TOWARDS A NORTH AMERICAN CIRCULAR ECONOMY FOR ELECTRIC VEHICLE BATTERIES

EVENT SUMMARY REPORT

JANUARY 2022

Smart Prosperity Institute

Towards a North American Circular Economy for Electric Vehicle Batteries

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January 2022

This event was held on October 6th, 2021 as a side event to the World Circular Economy Forum 2021.

Supporting Partner Acknowledgements

THE CANADIAN MINERALS AND METALS PLAN

Smart Prosperity Institute

M·E·R·G MATERIALS EFFICIENCY RESEARCH GROUP

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Background

The transition to a low carbon future will require vastly expanded use of large batteries for electric vehicles of all sizes, as well as household, commercial and industrial energy storage. Global battery demand is expected to grow by 25% annually through 2030. As a key element necessary to meet Paris Agreement goals of 2˚C and in keeping with the UN Sustainable Development Goals, the full-scale deployment of these forms of energy storage to support greater electrification needs to be both accelerated and designed for true sustainability.

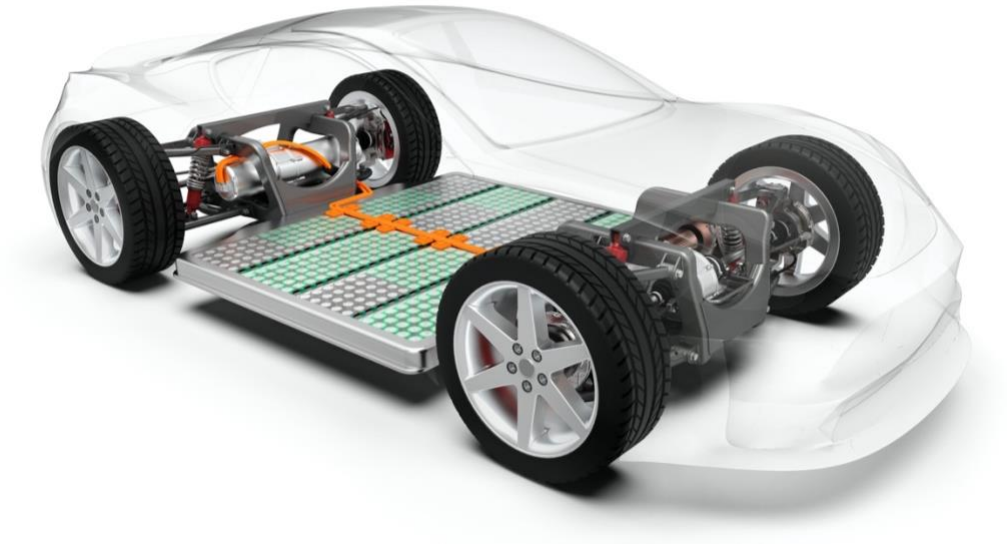
This transformation will require unprecedented levels of investment, collaboration and innovation across both private and public sectors to support the development of safe and responsible battery value chains. For value chains, adopting a circular economy approach stands to reduce environmental and impacts and retain value from critical minerals and other raw materials. To do so will require new approaches in technology, business models and financial tools, public infrastructure as well as policy and regulation. The Global Battery Alliance's *Vision for a Sustainable Battery Value Chain in 2030* outlines many aspects of what a transformative path could look like, and the many economic, environmental and social benefits it could yield.

With a highly integrated automotive and transportation sector, is North America ready to realize this vision for circular battery value chains? If so, what do companies, governments and others need to do? Who needs to work together, and what key enabling actions would set us on the path to a zero waste, low carbon economy for the burgeoning future of electric vehicles (EV) batteries? What are the opportunities and risks in reusing and repurposing battery cells prior to recycling? With battery value chains rapidly evolving and the potential to scale up new innovations, the decisions we make now will have a lasting impact over the coming decades.

