Assessing the Impact of Propulsion Québec

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About

The Transition Accelerator L'Accélérateur de transition

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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.

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Summary

The rise of industrial policy has intensified national competition in the global transition to a net zero economy. Independent intermediaries can help states adopt a more strategic approach to navigating this context and securing net-zero prosperity. This report assesses the impact of Propulsion Québec—as an independent intermediary—on Quebec's electric transportation sector and draws lessons to advance robust industrial policy.

Key Findings

This report finds that Propulsion Québec:

- Played a key role in recognizing the economic opportunity of battery manufacturing and putting it on the policy agenda
- Helped develop policy strategies that leverage Quebec's strengths to position it strategically in the global battery value chain
- Contributed to more targeted climate and industrial policies to seize Quebec's economic opportunities
- Helped align the province's policy mix and remove institutional barriers to facilitate the scaling-up of homegrown innovations into thriving businesses

Independent intermediaries can help states adopt a more strategic approach to navigating this context and securing net-zero prosperity.

In the electric vehicle battery sector alone, Propulsion Québec has helped catalyzed, since its creation in 2017:

- **$16 billion of investment** announced in Quebec's battery sector, from mining and processing of critical minerals to battery component production, assembly, and recycling
- **As much as 6,000 new jobs** to be created in the battery sector
- **Around 13-fold increase** in the number of electric school buses and hybrid city buses on the road (as of 2022)
- **300 percent increase** (between 2017 and 2022) in the average number of new patents in PQ's Canadian start-up member companies (compared with the 2011-2016 period)
- **Nine innovation infrastructures** established in the electric and smart transportation sector

Lessons drawn from Propulsion Québec for robust intermediaries in industrial policy show the need to:

- Empower the private sector and in particular start-ups which tend to better anticipate market trends than established actors
- Set up a politically independent organization, which makes it flexible and agile in responding to rapidly changing market dynamics, and in pressuring government to correct misguided policies
- Create a permanent institutional structure with a clear mandate and working on specific issues that facilitates access to quality information on barriers and opportunities in the economy to inform policymaking
- Include a wide range of stakeholders of different sizes and from different fields of activity to gain a multi-faceted view of the challenges, and to promote cross-sector collaborations that can help overcome departmental silos

Introduction

In recent years, net-zero industrial policy—that is, the intentional effort by states to restructure the economy towards zero- or low-emissions, resource-efficient prosperity—has gained momentum in climate policy debates (Allan et al., 2021). In most of the Western world, this marks a shift from a long-standing focus on carbon pricing to a broader range of public policies to align environmental protection with economic growth (Meckling & Allan, 2020). This is a welcome development. With geopolitical conflicts on the rise and the need to rapidly transform the economy and reach net zero emissions by mid-century, carbon pricing—although important—appears insufficient and risky for navigating this complex environment. States need a modern industrial policy to secure an advantageous position in the emerging global net-zero economy.

Yet relying on public investment and regulation to drive technological and industrial change raises governance issues. Canada illustrates this challenge. The federal government signalled the importance of a "robust" industrial policy to drive the net-zero transition and grow the Canadian economy (Department of Finance Canada, 2022), but its industrial strategy remains incomplete to date. The federal government has pledged significant climate investments but lacks an institutional framework to structure ongoing interactions between the public and private sectors (Allan et al., 2022; Haley, 2023). This gap risks spreading public and private capital across the economy, rather than actively targeting it to seize Canadian economic opportunities.

A robust industrial policy goes beyond public funding. It requires productive interactions between the public and private sectors to steer and manage structural and institutional change towards thriving net-zero pathways (Altenburg & Rodrik, 2017).

The federal government signalled the importance of a "robust" industrial policy to drive the net-zero transition and grow the Canadian economy (Department of Finance Canada, 2022), but its industrial strategy remains incomplete to date.

For states, this means creating institutional settings that enable private and public players to collaborate towards common goals.

Independent intermediaries can play a key role in achieving this objective. Fundamentally, they operate as a policy network: that is, a public-private forum where actors can discuss problems, find solutions, and coordinate their actions based on reciprocal relationships and trust (Shin, 1991; Wade, 2012). In principle, an intermediary organization can take many institutional forms and pursue a variety of objectives. What is important is that it acts as an "embedded-autonomous" actor: that is, it has a good knowledge of what public and private actors are doing (embedded), while retaining its autonomy (autonomous) to be nimble and flexible (Evans, 1995).

Propulsion Québec provides an example of an independent intermediary in net-zero industrial policy. Created in 2017, its mission is to mobilize the ecosystem to make Quebec a global leader in the electric and smart transportation sector. Since its creation, Quebec's electric and smart transportation sector has grown rapidly: for example, manufacturing companies in the electric and smart transportation sector have grown from $0.6 billion in annual revenues and 1,300 jobs in 2016 to $2.5 billion and 6,165 jobs in 2021—an increase of over 300 percent and 375 percent, respectively (Propulsion Québec, 2023). This makes Propulsion Québec a promising case to explore for its role as an independent intermediary in intentionally coordinating the public and private sectors to secure net zero prosperity.

In this context, this report aims to explore the following questions:

i. *What has been the impact of Propulsion Québec on the development of an electric transportation industrial cluster?*

ii. *What lessons can be learned from the case of Propulsion Québec for advancing robust independent intermediaries and industrial policy?*

Approach to Assess the Impact of Propulsion Québec

We use two main methods to explore these questions: (i) tracing Propulsion Québec's role in policy change and (ii) analysing the economic development of Quebec electric transportation sectors. The report employs two main methods of data collection. The first consists of interviews with Propulsion Québec staff and members. The second method consists of collecting secondary data from Propulsion Québec and government reports, newspapers and specialized websites (e.g., Justia Patents).

The paper is structured as follows. Section 1 briefly introduces Propulsion Québec. Section 2 explores its role in policy change. Section 3 presents the development of key sectors of the electric transportation cluster in Quebec. The last section presents the conclusions of the analysis and directions for future research.

1. About Propulsion Québec

Propulsion Québec is Quebec's electric and smart transportation cluster. It brings together more than 250 members in a collaborative effort to build competitive industries in the electric and smart transportation sector. Its members include industrial and institutional actors, users and operators, and international players. As a public-private organization, it plays a key role in catalyzing information flows between government and industry to align the institutional framework with technological and industrial change. To this end, the organization has set up permanent working groups

composed of Propulsion Québec members and ecosystem players to discuss key issues and priorities for building a thriving electric and smart transportation sector. Priority areas include institutional reform, batteries, public policy, innovation, demonstration and commercialization, supply chains, workforce, and financing.

In recent years, Propulsion Québec has brought together hundreds of players to promote coordination and cooperation within the ecosystem. This is reflected in the rapid growth of its membership—from 26 in 2017 to 273 in 2023—and the thousands of participants in events organized by the organization (e.g. webinars, regional tour, forums, conferences, and the public launch of reports). Moreover, the public-private organization launched a roadmap in 2021 called Ambition 2030 EST following the consultation of more than a hundred actors in the ecosystem. The initiative brought together ecosystem players around shared visions and strategies for 2030 with clear targets and timetables. All this underlines the key role played by Propulsion Québec in developing, organizing and mobilizing the electric vehicle (EV) sector in Quebec. The following explores its role in policy change.

Propulsion Québec has played a key role in putting battery manufacturing on the policy agenda.

2. Propulsion Québec and Policy Change

This section presents some of the roles played by Propulsion Québec in policy change. It focuses on four key functions with relevant examples: (2.1) agenda setting, (2.2) policy strategy and lobbying, (2.3) problem framing, and (2.4) policy alignment.

2.1. Agenda Setting: The Lithium-Ion Battery Sector

In the early stages of Propulsion Québec's creation, the provincial government's transportation strategy largely gravitated around two main economic priorities: (i) commercial EVs (buses, trucks) and (ii) critical minerals. This approach was reflected in the government's strategic transportation documents such as *the transport electrification action plan 2015-2020 and the action plan for the ground transportation and sustainable mobility industry 2018-2023*. At the time, the Quebec government paid little attention to the segments of the technological supply chain that link these two sectors: electric vehicle battery.

Propulsion Québec has played a key role in putting battery manufacturing on the policy agenda. As interviewees pointed out, a key initiative was the commissioning of a report on the lithium-ion battery industry in Quebec. This study quantified the economic opportunities in the global battery value chain and identifies Quebec's strengths and weaknesses to compete in this sector.

