analyse the effectiveness of these measures (Government of Quebec, 2024a). A flow chart outlining the entire process can be seen in figure 6.



**Figure 6:** The environmental impact assessment and review process in Southern Québec (Government of Quebec, 2024a).

In Northern Quebec, a similar process environmental assessment process is followed. In the Northern Quebec impact assessment procedure impact assessment statements are reviewed by either the Environmental and Social Impact Assessment Committee (COMÉV), or the Kativik Environmental Quality Commission (KEQC) if the located north of the 55<sup>th</sup> parallel (Government of Quebec, 2024b). Other differences include the consultation process allowing for increased involvement with local Indigenous communities, and an omission of internal independent analysis of a given project (Government of Quebec, 2024b), likely due to capacity concerns.

In addition to requiring environmental assessments for mining projects, Quebec also has policies designed to ensure environmental protections and sustainable development. First of all,

the Quebec government funds a Joint Research Program to support Sustainable Development of the Mining Sector through the *fonds de recherche du Québec*'s nature and technology division (FRQNT), which conducts government funded research pertaining to clean innovation and climate change (FRQNT, 2024; Government of Quebec, 2020). Additionally, Quebec offers and facilitates an ÉCOLOGO® certification for mineral exploration, allowing companies and service providers to verify their responsible practices and environmental impact reduction efforts (Government of Quebec, 2020). Moreover, since 2014 the Quebec Mining Association has mandated that member organizations comply with the Towards Sustainable Mining Initiative (Government of Quebec, 2020). This initiative requires that mine operators self-report on a total of 30 indicators pertaining to tailings management, Indigenous and community relations, biodiversity management, energy use and GHG emissions management, health and safety, crisis management and water stewardship (Government of Quebec, 2020). Results of the self-reporting questionnaires are then collected from members and submitted to an independent auditor every three years.

The literature surrounding sustainable mining policy emphasizes the importance of clear government regulation to mitigate and monitor the environmental impacts of mining activities (Atlin & Gibson, 2017; Carvalho, 2017; Javed et al., 2024; Marques, 2016). Environmental assessments play a crucial role in the mining policy landscape, allowing for development of mitigation measures and compensation schemes in order to prevent serious mining-related consequences such as biodiversity loss, land use change and environmental pollution (IEA, 2021). Canadian mining companies, in particular, have a history of conducting business in a way that has had detrimental environmental and social impacts, both in Canada and abroad, particularly in regions with weak environmental regulation (Marques, 2016). Though industry

groups, such as the Ontario Mining Association, boast about the environmentally and socially conscious actions of its members (Ontario Mining Association, 2024), skepticism persists due to perceptions of corporate ‘greenwashing’ (Marques, 2016).

Moreover, though the perception is that the implementation of environmental additional regulation may deter investment, research has found that that isn’t necessarily the case. Söderholm et al. (2015), for example, found that increased environmental regulation has not constituted any major impediment to mineral-related investment; instead, factors such as geological potential and political stability often drive investment decisions (Söderholm et al., 2015). Criticisms of environmental regulation tend to focus more on uncertain approval timelines than on disagreement with the standards themselves (Söderholm et al., 2015). Therefore, governments can and should implement comprehensive environmental legislation for mining activity, so long as the approval process is timely, transparent, and consistent.

Atlin and Gibson (2017) propose that environmental assessment regimes should be designed to address the cumulative negative effects of mining operations at both regional and project-specific levels. They advocate for multidimensional assessments covering the full suite of cumulative effects over multiple spatial and temporal scales, ensuring long-term sustainability. Their recommendations emphasize the importance of credibility, authority, and accountability in environmental assessment processes. Assessments should be credible, establishing explicit and open processes for evaluating project proposals and their alternatives. They should also be authoritative, ensuring compliance from all stakeholders involved. Moreover, assessments must be accountable, aligning mitigation and monitoring responsibilities clearly between government and industry (Atlin & Gibson, 2017).

In conclusion, the examination of environmental policies in Ontario and Quebec reveals stark differences in their approaches to mining development. Ontario's framework, while emphasizing some environmental considerations, notably lacks mandatory environmental assessments for mining projects, relying instead on voluntary adherence to provincial standards. In contrast, Quebec mandates thorough environmental assessments for all mining developments, coupled with stringent monitoring and mitigation measures to ensure environmental protection and sustainable development. Moreover, Quebec's initiatives, such as the Joint Research Program and the ÉCOLOGO® certification, demonstrate a proactive commitment to environmental stewardship within the mining sector. As discussions surrounding sustainable mining policy underscore, effective environmental regulation is crucial to mitigate adverse impacts and foster responsible mining practices. Recommendations from scholars like Atlin and Gibson advocate for comprehensive, multidimensional, and accountable environmental assessment regimes to address cumulative negative effects and ensure long-term sustainability. Ultimately, by implementing robust environmental legislation and transparent approval processes, governments can balance environmental protection with economic development, fostering a mining industry that operates responsibly and ethically.