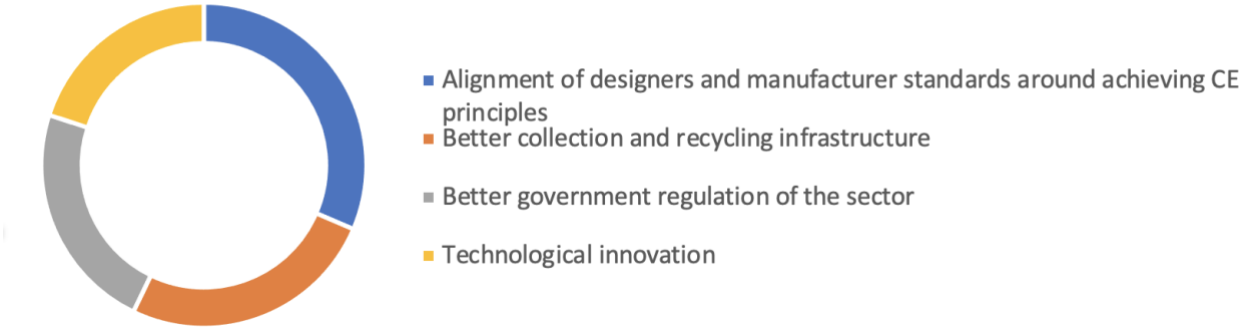
This WCEF Side Event sought to examine these questions through dialogue with experts and key stakeholders from a range of countries, and through engagement with participants interested in moving priority actions forward sooner than later.

There were 147 registrants from Africa, North America, Asia, Latin America and Europe.

To view a recording of the presentations, click the 'Play' button.



Poll #1: **What do you believe is the most important obstacle to be addressed in advancing a circular economy for EV batteries in North America?**



Introduction

***Jeff Labonté**,*
Assistant Deputy Minister,
Lands & Minerals Sector, Natural Resources Canada

- In Canada, sales of EVs are 55,000 units a year or 3-4 percent of total. This number will grow exponentially. Canada is committed to mandating that all new light-duty vehicles sold be zero emission by 2035, with an interim sales target of at least 50 percent by 2030.

- By 2030, industry experts project end-of-life EV batteries will become a global source of over 380,000 tonnes of recyclable metals — including lithium, nickel and cobalt. The growth of EV sales requires a safe and sustainable supply of critical minerals for batteries. Canada could be a global leader in this space. Projected sales for EVs suggest that the demand for lithium and cobalt will exceed amounts produced from mining. As a result, product durability and the reuse of expired batteries will be very important going forward. Applying circular economy principles will be a key step in developing sustainable value chains.

- The Government of Canada is a member of the Global Battery Alliance, which is establishing a platform to facilitate a traceable value chain for electric vehicle and stationary batteries, among other things. In addition, Canada and the U.S. are cooperating on the Joint Action Plan on Critical Minerals Collaboration to advance our mutual interest in securing supply chains. Canada is also engaged with the EU and Japan in related discussions.

- Governments know that steps can be taken to support a circular economy for batteries including R&D, policy development, and the exchange of data among key stakeholders. This is where industry, government, academia, innovators and all players with a stake in the circular economy for batteries must come to the table with resources and a spirit of collaboration.

Key Takeaways: Panel Presentations

Panel 1: Towards a Circular Economy Model for EV Batteries Globally and in North America

The first panel focused on the vision for the circular economy futures at the international, continental and national levels. What are the key issues and objectives that need to be addressed in order to meeting the urgent need for creating closed loop systems and optimizing the use of EV batteries and materials throughout their full life cycle?

Moderator: **Alan Young**, Materials Efficiency Research Group

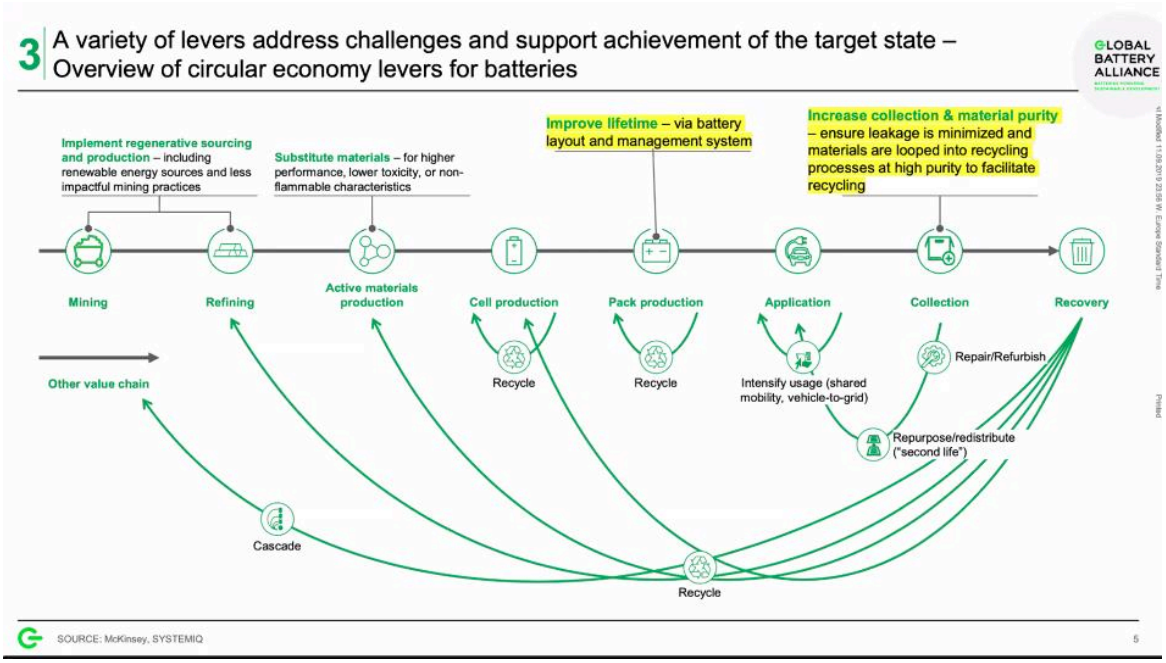
Panelists:

Mathy Stanislaus,
Director of Public Policy and Engagement, Secretariat of the Global Battery Alliance

John Kyte,
Director of Communications and Programs, Responsible Battery Coalition

Emma Jarratt,
Managing Editor, Electric Autonomy Canada

Key Themes and Insights



- The Global Battery Alliance shared their Vision for a Sustainable Battery Value Chain in 2030, an overview of essential circular economy (CE) strategies and actions necessary to reduce impact and capture value throughout battery value chains.
- A circular battery value chain can be a major driver to meet the Paris Agreement target. Using CE principles and practices, it will be possible to lower emissions and lower costs, accelerate the adoption of batteries as a key low carbon transition pathway, while doubling the economic value created to an estimated $130-185 billion, globally.
- To achieve this vision, it is essential to fully integrate repurposing, repairing, refurbishment along with effective recycling of materials as part of the solution.
- Reliable data and data governance rules are fundamental to tracking materials flows and emissions. To this end, battery passports are seen to be a practical, strategic tool in enabling circular value chains.
- More investment and attention are required towards designing for repurposing and remanufacturing and battery service (versus product) business models,.
- Serious attention is needed to a range of second use challenges in order to avoid premature recycling and to optimize potential value. Existing consumer ownership models, transportation safety, liability and insurance are complications in the transition to a Circular Economy.
- An important step forward has been the development of "Principles to guide the materials, manufacturing and management of EV batteries" by the Responsible Batteries Coalition, which are widely endorsed by supply chain actors.
- Key supply chain elements remain very siloed, and existing EPR schemes do not address EV batteries. R&D labs, OEMs, recyclers and miners typically do not collaborate to design integrated strategies. In part this is due to different business goals (e.g., durability versus recyclability, repurposing or direct recycling priorities.)
- Progress toward coordination is reflected in the 2021 launch of a five-year Canadian initiative called "Accelerate ZEV" that brings together key players across Canada—from mining to mobility, R&D to commercialization, vehicle assembly to infrastructure around supply chain solutions.
- Given the different CE challenges and opportunities of EV batteries as well as current prohibitive costs in battery materials recycling technology, governments have an essential role to play in designing regulations and programs that incentivize the capture and use of recycled materials for EV batteries.
- Policy and infrastructure alignment between US and Canada is critical given materials and market flows that are often north/south, rather than east/west.

Panel 2: Current State of Reuse and Recycling Supply Chains for EV Batteries in North America

The second panel focused on what we know about current material flows and key gaps in data and supply chains, as well as recycling business model perspectives on evolving North American EV battery markets

Moderator: **Maria Kelleher**, Principal, Kelleher Environmental

Panelists

Jeff Haltrecht
Executive, Call2Recycle

Kunal Phalpher
Chief Commercial Officer, Li-Cycle

Taylor L. Curtis
Regulatory-Policy Analyst/Attorney, U.S. Department of Energy's National Renewable Energy Laboratory (NREL)

