CANADA'S ELECTRIC VEHICLE BATTERY SUPPLY CHAIN
SECTOR PROFILE

MARCH 2024

ABOUT ECO CANADA

Environmental Careers Organization (ECO Canada) is a not-for-profit corporation established in 1992 as part of Canada's Sector Council Initiative. ECO Canada is focused on identifying, communicating, and meeting the needs of environmental practitioners, employers, educators, and students. Its vision is to build the world's leading environmental workforce.

ECO Canada has supported Canada's environmental workforce by establishing professional development resources, training programs and educational partnerships, conducting in-depth labour market research and providing the largest industry-specific job board.

ECO Canada's programs and services are developed through strong national partnerships, consultative strategic planning, and ongoing labour market research. Its labour market research provides valuable insights into environmental career trends, which can be used by governments, educators, youth, and industry partners to make decisions and formulate strategies. To learn more, please visit www.eco.ca.

ACKNOWLEDGEMENTS

We acknowledge the research expertise provided by Foresight Canada. We are also thankful for the invaluable information provided by the organizations who participated in our interviews.

- Canadian Critical Minerals and Materials Alliance
- Clean Energy Canada
- ArcelorMittal
- Nano One Materials
- Next Generation Manufacturing Canada
- NFI Group
- Summit Nanotech
- Transition Accelerator
- Trillium Network for Advanced Manufacturing
- Umicore
- Wyloo Metals Canada

Many thanks to those who have provided ongoing advice and feedback regarding our research through ECO Canada's Sectoral Workforce Solutions National Advisory Committee.

Individuals or organizations interested in contributing to future research projects can send a request to research@eco.ca

Natural Resources Canada | Ressources naturelles Canada

Funded by the Government of Canada's Sectoral Workforce Solutions Program | Canada

The opinions and interpretations in this publication are ECO Canada's and do not necessarily reflect those held by the Government of Canada.

LIABILITY DISCLAIMER AND TERMS OF USE

For comments or questions, contact: Research@eco.ca

FORWARD-LOOKING DISCLAIMER

This sector profile report (the "Report") on Canada's electric vehicle (EV) battery supply chain has been prepared by Foresight for ECO Canada (ECO) solely for informational purposes.

The Report contains forward-looking statements that reflect current expectations and projections about future events, trends, and developments in the national and global electric vehicle (EV) battery supply chain sector. These forward-looking statements involve known and unknown risks, uncertainties, and other factors that may cause actual results, performance, or achievements to materially differ from any future results, performance, or achievements expressed or implied by such statements.

Forward-looking statements in this Report may include, but are not limited to, projections about:

- Trends in the EV battery supply chain sector nationally and globally.
- Anticipated investments in EV battery production and assembly within Canada.
- Expected labour market trends, including employment opportunities and skill requirements in the Canadian EV battery supply chain.
- Developments in technology and innovation, including automation, in EV and EV battery manufacturing processes.

These statements are based on various assumptions and analyses made from data sources ECO has deemed reliable of historical trends, current conditions, expected future developments, and other factors we believe are appropriate. While we strive to provide insightful and thoughtful reports, we caution the reader that forward-looking statements are inherently subject to business, economic, competitive, and regulatory uncertainties and risks, which could cause actual outcomes to differ materially from those anticipated in the forward-looking statements.

The information presented in this Report is based on data and resources available during writing. ECO is not obligated to update or revise any forward-looking statements, whether because of new information, future events, or otherwise, except as required by applicable law. Readers are advised not to place undue reliance on these forward-looking statements. ECO disclaims any intention or obligation to update or revise any forward-looking information, whether due to new information, future events, or otherwise.

The reader should read this disclaimer in conjunction with the entire Report. ECO encourages readers to consider all factors mentioned herein before making any decisions based on the information provided.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Canada is in a unique position to become a major player in the global Electric Vehicle (EV) battery supply chain. Investment in Canada's EV battery supply chain has been substantial to date, with billions of public and private sector dollars flowing into the establishment of EV and EV battery manufacturing facilities. These investments have resulted in hiring increases across the board and rising demand for workers with skills relevant to the production of batteries, critical minerals, and EVs.

The challenge is finding workers with the right skills, in the right place, at the right time. Shifting to EV manufacturing in Canada will create significant demand for workers with different skills than those needed for traditional internal combustion engine vehicle (ICEV) manufacturing. Further, the manufacture of the EV battery requires specialized skills for materials processing and cell assembly that are very difficult to find in Canada as this is not an industry that has previously existed in the country.

Occupations critical to Canada's EV battery supply chain include:

TECHNOLOGISTS AND TECHNICIANS

- Electrical and electronics engineering
- Mechanical engineering
- Industrial engineering and manufacturing

ENGINEERS

- Chemical
- Industrial and manufacturing
- Electrical and electronics
- Mechanical
- Metallurgical and materials
- Mining

COMPUTER AND DATA SCIENCE

- Computer engineers
- Software engineers
- Data scientists

SUPERVISORS

- Machining, metal forming, shaping and erecting trades
- Mechanic trades
- Electronics and electrical products manufacturing
- Motor vehicle assembling
- Supply chain, tracking and scheduling coordination

SKILLED TRADES

- Industrial electricians
- Heavy-duty equipment mechanics
- Construction millwrights and industrial mechanics
- Welders and relate machine operators

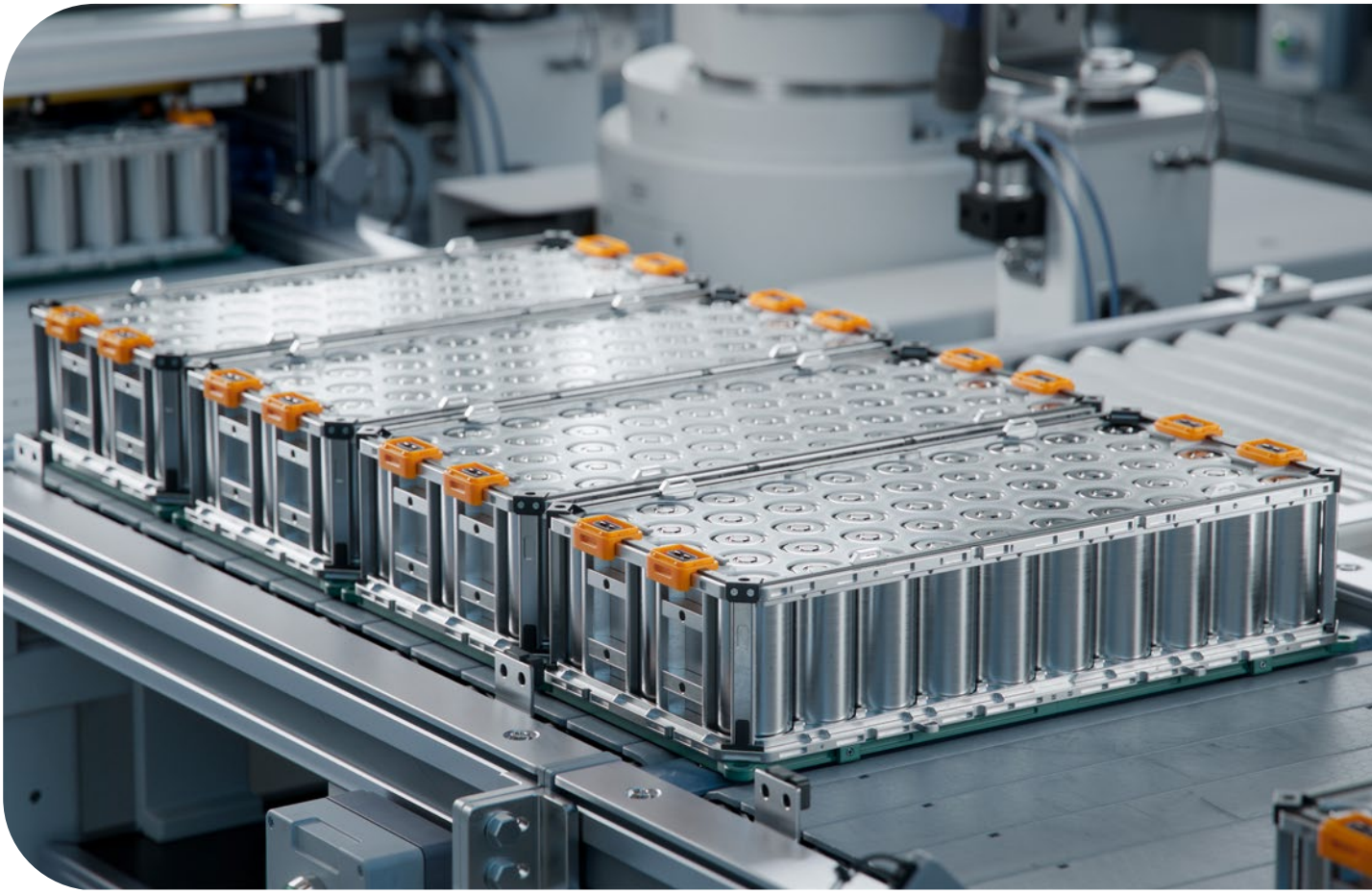
LABOUR

- Electronics assemblers, fabricators, inspectors and testers
- Metal fabrication
- Mineral and metal processing
- Electrical apparatus manufacturing machine operators and inspectors
- Material handlers
- Motor vehicle assemblers, inspectors and testers

Despite these being the most critical occupations, it is important to note that in the EV transition, and the creation of an entire supply chain, demand for workers will be apparent in many occupations. As companies establish, workers will be needed in logistics, transportation, finance, human resources, sales, and other roles essential to corporate operations. Developing the infrastructure to support the EV transition will necessitate workers in civil engineering, construction, utilities, and planning among others.