#### 3.3.4 Reclamation Requirements

Mine reclamation, the process of restoring land disturbed by mining activities to a beneficial state, is a critical aspect of responsible resource extraction (Lima et al., 2016; Steenhof, 2015; Tremblay & Hogan, 2016). Mine closure and reclamation is the final phase of the mining life cycle and involves the cessation of operations, reclamation of the mine site, including the rehabilitation of environmental and social damages, and the relinquishment of the property back to the issuing government (Kabir et al., 2015). Mine reclamation is a critical

component of mine operations, for it minimizes both environmental and social damages associated with the project as well as helps mining companies secure the social licence they need in order to continue to operate (Steenhof, 2015). The unplanned closure of mines can create many environmental problems such as the release of acid drainage into waterways, environmental contamination and impacts to local communities (Kabir et al., 2015). Good mine closure policy should consist of both social and environmental impact alleviation, progressive rehabilitation of social and environmental damage, community involvement, early commencement of the closure process, and government support (Kabir et al., 2015).

Both Ontario and Quebec have established regulatory frameworks to govern mine reclamation and closure which are relatively similar. This section compares and contrasts the mine reclamation requirements in Ontario and Quebec, focusing on key aspects such as regulatory oversight, closure planning, financial assurance, and post-closure responsibilities.

In Ontario, oversight of mine reclamation is managed by the MNDM, as outlined in the *Ontario Mining Act*. Mining proponents are required to submit a closure plan before any mineral exploration work commences as well as continuously rehabilitate sites throughout the mine's operational lifespan, with periodic reviews of closure costs by the provincial government every three years. Closure plans must include information such as an overview of the project, site description and a proposed rehabilitation plan. This plan must then be reviewed and approved by the MNDM (Ontario Mining Act, 1990).

In Quebec, the *Ministère de l'Énergie et des Ressources Naturelles* (MERN) oversees mine reclamation and closure. Similar to Ontario, reclamation/closure plans must be submitted before any work begins and be reviewed and approved by the MERN prior to any development or extraction activity begins. Closure plans must be written in French and include similar

information to that required by Ontario: site description, project overview and planned rehabilitation procedure following mine closure. Mining companies are required to submit revised closure plans every five years and annual assessments of post-closure work to the MERN and relevant authorities (Quebec Mining Act, 2024).

Both Ontario and Quebec require proponents to provide financial assurance to cover the costs of mine reclamation and closure in case of default. In Ontario, various forms of financial assurance are permissible, including cash, letters of credit, bonds, or mining reclamation trusts. The amount and timing of financial assurance must be sufficient to cover rehabilitation work at different stages of the mining project. Financial credit tests are also conducted to ensure the financial stability and creditworthiness of the mining company prior to mining commencement (Ontario Mining Act, 1990). In Quebec, proponents are similarly required to furnish a financial guarantee covering anticipated reclamation expenses for the entire mining site. Acceptable forms of guarantees include cash deposits, bonds, investment certificates, letters of credit, security or guarantee policies, or trusts established in accordance with provincial laws. Payment is divided into three instalments within a two-year period following plan approval, with specific conditions for adjustments based on closure work progress or changes in mining operations (Quebec Mining Act, 2024).