It identified three priority areas for growth:

i. Developing a vertically integrated resource extraction and processing industry;

ii. Attracting strategic partnerships to build facilities for cell and component (such as cathodes and anodes) manufacturing;

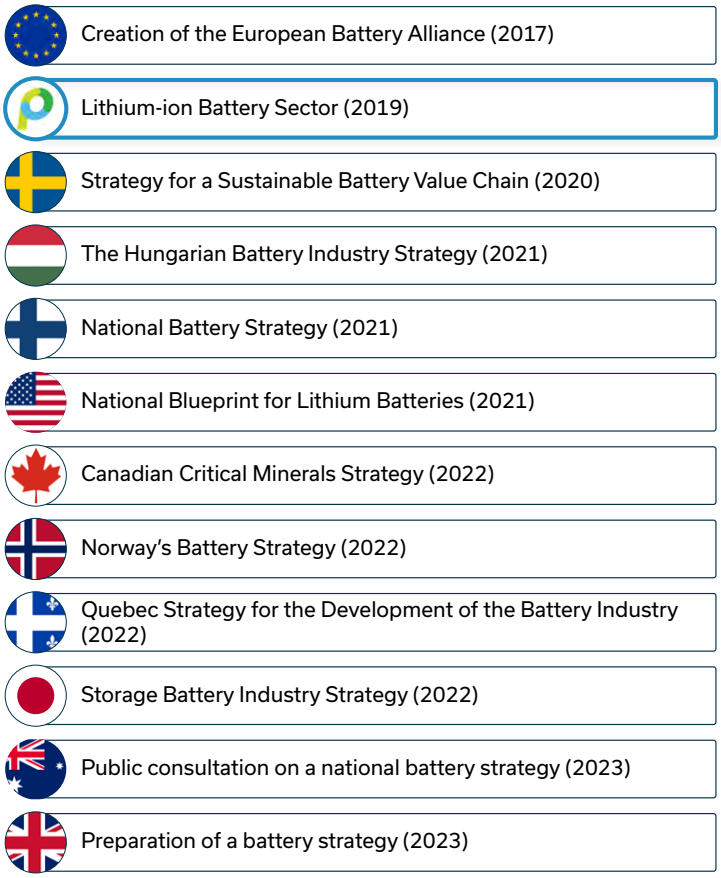
iii. Developing a battery recycling industry.

Overall, the central message of the report was that Quebec was well positioned to build competitive industries in the global battery value chains but had to act quickly to take advantage of the window of opportunity.

One reason is that few Western countries were at that time active in building up domestic production of lithium-ion batteries. This makes Propulsion Québec a forerunner in the Western world in recognizing the strategic role of the battery industry and developing a strategy to position its economy advantageously in the global battery value chain, as shown in Figure 1.

According to interviewees, the 2019 report really helped put the lithium-ion battery on the political agenda. Propulsion Québec's close links with the industry and its in-depth understanding of market dynamics were instrumental in recognizing this economic opportunity and developing a credible case to bring government on board. Following the report's publication and meetings between Propulsion Québec and decisionmakers, the Minister of the Economy, Innovation, and Energy (MEIE) has mandated Investissement Québec (IQ) to build on Propulsion Québec report to develop its battery strategy (La Presse Canadienne, 2019). Propulsion Québec also supported the government in the development of its strategic policy documents, including the Quebec plan for the development of critical and strategic minerals 2020-2025 and Quebec's battery development strategy.

Figure 1. Selected battery strategies



2.2. Policy Strategy and Lobbying: Traceability Mechanism and Battery Recycling

Beyond policy agenda setting, Propulsion Québec played an active role in the development of the battery industry. Two key functions stand out: (i) developing strategies to overcome Quebec's weaknesses and (ii) influencing political decisionmakers to align government policies with industry needs.

i. Policy Strategy to Overcome Economic Barriers

A major hurdle for building domestic industries in the battery sector in Quebec was its competitive challenges (e.g. higher labour and production costs) compared to its international competitors, mainly in Asia. As the General Manager of IQ pointed out: "If it costs 100 million to build a plant in Quebec, the same plant will cost around 20-30 million in China and 50-60 million in South Korea" (Canadian Club of Montreal, 2023). This cost gap made it difficult for the province to attract foreign investment to build domestic facilities in advanced technology segments (such as cell and cathode manufacturing).

In this context, Propulsion Québec has developed a strategy aimed at capitalizing on the province's strengths to position it advantageously in the global economy.

A key initiative is the 2020-2022 pilot project on a traceability mechanism for battery minerals. The project was funded by the governments of Quebec and Canada and coordinated by Propulsion Québec in partnership with Nouveau Monde Graphite (graphite production), Optel (traceability technologies) and the International Reference Center for Life Cycle Assessment and Sustainable Transition (CIRAIG) (life cycle analysis). The project successfully demonstrated the feasibility of a traceability mechanism to assess the environmental and social performance of graphite extraction and processing. Building on and aligning with the work of the Global Battery Alliance (GBA), the pilot project advances the objective of developing a battery passport to ensure the transparency of the social and environmental performance of all stages of the battery life cycle.

This battery passport initiative offers at least three strategic advantages for the Quebec economy (Propulsion Québec, 2022). First, thanks to its clean electricity and socially responsible practices, the battery passport gives the province a competitive edge by creating demand for its socially and environmentally responsible products. Second, it fosters the development of cost-effective and efficient battery supply chains. For example, access to battery chemistry data can help recycling industries to dose and align their chemical processes to minimize economic and environmental costs (New York SME, 2022). This facilitates collaboration between firms along the supply chains (e.g. Nouveau Monde Graphite, 2021a). Third, and related to the first and second, the traceability mechanism can act as a lever to attract foreign investment and major corporations in the province.

Political decisionmakers have recognized the value of this strategy to promote the competitiveness of the Quebec economy. As mentioned by the MEIE Minister, “this pilot project will contribute to the development of the battery industry and is fully in line with our strategy” (Propulsion Québec, 2020a). The Prime Minister of Canada and IQ are both championing Quebec’s goal of producing the world’s greenest batteries, and companies that moved to Quebec have also cited this dimension in explaining their investments in the province. For example, the Swedish company Northvolt, which has announced the construction of a battery cells factory in the province worth CAD$ 7 billion, said: “we want to make the greenest battery in the world”.

The strategy of using hydroelectricity as a lever to develop Quebec's battery industry contributed to a change in electricity allocation management. Previously, Hydro-Quebec was required to connect all proposed industrial projects with an electric capacity under 50 MW. Since 2023, the Minister of MEIE has had to approve any industrial project with a capacity above 5 MW. As the Minister of MEIE points out, the objective of the reform is to allocate energy effectively to achieve the government's climate objectives, while developing its strategic sectors (Government of Quebec, 2023).

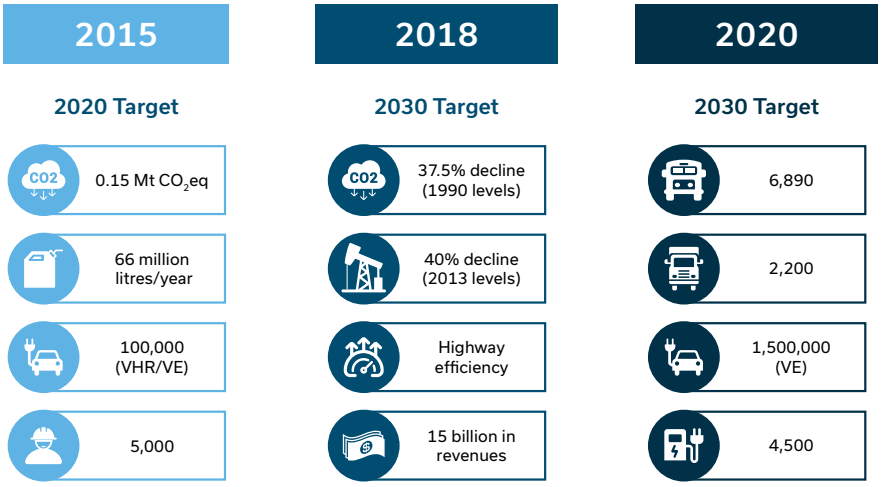
ii. Influencing and Lobbying Government Officials

Propulsion Québec has played a key role in generating expertise on critical aspects of the battery supply chain and in influencing governments to ensure best practices in regulation and public policy. Battery recycling is a good example. The Quebec government first commissioned Propulsion Québec to produce a report on the potential for an extended producer responsibility (EPR) mechanism for EV batteries (Propulsion Québec, 2020b). Following the report, the government proposed a regulatory framework that was largely perceived as inadequate by the electric and smart transportation ecosystem. As one interviewee pointed out, Propulsion Québec helped mobilize the ecosystem and put pressure on the government to review its approach. The public authorities responded by revising their regulation. At the time, some players in the automotive industry recommended that EV batteries be recycled voluntarily. Propulsion Québec, for its part, has argued in favour of a mandatory battery recycling mechanism. A key reason is that a voluntary system would risk prioritizing high-value materials at the expense of low-value materials, which could result in large quantities of battery materials not being recycled, with the attendant environmental and economic costs (Thibault, 2020). This policy advocacy has proved somewhat fruitful. In 2023, the Minister of the Environment explicitly indicated its intention to introduce a mandatory battery recycling mechanism (Lachance, 2023a). To this end, it has set up a working group on battery recycling and valorization, of which Propulsion is a member. In this context, Propulsion Québec played an important role in mobilizing the ecosystem, lobbying the government to change its position, and providing expertise to develop a new battery recycling mechanism.