Sustainability and policy-related roles will be a core component of ensuring the success of the supply chain. Environmental management skills such as environmental impact assessment, remediation, regulatory compliance, conservation and stewardship, and sustainability integration are also essential for workers, as there is a need for industry in the EV battery supply chain to effectively manage their climate and environmental impact, comply with regulations, and meet stakeholder expectations.

Overall, the growth of the EV battery supply chain in Canada has the potential to reshape the workforce landscape, creating new opportunities in related industries, while also necessitating adjustments for workers in traditional automotive sectors. Effective workforce planning, training programs, and government support will be essential to maximize the benefits of this transition for Canadian workers.



THE CANADIAN EV BATTERY LANDSCAPE: CANADA'S COMPETITIVE EDGE

According to the International Energy Association (IEA), the transition to a clean energy system is driving an increase in mineral markets, and in their sustainable development scenario, global EV sales exceed 70 million by 2040.[1]

The EV battery supply chain and manufacture of EVs in North America is a significant opportunity for Canada. A combination of the right resources, an industrial culture prioritizing strong environmental, social, and governance (ESG) performance, and existing automotive manufacturing expertise puts Canada in a strong position to take advantage of this industrial shift.

The minerals and metals required for making an EV, and their expected demand growth from 2020 to 2040 include:[2]

Copper	**3x** ↑
Lithium	**42x** ↑
Cobalt	**21x** ↑
Rare earth elements	**7x** ↑
Nickel	**19x** ↑
Manganese	**8x** ↑
Graphite	**25x** ↑

1 International Energy Agency, 2021.
2 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.

Canada has all these material resources and the mining expertise and sustainability focus to be a top global producer of battery metals.[3]

Canada also has an established vehicle manufacturing industry. Leading automakers like Ford, Stellantis, and Volkswagen have already invested in EV manufacturing operations in Canada.[4]

With high projected demand, and strong potential to create a robust supply chain, Canada's opportunity is there for the taking.

The Economic Impact

Economic modelling done by Clean Energy Canada and the Trillium Network for Advanced Manufacturing projects that the EV battery supply chain in Canada could support between **60,000 and 250,000 jobs** (direct and indirect) and directly contribute up to $24 billion in GDP by 2030.[5]

As of 2024, Canada has already seen **major investments** from companies across the supply chain including Stellantis and LG Energy Solution, Northvolt, Unicore, Volkswagen, and Ford into developing Canada's battery market, which will create thousands of jobs in the coming years.

While investments in battery production and EV assembly have been largely concentrated in Ontario and Quebec, the supply chain's development is projected to create jobs across the country in areas such as mineral exploration, mining, battery materials, and recycling and reuse, particularly in mineral-rich areas.[6]

The challenge is developing the **skills and workforce** needed to ensure a thriving EV battery supply chain, boosting Canada's manufacturing prowess.[7]

3 Allan, 2022.
4 Amadee & Loertscher, 2023.
5 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022; Natural Resources Canada, 2022.
6 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.
7 Canadian Battery Task Force, 2022.

INTRODUCTION

The demand for electric vehicles (EVs) is growing worldwide, and Canada has a chance to be a world leader in the sector. Countries including Canada are setting ambitious targets to transition to zero-emission vehicles (ZEVs) including EVs in pursuit of emission reduction and achieving net zero goals. Market and investment trends, both global and domestic, suggest an opportunity to maximize the value of Canada's battery production supply chain and meet the growing demand for EVs.

Canada is the only country in the Western Hemisphere with known reserves of all the raw materials necessary to manufacture EV batteries[8] and has ample mining expertise and strong environmental, social, and governance (ESG) credentials.

In the Canadian context, the emergence of the EV battery supply chain signifies a strategic opportunity to position the nation as a leader in clean energy innovation. However, Canada's potential leading position is not solidified with the domestic EV battery supply chain facing significant gaps. Underscoring this potential is the need for a highly skilled and adaptable workforce. This sector profile provides a comprehensive overview of the Canadian EV battery supply chain with a focus on the workforce, exploring key trends, challenges, and opportunities shaping the future of this burgeoning industry.

This report, based on secondary research and stakeholder interviews, aims to shed light on the crucial role of human capital in driving forward the transition to electric mobility and ensuring a sustainable energy future for generations to come.

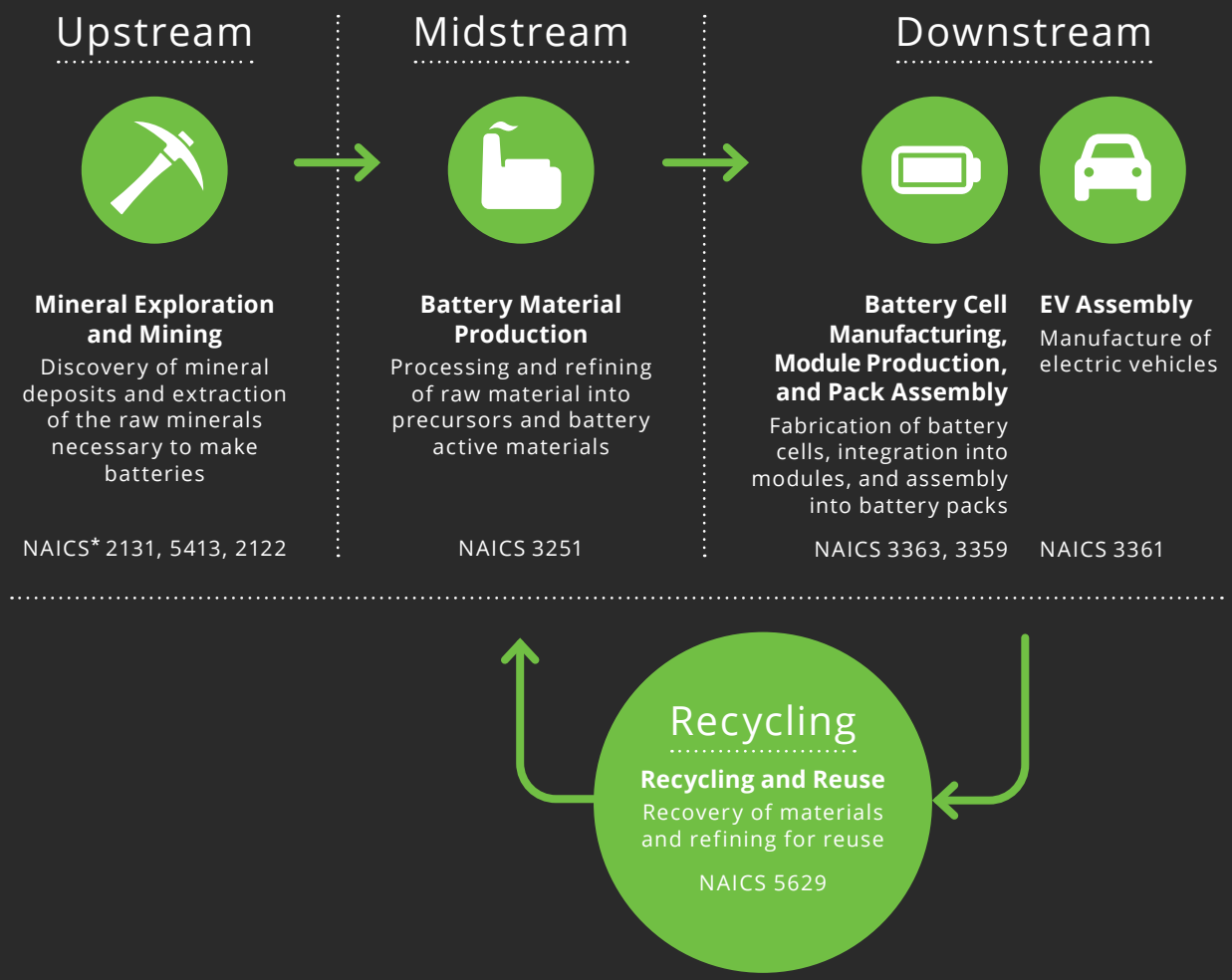
8 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.

SPOTLIGHT: The EV Battery Supply Chain Sector Defined

From a high-level perspective, a supply chain is an entire system of production that encompasses all the raw materials used to manufacture a product. The system required to manufacture EVs includes everything from mining the metals and minerals needed to make batteries, to processing those materials, to manufacturing and recycling the end products. This study focuses on the supply chain segments summarized in Table 1.

Figure 1

The EV battery supply chain segments and definitions



*NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM CODES

Sources: Allan, 2022; Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.

