

A Roadmap for Canada's Battery Value Chain

Building a national strategy for critical minerals
and green battery metals

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E3 Lithium
Eagle Graphite
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Global Energy Metals Corp
Giga Metals
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Lithium Bank
Lomiko Metals
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Matrix Solutions
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Nano One
Ni-Cat
NRCan
Retriev Technologies
Sherritt International
Teck Resources
The Metals Company

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About us



The Transition Accelerator exists to support Canada's transition to a net-zero future while solving societal challenges. The Transition Accelerator works with innovative groups to create visions of what a socially and economically desirable net zero future will look like and build out transition pathways that will enable Canada to get there. The Accelerator's role is that of an enabler, facilitator, and force multiplier that forms coalitions to take steps down these pathways and get change moving on the ground. transitionaccelerator.ca



The Battery Metals Association of Canada (BMAC) is a national non-profit association of industry participants and champions from across all segments of the battery metals value chain. From mining to specialty chemical refining, manufacturing, end use and recycling, BMAC is focused on coordinating and connecting the segments of this value chain, ensuring Canada captures the economic potential of the sector and is able to attain its electrification targets. Together, our members collaborate to accelerate the development of the battery metals ecosystem in Canada. bmacanada.org



Accelerate, Canada's ZEV supply chain alliance, works across sectors to leverage strengths and experience to ensure Canada becomes a global ZEV leader as the world shifts to net-zero and zero-emission vehicles. Bringing together companies and organizations from across the ZEV landscape – from mining to mobility, R&D to commercialization, and vehicle assembly to infrastructure – with labour unions, ENGOs, researchers and post-secondary institutions, Accelerate is a forum for members to collaborate, strategize and advance priorities that will support the accelerated development of a ZEV supply chain in Canada. acceleratezev.ca



The Energy Futures Lab was created to address a growing sense of polarization in Canada. Since its inception in 2015, the EFL has brought together stakeholders from across the energy system to collaboratively develop solutions for a low-emissions energy future. This approach has highlighted the importance of drawing on diverse perspectives to address complex, system-level challenges. energyfutureslab.com

A Growing Global Opportunity

Demand for electric vehicles is outstripping even the most optimistic projections.¹ Battery pack prices are rapidly declining and exciting new models are hitting showroom floors.² Just weeks after unveiling the F-150 Lightning, Ford announced it was doubling production to meet demand.³ We are witnessing the mainstreaming of electric vehicles in real time.

The transition to electric vehicles (EVs) is already having a disruptive impact. The rapid demand growth in EV and electricity storage is putting enormous pressure on the supply of metals and minerals used for the production of these decarbonizing technologies. In the near-term, global market uptake of EV metals production is likely to absorb Canadian output of nickel, cobalt, lithium, phosphorous, and rare earths faster than new production can be developed.

What must be done today to build a Canadian battery metals industry that will be a significant contributor to Canada's long-term prosperity?

The economic imperative to develop an EV ecosystem in Canada is clear. Cars and automotive parts are Canada's number 2 export, behind oil and gas.⁴ Both the internal combustion vehicle and the oil and gas industry will be disrupted by the energy transition. Canada needs to act fast to replace these exports. Meanwhile, the development of an EV ecosystem represents a once-in-a-generation opportunity to support long-term Canadian prosperity.

In order for Canada to secure a place in the global economy of a net-zero world, it must urgently build its supply chains for the battery and EV industry. Both government and industry are working hard on this and there have been a number of recent positive developments. Vale will supply nickel from its Sudbury operation for cathode production in Sweden, BASF and POSCO will make cathodes in Bécancour, while LG will make battery cells and modules in Windsor.⁵ Ford's doubling of the F-150 Lightning production led Magna to expand its battery housing production in Chatham.⁶ While these projects are exciting, Canada needs a comprehensive strategy to ensure that



these investments produce a viable supply chain and support the broader battery and EV industry.

What must be done today to build a Canadian battery metals industry that will be a significant contributor to Canada's long-term prosperity?

To seize the opportunity at hand, Canada needs collaborative partnerships between governments, firms, indigenous communities and organizations, universities, and civil society organizations. These public-private-indigenous partnerships are needed to accelerate development along each segment of the battery metals supply chain. Ensuring that the strategy, roadmap and action plan include proactive, meaningful collaboration with indigenous groups is of particular importance and these efforts must be undertaken in a manner that recognizes historical inequities and promotes economic success of indigenous groups and communities.