2.3. Problem-Framing: Climate Action as Leverage for Economic Development

Beyond the battery sector, Propulsion Québec has also contributed to a shift in the government's approach towards commercial EVs. One example of this is the government's transportation targets. Between 2015 and 2018, transport targets have focused on various environmental and economic objectives (see Figure 2). That includes reducing emissions and fossil fuel consumption, deploying plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EV), creating jobs, and generating revenue in the land transport sector. While these targets are welcome for advancing low-carbon transitions, their ability to stimulate domestic economic development remains somewhat uncertain. One reason is that they provide little information on the type of structural transformation needed to achieve them.

Figure 2. Evolution of Key Quebec Government Targets for the Transportation Sector, 2015-2020



Source : Quebec Ministry of Transport (2015; 2018; 2020)

With the Green Economy Plan (2020), the provincial government's transport targets have changed in at least one important respect: the plan introduces specific production targets for sub-sectors in which the province has domestic producing industries. These include school buses, city buses and charging stations. As one interviewee in the private sector pointed out, these targets provide guidance on the direction and pace of future economic development and help businesses coordinate their activities: for example, targets for electric school buses help suppliers of bus components and producers of electric charging stations to anticipate annual demand and align their production accordingly. Setting the right level of targets is important, however. Targets that are too high are likely to lead to failure and discourage players, while targets that are too low are unlikely to activate companies.

According to interviewees, Propulsion Québec has played two main roles in setting policy targets. First, it has supported the government's approach to view climate policies as a lever for economic development. Second, it helped to "frame" government targets in light of the production capacity of specific industries to favour alignment between policy targets and industrial development.

This change in targets went hand in hand with a change in public investments for commercial electric vehicles. Electric buses are good examples. As Figure 3 shows, public funding for the purchase of electric school buses has increased by around 8-fold between the 2015 and 2020 programmes. Similarly, Figure 4 shows that public funding for the acquisition of electric city buses has more than doubled in recent years: from 940 million for 830 hybrid buses in 2018 to 2.2 billion for 1,229 all-electric buses.

Figure 3. Quebec Electric School Bus Programs

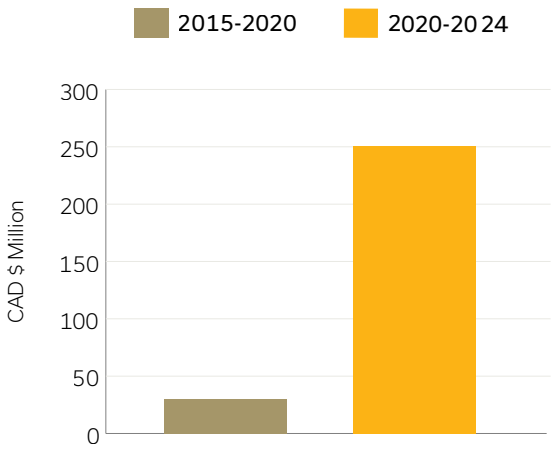
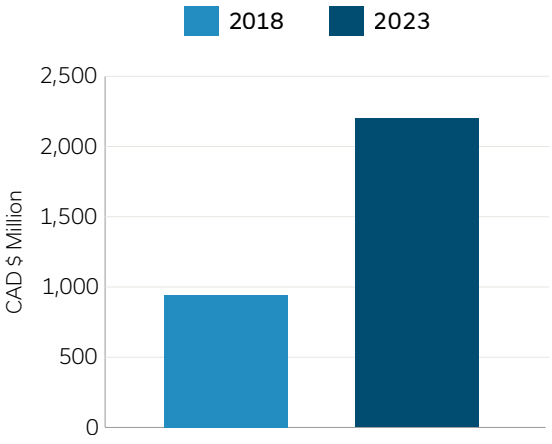


Figure 4. Public Procurement for Electric City Buses*



*Comparison of two public contracts for the purchase of electric city buses at some point in time

Moreover, the Quebec government has introduced a local content requirement (LCR) to the 2020 electric school bus program. As a result, only electric school buses assembled in Canada are eligible for public funding (with some exceptions). The LCR holds the potential to transform the structure of the province's school bus market. In Quebec, around 80% of school buses are type C, and American manufacturers produce most of those powered by diesel: Bluebird (Georgia), International (Oklahoma), and Thomas (North Carolina) (Breton, 2018). Replacing these buses with electric models manufactured locally stimulates the province's economic development and reduces its trade deficit as its economy decarbonizes. Propulsion Québec's close ties with the industry helped identify this opportunity and promote the use of climate policy as a lever for economic development.

Yet the transition from fossil fuel-powered school buses to electrification has not been without its hurdles. At present, the penetration rate of electric school buses seems insufficient to meet the target of 2,500 school buses by 2024 (McEvoy, 2023). At least two factors have contributed to this shortfall: (i) supply chain bottlenecks during the COVID-19 pandemic and (ii) transport operators' opposition to electric school buses (Arsenault, 2021; Montembeault, 2022).

Propulsion Québec took initiatives that help address both issues. Regarding opposition from school bus operators, the organization published in 2022 the *Transporter +* technical guide, which aimed to inform industry players about the operational requirements of the technology and infrastructure (e.g. charging stations), and outline various solutions enabling operators to make an effective shift towards electrification. With regard to supply chain bottlenecks, Propulsion Québec is currently working on an initiative to map Quebec suppliers and develop tools (e.g. platforms) to foster collaboration between producers and suppliers and address barriers (e.g. lack of supply, lack of product standardization, high cost, and so on).

Beyond school buses, Propulsion Québec has also contributed to aligning the institutional setting with the economic development of commercial vehicles more broadly. Three initiatives stand out. First, as one interviewee pointed out, Propulsion Québec has played a key role in supporting the government to introduce a zero-emission vehicle (ZEV) mandate for new medium- and heavy-duty vehicles (MHDVs) (planned for 2024) (Lachance, 2023b).

Second, Propulsion Québec has been active in promoting the modernization of the government's public procurement model. In their 2020 report "Making public procurement a strategic tool for economic development and innovation in Quebec" realized with the Chamber of Commerce of Metropolitan Montreal (CCMM), Propulsion Québec presents policy recommendations to make public procurement an economic development tool for the electric and smart transportation sector. A key idea was to make sustainable development and innovation the norm for selecting contractors and the lowest bidder rule (previously the norm) the exception.

Following this report and public consultations of Propulsion Québec members and other actors, the Quebec government reformed in 2022 *Act respecting contracting by public bodies* (Bill 12) to allow public buyers to require the inclusion of at least one sustainable development clause in offers to purchase. There is room for improvement, however. Cities and their public transport authorities are not included in the *Act respecting contracting by public bodies*, nor is the inclusion of innovation and sustainable economic development criteria mandatory (CCMM, 2022; Léveillé, 2023).

Finally, a third initiative involved lobbying the government to increase funding for public transport. In its 2020 brief on Bill 44 (*An Act to promote effective governance in the fight against climate change*), Propulsion Québec proposed that the Plan Québécois des infrastructures (PQI) devote half its budget to public transit and the other half to the road network. This recommendation was adopted. Whereas the amount of public funding for public transit was around 30 percent in the last PQI, the 2022-2032 PQI allocates 50/50 of investments between public transit and network maintenance. It also includes more than a billion dollars for dedicated lanes and preferential measures for buses.

2.4. Policy Alignment: Innovation Zone

In addition to promoting industrial and technological change, Propulsion Québec has also been active in scaling-up homegrown innovation. This is an area in which Canada has long been struggling (Asselin et al., 2020; Breznitz, 2021). Quebec is no exception. The failure to develop Hydro-Quebec's lithium iron phosphate (LFP) battery patents, where the patent license was granted free of charge to China for domestic production (IEA, 2022), is just one example of this challenge.