GLOBAL AND CANADIAN TRENDS IN THE EV BATTERY SUPPLY CHAIN

Global Trends

As the urgency of global greenhouse gas (GHG) emission reduction grows, the need for the electric mobility transition will need to increase. Countries around the world are thus implementing policies to enforce the adoption of zero-emission vehicles (ZEVs), including EVs. In 2023, the European Union (EU) implemented carbon dioxide emissions standards for light-duty vehicles (LDVs) requiring a 100 percent reduction in emissions of new cars and vans by 2035.[9] California approved the Advanced Clean Cars II rule in 2022 which requires 100 per cent of passenger LDV sales to be ZEVs by 2035, a mechanism that has been adopted by several other states.[10] Japan announced a target of 100 percent electric LDVs by 2035 in 2021. And many other countries including the United Kingdom, Indonesia, New Zealand, and South Korea have implemented incentives or regulations of their own to increase EV adoption.[11]

China is the current world leader in EV battery manufacturing. It is estimated that the country claims 80 per cent of the battery cell manufacturing capacity as well as battery material refining capacity globally.[12] Considering the geopolitical tensions and global supply chain disruptions experienced over the past few years, many countries are taking steps to compete in this space, especially as EV demand and sales steadily increase.

The International Energy Agency (IEA) reported that 14 percent of all new cars sold in 2022 were electric, exceeding 10 million in sales.[13] China has the largest market for EVs, with 60 percent of all global EV sales, followed by Europe and the United States (US).[14] However, the markets with the highest percentage of EV sales are Norway (80 percent), Iceland (41 percent), Sweden (32 percent), the Netherlands (24 percent), and China (22 percent).[15] Looking to leading regions like Norway, the only country where the majority of car sales are EVs, it is evident that a strong policy framework is a major factor to the rise of EV prevalence. The Norwegian government has been promoting EV adoption since 1990.[16] Infrastructure is another key factor in Norway as well as in other leading regions like China, which has reportedly installed more charging points than the rest of the world combined.[17]

9 International Energy Agency, 2023b.
10 Ibid.
11 Ibid.
12 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.
13 International Energy Agency, 2023a.
14 Ibid.
15 Jaeger, 2023.
16 Ibid.
17 Ibid.

With demand projected to increase dramatically over the coming years, global policies are also targeting development of supply. The EU's 2023 Green Deal Industrial Plan includes provisions to fast-track permitting for manufacturing facilities, including battery production, as well as a focus on developing a Critical Raw Materials Act to secure materials.[18] India's Production Linked Incentives in Advanced Chemistry Cell Battery Storage was launched in 2021 to bolster battery manufacturing capabilities in the country.[19] And the US *Inflation Reduction Act* (IRA) of 2022 includes the Clean Vehicle Tax Credit to incentivize North American manufacturing of EVs, and the Advanced Manufacturing Production Tax Credits to subsidize domestic battery production.[20] The IRA is expected to have an outsized impact on the development of the North American EV battery supply chain and has reportedly already spurred over $62 billion in investment and grew EV-related jobs by 27 percent.[21] Requiring roughly half of the value of battery components to be produced or assembled in North America, and 40 percent of the value of critical minerals used to be sourced from the US or a free trade partner,[22] the IRA will also have significant impact on Canada's EV battery supply chain as a potential supplier to the US automotive market.

The global shift to EVs is propelling major industrial reorganization across several sectors, including mining, automotive manufacturing, battery manufacturing, and battery recycling. EVs use six times the amount of metals and minerals as an internal combustion engine vehicle (ICEV), thereby increasing the need for mining.[23] Manufacturing will change as a result of differing assembly requirements between EVs and ICEVs. For example, EVs need a battery pack and electric motor rather than an engine, which necessitates very different manufacturing processes.[24] Additionally, this shift to EVs represents significant investment in civil infrastructure, including charging stations, industrial land development, and increased electricity generation.[25] These fundamental changes to industrial organization have spurred policy-based competition as various governments compete for the lead and a 'slice of the pie'.[26] Despite China's dominance in the current EV battery supply chain, increasing market demand and efforts to onshore manufacturing to North America represents a chance for Canada to compete.

18 International Energy Agency, 2023b.
19 Ibid.
20 Ibid.
21 Fujita, 2023.
22 Ibid.
23 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.
24 McNally, 2023.
25 Next Generation Manufacturing Canada, 2022.
26 Jones et al., 2023.

National Trends

The Canadian government has taken note of the large opportunity for Canada to position itself as a global leader in the EV supply chain and implemented policies in pursuit of the EV transition.

Notably, on the demand side, the federal government introduced the Electric Vehicle Availability Standard in 2023, which mandates the phase-out of ICEV sales, with gradually increasing EV sales requirements for automakers reaching 100 percent by 2035.[27]

On the supply side, and in addition to billions of dollars of investments in the EV battery supply chain from the federal government, the Clean Technology Manufacturing Investment Tax Credit (ITC) introduced in the 2023 federal budget is intended to incentivize private investment in manufacturing of batteries, EVs, recycling, or extraction and processing of critical minerals including lithium, cobalt, nickel, graphite, copper, and rare earth elements.[28]

To capitalize on this potential, Canada has negotiated several deals with major EV and EV battery supply chain players. NextStar Energy, a joint venture of LG Energy Solution and Stellantis, is currently constructing a $5 billion EV battery manufacturing facility with an annual production capacity of 49.5 gigawatt hours (GWh) in the Windsor, Ontario area.[29] Umicore has invested almost $2 billion in the construction of a battery materials plant in Loyalist, Ontario to produce cathode active materials (CAM) and precursor (pCAM).[30] Ford has invested $1.8 billion to upgrade its existing Oakville, Ontario assembly plant to produce electric vehicles.[31] And Northvolt is investing in a $7 billion EV battery manufacturing facility outside Montreal, Quebec with an initial production capacity of 30 GWh.[32]

27 https://www.canada.ca/en/environment-climate-change/news/2023/12/canadas-electric-vehicle-availability-standard-regulated-targets-for-zero-emission-vehicles.html.

28 https://www.canada.ca/en/department-finance/news/2023/11/canada-announces-first-major-investment-tax-credit-project-to-create-good-jobs.html.

29 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022; CTV News Windsor, 2023.

30 "Umicore Confirms Expansion of Its EV Battery Materials Production Footprint in Canada", 2023.

31 "Ford's Oakville, Ontario, Complex Prepares to Build Next-Gen EVs; C$1.8 Billion Transformation Begins 2024", 2023.

32 Mukherjee & Rajagopal, 2023.

SPOTLIGHT: Notable Recent Investments in Canada

Table 1

Notable Canadian EV battery supply chain investments (as of February 2024)

Companies	Subsector	Location	Investment Amount (CAD)	Estimated New Jobs
Umicore (Amadee & Loertscher, 2024; "Umicore Confirms Expansion of Its EV Battery Materials Production Footprint in Canada," 2023)	Battery Material Production	Loyalist, ON	$2.1 billion	600
NextStar Energy (Stellantis and LG Energy Solutions) (CTV News Windsor, 2023)	Battery Cell Manufacturing, Module Production, and Pack Assembly	Windsor, ON	$5 billion	2,500
Volkswagen - PowerCo SE (Butler, 2023)	Battery Cell Manufacturing, Module Production, and Pack Assembly	St. Thomas, ON	$16.3 billion	3,000
Magna (Office of the Premier, 2023)	Battery Cell Manufacturing, Module Production, and Pack Assembly	ON (six locations)	$471 million	1,000
General Motors CAMI (Canadian Press, 2022)	EV Assembly	Ingersoll, ON	$2 billion	300
Ford (Amadee & Loertscher, 2024)	EV Assembly	Oakville, ON	$1.8 billion	345
General Motors-POSCO (Amadee & Loertscher, 2024; Shakil, 2023)	Battery Material Production	Becancour, QC	$600 million	200
Volta Energy Solutions (Solus Advanced Materials) (Ljunggren, 2023)	Battery Cell Manufacturing, Module Production, and Pack Assembly	Becancour, QC	$450 million	260
Northvolt (Jonas, 2023)	Battery Cell Manufacturing, Module Production, and Pack Assembly	Montreal, QC	$7 billion	3,000

Despite these prominent deals attracting key global corporations, Canada's leadership position in the sector is not yet secure. In fact, there are notable gaps in Canada's supply chain that represent significant barriers.

Most of the investment in Canada to date has been in the later midstream and downstream segments (i.e., EV assembly, battery cell manufacturing and pack assembly, and battery active materials manufacturing) with no strategy to achieve balanced investment in the upstream and early midstream segments (i.e., mining and mineral processing). Canada currently does not have the ability to process critical minerals to the battery-grade materials that are needed for later midstream and downstream industries.[33] Further, despite having known reserves of all the minerals needed for EV battery manufacturing, the scale of demand for critical minerals will exceed our production capabilities from a mining perspective.[34] Massive investment will be required to increase production capacity.

Timelines are also concerning as it takes years for mining projects to become operational and can take decades for production.[35] The growth in mining activity required to meet the fast-growing demand for EV battery minerals will need to balance industrial activity with environmental and social responsibility and partnerships and collaboration with Indigenous communities. In seeking to shorten timelines Canada must therefore take a considerate approach to streamlining permitting and approval processes.[36]

33 Jarvis, 2023.
34 Paas-Lang, 2023.
35 Next Generation Manufacturing Canada, 2022; Paas-Lang, 2023.
36 Allan, 2022.

SPOTLIGHT: Supply Chain and Infrastructure Gaps Identified in Stakeholder Interviews

We interviewed stakeholders representing organizations across the supply chain, as well as sector experts from research institutions or non-governmental organizations (NGOs) in the space. These interviews revealed the following insights into the barriers to developing Canada's EV battery supply chain.

Supply chain gaps are a critical barrier to developing the sector.