This report is a call to action from the Battery Metals Association of Canada (BMAC), along with its partners the Energy Futures Lab, Accelerate ZEV and The Transition Accelerator for a bold national strategy, roadmap, and action plan.

The report makes four main interventions:

- 1.** Canada needs a bold and clear target for battery metal and EV production.
- 2.** Canada must systematically build homegrown capacity in strategic niches along the supply chain.
- 3.** The midstream segment of chemical production is the key to an integrated supply chain.
- 4.** Canada can use co-produced roadmaps to underwrite catalytic investments that connect the upstream, the midstream, and the downstream.



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To retain its global position and meet its climate goals, Canada must produce 1,300,000 electric vehicles by 2030 as well as the raw materials, processed metals, and batteries for 100 gigawatt hours (GWh) of battery capacity.

A Bold and Clear Target

The bold and clear target in this report rests on two key premises. First, Canada should, as an initial benchmark, build an EV supply chain from mines to vehicles that replicates its current 10% share of North American automotive manufacturing.

Second, Canada should develop this capacity at a pace necessary to meet the government's ZEV sales mandates of 60% of light-duty vehicles by 2030 and 100% by 2035.

There are many geopolitical and technological uncertainties in the battery space. This report begins from three forward-looking assumptions to streamline our analysis and simplify the exercise of navigating these uncertainties:

- » The North American EV industry will be tightly integrated, just as the internal combustion engine (ICE) industry is, and there will be prioritization of local content in battery metals for geopolitical reasons.
- » An effective Canadian strategy must be aligned with the Canada-US critical minerals strategy and privilege domestic North American businesses while preserving Canada's interests in an equitable manner.
- » EV battery technology will continue to progress, but for the next 20 years, markets will be dominated by nickel-rich and lithium-iron-phosphate cathode chemistries. Emerging technologies will not fundamentally alter metal needs in the next two decades.⁷

These premises form the basis for a clear goal and national target:

To retain its global position and meet its climate goals, Canada must produce 1,300,000 electric vehicles by 2030 as well as the raw materials, processed metals, and batteries for 100 gigawatt hours (GWh) of battery capacity.

While this is an ambitious target, it is achievable and comprises a vital foundation for Canada's future economy and prosperity.



Building Canada's Homegrown Capacity and Ecosystem

The battery value chain includes mining of raw materials (upstream), processing of these mined materials into battery active materials (midstream), manufacturing the batteries themselves, the use of these batteries (e.g. EVs) (downstream), and the end-of-life recycling of batteries.

Recent announcements and reports suggest that the government's strategy is to use foreign direct investment (FDI) to build a chain starting with automotive original equipment manufacturers (OEMs), moving "up" to cathode active material production, pulling in existing local metals where possible. This is an essential starting point.

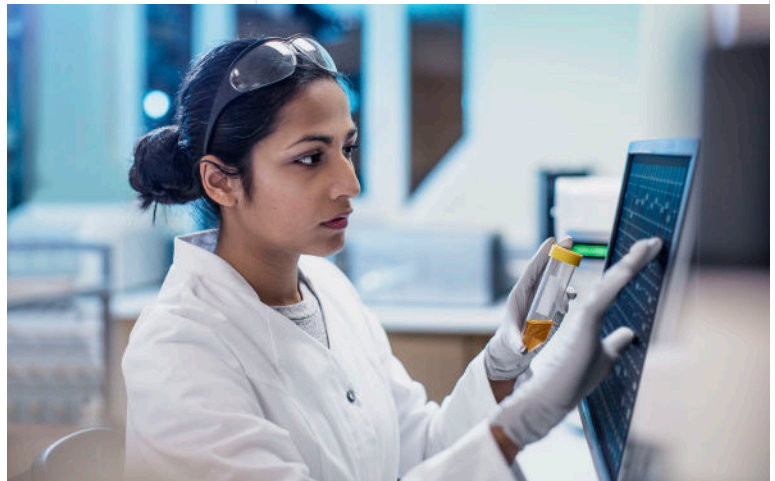
However, it is critical that this FDI and downstream-driven strategy be complemented by efforts to maximize the potential of an integrated Canadian battery supply chain, leverage foreign investments into homegrown capacity, and build a vibrant innovation and industrial ecosystem.

If foreign automotive OEMs dictate the strategy, they may build the supply chain in ways that do not serve the long-term economic and security interests of the country.

Canada must leverage investments in the EV and battery supply chain to build homegrown capacity and establish a strong national ecosystem.