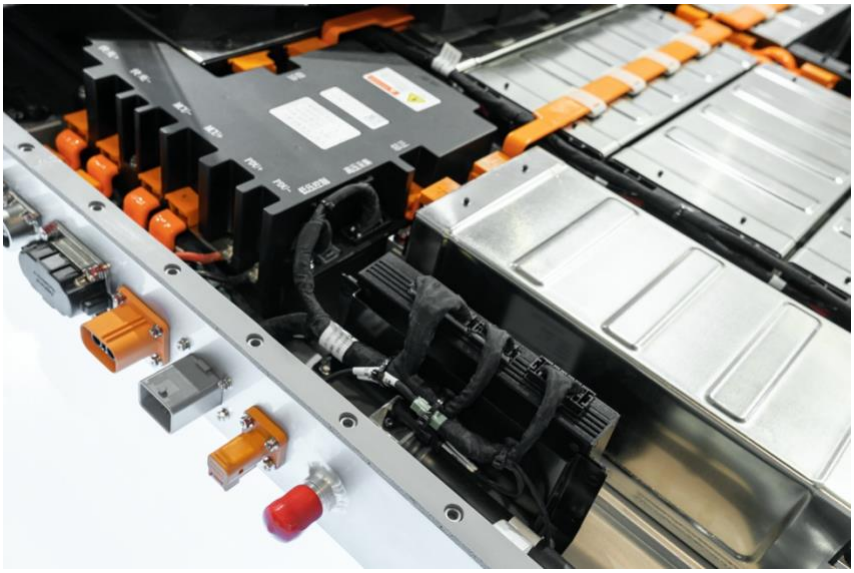
Key Themes and Insights

- The volume of end of life (EOL) EV batteries is expected to grow dramatically in North America over the coming decade, with a 2019 study on EV battery recycling and re-use for the American Petroleum Institute estimating that 525,000 EV batteries will reach end of life by 2025 and over one million units will hit end of life by 2030.
- The imperative for both re-use and recycling is urgent, but costs are a key barrier. 60% of existing costs for managing EOL batteries are rooted in logistics and transportation. Smarter logistics networks are required to optimize movement of EOL batteries across the continent.
- According to Call2Recycle, the primary problem in keeping batteries out of landfills is not capacity or capital, it is coordination among different actors in the supply chain, including governments and consumers.
- Effectively managing and moving EV batteries requires publicly available, standardized data on volume, location, and condition of batteries. In the absence of reliable information on where, when and what types of recoverable materials and reusable products are available, it is difficult to make meaningful investments.
- Current regulations governing the handling and transportation of batteries often involve hazardous waste categorization, are highly variable across regions, complex, and prohibitively costly.

- There is a strong need for designing and aligning regulations specific to EV batteries that will address CE objectives, as well as associated risks, in a more efficient and cost-effective manner.
- Current mix of NiMH (80%) and Li-Ion batteries (20%) is expected to reverse by 2030, with Li-Ion becoming 80% market share. It is expected that the volume of NiMH will not decrease significantly; rather, the volume of Li-Ion will grow at a very rapid rate.
- Growth in volume should contribute to reduced per unit cost of transportation for EOL batteries.
- Trends in recycling will be largely affected by raw material supply issues. Uncertainty about future supplies of cobalt, lithium and even nickel will be key in driving the value and need for recycling.
- Current innovation focuses mainly on extending battery range and life span. The next wave of innovation needs to focus on design for re-purposing and recovery, reduce waste and increase rates, and battery value retention. However, the repurposing of batteries needs to overcome OEMs' current hesitancy to verify repurposed batteries.
- In order to optimize the potential for repurposing and encouraging second life for batteries there are a range of issues to be addressed, including greater alignment and standardization of design and chemistry to promote safety, reliability and flexibility in use.
- There is a strong need for building consumer awareness and confidence so that they can better engage with CE principles for retaining/extending battery life. “EOL” is probably a phrase which need to be re-visited to better encourage participation in second life markets. An alternative phrase is "end-of-use" or EOU, which can be addressed via refurbishing or remanufacturing.

Panel 3: Design and Manufacturing Issues for Optimizing Circular Economy Potential for Batteries in Passenger and Commercial EVs

The third panel looked at key considerations/challenges and opportunities in enabling a closed loop, circular economy approach to batteries, their components and mineral compounds, which addresses safety, environmental and economic objectives.



Moderator: Geoff McCarney, Director of Research, Smart Prosperity Institute

Panelists

Dan Bowerson,
Senior Director, Energy and Environment, Alliance for Automotive Innovation

Sankar Das Gupta,
Co-founder and CEO, Electrovaya Inc.

Jeff Spangenberger,
Materials Recycling Group Leader, Argonne National Laboratories

Key Themes and Insights

- Lead acid batteries already are a very good news story about product management with greater than 95% rates of recycling. However, NiMH and Li–ion batteries pose a number of different challenges (size, weight, chemistry, complexity of cell design, etc.), which require a different approach, and the need for new strategies and tools.
- Dramatic increases in EVs (from 4% to 50% by 2030) will require and drive major production, recycling and service infrastructure transformation.
- Key obstacles/challenges include uncertainty in supply of critical minerals needed for battery function (cobalt, lithium, others), as well as a significant gap in current capacity and technology to recycle in a safe and cost-effective way.