- The lack of a battery materials processing sector is a huge opportunity that is lacking in Canada, and a critical part of growing the overall battery manufacturing sector.
- The timeline for Canada to establish enough new mining operations for critical minerals at the scale needed will be very difficult to accomplish. It takes decades for a mine to establish and produce.
- The battery recycling/reuse side of the supply chain is currently fragmented. We do not yet have the systems set up to efficiently and effectively capture minerals and metals for reuse. However, there is a large opportunity to grow the battery recycling sector to satisfy the exponentially growing need for critical minerals considering the timelines needed for primary resource extraction.

Infrastructure gaps are an important barrier to overcome in establishing the supply chain.

- Major industrial projects will need sufficient electricity supply, road networks, and industrial land tracks for large manufacturing operations. In many cases, that infrastructure is not yet established.

CANADIAN EV BATTERY SUPPLY CHAIN WORKFORCE TRENDS

The Canadian workforce stands at the forefront of a transformative era as we seek to develop an EV battery industry. As the global demand for electric vehicles continues to surge the capacity and capabilities of the Canadian labour market becomes an increasingly significant part of the conversation. This section explores the dynamics of the Canadian EV battery supply chain workforce, delving into labour market trends and discussing the critical skills and occupations needed to shape the future of sustainable transportation.

Labour Market Trends

Investment in the Canadian EV battery supply chain has been substantial to date, with billions of public and private sector dollars flowing into the establishment of EV and EV battery manufacturing facilities.[37] With this surge of industrial investment comes heightened demand for workers with particular skill sets. NextStar Energy's Windsor plant will create approximately 2,500 jobs as they manufacture lithium-ion battery cells and modules,[38] Northvolt's Montreal-based battery cell manufacturing facility will create up to 3,000 jobs in the region,[39] General Motor's CAMI Assembly plant in Ingersoll will add almost 300 jobs to support the addition of battery module production to their EV manufacturing operations,[40] and thousands more jobs will be created through investments from Umicore, Ford, Volkswagen, and beyond. These investments have resulted in hiring increases across the board and rising demand for workers with skills relevant to the production of batteries, critical minerals, and EVs.[41]

37 Hinton, 2024.
38 CTV News Windsor, 2023.
39 Jonas, 2023.
40 GM, n.d.
41 Ontario Vehicle Innovation Network (OVIN), 2023.

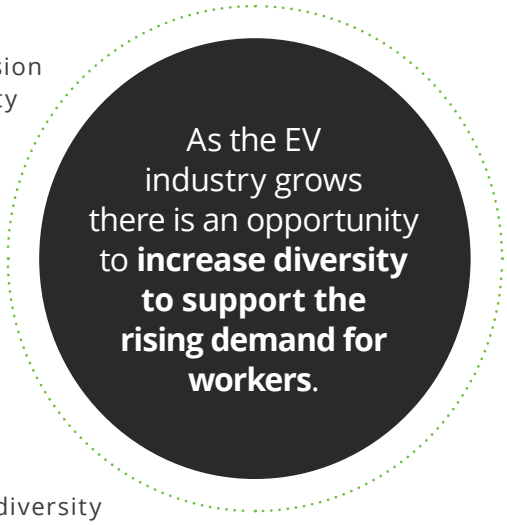
The availability of jobs is therefore not the problem, what will be the challenge is finding workers with the right skills, in the right place, at the right time. EV manufacturing and EV battery manufacturing has created significant demand for workers, but workers with different skills than those needed for traditional ICEV manufacturing. Though Canada has an existing automotive manufacturing sector that employs almost 500,000 workers,[42] the change in manufacturing processes will impact the worker expertise needed by original equipment manufacturers (OEMs).[43] The manufacture of the EV battery requires specialized skills for materials processing and cell assembly that are very difficult to find in Canada as this is not an industry that has previously existed in the country.[44] Ultimately we are witnessing a shift in industrial organization as we move from a fuel-intensive to a material-intensive energy system. With this shift comes the reshaping of traditional supply chains and a change in demand for jobs and skills. The transition to a material-intensive energy system will necessitate a skilled and adaptable workforce.

In addition to the skills gap evident in the workforce it is becoming increasingly difficult for employers to find workers for a variety of factors, one of which is location. Often, the location of operations are not necessarily in places with an abundance of workers, and it has been increasingly difficult to attract young workers to roles in more remote locations, such as in the mining sector. Another factor is the heightened timeline. The EV battery supply chain is growing fast, and the demand for workers with the right skills and in the right quantity will be swift. There is also competition to attract and retain workers to EV battery supply chain roles as adjacent 'green sectors' like renewable energy look for candidates with similar skills, and as larger, more established regions like the US look to Canadian talent to fill their EV battery supply chain roles with higher salary offerings. Adding to the issue is the aging workforce in Canada, and the need to replace retiring employees.

The fast-paced establishment of this supply chain and the associated demand for labour has pushed some companies to look to international workers for support. NextStar faced significant backlash from politicians after bringing in about 1,600 workers from South Korea to support in the establishment of their Windsor EV battery plant.[45] However, sector experts note that this is not a surprising move from the company with the current lack of expertise in this space among the Canadian workforce.[46]

42 *Investing in Canada's Auto Sector, It's Workers, and Our Clean Future*, 2022.
43 FOCAL Initiative, 2021.
44 Jarvis, 2023.
45 CBC News, 2023.
46 CBC News, 2023.

As the demand for workers soars, equity, diversity, and inclusion (EDI) in the EV battery supply chain workforce is a high priority and an opportunity to bring in workers who may not have otherwise considered entry into the sector. Women are under-represented in the traditional automotive and manufacturing sector workforce, comprising 23 per cent of assembly workers, 25% of parts production workers, and 28 per cent of the manufacturing labour force in comparison to 48 per cent of the broader Canadian workforce.[47] Indigenous workers represent just 2 per cent of the automotive workforce, and 26 per cent and 42 per cent of workers in the vehicle assembly and parts production sectors respectively identify as visible minorities.[48]



As the EV industry grows there is an opportunity to increase diversity to support the rising demand for workers. Additionally, as the prevalence and shift to EVs has roots in the need for emissions reduction there is a growing scrutiny on all parts of the supply chain to meet high ESG standards. Companies across the supply chain are taking note and are seeing the mutual benefit of growing with strong social and environmental values, including a commitment to EDI. The EV battery sector has the potential to position itself as an attractive field in which to work for women, BIPOC, and youth workers, broadening the talent pool and benefiting companies across the supply chain.

Technology and Innovation Trends and the Workforce

One of the foremost technology trends in common discourse over potential impacts to the workforce is the integration of automation into manufacturing processes. The integration of automation into EV and EV battery manufacturing presents both challenges and opportunities for the workforce. One argument proposes that automation threatens certain traditional manufacturing jobs as tasks become increasingly automated, leading to concerns about job displacement. Another challenge is the need for reskilling or upskilling of the workforce to create skillsets conducive to new automated manufacturing processes. However, the rise of automation can also be seen as an opportunity for workers to transition into higher-skilled roles that involve overseeing and maintaining automated systems, programming robots, and analyzing data generated by smart manufacturing technologies. Furthermore, automation can be a potential solution to the workforce gaps evident in the Canadian labour market. Companies can use "digital labour" to automate repetitive or dangerous tasks, giving more flexibility for human workers to focus on higher value tasks.[49] Mitigating the negative impacts of automation on the workforce will require conscious effort on the part of employers to invest in workforce training and development programs that equip workers with the skills needed to thrive in an automated manufacturing environment. Technology such as AI may even be used in training programs to support personalized learning.[50]

47 FOCAL Initiative, 2020.
48 Quick Facts on Canada's Auto Industry, n.d.
49 Favilla & Chandrasekaran, 2023.
50 Favilla & Chandrasekaran, 2023.

SPOTLIGHT: Technology And Manufacturing in the EV Battery Supply Chain

Technology has the potential to address many of the challenges in developing the EV battery supply chain in Canada. Examples of how technology can improve the manufacturing process include:

Data analytics and AI

Predictive maintenance: AI and data analytics can be employed to predict equipment failures and schedule maintenance proactively, minimizing downtime and optimizing workforce productivity.

Supply chain optimization: AI can enhance supply chain management by predicting demand, optimizing inventory levels, and improving overall efficiency. (Favilla & Chandrasekaran, 2023)

Digital twins and simulation

Process simulation: Digital twins and simulation technologies can be used to model and optimize manufacturing processes, allowing for experimentation and improvement without disrupting the actual production line. (Favilla & Chandrasekaran, 2023)

Remote monitoring and control

Remote operations: Technologies that enable remote monitoring and control of manufacturing processes can provide flexibility and may lead to changes in the traditional work environment.

Virtual reality (VR) and augmented reality (AR)

Training and education: VR and AR technologies can be utilized for training purposes, allowing workers to learn and practice in virtual environments before engaging with real-world equipment.

Robotics and automated vehicles and equipment

Precision and consistency: Automated systems can handle delicate and intricate tasks with a level of precision challenging for manual labour.

Worker safety: Automation can reduce the exposure of workers to potentially harmful substances and mitigate the risk of accidents.

Ultimately, deploying technology in operations represents an opportunity for the EV battery supply chain to look to innovation to do things in a better way. Entrepreneurs and innovators can play a crucial role in driving the evolution of the sector and build new, sustainable industrial systems. From innovation in battery chemistry and materials science, to battery manufacturing processes to battery recycling and reuse, innovation across the supply chain has the potential to enhance the performance, efficiency, and sustainability of EV batteries. In addition to technological innovation, entrepreneurs can also contribute to the EV battery supply chain through business model innovation and market development such as innovative financing and leasing models.