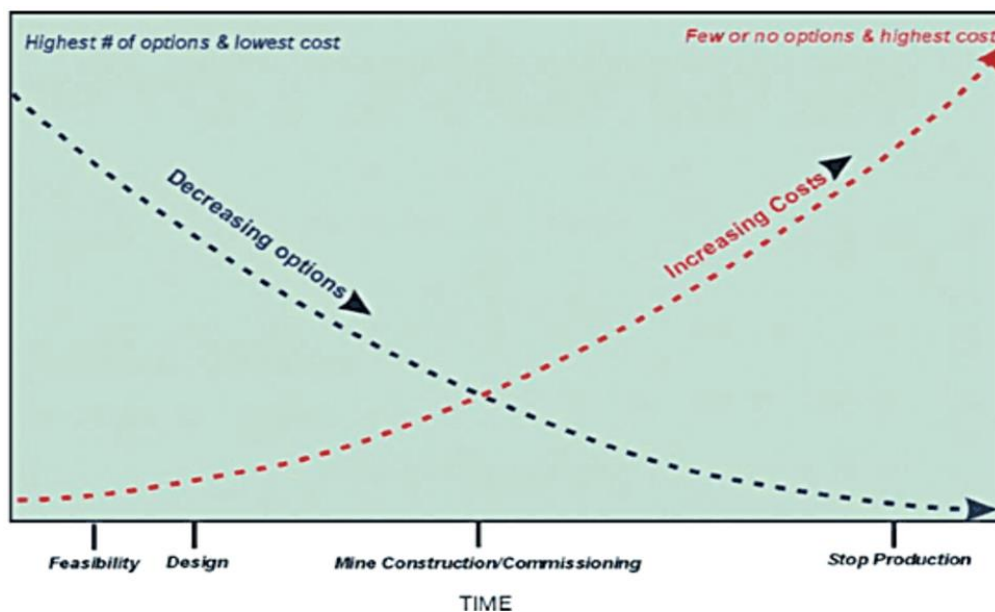
Both provinces impose post-closure responsibilities on mining companies to monitor and assess the effectiveness of reclamation efforts. In Ontario, proponents must submit annual assessments of post-closure work to the ministry, summarizing progress, expenses, research outcomes, and monitoring results. The ministry retains oversight authority to ensure compliance with closure standards and may issue a certificate of release upon satisfaction that the land no longer poses environmental or health risks (Ontario Mining Act, 1990). Quebec similarly

requires mining operations to submit annual assessments of post-closure work to the MERN and relevant authorities annually. These assessments provide updates on work progress, expenses, research outcomes, and monitoring results. The MERN may grant extensions for closure work commencement and issue a certificate of release upon completion, affirming that affected areas meet reclamation requirements under the *Mining Act* (Quebec Mining Act, 2024).

To date, Ontario and Quebec have enacted relatively similar policies around reclamation, mine closures and reclamation protocols. However, this equilibrium may soon shift due to the recent enactment of Ontario's *Building More Mines Act* (Building More Mines Act, 2023). This legislation fundamentally alters established practice by eliminating government-led technical reviews of mine closure plans, entrusting mining companies to internally certify these plans through designated "qualified persons." Moreover, the Act introduces provisions for deferring parts of closure plans, enabling projects to proceed with incomplete plans while allowing proponents to phase financial assurances alongside the construction of mine infrastructure. It also permits alternative rehabilitation measures and post-closure land uses, potentially facilitating the rehabilitation of land to industrial standards rather than natural habitats. Such drastic changes could significantly hinder the Ontario government's ability to ensure the appropriate and sustainable restoration of mine sites, as well as leave the government vulnerable to additional fiscal and environmental costs associated with incomplete and irresponsible mine rehabilitation practices.

Such a shift in reclamation policy does not appear wise for a variety of reasons. Firstly, research indicates that, over time, the cost of implementing preventative and remedial technologies increases, while the amount of options available to the mine operator to restore the mine site to an appropriate 'reclaimed' state decreases (Figure 7; Tremblay & Hogan, 2016).

Therefore, deferring the reclamation process and payment assurances not only limits the effectiveness of restoration efforts but also lacks strong fiscal sense. Secondly, mine closure regulation was originally introduced in the mid 1900s to address the growing problem of mining operations abandoning their sites and leaving the public to deal with remediation efforts (MacKasey, 2000). Ignoring this relatively recent history places the province in a vulnerable situation that existing laws were enacted to prevent. Additionally, unforeseen events such as drops in mineral prices or insurmountable infrastructural problems have caused many mines to close ahead of schedule. In the case of bankruptcy, companies are unable to pay for restoration, shifting the responsibility to the government and taxpayers (Carvalho, 2017; MacKasey, 2000).



**Figure 7:** Mine remediation options and costs over time (Tremblay & Hogan, 2016).

#### 4.0 Conclusion

This study provides an examination of the juridical policy landscape surrounding critical mineral extraction and production in Canada. In particular, this work examines the jurisdictional

overlap of the two Canadian jurisdictions most likely to be major mineral contributors to Canada's future EV battery supply chain: Ontario and Quebec.