As one interviewee in the private sector pointed out, Propulsion Québec has played an active role in promoting the emergence of innovation zones to link research and development (R&D) activities with industrial development. In recent years, the government of Quebec has created many innovation zones around key priority areas in the electric and smart transportation sector. A good example is the Energy Transition Valley (2023). As an innovation zone, it links three municipalities (Bécancour, Trois-Rivières and Shawinigan) and focuses on the development of innovations around three strategic sectors: batteries, electric transport and hydrogen production. Involving 10 educational institutions as part of a collaborative innovation approach, this initiative aims to align R&D with business needs and support homegrown innovations at all stages of the innovation chain. With members from a wide range of sectors (firms across different segments of the value chain, R&D centres, financial institutions, public transport operators, universities, and so on), Propulsion Québec helps identify and remove the various barriers (financial, technical, employment) that hinder the growth of innovation into successful businesses.

Propulsion Québec has played an active role in promoting the emergence of innovation zones to link research and development (R&D) activities with industrial development.

Overall, this section illustrates the key roles played by Propulsion Québec in policy change. These include identifying sector-specific barriers, providing expertise and quality information to identify economic opportunities (battery), supporting the development of policy strategy to position Quebec advantageously in the global economy (traceability mechanism), aligning the institutional system and policy mix with economic development (e.g. battery recycling, public procurement), and dealing with opposition. The following explores the economic development of the electric transportation sector in Quebec.

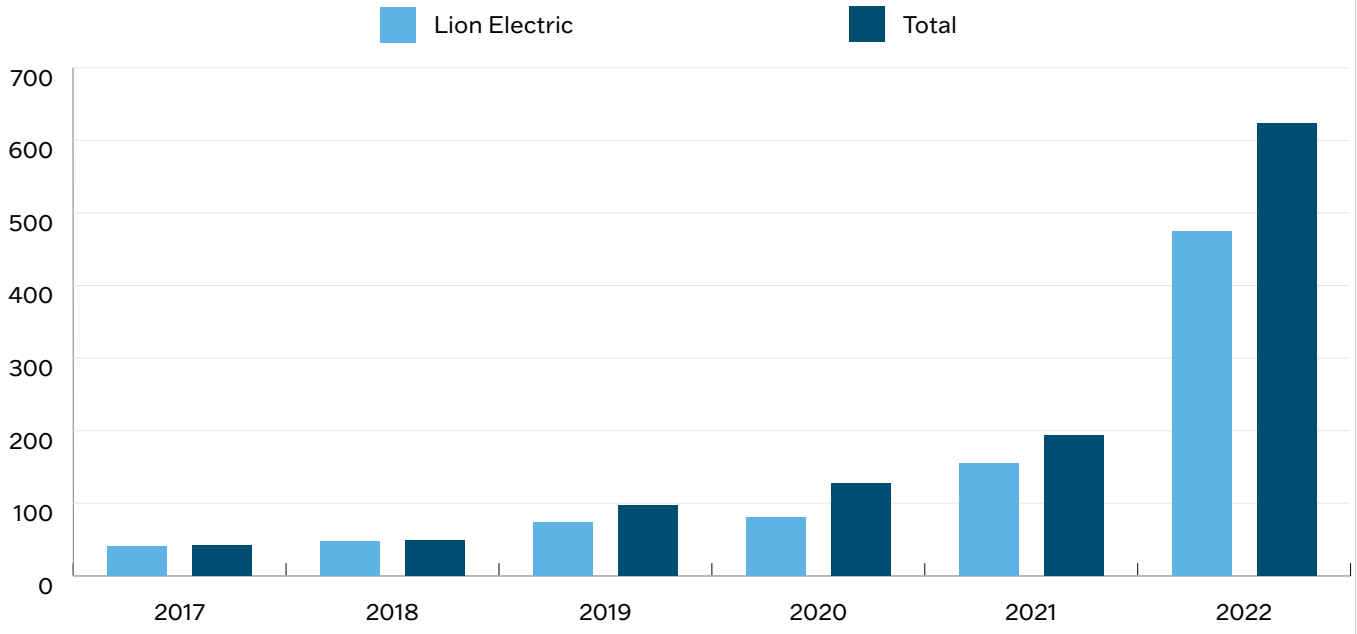
3. Measuring the Economic Development of Quebec's Electric Transportation Sector

In light of Propulsion Québec's role in policy change, this section explores the development of the electric transportation sector along three main elements: (3.1) the development of the commercial vehicle sector, through the example of electric buses, (3.2) the growth of investment and employment in the battery sector, and (3.3) the growth of Canadian companies in the electric transportation ecosystem in Quebec.

3.1. Growth in Domestic Production of Commercial Electric Vehicles

Quebec's commercial electric vehicle sector has grown rapidly in recent years. Consider electric school buses. It went from a total of 42 in 2017 to 624 in 2022—a more than 13-fold increase in six years. As shown in Figure 5, Lion Electric is the leading supplier of electric school buses, accounting for almost 80 percent of the market in 2022. Replacing fossil-based school buses manufactured largely in the USA with a product assembled and partly produced in Quebec helps stimulate local employment: for example, the number of Lion's employees went from 120 in 2017 to more than 1, 000 in 2022 (Halin, 2018; Lion Electric, 2022).

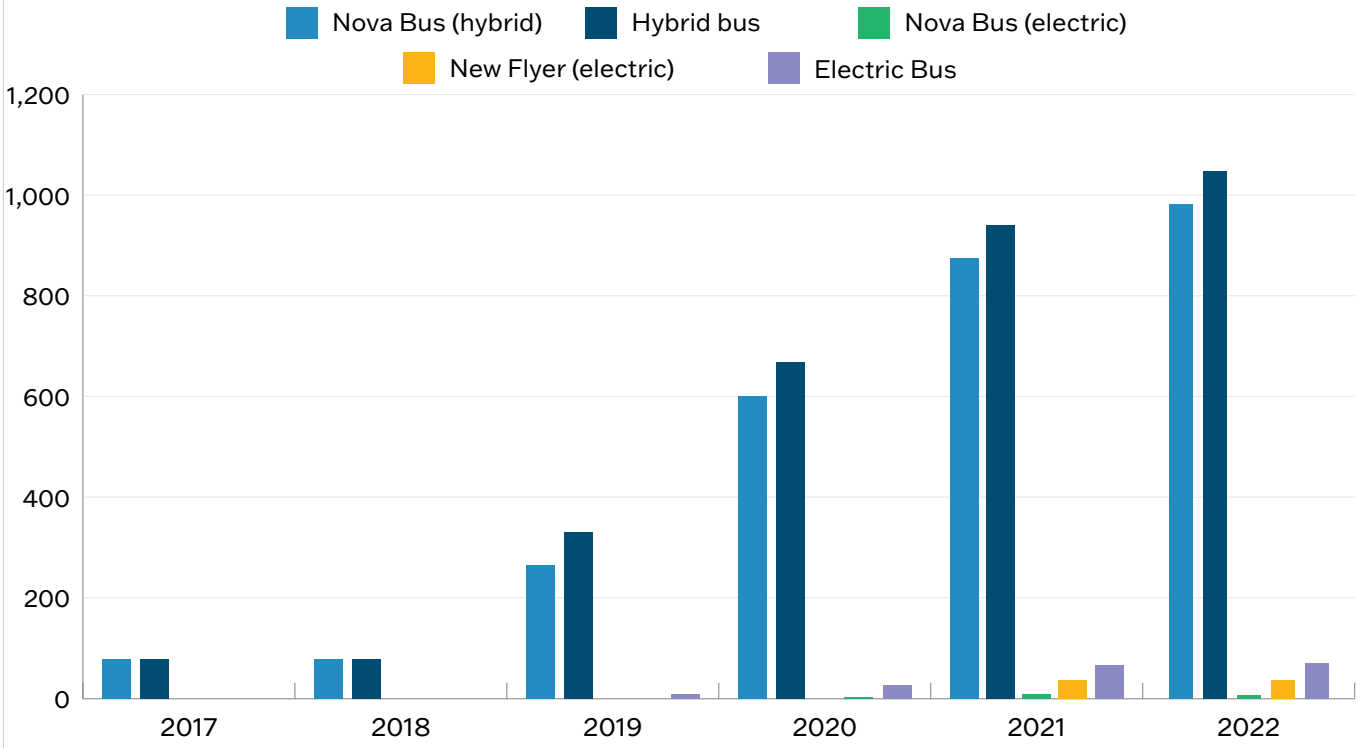
Figure 5. Evolution of Total and Lion Electric School Buses in Quebec, 2017-2022



Source: Propulsion Québec (2023)

Similarly, there has been an increase in the number of hybrid electric buses on Quebec roads: from 73 in 2017 to 987 in 2022, as shown in Figure 6. Nova Bus has been the main supplier of the domestic market demand. In 2022, Nova Bus accounted for almost 94 percent of the Quebec hybrid city bus market. Nova Bus' share of the Quebec market for all-electric city buses remains small, however, at around 10 percent. But with the recent $2.2 billion contract awarded to the company for the purchase of 1,229 buses, this share is set to increase over the next few years. With a supply chain that includes more than 20 Quebec suppliers and 800 workers (welders, assembly teams) at its plants (Bérard, 2023), this will spur local employment and economic growth as the economy decarbonizes.