Critical Occupations and Skills

From mining and refining raw materials to manufacturing advanced battery technologies and vehicles there are critical occupations that will play a crucial role in shaping the success of the sector. In the EV battery supply chain, the occupations most critical to the sector are engineers, technologists and technicians, skilled trades, operators and labourers (see Table 2).

Table 2

Important occupations for the EV battery supply chain

Occupation Type	Occupation (NOC)	Subsector				
		Mineral Exploration and Mining	Battery Material Production	Battery Cell Manufacturing, Module Production, and Pack Assembly	EV Assembly	Recycling and Reuse
Technologists and Technicians	Electrical and electronics engineering technologists and technicians (NOC 22310)		X	X	X	X
	Mechanical engineering technologists and technicians (NOC 22301)	X	X	X	X	X
	Industrial engineering and manufacturing technologists and technicians (NOC 22302)		X	X	X	X
Engineers	Chemical engineer (NOC 21320)		X	X		X
	Industrial and manufacturing engineers (NOC 21321)		X	X	X	X
	Electrical and electronics engineers (NOC 21310)		X	X	X	X
	Mechanical engineer (NOC 21301)	X	X	X	X	X
	Metallurgical and materials engineers (NOC 21322)		X	X		X
	Mining engineer (NOC 21330)	X				
Computer and Data Science	Computer engineers (except software engineers and designers) (NOC 21311)		X	X	X	X
	Software engineers and designers (NOC 21321)		X	X	X	X
	Data scientists (NOC 21211)		X	X	X	X

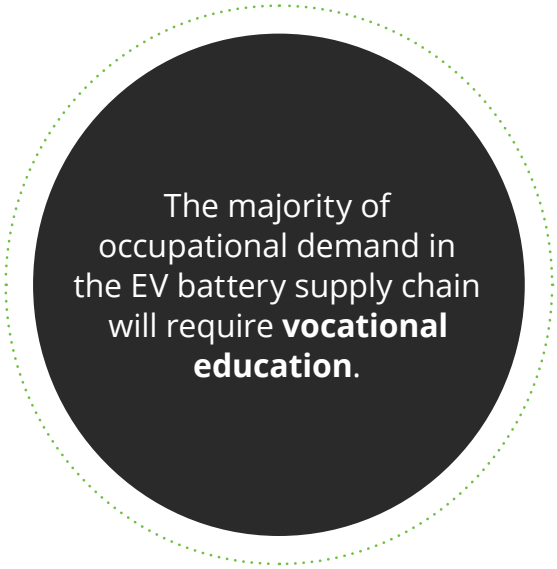
Occupation Type	Occupation (NOC)	Subsector				
		Mineral Exploration and Mining	Battery Material Production	Battery Cell Manufacturing, Module Production, and Pack Assembly	EV Assembly	Recycling and Reuse
Labour	Electronics assemblers, fabricators, inspectors and testers (NOC 94201)			X	X	
	Labourers in metal fabrication (NOC 95101)			X	X	
	Labourers in mineral and metal processing (NOC 95100)	X	X			X
	Machine operators and inspectors, electrical apparatus manufacturing (NOC 94205)	X	X	X		X
	Material handlers (NOC 75101)	X	X	X	X	X
	Motor vehicle assemblers, inspectors and testers (NOC 94200)				X	
	Other labourers in processing, manufacturing and utilities (NOC 95109)		X	X	X	X
Skilled Trades	Industrial electrician (NOC 72201)	X	X	X	X	X
	Heavy-duty equipment mechanics (NOC 72401)	X				
	Construction millwrights and industrial mechanics (NOC 72400)	X	X	X	X	X
	Welders and related machine operators (NOC 72106)				X	
Leadership	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations (NOC 72010)			X	X	
	Contractors and supervisors, mechanic trades (NOC 72020)	X	X	X	X	X
	Supervisors, electronics and electrical products manufacturing (NOC 92021)		X	X	X	
	Supervisors, motor vehicle assembling (NOC 92020)				X	
	Supervisors, supply chain, tracking and scheduling coordination occupations (NOC 12013)	X	X	X	X	X

Labour and Skilled Trades

Labour roles, such as assemblers, operators, and inspectors and skilled trades roles such as electricians, mechanics, and welders will be needed in the highest quantity. Research from the Ontario Vehicle Innovation Network (OVIN) projects a high labour market gap for manufacturing and skilled trades workers as demand is expected to well exceed market supply.[51] It is also notable that Chinese battery giant CATL reported that in 2022, over 75 per cent of employees did not have a bachelor's degree, and China is actively pushing vocational educational pathways for students to develop the skills required for the country's EV and semiconductor industry jobs.[52] The majority of occupational demand in the EV battery supply chain will require vocational education, and these roles will require skills specific to EVs and EV battery manufacturing.

Demand Across the Supply Chain

Critical occupations, and the specific skills needed in workers will differ across the various parts of the supply chain. In **mineral exploration and mining**, mining engineers are critical, as well as labour roles such as miners and blasters, and skilled tradespersons including heavy-duty equipment mechanics, electricians, and millwrights. Critical occupations for **battery material production** require specialized expertise from chemical engineers and metallurgical and materials engineers. **Battery components and cell manufacturing and assembly** note electrical and mechanical engineers and related technicians and technologists as critical, particularly those with battery experience, but manufacturing labour and tradespersons are also highly critical.[53] Similarly in the **EV assembly** subsector, labour roles including assemblers, inspectors, and testers will be critical and needed in large quantities. These roles will differ from ICEV assembly roles due to differences between the components and manufacturing process of EVs and ICEVs, as well as increased digitization and the rising prevalence of automation.[54] EV assembly will also require skilled tradespersons and technicians, especially those with electrical and mechanical expertise. Critical occupations in **battery recycling and reuse** include similar hard tech roles to the rest of the supply chain like chemical and metallurgical and materials engineers, technicians, and skilled labour roles.



51 Ontario Vehicle Innovation Network (OVIN), 2023.
52 CATL, 2023; Cheng, 2023.
53 Ontario Vehicle Innovation Network (OVIN), 2023.
54 McNally, 2023.

Despite these being the most critical occupations, it is important to note that in the EV transition, and the creation of an entire supply chain, demand for workers will be apparent in many occupations. As the manufacturing process becomes more advanced and digital across all parts of the supply chain, demand for computer and data scientists will increase. As companies establish, workers will be needed in logistics, transportation, finance, human resources, sales, and other roles essential to corporate operations. Developing the infrastructure to support the EV transition will necessitate workers in civil engineering, construction, utilities, and planning among others. Sustainability and policy-related roles will be a core component of ensuring the success of the supply chain. Overall, the growth of the EV battery supply chain in Canada has the potential to reshape the workforce landscape, creating new opportunities in related industries, while also necessitating adjustments for workers in traditional automotive sectors. Effective workforce planning, training programs, and government support will be essential to maximize the benefits of this transition for Canadian workers.

We can take a rough assumption that **75 per cent** of projected workers or about **82,863 total employees** will be working as technicians, technologists, skilled trades, or labour.

To quantify the potential occupational demand across the EV battery supply chain in Canada, certain assumptions must be accepted. In modelling from the Trillium Network for Advanced Manufacturing and Clean Energy Canada, four scenarios were presented to model the potential economic impact of Canada's EV battery supply chain.[55] The scenarios project between 60,000 and 250,000 direct and indirect jobs supported by 2030, depending on factors such as EV sales targets, mining production capacity, and level of investment.[56] In the second most restrictive scenario where Canada reaches ZEV sales targets, expected direct workers are 110,485.[57] Assuming CATL's employee distribution statistics in which over 75 per cent of their employees did not have a bachelor's degree[58] and assuming the **on-target scenario which indicates 110,485 jobs**, we can take a rough assumption that 75 per cent of projected workers or about **82,863 total employees will not have a bachelor's degree**, thereby will be working as technicians, technologists, skilled trades, or labour.

55 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022; Trillium Network for Advanced Manufacturing, 2022.
56 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.
57 Trillium Network for Advanced Manufacturing, 2022.
58 CATL, 2023.

