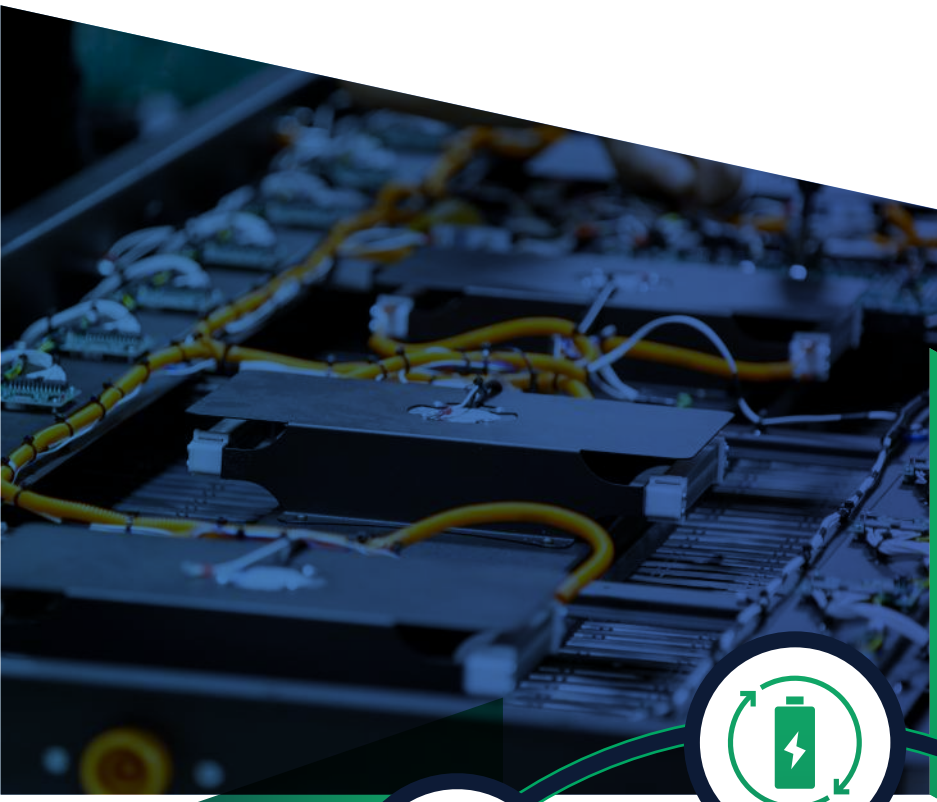

ACCELERATE'S *BATTERY INNOVATION ROADMAP*

accelerate
Canada's ZEV Supply Chain Alliance

WHY BATTERIES?

As global economies transition to a decarbonized future, policy priorities have been shifting towards more net-zero technologies where batteries play a critical role. Batteries underpin the electrification of key industries, enabling opportunities in harnessing clean energy and technology. Lithium-ion batteries, in particular, are essential for the electricrification of transportation and the rapid evolution of the automotive industry. Beyond just electric vehicles (EVs), batteries also enable clean, affordable and reliable electricity to support the Canadian economy's transition to net-zero emissions by 2050.

Canada has been home to several world leading battery innovators from the private and public sectors. Though we've had hurdles in turning these innovations into global homegrown companies, there's significant opportunity moving forward to capture the value-added economic benefits associated with manufacturing and mass production of next generation batteries.

Recent investments into Canada by global battery firms represent important anchors for our domestic industry. However, Canada must also build our capacity to develop, commercialize, and scale up domestic battery innovations. To do so, Canada needs a comprehensive strategic approach that identifies the actions that will scale innovation and capture the economic and labour-market value of the emerging global battery market.

"The fight against climate change demands global electrification, and every viable battery technology has a role to play. Batteries can be improved both through incremental advances and through breakthroughs. Now more than ever, Canada has the opportunity to build on its historic contributions to battery technology and lead the charge in next-generation batteries"

Dr. Jeff Dahn – Professor Emeritus, Principal Investigator - NSERC/Tesla Canada/Dalhousie Alliance Grant

The Accelerate Alliance is working with its members, partners and industry stakeholders to build a Battery Innovation Roadmap that will develop a shared vision of success and define the strategies, objectives, pathways and timelines to support Canadian battery innovation. The Roadmap is intended to be a living document that can be modified as battery technology and the industry evolve with time.

WHY INNOVATION?

While significant advances have been made over recent decades in enhancing battery performance and safety, as well as reducing cost, there's still ample room for innovation. The Roadmap classifies innovation drivers into the following categories:

Market Application: These drivers relate to market demands including performance, cost, and safety of batteries. For example, improving cold weather performance or extending battery life to enable vehicle-to-grid integration. Cost reduction is also a focus, aiming to enable applications such as medium and heavy-duty electric vehicles or long-duration stationary storage.

Geopolitical Pressures: This category focuses on the global implications of battery production. For example, exploring innovations to reduce or completely phase out the use of conflict minerals and metals in batteries (e.g., cobalt), as well as addressing international sourcing and ethical concerns.

Environmental Considerations: These drivers prioritize the eco-friendliness of batteries. For example, developing batteries with enhanced recyclability and a reduced impact on the environment throughout their lifecycle, thereby contributing to a greener and more sustainable future.