Figure 6. Evolution of Total and Nova Bus Electric Buses in Quebec, 2017-2022



Source : Propulsion Québec (2023)

3.2. Rise of Investments in Quebec Battery Value Chains

Since the publication of Propulsion Québec's report in 2019, the battery industry experienced major growth in investment flows and employment creation. As of 2023, the Quebec battery industry accounts for $16 billion of planned investment (at different stages of development) and more than 6,000 jobs created, as shown in Figures 7 and 8. The recently announced cell plant of Northvolt alone represents roughly 40 percent of the total investment and 45 percent of (expected) job creation. Lithium (raw materials and materials processing) and cathode active materials are other key investments, accounting for almost 35 percent of the investment and 30 percent of the (expected) jobs created. Taken together, this means that most investment targets the midstream segments of the battery value chain (i.e. materials processing and cell manufacturing), with some overlap with the upstream segment (raw materials production). This has two major advantages: (i) it favors high-value-added economic activities and (ii) stimulates demand for the upstream and downstream (battery module and pack) segments, helping to catalyze investment across the full battery value chain.

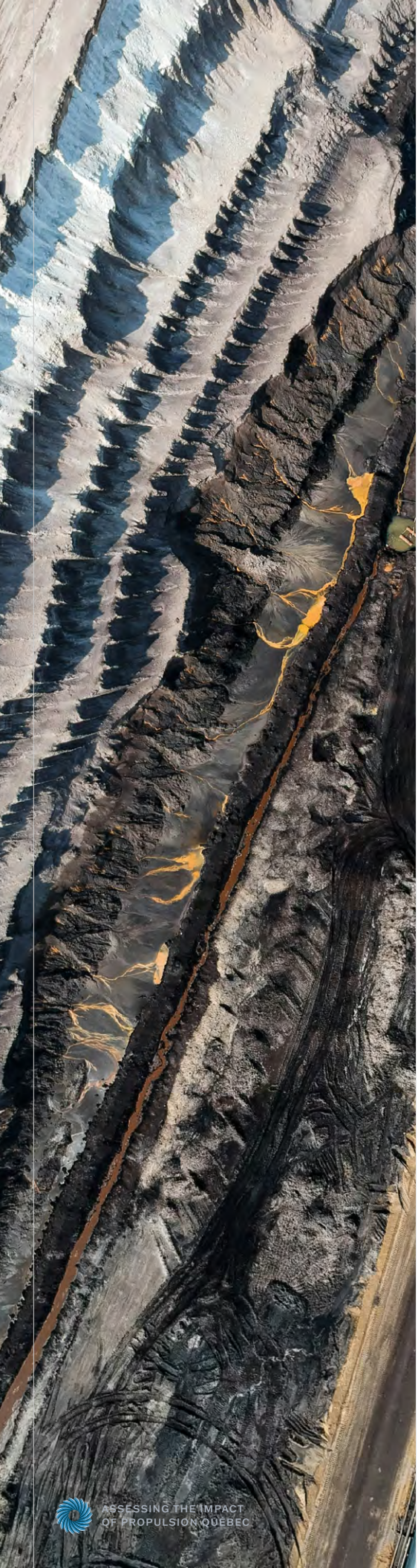
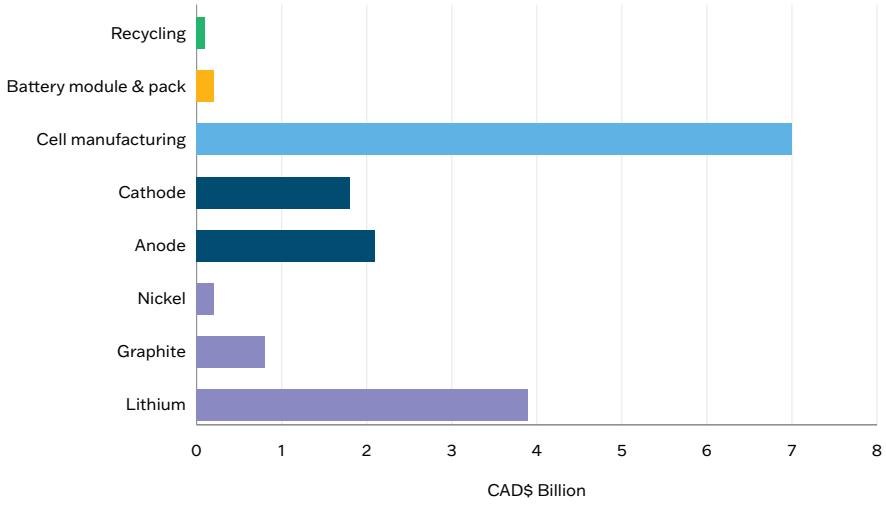
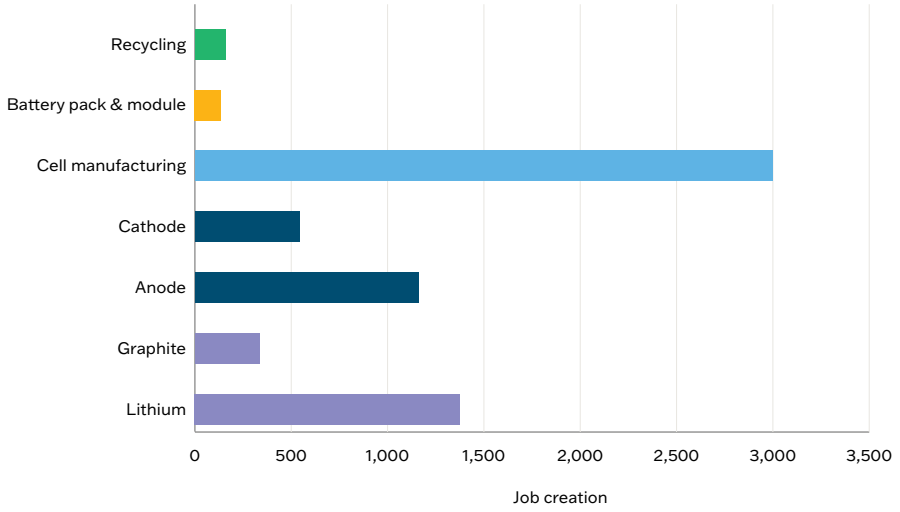


Figure 7. Planned Investments in Quebec Battery Value Chains, 2023



Source: See Appendix A

Figure 8. Expected Job Created in the Quebec Battery Value Chains, 2023



Source: See Appendix A

The local transformation of minerals into a high-value-added product represents a turning point in the province's traditional approach to exporting its natural resources. It also positions the province strategically to capture market share for the supply of battery-grade materials that are needed to produce electric vehicles in North America. Refined lithium and graphite (coated spherical purified graphite [SPCG]) are good examples. Currently, three lithium refinery projects are under development—the Sayona project at La Corne to produce lithium carbonate (feasibility study), the Nemaska Lithium project at Bécancour to produce lithium hydroxide (under construction) and the Sayona project at Moblan to produce lithium hydroxide (feasibility study)—and one refined graphite production project—the Nouveau Monde Graphite project linking the Matawine mine to its future Bécancour plant.

As a ballpark estimate, this planned production capacity for battery-grade lithium and graphite could produce around 1.8 million and 750,000 light-duty vehicles (LDVs) respectively, as shown in Table 1. Given that Canada accounted for around 8 percent of the 14.8 million vehicles manufactured in North America in 2022, Quebec could roughly supply more than all the refined lithium needed to support the electrification of current Canadian automotive production and more than half of the refined graphite required. This represents market opportunities generating gross revenues of over CAD $4 billion a year. Moreover, all these projects will rely on local mining production and are highly vertically integrated (from mining to materials processing), offering the prospect of a geopolitically stable supply of quality battery materials.