Based on the same modelling, in the on-target scenario, the estimated expected number of jobs per supply chain segment are:[59]

- Mineral exploration and mining: 2,500
- Battery material production: 11,500
- Battery cell manufacturing, module production, and pack assembly: 12,200
- EV assembly: 82,000
- Recycling and reuse: 1,000

Skills and Qualifications

Table 3

Qualification requirements for critical occupation types in the EV battery supply chain

Occupational Type	Qualifications (Employment and Social Development Canada, n.d.)
Technologists and Technicians	• 2-3 year college program - technologists • 1-2 year college program - technicians • Certification may be required
Engineers	• Bachelor's degree in engineering • Licensing by an association of professional engineers (P.Eng. designation)
Computer and Data Science	• Bachelor's degree in computer engineering or a related area and licensing by an association of professional engineers is required for computer engineers
Manufacturing Labour	• Some or full secondary school education may be required • Some roles may require on-the-job training • Some roles may require post-secondary courses or apprenticeship programs (i.e., electronic testing, assembling, etc.)
Skilled Trades	• Secondary school education and training programs or a vocational program is required • 3-5-year apprenticeship program or acceptable work experience is required for eligibility for trade certification • Red Seal examination and endorsement is sometimes required
Leadership	• Qualifications for associated occupational type are required, plus several years of workplace experience • Post-graduate degrees (MBA's or relevant specializations) are often required

59 Clean Energy Canada & Trillium Network for Advanced Manufacturing, 2022.

The general qualification requirements for different critical occupation types in the EV battery supply chain can be found in Table 3. A 2023 OVIN report notes that 62 percent of battery manufacturing sector workers who completed an educational program studied engineering and engineering technologies, mostly in electrical, mechanical, chemical, and mechatronics.[60]

The skills most critical to the success of the EV battery supply chain are those which require hard tech skills. In the context of manufacturing, hard tech skills encompass a range of technical abilities and knowledge required to design, operate, and optimize manufacturing processes and systems. These skills are used in critical occupations such as engineers, technologists and technicians, skilled trades and labour roles. Hard tech skills critical to the sector include:

- Automation and robotics
- Battery recycling
- Battery science
- Chemical
- Data analytics
- Electrical
- Electronics
- Electrochemistry
- Manufacturing
- Materials science
- Mechanical
- Mechatronics
- Metallurgy
- Mineral processing

In addition to the hard skills listed previously, there are many crucial soft skills that are integral to the success of the workforce. From critical thinking to collaboration to problem-solving, these abilities form the backbone of efficient manufacturing operations and are core skills employers look for in the workforce. Understanding root cause analysis and lean manufacturing principles are important skills as employers look to workers who can improve efficiency, quality, and optimize processes as manufacturing demand steadily increases.

Environmental management skills such as environmental impact assessment, remediation, regulatory compliance, conservation and stewardship, and sustainability integration are also essential for workers, as there is a need for industry in the EV battery supply chain to effectively manage their climate and environmental impact, comply with regulations, and meet stakeholder expectations. As a sector with foundations in emissions reduction and climate change mitigation, it is important for all workers to have a general, baseline knowledge of sustainability principles because it fosters a sense of responsibility and accountability to environmental metrics among employees. Moreover, as sustainability becomes increasingly important to consumers and regulatory bodies, possessing this knowledge enhances competitiveness, social license, and ensures compliance with evolving environmental standards.

60 Ontario Vehicle Innovation Network (OVIN), 2023.

SPOTLIGHT: Workforce Needs and Challenges Identified in Stakeholder Interviews

To gain additional insights into the occupations and skills required by Canada's EV battery supply chain, we interviewed stakeholders representing organizations across the supply chain, as well as sector experts from research institutions or non-governmental organizations (NGOs) in the space.

Table 4

Common Themes Identified in Stakeholder Interviews

What are the key workforce needs of EV battery supply chain companies?	
Workers most frequently hired include:	• Labour for manufacturing and assembly • Technicians and technologists
Workers most difficult to hire include:	• All occupations will be difficult to hire at first as a new industry to Canada – Difficult to find workers with relevant experience – Difficult to find workers with the right skills plus leadership experience • Skilled trades • Technicians and technologists • Labour for manufacturing and assembly • Engineers (in some parts of the supply chain)
Workers that will be most difficult to hire in the future include:	• Skilled trades • Technicians and technologists • Engineers, specifically materials engineers
Hiring activity changes expected:	Hiring increases are expected at all participating companies
What are the key workforce barriers to developing the EV battery supply chain in Canada?	
Workforce gaps – both in skills and in quantity of workers – is the largest challenge for companies.	• The fledgling battery manufacturing sector in Canada and the lack of a mineral processing subsector means that workers with the specific skill sets needed do not currently exist in the country. • There is a shortage of hard technical skills in the country. • There is a lot of work to be done to upskill or reskill current workers. As the auto sector transitions from ICEVs to EVs, we are moving from a demand for mechanical skills to a demand for materials/chemistry/electrical skills. The rise of digitization and automation in manufacturing will also require workers to upskill. • We have an aging workforce in Canada, particularly in the automotive sector, meaning a wave of retirements is expected to happen over the next decade, further exacerbating the need for workers. • It is currently a challenge to bring foreign workers into Canada to fill job demand. It is also a challenge for international workers to get certifications recognized once entering Canada.

Academia is not currently leading students to where job demand exists, exacerbating the workforce gaps.	• Starting at the high school level and beyond, educational institutes should be encouraging students to train for skills related to job demand, especially in the hard technologies. • There is a lack of focus on manufacturing, critical minerals, metallurgy, and materials science-related programs. • Despite demand for hard tech skills in cleantech, traditional academic programs that produce workers with the skills to work in "hard tech" roles (i.e., chemical engineering, materials engineering) are not marketed as leading into sustainability careers. Therefore, these programs may not be attracting students interested in working a sustainability-related role. • Additionally, with the huge demand for skilled labour and tradespeople, there is a need to encourage more students to go into vocational education programs. • There is a need for industry to be more closely involved in academic program development in order to train future workers with the skills in demand by industry.
What are some of the potential challenges and opportunities facing the workforce within the EV battery supply chain in Canada?	
Workers will have to be lifelong learners in this sector as it is rapidly changing.	• The EV and EV battery manufacturing sector is developing with a high rate of change on a large scale. Workers will need to be willing to constantly retrain and learn throughout their careers. • As technology advances, EV and EV battery manufacturing may look completely different in the future. New materials, automated processes, and other innovations will require companies and workers to adapt and be nimble.
Technology development is both a challenge and an opportunity for the workforce.	• Upskilling and retraining will likely be required for workers. For example, workers will need to develop skills related to automation and maintaining an increasingly digital and automated environment on the manufacturing floor. • Technology to improve efficiency and automate processes (i.e., AI) could be an opportunity to alleviate some of the workforce gaps experienced by the Canadian supply chain.
There is a large opportunity for workers from other industries with transferable skills to work in the EV battery supply chain.	• In sectors that will see a decline in coming years, there is an opportunity to reskill workers to clean economy sectors. For example, there are a lot of transferable skills from oil and gas sector occupations to occupations in the EV battery supply chain, such as in mining. However, there are currently no clear pathways to do this. • Workers with transferable skills from related sectors have an opportunity to work in the EV battery supply chain with some upskilling or reskilling. This is particularly true for workers from traditional automotive manufacturing, other manufacturing, chemical, or agricultural industry roles, in addition to workers with electrical or military experience. • Companies are beginning to do more in-house and on-the-job training. As the labour shortage looms, companies are taking onus to ensure they can fill roles in demand. This often includes looking for workers in other industries with transferable skills and training them with the specific skills required for EV and EV battery manufacturing operations.

CONCLUSION

As Canada positions itself as a key player in the global EV market, the development of a skilled workforce is paramount to ensuring the resilience and competitiveness of the entire supply chain. This profile report provides a brief overview of national and global trends in the EV battery supply chain and in the associated labour market, identifies critical occupations and skills needed for Canada's EV battery supply chain, and provides employer feedback on common barriers facing the supply chain, current and future demand for workforce skills, and hiring needs and challenges.

As the demand for EVs skyrockets, Canada's EV battery supply chain must identify and find solutions to major issues and gaps to solidify the country's position as a reliable and competitive manufacturing powerhouse. The research and employer engagement conducted in this initiative highlighted the current workforce in Canada as a major hindrance to the development of the sector for a variety of reasons, the most notable of which is a gap in required skills. Through investments in workforce development initiatives by the public and private sectors, targeted collaboration between academia and industry on national educational priorities, and the identification and widespread promotion of upskilling or reskilling pathways, stakeholders can cultivate a diverse and inclusive workforce capable of driving innovation and meeting the evolving demands of the industry.

As an early-stage industry that is, at its core, born of the global movement to a green economy, the EV battery supply chain has the chance to prioritize sustainability from raw material extraction to end-of-life battery disposal. This includes promoting responsible sourcing of materials, minimizing energy consumption and emissions in manufacturing processes, and developing closed-loop recycling systems to recover and reuse valuable materials from spent batteries. This commitment to sustainability will benefit the environment and the workforce, will attract the business of countries and corporations prioritizing ESG performance, and may also impact the career choices of a young, values-based generation of workers.

Ultimately, by prioritizing workforce development and a commitment to industrial sustainability, Canada can strengthen its position as a global leader in electric vehicle manufacturing, creating economic opportunities and contributing to a more sustainable future for all.

As the demand for EVs skyrockets, Canada's EV battery supply chain must identify and find solutions to major issues and gaps to solidify the country's position as a reliable and competitive manufacturing powerhouse.

APPENDIX – RESEARCH METHODOLOGY

To develop this report, we gathered information on the occupations needed for Canada's EV battery supply chain by performing secondary research and conducting stakeholder interviews with representatives 11 organizations reflecting of the various sectors of the supply chain.