A Strong Midstream is the Linchpin of the Battery Metals Supply Chain

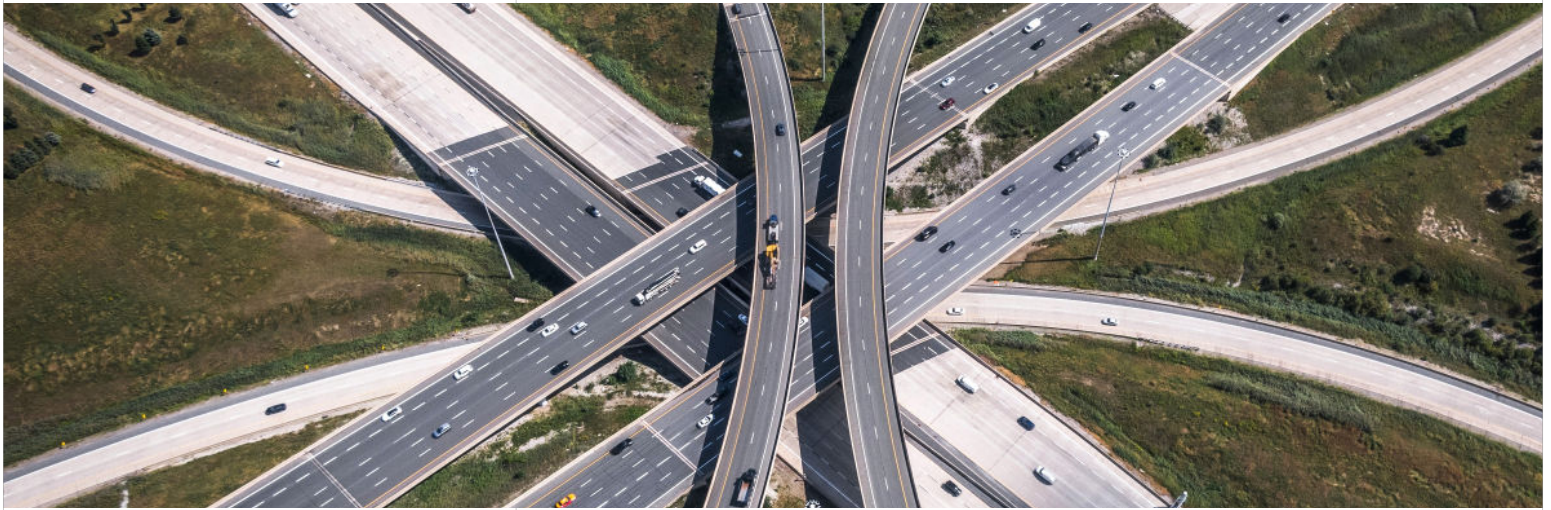
A strategy can originate in the upstream, midstream, or downstream. Conventional wisdom suggests that we need to start downstream, with consumers and automotive OEMs. This report presents an alternative vision. Rather, **it is the midstream, i.e. chemical processing of mined materials into battery active materials, that should serve as the linchpin** in an integrated supply chain that is competitive over the long run. The value of downstream manufacturing and upstream mining is clear and well understood. But, their success depends on the midstream.



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Building the midstream helps the whole supply chain by driving demand-pull for upstream mining and providing the supply-push needed to feed downstream production.

The midstream produces battery active materials, which are high-value added, exportable, and can be aligned with collaborative efforts such as the Canada-US critical minerals strategy to insulate against competitive national targets. The midstream anchors an integrated supply chain that uses Canada's expertise in green chemistry to establish efficient pathways from mines to battery active material.



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An acute issue facing Canada's battery metals industry today is that there is very little midstream production within its borders, and Canada risks falling further behind as other nations jockey to ramp up. This is why Nano One's purchase of Johnson Matthey's lithium-iron-phosphate (LFP) cathode production facility in Québec is so important.⁸ Johnson Matthey's facility is the only cathode production facility in North America, so this project leverages existing expertise in a segment of long-term strategic value.

As another example, nearly all global natural graphite processing occurs in China.⁹ Canada is endowed with large graphite resources, and bolstering and scaling Canadian graphite production would create security and a myriad of economic benefits.

Canada should seek to mine and process lithium, nickel, cobalt, manganese, iron, phosphate, and graphite here in Canada.