Table 1. Production and Economic Potential of Quebec's Refined Graphite and Lithium

Battery-grade materials	Firms	Planned production capacity (tpa)	Potential gross revenues (CAD million)	Number of LDV equivalent	% of vehicles manufactured in Canada in 2022
Lithium carbonate equivalent (2017)	SAYONA Nemaska Lithium	77,000	3,800	1,180,000	145
Spherical-coated purified graphite (2025)	NMG	45,000	570	750,000	60

Assumptions: 850g of LCE in a battery per kWh; typical electric vehicle (50 kWh battery capacity) (Gielen, 2021); 1,200 t of graphite anode = 1 GWh (Nouveau Monde Graphite, 2021b); average price of natural CPSG = 9,500 USD/t (Westwater Resources, 2023); Average price of LCE = 37,000 USD/t (2022) (Statista, 2023); conversion factor: 1USD = 1.34 CAD; North American vehicle production (Statista, 2024). Since the analysis, the price of lithium has fallen considerably over the period 2023 to 2024 (Arsenault, 2024). At present, however, it seems unlikely that such price levels will persist over the long term.

In this context, the province's integrated upstream and midstream segments of the battery value chain—from mining to the production of battery-grade materials—gives it a competitive position in the North American battery market. Its ability to attract major equipment manufacturers illustrates the attractiveness and quality of its battery strategy. Ford and GM's planned investments in a cathode manufacturing plant in Bécancour is a good example. Taken together, these projects represent an investment of CAD $1.8 billion to produce up to 75,000 tons of cathode active materials (CAMs), which represents about 40 percent of the total cell cost (Randall, 2023; Waddell, 2023). Moreover, these multinationals bring significant resources to the province and can support the development of start-ups through a variety of strategic partnerships (see Table 2).

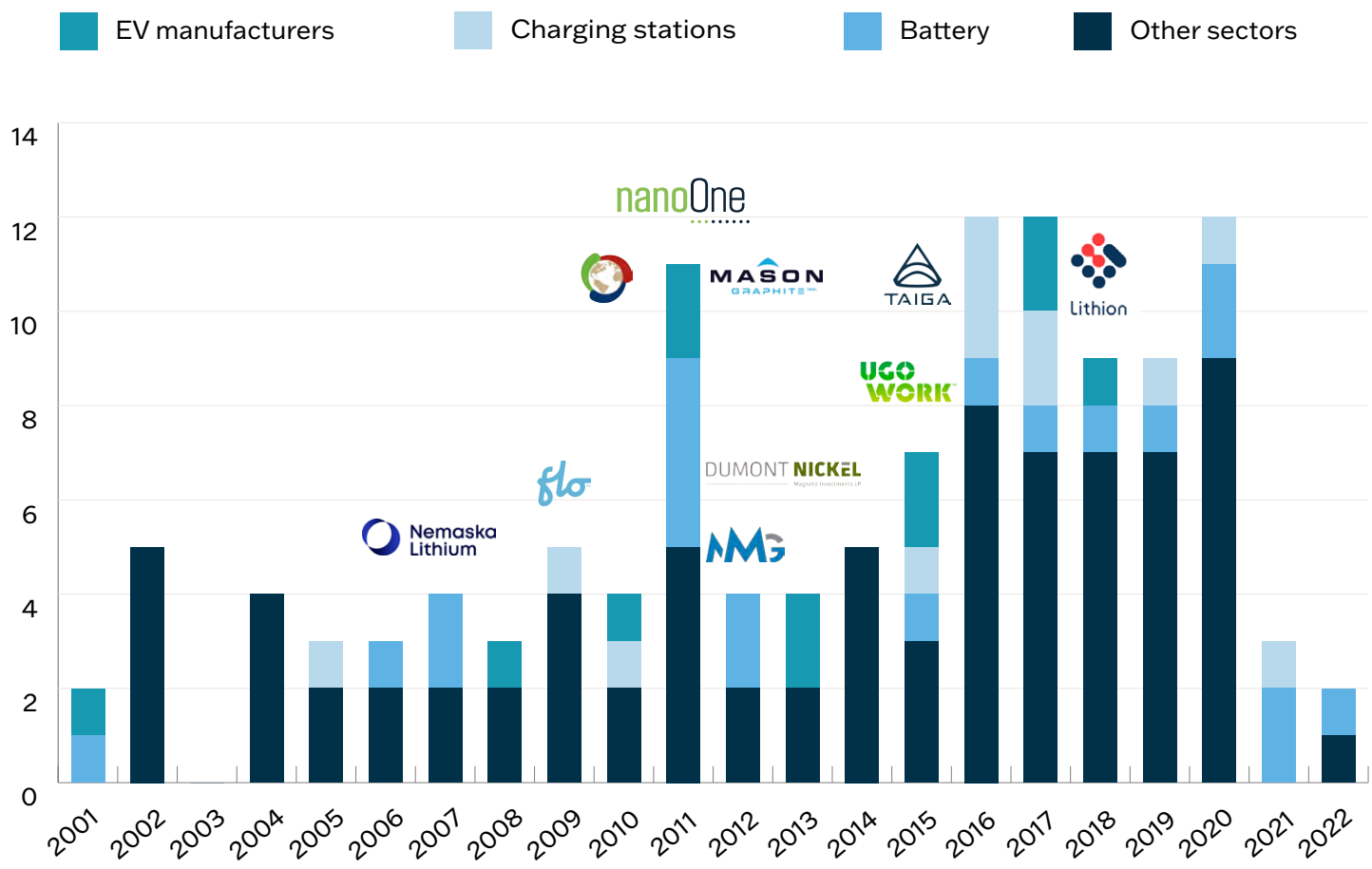
Table 2. Some Collaboration Agreements Between Multinationals and Canadian Firms in the Battery Sector

Firm	Year	Type of collaboration
Ford, Nemaska Lithium	2023	Lithium hydroxide supply agreement
umicore, nanoOne	2023	Joint development agreement on cathode active materials
nanoOne, BASF	2022	Joint development agreement to co-develop a process for improving CAM production efficiency
Lithion, gm	2022	GM's financial arm annouces investment in Lithion Technologies
Panasonic, Mitsubishi, NMG	2022	Panasonic invest in Nouveau Monde Graphite to produce SCPG
gm, Vale	2022	Agreement between Vale and GM for long-term supply of battery-grade nickel sulfate

3.3. The Growth of Canadian Homegrown Companies

While foreign investments play an important role in Quebec industrial strategy, the development of the commercial electric vehicle and battery sector also illustrates the growth of many Canadian homegrown companies. As in Figure 9, there has been a growing number of new entrants (that are Propulsion Québec members) to the electric and smart transportation sector in Quebec. Several of them have experienced rapid growth in recent years. That includes Lion Electric, Flo/AddEnergie (Baril, 2021), and more recently Lithion Technologies (Dubuc & Arsenault, 2023). Others are well placed to compete in high-value-added economic activities. Prominent examples include Nemaska Lithium and Nouveau Monde Graphite, with projects spanning from mining to mineral processing.

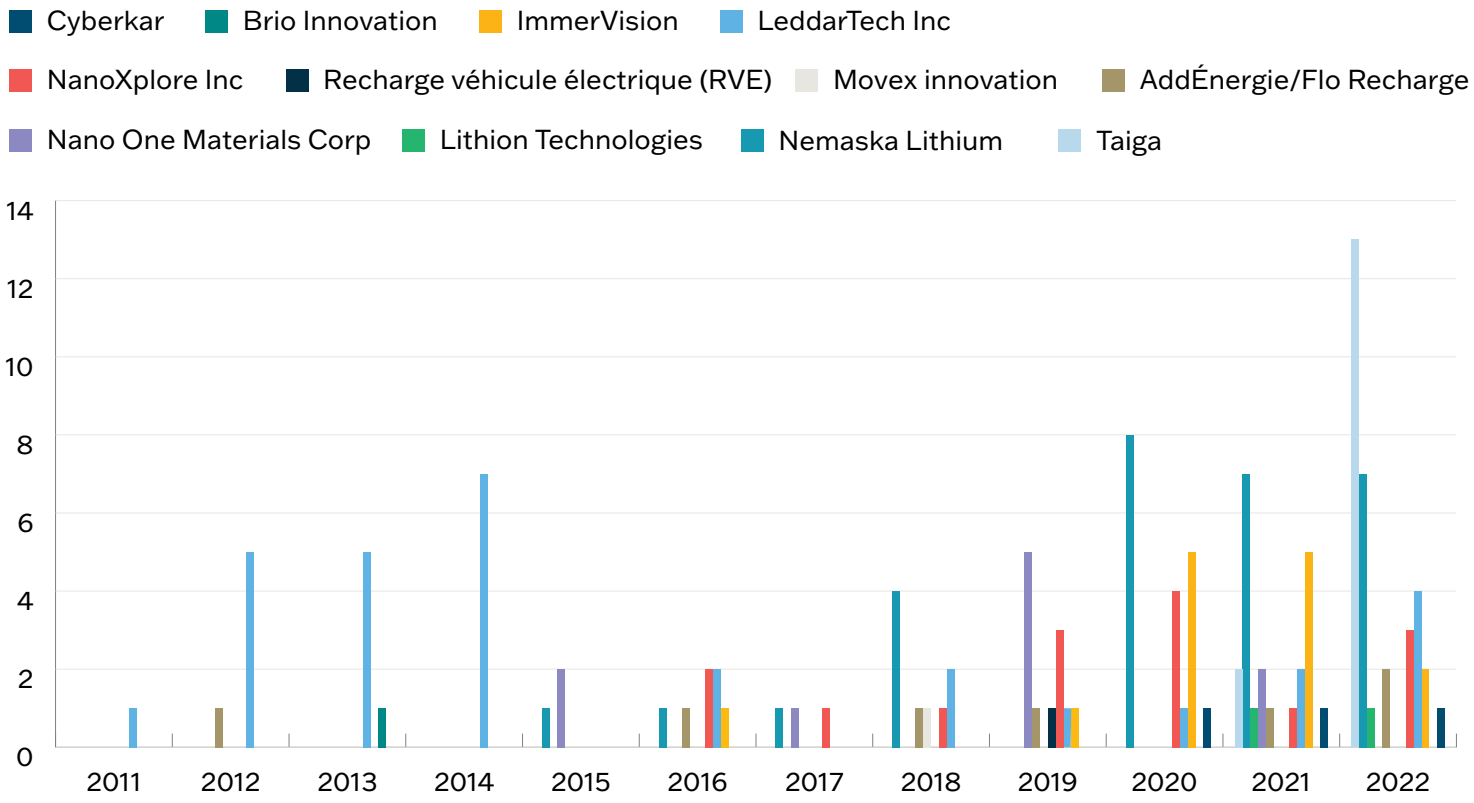
Figure 9. New Entrants (Propulsion Québec Members*) and Selected Homegrown Canadian Firms in Prioritized Sectors