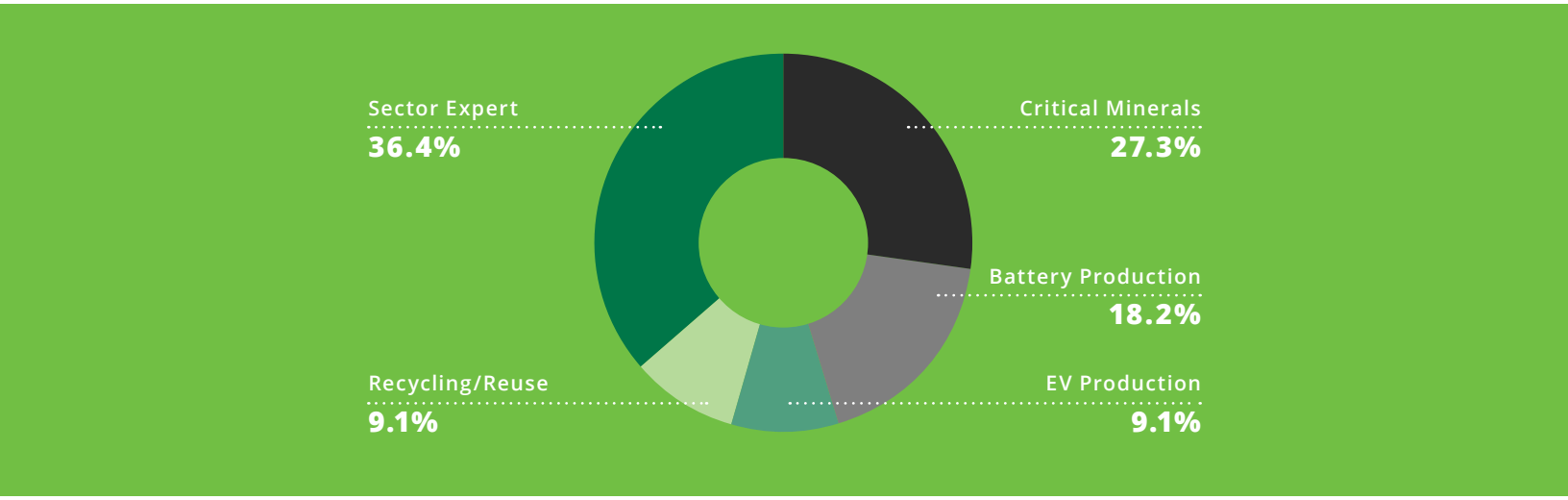
Stakeholder Respondent Profile

We interviewed individuals from the following organizations:

- Canadian Critical Minerals and Materials Alliance
- Clean Energy Canada
- ArcelorMittal
- Nano One Materials
- Next Generation Manufacturing Canada
- NFI Group
- Summit Nanotech
- Transition Accelerator
- Trillium Network for Advanced Manufacturing
- Umicore
- Wyloo Metals Canada

Figure 2

Supply chain representation of stakeholder engagement participants



The largest group of interviewees were sector experts from research institutions or NGOs who had knowledge of the workforce needs and issues from the perspective of the entire supply chain. Recycling/reuse stakeholders were one of the lowest represented groups, which is likely reflective of a smaller supply chain segment, and a nascent sector in Canada. Overall, the authors encountered recruitment challenges in attracting stakeholders to participate. This may be due to several factors, including interview fatigue among stakeholders, and the fact that many of the prominent companies in Canada's EV battery supply chain are international corporations still in the process of establishing Canadian operations.

REFERENCES

Allan, B. (2022). *A Roadmap for Canada's Battery Value Chain*. The Transition Accelerator, Battery Metals Association of Canada. https://transitionaccelerator.ca/wp-content/uploads/2022/06/A_Roadmap_For_Canadas_Battery_Value_Chain_Full.pdf

Amadee, A., & Loertscher, A. (2023, March 28). *Why Canada has the potential to become an EV battery supply chain powerhouse*. Dentons. https://www.dentons.com/en/insights/newsletters/2023/march/28/dentons-batteries-and-evs-bulletin/why-canada-has-the-potential-to-become-an-ev-battery-supply-chain-powerhouse

Amadee, A., & Loertscher, A. (2024, February 14). Canadian batteries and EVs: 2023 review and outlook for 2024. *Dentons*. https://www.dentons.com/en/insights/newsletters/2024/february/14/dentons-batteries-and-evs-bulletin/2023-review-and-outlook-for-2024

Butler, C. (2023, March 13). Volkswagen to open its first North American EV battery plant in St. Thomas, Ont. *CBC News*. https://www.cbc.ca/news/canada/london/volkswagen-ev-battery-plant-ontario-1.6777144

Canadian Battery Task Force. (2022). *A Batteries Blueprint for Canada*. Canadian Battery Task Force. https://www.beacdn.com/download/?url=https://www.beacdn.com/apps/2m0Qykbx5n/e2L8WRax07/BdAqZQEyW3/files/i1687364784sdc10291ca20.pdf&preview=1f&name=A-Batteries-Blueprint-for-Canada.pdf

Canadian Press. (2022, December 6). *Trudeau, Ford mark opening of Canada's first full-scale electric vehicle plant*. CityNews Kitchener. https://kitchener.citynews.ca/2022/12/06/trudeau-ford-mark-opening-of-canadas-first-full-scale-electric-vehicle-plant-6204869/

CATL. (2023). *CATL 2022 Environmental, Social and Governance (ESG) Report*. CATL. https://www.catl.com/en/uploads/1/file/public/202304/20230412124641_cxg8mo2in8.pdf

CBC News. (2023, November 20). Plan to bring in South Korean workers for NextStar battery plant sparks backlash. *CBC News*. https://www.cbc.ca/news/canada/windsor/stellantis-lg-energy-nextstar-electric-vehicle-battery-1.7033732

Cheng, E. (2023, December 21). China's EV and chip giants need workers — not necessarily college grads. *CNBC*. https://www.cnbc.com/2023/12/22/chinas-ev-and-chip-giants-need-workers-not-necessarily-college-grads.html

Clean Energy Canada, & Trillium Network for Advanced Manufacturing. (2022). *Canada's New Economic Engine*. Clean Energy Canada. https://cleanenergycanada.org/wp-content/uploads/2022/09/CanadasNewEconomicEngine_Web.pdf

CTV News Windsor. (2023, December 19). NextStar Energy EV Battery Plant celebrates construction milestone. *CTV News Windsor*. https://windsor.ctvnews.ca/nextstar-energy-ev-battery-plant-celebrates-construction-milestone-1.6693964

Employment and Social Development Canada. (n.d.). *National Occupational Classification 2021*. Government of Canada. Retrieved February 8, 2024, from https://noc.esdc.gc.ca/

Favilla, J., & Chandrasekaran, K. (2023, December 21). Reshoring manufacturing to the US: The role of AI, automation and digital labor. *IBM*. https://www.ibm.com/blog/reshoring-manufacturing-to-the-us-the-role-of-ai-automation-and-digital-labor/

Ferland, P. (n.d.). *Canada's battery supply chain will power the electric vehicle revolution*. Invest in Canada. Retrieved February 1, 2024, from https://www.pdac.ca/docs/default-source/conventions/2021-convention/industry-insights/invest-in-canada_pdf-format-batterysupplychain.pdf?sfvrsn=5e3c659f_4

FOCAL Initiative. (2020). *Automotive Industry Labour Market Analysis: Women's Participation in Canada's Automotive Industry*. FOCAL Initiative.

FOCAL Initiative. (2021). *The Impact of EV Production on the Automotive Manufacturing Supply Chain: Sources, Methods and Findings*. FOCAL Initiative. https://www.futureautolabourforce.ca//wp-content/uploads/2021/10/EV-Report-Final-Oct-4.pdf

Ford's Oakville, Ontario, Complex Prepares to Build Next-Gen EVs; C$1.8 Billion Transformation Begins 2024. (2023, April 11). *Ford*. https://media.ford.com/content/fordmedia/fna/us/en/news/2023/04/11/ford_s-oakville--ontario--complex-prepares-to-build-next-gen-evs.html

Fujita, A. (2023, August 16). *Inflation Reduction Act: How the climate law set a "trillion-dollar shift" for EVs into motion*. Yahoo Finance. https://finance.yahoo.com/news/inflation-reduction-act-how-the-climate-law-set-a-trillion-dollar-shift-for-evs-into-motion-155615359.html?guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sigKS0ITR4hQTUV3S9y4PjpLCvNTmEyaa0gjBLVdd2MAfVe0eqlRVvQflA3VfkfwNlgr6rqoZ6G0IAgfMjVpbMNHJ6NYjm0pE3eV3oJKvT8SzaneDtcEbcSUJQgUB0nyuPbt5hXZNLDxtV84lEJwVZg4p4_hqCc36LJaG_uU3b95f1&guccounter=2

GM. (n.d.). CAMI Assembly to Begin Battery-Module Assembly in 2024. *GM*. Retrieved February 13, 2024, from https://news.gm.ca/en/home/newsroom.detail.html/Pages/news/ca/en/2023/jul/0725_cami.html

Government of Canada. (2022, January 24). *North American Industry Classification System (NAICS) Canada 2022 Version 1.0*. Statistics Canada. https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=1369825

Hinton, J. (2024, February 12). In giving billions to electric car makers, Canada is blinded by economic delusion. *The Globe and Mail*. https://www.theglobeandmail.com/business/commentary/article-canada-electric-vehicle-companies-subsidies/

International Energy Agency. (2021). *Mineral requirements for clean energy transitions – The Role of Critical Minerals in Clean Energy Transitions*. International Energy Agency. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions

International Energy Agency. (2023a). *Global EV Outlook 2023*. International Energy Agency. https://www.iea.org/reports/global-ev-outlook-2023/executive-summary

International Energy Agency. (2023b). *Policy developments – Global EV Outlook 2023*. International Energy Agency. https://www.iea.org/reports/global-ev-outlook-2023/policy-developments

Investing in Canada's auto sector, its workers, and our clean future. (2022, May 2). Prime Minister of Canada. https://www.pm.gc.ca/en/news/news-releases/2022/05/02/investing-canadas-auto-sector-its-workers-and-our-clean-future