Accelerate's Battery Innovation Roadmap is a navigational tool that will help guide the path forward. It will identify the core innovation drivers, ensuring that Canada's battery journey addresses both global demands and unique regional challenges. By doing so, it will identify areas where Canada can offer significant contributions. But identifying avenues is only half the battle. The roadmap will also lay out concrete metrics that will not only enable us to track progress but also shape the definition of success, ensuring that Canada's battery industry moves in sync with the overarching vision of a net-zero future.

HISTORY OF CANADIAN BATTERY INNOVATION

Canadian innovators have made several groundbreaking contributions to the advancement of battery technology for over 40 years and counting. Their innovations have either already found their way to mass market or are enabling the next generation of battery technologies to continue driving down battery costs and ramping up adoption. Here we highlight a handful of examples from across the country and from across academia, industry, and government that underscore Canada's major contributions to battery innovation.

1978

The World's First Commercial Li Battery
British Columbia

Moli Energy is formed in 1979 in Burnaby BC and goes on to produce the world's first commercial rechargeable Li battery in the following decade.

1990

Ethylene Carbonate Jump Starts Li-ion Batteries
British Columbia

Researchers at Moli Energy Ltd. report on the role of ethylene carbonate (EC) in making Li-ion batteries viable. Every commercial battery cell today includes some ethylene carbonate in the electrolyte.

1999

FEC Boosts Battery Life
Ontario

Researchers from Canada's National Research Council (NRC) discover and patent fluoroethylene carbonate (FEC) as a small addition to the electrolyte that dramatically increases the cycle life of lithium-ion batteries.

2000

Carbon Coating Revolutionizes LFP Batteries
Quebec

At the International Meeting on Lithium Batteries, Université de Montréal /Hydro Quebec researchers report on carbon coating of lithium iron phosphate batteries, which was critical to making LFPs work. BASF, Sony, Mitsui licensed the technology soon after. LFP cathode materials are one of the two dominant lithium-ion battery chemistries used today.

High Power Potential of Li-Ion Batteries Revealed
British Columbia

At the Power 2000 Conference in Santa Clara, E-One Moli researchers show for the first time, that Li-ion cells designed for power can outperform other battery chemistries. Up until that point, Li-ion batteries were only used in electronics and this Canadian innovation opened the door for a new world of applications (e.g. power tools, e-bikes). E-one Moli is now the main supplier of battery cells to Dyson.

2001

NMC Changes the Battery Future,
Nova Scotia

Researchers from Dalhousie University in partnership with 3M develop and patent certain grades of lithium nickel-manganese-cobalt (NMC) oxide compounds. NMC material is now being used around the world in power tools and electric vehicles. 3M licensed the technology to Sanyo, Panasonic, Sony, Umicore and others and sold its patents to Umicore in 2016. NMC cathode materials are one of the two dominant lithium-ion battery chemistries used today.

2007

Advancing Solid-State Batteries
Alberta

In partnership with German collaborators, researchers from the University of Calgary discover a new garnet-type material that would enable the highly anticipated technology of solid-state batteries which offer the promise of higher energy storage, improved safety and longer lifespan.

2009

Renewed Promise of Lithium-Sulfur Batteries
Ontario

Researchers at the University of Waterloo made a big improvement to an older battery type called lithium-sulfur. Their new design makes these batteries last longer and hold more power. Plus, they're made with cheaper, easy-to-find materials, making them a promising option for the future.

accelerate
Canada's ZEV Supply Chain Alliance

ACCELERATE'S BATTERY INNOVATION ROADMAP THEMES

This roadmap will be structured around three central themes, each addressing distinct aspects of battery innovation and development.

Theme I | Technology:

The roadmap embarks on a comprehensive scan of the technological frontier, emphasizing both existing and emerging markets. It aims to discern what commercial battery chemistries will dominate the next few decades (e.g. LFP, sodium-ion, and vanadium flow). The roadmap also delves into other segments of the supply chain such as battery material processing and assessing Canada's potential in metallurgical and manufacturing processes. Furthermore, a dedicated focus on battery performance, especially concerning niche applications and Canadian challenges (e.g. cold weather performance).

Theme II | Innovation Infrastructure:

To propel Canada as a front-runner in battery innovation, the roadmap undertakes a rigorous assessment of Canada's industrial and innovation ecosystem. Recommendations will be set forth on building a robust infrastructure that is needed to create an innovative industry that can compete over a long transition. Essential to this are considerations for funding support, determining the sufficiency and specificity of existing funds. Equally vital are the tangible assets required for R&D, such as laboratories and demonstration lines. Lastly, the roadmap emphasizes the paramount importance of skills development and strategic intellectual property management.

Theme III | Industrial Policy:

Grounded in international best practices, this section analyzes Canada's potential to foster a thriving long-term battery industry. With references to global industrial policies, such as those employed by China, the US, and South Korea, the roadmap will dissect successful strategies that bolstered their domestic industries. The core tenet remains: industrial policy is scale-up policy. This theme highlights Canada's scale-up challenges and triumphs, advocating for an industrial policy that harmonizes innovation, procurement, regulatory, and trade policies. Supplementary focus areas within this theme include understanding the financial ecosystem essential for successful scale-ups and strategies for attraction and retention, emphasizing Canada's unique positioning in the global landscape.

In essence, this roadmap crystallizes Canada's vision for battery innovation through a triad of technology, innovation infrastructure, and industrial policy, each serving as a vital pillar for a sustainable, net-zero future.