*Includes Industrial and User & Operator Actors

Moreover, many of these Canadian junior companies have proved quite innovative. Two indicators stand out. The first is the number of patents. As Figure 10 shows, many of these new companies hold patents and their number has increased in recent years. Indeed, the number of new patents among Canadian junior companies went from an average of five between 2011-2016 to 16 between 2017-2022—a three fold increase since 2017. Economic sectors include batteries (Nemaska Lithium, 29; NanoXplore: 15; Nano One, 10; Lithion Technologies, 2), charging stations (Flo/AddÉnergie, 7; RVE, 1), electric vehicles (Taiga, 15; Movex Innovation, 1) and smart vehicles and infrastructures (LeddarTech, 30; ImmerVision, 14).

Figure 10. Patents of Selected Canadian Homegrown Firms



Source : Justia Patents (2023)

The second indicator is the creation of new innovation infrastructures, as shown in Table 3. In recent years, a number of junior Canadian companies set up research centers to drive innovation in their production techniques and products. These include Lion Electric, NanoXplore, and Nouveau Monde Graphite. Moreover, the emergence of new innovation infrastructures in the electric and smart transportation sector has contributed to the development and commercialization of homegrown innovations through strategic partnerships. Hydro-Quebec's Centre of Excellence in Transportation Electrification and Energy Storage (CETEES) illustrates this point with two members of Propulsion Québec: (i) a partnership with Lithion Technologies to develop the battery recycling technology and (ii) a collaboration agreement with Nouveau Monde Graphite to help commercialize the battery anode material technologies developed by Hydro-Quebec (Nouveau Monde Graphite, 2018). These partnerships illustrate the value of creating collaborative structures and cultures within the ecosystem. An independent intermediary such as Propulsion Québec is an asset in this context.

Table 3. List of New Research Centers, Institutes, and Laboratories in the Electric and Smart Transportation Sector, 2016-2023

Institution	Foundation	Location	Area of research
Institute for Electrification and Intelligent Transportation	2016	Montreal	Transport électrique et intelligent
Center of Excellence in Transportation Electrification and Energy Storage	2017	Varenne	Électrification et stockage de l'énergie
Nova Bus Development Center	2019	Saint-Eustache	Autobus urbain électrique
Institute Intelligence and Data (IID)	2020	Laval	Research in artificial intelligence and data science
BRP Electric Vehicle Development Centre	2021	Valcourt	Recreational vehicles
Nouveau Monde Graphite R&D Laboratory		Saint-Michel-des-Saints	Graphite and battery technologies (anode)
Innovative Vehicle Institute (St-Jérôme)	2022	St-Jerôme	Electric and intelligent transport
Alstom Innovation Center		St-Bruno	Green rail mobility solutions
NanoXplore Battery R&D Laboratory		Montreal	Graphene for lithium-ion batteries
Lion Electric Innovation Centre	2023	Mirabel	Battery

Concluding Remarks

This report assesses the impact of an independent intermediary in net-zero industrial policy through the case of Propulsion Québec. The objective is twofold: (i) to trace the organization's impact on policy change and the economic development of Quebec's electric transportation cluster, and (ii) to identify promising lessons for the governance of robust industrial policy. We draw three main findings and associated lessons.

» First, we find that Propulsion Québec has played a key role in the battery industry, in particular by recognizing the economic opportunity of the battery market and developing strategies that reflect Québec's unique challenges and strengths (e.g. traceability mechanism). For policymakers, this suggests the importance of adopting a *forward-looking strategy*: this means, mapping the (global and local) value chain of specific green technology and anticipating market trends to identify promising economic opportunities. An intermediary organization can help achieve this. A key element is to have a governance structure that empowers the private sector—in particular, bringing in startups who tend to anticipate market trends better than established players. *Political independence* is also important for two key reasons. The first is that it enables the organization to be nimbler and more flexible than public bodies. In the case of the battery, speed of action was key to seizing economic opportunities and responding to rapidly changing economic conditions. The second reason is that it enables the intermediary organization to pressure the government when its initiatives are perceived to be detrimental to the industry. The battery recycling program is a prime example.

» Second, Propulsion Québec helped advance public policies that are more *targeted* towards Québec's economic opportunities. Two examples illustrate this point. The first is the shift in the government's transportation targets. It went from a focus on environmental objectives (e.g. reducing emissions) and job creation to production

targets for green products that stimulate domestic industrial production (e.g. electric buses). Propulsion Québec's role in promoting policy and regulatory changes to encourage the purchase of commercial electric vehicles (such as the VZE standard for MHDVs) also contributes to the development of its domestic industry. The second example is the strong emphasis of Propulsion Québec's battery report on targeting key segments of the battery value chain where the province has comparative advantages (e.g. materials processing [lithium, graphite], battery recycling). These examples illustrate the importance of *high-quality information* on market and technological trends for industrial policy. An independent intermediary can be an asset in catalyzing information flows between government and business. A key element is to have a *permanent institutional structure* with a *clear mandate* and working on *specific problems*. This enables players with technical expertise to provide policymakers with ongoing information on context-specific barriers (high cost of labor and capital) and opportunities (promising start-ups; patents), and helps tailor public policies (targets, public investment) to business realities (challenges, opportunities) and change course when necessary.

» Third, Propulsion Québec contributes to the *alignment* of policies (innovation policy, transportation policy, economic policy) within the government. The Energy Transition Valley innovation zone is one example: it helps to align research and development (R&D) with the need of strategic industrial sectors to improve production techniques and promote regional economic development. For policymakers, this suggests the importance of having *coordination mechanisms* within the public sector. An intermediary organization can help with this task. A key element is involving a *diversity of stakeholders*. This helps take a holistic, multi-dimensional view of challenges and promote cross-sector collaborations that can help overcome departmental silos.