Jaeger, J. (2023, September 14). These Countries Are Adopting Electric Vehicles the Fastest. *World Resources Institute*. https://www.wri.org/insights/countries-adopting-electric-vehicles-fastest

Jarvis, M. (2023, July 7). How to Advance Canada's Critical Minerals Industry to Win in the Energy Transition. *The Future Economy*. https://thefutureeconomy.ca/op-eds/critical-minerals-mark-jarvis-giga-metals/

Jonas, S. (2023, September 29). EV battery giant Northvolt to build multibillion-dollar plant in Quebec. *CBC News*. https://www.cbc.ca/news/canada/montreal/quebec-northvolt-ev-battery-factory-1.6980767

Jones, B., Nguyen-Tien, V., Elliott, R., & Harper, G. (2023, June 27). The supply chain for electric car batteries is changing the world's geopolitics. *LSE Business Review*. https://blogs.lse.ac.uk/businessreview/2023/06/27/the-supply-chain-for-electric-car-batteries-is-changing-the-worlds-geopolitics/

Ljunggren, D. (2023, September 5). Unit of South Korea's Solus to build Canada copper foil facility as part of EV battery push. *Reuters*. https://www.reuters.com/business/autos-transportation/solus-unit-build-canada-copper-foil-facility-part-ev-battery-push-2023-09-05/

McNally, J. (2023). *Skills needs for zero- emissions vehicle and battery manufacturing in Ontario: Summary for policymakers*. The PLACE Centre, Smart Prosperity Institute.

Mukherjee, S., & Rajagopal, D. (2023, September 28). Sweden's Northvolt to build $5.2 billion battery factory in Canada. *Reuters*. https://www.reuters.com/business/autos-transportation/swedens-northvolt-build-52-bln-battery-factory-canada-2023-09-28/

Natural Resources Canada. (2022). *The Canadian Critical Minerals Strategy, from Exploration to Recycling: Powering the Green and Digital Economy for Canada and the World.* Government of Canada. https://www.canada.ca/content/dam/nrcan-rncan/site/critical-minerals/Critical-minerals-strategyDec09.pdf

Next Generation Manufacturing Canada. (2022). *Canadian Automotive Supplier Capability and EV Value Chain Analysis*. Next Generation Manufacturing Canada. https://ngen.ca/hubfs/NGen%20EV%20Report%20March%202022.pdf

Office of the Premier. (2023, February 15). *Major Investment Strengthens Ontario's End-to-End Electric Vehicle Supply Chain*. Government of Ontario. https://news.ontario.ca/en/release/1002723/major-investment-strengthens-ontarios-end-to-end-electric-vehicle-supply-chain

Ontario Vehicle Innovation Network (OVIN). (2023). *A Spotlight on Skills, Talent & Workforce Development: Battery Manufacturing for Electrification*. Ontario Vehicle Innovation Network (OVIN). https://www.ovinhub.ca/wp-content/uploads/2023/09/EY_OVIN_Public_Spotlight_Battery_UPDATED.pdf

Paas-Lang, C. (2023, April 8). Canada is sitting on a critical minerals mother lode. But is it ready for the new gold rush? *CBC News*. https://www.cbc.ca/news/politics/canada-critical-minerals-strategy-challenges-1.6803711

Pankratz, A. (2023, December 4). Canada's Proposed Clean Energy Tax Credits: Where Are We Now? *Fasken*. https://www.fasken.com/en/knowledge/2023/12/canadas-proposed-clean-energy-tax-credits

Quick facts on Canada's Auto Industry. (n.d.). Unifor. Retrieved February 13, 2024, from https://autotalks.uniforautohub.ca/quick_facts

Rabson, M. (2023, December 20). Canada lays out plan to phase out sales of gas-powered cars, trucks by 2035. *CBC News*. https://www.cbc.ca/news/politics/canada-electric-vehicles-2035-1.7063993

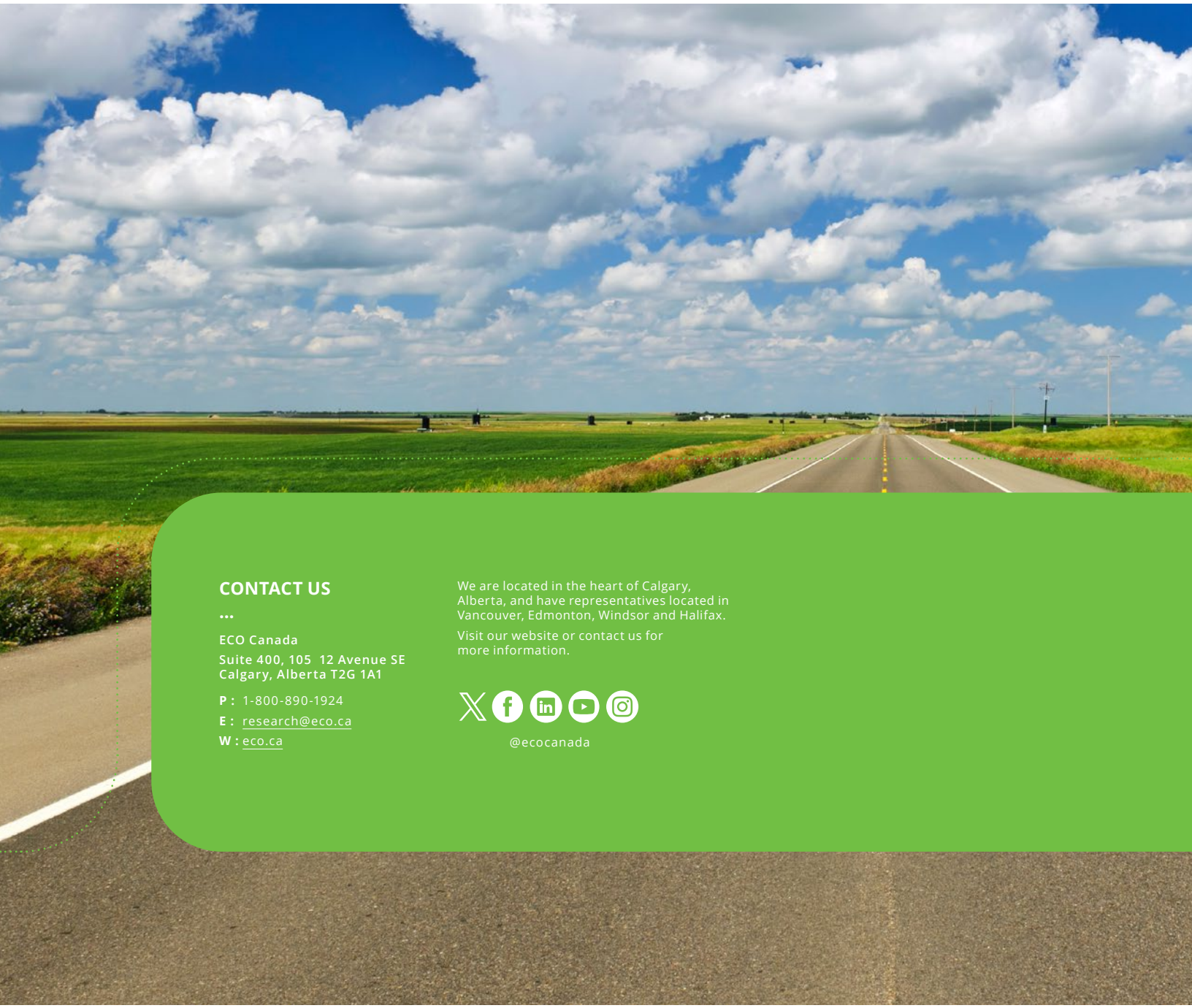
Shakil, I. (2023, May 29). *Canada, Quebec to provide about C$300 mln for GM-POSCO battery materials facility.* Financial Post. https://financialpost.com/pmn/business-pmn/canada-quebec-to-provide-about-c300-mln-for-gm-posco-battery-materials-facility

Statistics Canada. (2016, October 5). *National Occupational Classification (NOC) 2016 Version 1.0*. Government of Canada. https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=314243

Trillium Network for Advanced Manufacturing. (2022). *Developing Canada's Electric Vehicle Battery Supply Chain: Quantifying the Economic Impacts and Opportunities*. Trillium Network for Advanced Manufacturing . https://cleanenergycanada.org/wp-content/uploads/2022/09/Report_SupplyChainReport_vf_20220705.pdf

Umicore confirms expansion of its EV battery materials production footprint in Canada. (2023, October 16). *Umicore*. https://www.umicore.com/en/newsroom/umicore-confirms-expansion-of-its-ev-battery-materials-production-footprint-with-cam-and-pcam-plant-in-ontario-canada/

Yakub, M. (2024, February 5). Canada leaps to top spot in BloombergNEF battery supply chain ranking. *Electric Autonomy Canada*. https://electricautonomy.ca/2024/02/05/canada-top-spot-bloombergnef-battery-supply-chain-ranking/



CONTACT US

ECO Canada
Suite 400, 105 12 Avenue SE
Calgary, Alberta T2G 1A1

P : 1-800-890-1924
E : research@eco.ca
W : eco.ca

We are located in the heart of Calgary, Alberta, and have representatives located in Vancouver, Edmonton, Windsor and Halifax.

Visit our website or contact us for more information.

@ecocanada

Natural Resources Canada | Ressources naturelles Canada

Funded by the Government of Canada's Sectoral Workforce Solutions Program | Canada