A jurisdictional and regulatory review of the two provinces underscores a marked difference in their approaches to mineral policy, particularly in terms of mining taxation, exploration assistance, environmental policy, and reclamation requirements. While Ontario adopts a business-friendly and increasingly small-government approach, characterized by low taxation rates, generous tax incentives and limited government oversight, Quebec prioritizes more stringent environmental assessments and sustainable development initiatives to mitigate the ecological impact of mineral extraction activities. Both approaches will have their place if Canada wishes to increase the amount of critical minerals mined to support initiatives such as EV battery production in a sustainable fashion. However, governments must work to ensure that critical mineral exploration, development and production within Canada are both attractive to investors and environmentally sustainable, not one or the other.

Ontario's environmental protection regime has many areas in which it can be improved and does not entirely align with the objective of achieving sustainable extraction of critical minerals within the province. It appears the Ontario might be falling into what has been described as “the deregulation trap”, where governments make the mistake of using urgency for expansion as a rationale justifying deregulation and reduction of “red tape”, at the expense of providing responsible government oversight and due diligence policy (Kaiser & McCarney, 2024). Under the present Ontario administration, environmental assessment measures have already been gradually loosened under initiatives such as the *More Homes More Choices Act* (2019). A pattern of deregulation is continued under the recent *Building More Mines Act* (2023), which significantly alters requirements for mine reclamation approval and payment/fine

requirements, with the objective of encouraging increased private investment in Ontario's mineral sector. Until recently, large mining operations were still screened and had their potential environmental impacts mitigated through the federal government's *Impact Assessment Act*, however since this act was found to intrude upon provincial jurisdiction, provinces such as Ontario will no longer be able to depend on the federal government to protect against the environmental and social impacts of mining on their behalf (SCC, 2023). If Ontario wishes to be part of sustainable development in Canada's future economy, it is imperative for the province to implement meaningful government regulation to uphold the strong environmental and sustainability values they publicly boast (Government of Ontario, 2022). Literature suggests that Ontario should be able to do so without impeding investment and while still benefitting from the competitive advantage that their low taxation regime currently provides (Söderholm et al., 2015).

Quebec, on the other hand, has a more comprehensive environmental policy landscape related to mineral extraction, which should be seen as an asset when considering location of future critical mineral production to support the EV battery supply chain. Though Ontario currently vastly outperforms Quebec in extraction and production of key minerals associated with EV battery production such as Ni and Co (Atlas of Canada, 2023a), it is possible that changing material requirements of new EV battery technologies could impact the critical mineral landscape within Canada. It is expected, for instance, that the next generation of Li-ion battery technologies, set to enter the market in the next 5-10 years, will contain significantly less Ni content (Ibarra-Gutiérrez et al., 2022). Therefore, the future of the Canadian mineral production may be less dependent on provinces with weaker environmental protection requirements, such as Ontario, and could therefore prioritize extracting minerals jurisdictions that have ample supply,

financial resources, and comparatively strong environmental policy, such as Quebec or British Columbia (Atlas of Canada, 2023a).

Studies by the World Bank (2020) and the International Energy Agency (2022) have found that associated emissions footprints caused by critical mineral extraction are likely to be only a small fraction of footprints stemming from the continued extraction and use of fossil fuels. Regardless, the emissions and environmental impacts associated with production of critical mineral resources are an important environmental consideration, especially if extraction of such minerals is linked to wider climate goals (Kerr, 2023). Facilitating low-carbon extraction of critical minerals is a particular challenge in northern and remote regions of Canada, where access to renewable or low-carbon energy options are limited (Kerr, 2023).

Both Ontario and Quebec possess some of the cleanest, low-carbon electrical grids in the world, generating electricity using 94% and 99% non-emitting sources, respectively (CER, 2024a, 2024b). Both provinces promote these ‘clean statistics’ in their critical mineral strategies as reasons for why their respective jurisdictions are favourable for sustainable critical mineral extraction (Government of Ontario, 2022; Government of Quebec, 2020). In order to realize true sustainable, low carbon mining, however, both provinces will need to invest in considerable transmission infrastructure in order to provide mining operations with access to this low-carbon energy, particularly in remote regions of the provinces, where most mining operations are currently located.

Moving forward, it will also be important to encourage the recycling and sustainable use of critical minerals once they have been extracted, in order to sustainably support demand for net-zero industries such as the EV battery market. Research has found that the utilization of recycled battery cathodes, such as NCA and NCM, save the equivalent of 6.46 kg of CO<sub>2</sub> per kg

of cathode material used, compared to sourcing virgin material (Gonzales-Calienes et al., 2023). Additionally, the economic and environmental costs of utilizing recycled cathode material has been shown to be 48% and 54% lower, respectively, than production from virgin materials (Gonzales-Calienes et al., 2023). Therefore, though increased mining of virgin materials will certainly be needed to meet the material demands of a decarbonizing economy, it is important for policy makers to recognize that other pathways exist to secure critical minerals required for low-carbon technology supply chains, such as EV batteries.