Directions for Future Research

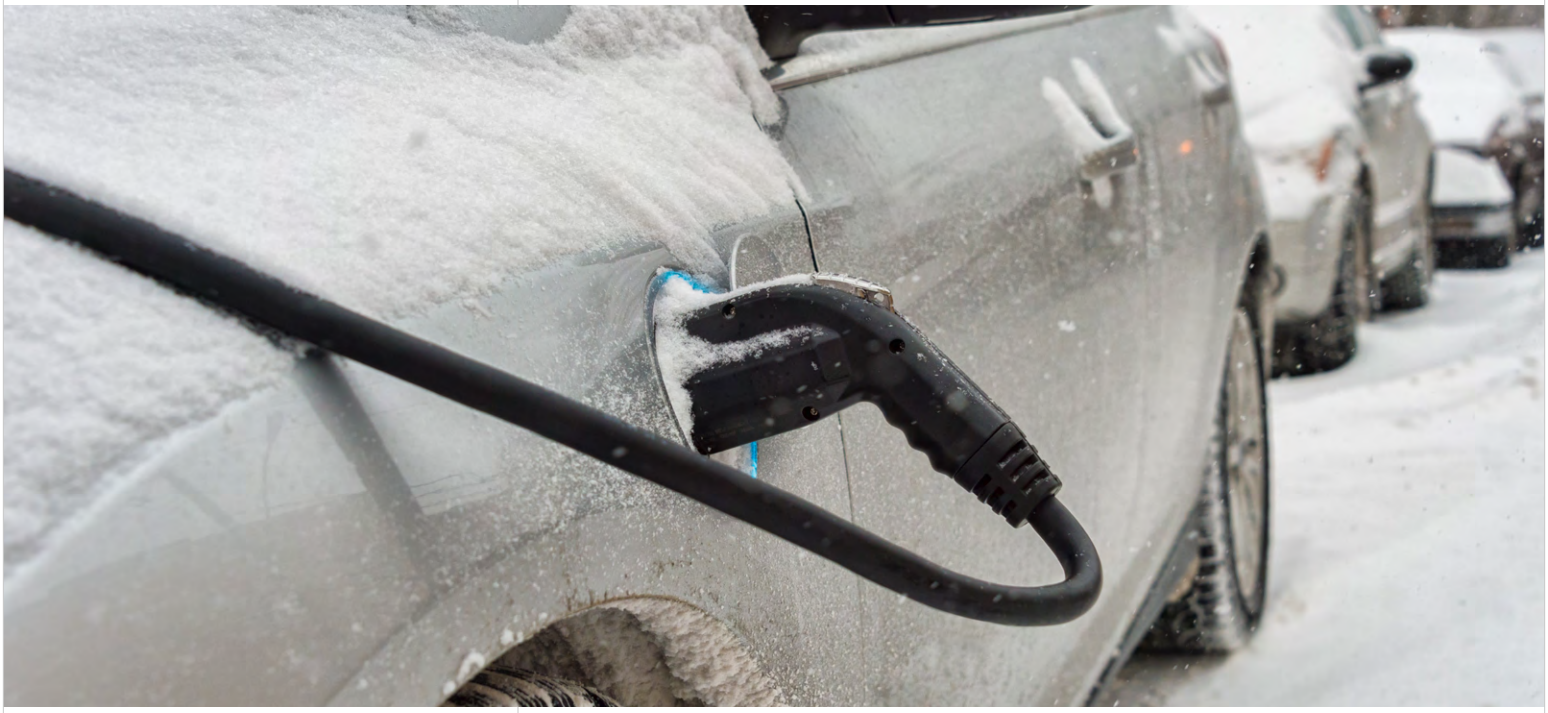
This report is a first step in assessing the role of independent intermediaries in advancing industrial policy. We have three suggestions for future research to explore this topic further.

» First, a *social network analysis* could prove useful in gaining a better understanding of interactions within the ecosystem. This includes the intensity, scope and type of players involved in the electric transportation ecosystem in Quebec. To this end, a promising research method would be to ask Propulsion Québec members about their suppliers (foreign companies, Quebec companies, Propulsion Québec members) to map the supply chains of the main electric transport technologies.

» Second, a *media analysis* could prove valuable in assessing Propulsion Québec's impact on public discourses. This could advance our understanding of its impact on the ideas and narratives shaping the transition towards a Quebec electric transportation sector. One way of doing this would be to carry out keyword searches on databases (e.g. Eureka) to measure both the presence of Propulsion

Québec (e.g. Michelle Llambias Meunier; Propulsion Québec) and certain ideas (e.g. electric and smart transport, battery industry) in the public space (e.g. newspapers) over time (before and after the creation of Propulsion Québec).

» Third, *international comparison* could advance our understanding of an independent intermediary in industrial policy; for example, exploring jurisdictions that have experienced similar growth in the electric transportation sector in recent years (e.g. British Columbia, Sweden). Such comparative analysis could also focus on specific industries (e.g. batteries) and explore jurisdictions with public-private partnerships acting as independent intermediaries. Overall, further engagement with comparative analysis could help rigorously test the present findings and better understand the role of independent intermediaries in different political and institutional contexts.



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Appendix A

Mining Exploitation & Processing

Activity area	Project	Investment (CAD$ Million)	Estimated job creation	Reference
Lithium	(Authier)	120	176	https://www.lecitoyenrouynlasarre.com/article/2019/11/14/le-projet-authier-lithium-prend-de-la-valeur
	Lithium Amérique du Nord (La Corne)	555	220	https://ici.radio-canada.ca/nouvelle/1990450/mines-lithium-sayona-abitibi-economie https://ici.radio-canada.ca/nouvelle/1853782/authier-la-corne-lihium-mine-complexe-minier
	Moblan	500	150	https://comexqc.ca/wp-content/uploads/V3_Annx-04.00_MobLi_EIES-3214-14-62_Vol-3-mod.pdf https://www.lapresse.ca/affaires/entreprises/2023-01-04/strategies/sayona-en-voie-de-devenir-le-premier-producteur-nord-americain-de-lithium.php
	James Bay (Allkem)	380	220	https://www.journaldequebec.com/2022/11/28/un-projet-de-380-millions--verra-le-jour-a-la-baie-james
	Rose Lithium Tantale (Critical Elements)	341	200	https://ici.radio-canada.ca/nouvelle/1646142/nord-quebec-autochtones-poissons-rose-lithium-lac-cris https://www.ree.environnement.gouv.qc.ca/dossiers/3214-14-053/3214-14-053-15.pdf
	Nemaska Lithium (Wabouchi + Bécancour)	2,000	410	https://www.lapresse.ca/affaires/entreprises/2022-06-30/une-relance-qui-coute-cher-pour-nemaska-lithium.php https://www.lapresse.ca/affaires/entreprises/2023-06-14/nemaska-lithium-a-becancour/au-moins-un-demi-milliard-de-plus-que-prevu.php
Graphite	Matawine	350	97	https://www.bape.gouv.qc.ca/fr/dossiers/projet-minier-matawinie-a-saint-michel-des-saints/ https://www.ree.environnement.gouv.qc.ca/dossiers/3211-16-019/3211-16-019-2.pdf
	Lac Guéret	258	100	https://ici.radio-canada.ca/nouvelle/1140389/le-projet-de-mason-graphite-coutera-plus-cher https://www.journaldequebec.com/2018/07/11/mason-graphite-fait-le-point
	La Loutre	236	140	https://lomiko.com/fr/projets/projet-la-loutre/ https://lomiko.com/la-loutre-community-updates/frequently-asked-questions/
Nickel	Bécancour	200		https://www.lapresse.ca/affaires/entreprises/2022-11-17/filiere-quebecoise-des-batteries/le-geant-vale-s-apprete-a-debarquer-au-quebec-grace-a-gm.php

Cell Manufacturing & Components

Activity area	Project	Investment (CAD$ Million)	Estimated job creation	Reference
Anode active material	Baie-Comeau	1,000	750	https://www.lesaffaires.com/dossier/industrie-miniere-la-course-aux-minerais-d-avenir/le-triathlon-de-nouveau-monde-graphite/640966
	Bécancour	350	150	https://www.lenouvelliste.ca/2020/10/27/nouveau-monde-graphite-arrive-a-becancour-avec-ses-350-m-dinvestissements-62eb8b6b842e3c115009822481d43b7e/
Copper foil (anode material)	Granby	750	260	https://ici.radio-canada.ca/nouvelle/2008008/voiture-electrique-batterie-solutions-volta
Cathode active material	Ultium Cam (Bécancour)	600	200	https://www.tvanouvelles.ca/2023/05/29/gm-posco-sinstallera-a-becancour
	Ford (Bécancour)	1,200	345	https://www.tvanouvelles.ca/2023/08/17/plus-de-640-m-pour-la-construction-dune-usine-ford-a-becancour
Cell manufacturing	Northvolt (St-Basile-le-grand)	7,000	3,000	https://www.tvanouvelles.ca/2023/09/28/northvolt-le-plus-important-investissement-prive-au-quebec-sera-annonce-ce-matin

Battery Module and Pack & Recycling

Activity area	Project	Investment (CAD$ Million)	Estimated job creation	Reference
Battery module and pack	Lion Electric (Mirabel)	200	100	https://www.ledevoir.com/economie/789241/l-usine-de-batteries-de-lion-ouvre-ses-portes-a-mirabel
Recycling	Lithion technologies (St-Bruno-de- Montarville)	80	160	https://www.lapresse.ca/affaires/entreprises/2022-04-01/filiere-batteries/une-usine-de-recyclage-verra-le-jour-dans-la-region-montrealaise.php

The Transition Accelerator

L'Accélérateur de transition