Canada Needs Major Catalytic Investments

Catalytic investments pool public, private, and indigenous finance to deliver a national strategy. Catalytic investments could allow Canada to overcome the chicken-and-egg problem that often plagues new industries, in which development is incremental instead of transformative, and there is insufficient capital deployed on a timely basis to unlock the full potential.¹⁰ A catalytic investment program can take many forms, including subsidies, direct equity investments, loans and loan guarantees.

A coordinated program of catalytic investments within a national industrial strategy has tremendous potential to help establish a battery and EV supply ecosystem in Canada on a timely basis. However, this requires urgent action and a strong government commitment to begin to build local supply chains that tie existing and new funds to strategic priorities.

Catalytic investments are pro-active—they seek to build an industry in accordance with an overarching vision. Many of Canada’s business development and net-zero funds are set up to passively accept applications from existing firms, rather than sourcing opportunities and collaborating to fill holes in the supply chain. Moreover, existing funds and programs tend to privilege individual firms, especially commercial stage ones. Large, public demonstration funds would help build strong ecosystems and firms in tandem.

A Roadmap for Canada’s Battery Material Industry

To be effective, catalytic investments need clear timetables and targets. Canada needs a roadmap that provides the targets, timetables, and priority actions to guide and align investments. A roadmap is, in turn, the foundation of a national industrial strategy that positions the industry in the broader domestic and international landscape. This report provides a preliminary roadmap for Canada’s battery metals industry building from key discussions and addressing key challenges identified in a series of targeted workshops engaging the BMAC community.

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Building out the midstream is the most critical near-term priority which will allow Canada to capture high value-added segments of the supply chain and develop the homegrown capacity necessary to secure a strong global position.

This roadmap articulates four high-level goals corresponding to four segments of the supply chain: mining, chemical processing, cell manufacturing, and recycling, each with a concrete priority action along with additional cross-cutting actions and policy recommendations (Table 1).

Priority actions in a national strategy

1. **Mining:** develop creative financial mechanisms to unlock nickel, lithium, graphite and rare earth development.
2. **Chemical production:** create a hub and spoke system for integrated chemical processing to produce battery active materials.
3. **Cell manufacturing:** evaluate which cell components Canada has the greatest opportunities to compete in and strategize how to learn from foreign direct investments in cell manufacturing.
4. **Recycling:** put in place strong extended producer responsibility requirements to catalyze the recycling market and harmonize regulations and standards to activate the ecosystem.

Cross-cutting themes: to create an integrated supply chain, government and industry must work together to co-create an industrial and innovation ecosystem that builds homegrown capacity over time.

Policy recommendations: use roadmaps to guide and align public funds; refocus existing and future funds to take an active role in forging supply chains; and ensure there are ample funds for large demonstrations of new technologies and business models.

Taken together, the action plan detailed in this report does two things. First, it highlights near-term actions to bring the supply chain online fast and identify where to effectively target catalytic investments and policies. Second, it outlines the building blocks of a battery and EV supply ecosystem. Building out the midstream is the most critical near-term priority. This is priority action 2 of the 4 point priority action list, involving the establishment of a hub



and spoke system for integrated chemical processing. It will allow Canada to capture high value-added segments of the supply chain and develop the homegrown capacity necessary to secure a strong global position.

In addition to an industry-level strategy, this report also outlines specific battery metal strategies for key metals. These metals strategies include details of how battery metals are mined and processed, which must be understood to develop effective strategies. This report focuses on four commodities as a starting point: lithium, nickel, graphite, and rare earths. For each metal, we have evaluated the current supply chain and the Canadian landscape, and identified a proposed path forward. This report does not address details pertaining to other metals that will form part of a full battery and EV supply chain, including cobalt, manganese, copper, iron, phosphate, and aluminum, which we note should be evaluated in the future as part of a robust national strategy.

Time To Get Started

The best way to advance these priority actions, grow an ecosystem, and further refine an industrial strategy, is by setting collective targets and increasing coordination. It sounds simple but research on industrial strategy shows that clear goals and increasing communication can catalyze action up and down the supply chain.¹¹

The forging and fostering of a public-private-indigenous partnership that brings together an independent organization and a small, autonomous government agency or task force is a key component of creating and delivering an action plan guided by clear targets and an adaptive set of policy tools tailored for the challenge at hand.¹²

The Battery Metals Association of Canada, the Energy Futures Lab, the Transition Accelerator and Accelerate ZEV have the desire, knowledge, skills and actors to foster this partnership and are keen to explore and support next steps.



Spodumene



Neodymium



Nickel



Graphite

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