Finally, it is important to acknowledge the notable omission of Indigenous-related policy pertaining to Canadian critical minerals in this research. This important aspect of the mineral policy sphere was omitted due to the capacity limitations of a Major Research Project and the complexity of the issue. As has been highlighted in literature, it will be incredibly important for government and industry to collaborate and work alongside Indigenous communities and stakeholders to help realize decarbonization, sustainability and reconciliation objectives (Agusdinata et al., 2022). Mining developments in Indigenous territories carry with it significant risk in disrupting Indigenous cultures and economies (Allard & Curran, 2023), and therefore the importance of such considerations should not be understated. As Canada moves toward reconciliation with its Indigenous population, and the realization of the federal government's 2021 *United Nations Declaration on the Rights of Indigenous Peoples Act*, Canada will be required to work in consultation and cooperation with Indigenous peoples to realized many of its mineral extraction and production goals. Many Indigenous communities and organizations, have considerable objections to the expansion of mineral extraction and production in and adjacent to their communities. Such objections are expected and warranted, stemming from a history where resource extraction in Canada has supported the advancement of settler colonialism (Kingsbury

& Wilkinson, 2023), and where past mining operations have been linked to issues such as water contamination, destruction of local ecosystems, and many other human health and environmental impacts negatively affecting Indigenous communities (Keeling & Sandlos, 2015; Sandlos & Keeling, 2016). Fostering meaningful dialogue and equitable partnerships between government, industry, and Indigenous stakeholders is imperative to ensure that future mineral extraction endeavours prioritize Indigenous rights, environmental sustainability, and community well-being.

The intricate tapestry of Canada's environmental laws, federalist structure, and ongoing efforts toward Indigenous reconciliation create a challenging landscape for the facilitation of rapid critical mineral expansion. Balancing these factors is paramount for fostering a sustainable and responsible approach to critical mineral extraction and production in Canada's pursuit of a cleaner energy future. Achieving a sustainable and resilient critical mineral supply chain requires a delicate balance between investment attractiveness and environmental responsibility. Policy makers must prioritize stringent environmental regulations while incentivizing mineral exploration sustainable resource management. By focusing on and achieving this balance, Canada can emerge as a global leader in responsible critical mineral extraction, supporting the transition towards a greener, low-carbon economy.

*“A transition that heavily depends on mining new materials without considering materials and energy for what, for whom and at what socio-environmental costs will only reinforce the injustices and unsustainability that have led us to the climate crisis in the first place” (Deniau et al., 2021)*

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## Appendix A – Incorporation of second reader’s comments

Below are the comments I received from my second reader, Dr. Jean-Thomas Bernard, on my original proposal. Information on how each point was addressed is included in red below the comment which it is responding to.

### Minor comments on your proposal

By Jean-Thomas Bernard, March 3, 2024

I presume that you assume that the objective of Canada is to be self sufficient in the production of batteries. You need to make this explicit, or present the relevant assumption in this respect. Canada is an open economy.

- The answer to his first assumption is ‘no’ (I was not assuming that the objective of Canada is to be self sufficient in the production of batteries). For my research the only assumption is that Canada will experience increased demand for critical minerals used in batteries (both domestically and from trading partners) and we are exploring the regulatory mechanisms likely to oversee that push for increased extraction.

P.2, para.2, ln 4: can capture and store co2 emissions and utilize low carbon energy

- The wording in the section was originally: “Net-zero trajectories, such as Canada’s, involve rapid deployment and adoption of technologies which can capture, store and utilize low-carbon energy.”
- Dr. Bernard thought that I was referring to carbon capture and storage technologies due to my wording, however I was discussing the generation and utilization of renewable energy.
- To increase the clarity of this sentence I changed the wording to “Net-zero trajectories, such as Canada’s, involve rapid deployment and adoption of technologies which can generate, store and utilize low-carbon energy.”

P.4, ln 1: Other metals such as copper and nickel

- The section this comment was referring to was removed from the final research project.

P.6, para.2: resource extraction in Canada has supported

- The section this comment was referring to was removed from the final research project.

P.7, last para., ln 2: SPI (definition)

- Smart Prosperity Institute (SPI) projections did not end up being used for this research, however I recognize that I should have defined the acronym before using it in my proposal.

P.8, para.1, ln.2 : one of the references to SPI is redundant

- Again, SPI projections did not end up being used in this research.