- Short term priorities are to expand domestic capacity for both manufacturing and recycling of both cathode and non-cathode materials.
- Research and innovation investments need to be initiated now for the mid to longer term goals of battery repurposing and second-life capabilities, which will allow for greater extraction of value before recycling. Part of the future focus should be on the development of viable leasing models that address existing safety and liability concerns.
- Government and civil society support are needed to enable the kind of supply chain coordination and collaboration necessary to meet the logistical, scientific, economic and regulatory issues associated with these goals.

Panel 4: Policy Approaches and Instuments for Advancing Electric Vehicle Battery Economies

The final panel focused on the role of the public sector in supporting progress throughout battery supply chains, from research and development, to regulation and infrastructure.

Moderator: Rob Sinclair, Senior Policy Advisor, Canadian Minerals and Metals Plan, Natural Resources Canada

Panelists:

Jean-François Béland, *Vice President of Ressources Québec, Investissement Québec*

Caroline Godkin, *Deputy Secretary Environmental Protection and Emergency Response, California EPA*

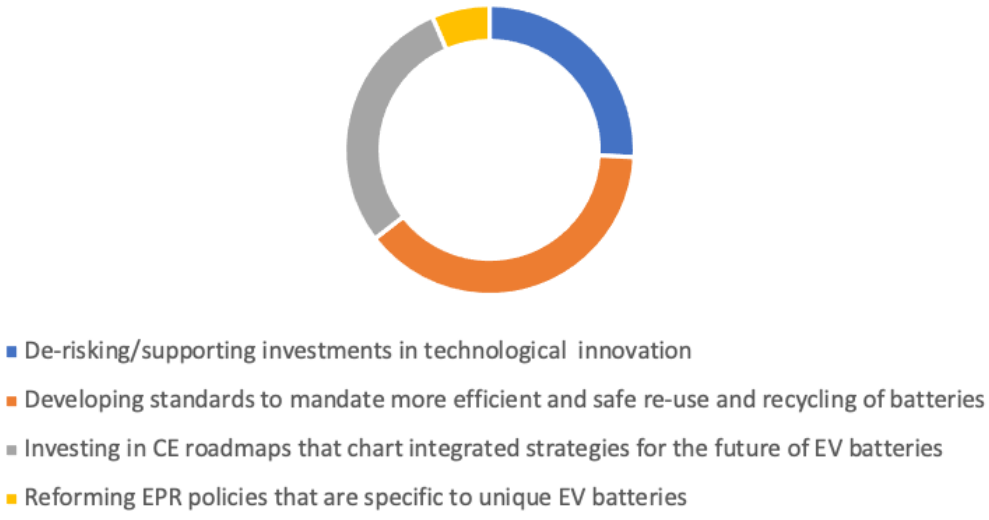
Ewout Deurwaarder, *Policy Officer Batteries and Ecodesign, European Commission*

Key Themes and Insights

- Quebec has shown strong political and public policy leadership as well as an innovative approaches to partnerships with a range of industry players, as well as the federal government in their development of an aggressive Quebec battery strategy, which includes all aspects of battery development from mineral extraction to manufacturing and recycling.
- Quebec's combination of clean hydro energy, domestic supplies of nickel, lithium, graphite and other materials create a strong foundation on which to build a new CE battery industry.

- Investing in greater collaboration across North America is critical to accelerating progress towards the goal of creating north/south and major market hub development.
- California is positioning itself to be a key player in the EOL battery management as the volume of EOL EV battery stocks grows in the coming years. They have created a diverse Lithium-ion Car Battery Recycling Advisory Group to advise government in developing the many strategies and tools needed to meet this aspiration.
- California is planning to bring in legislation that will ensure 100% of EOL EV batteries in the state are either reused or recycled. Within this strategy there is a recognized need to prioritize high-value recycling, quality return, and information & data sharing. As well, it seeks to ensure that there is no unregulated grey market and that there are just transition measures that avoid unfair burdens on marginalized communities that need transportation services.
- The EUs recent battery regulation reforms have provided global leadership in this field. The new laws (effective in 2022) will introduce mandatory requirements on sustainability (such as carbon footprint rules, minimum recycled content, performance and durability criteria), safety and labelling for the marketing and putting into service of batteries, and requirements for EOL management.
- To support the implementation of these measures there are also parallel investments in R&D, eco-design market innovation, skills development that are aligned with a larger European Commission's CE Action Plan.

Poll #2: **Where should governments focus their efforts to support a circular economy for EV batteries?**

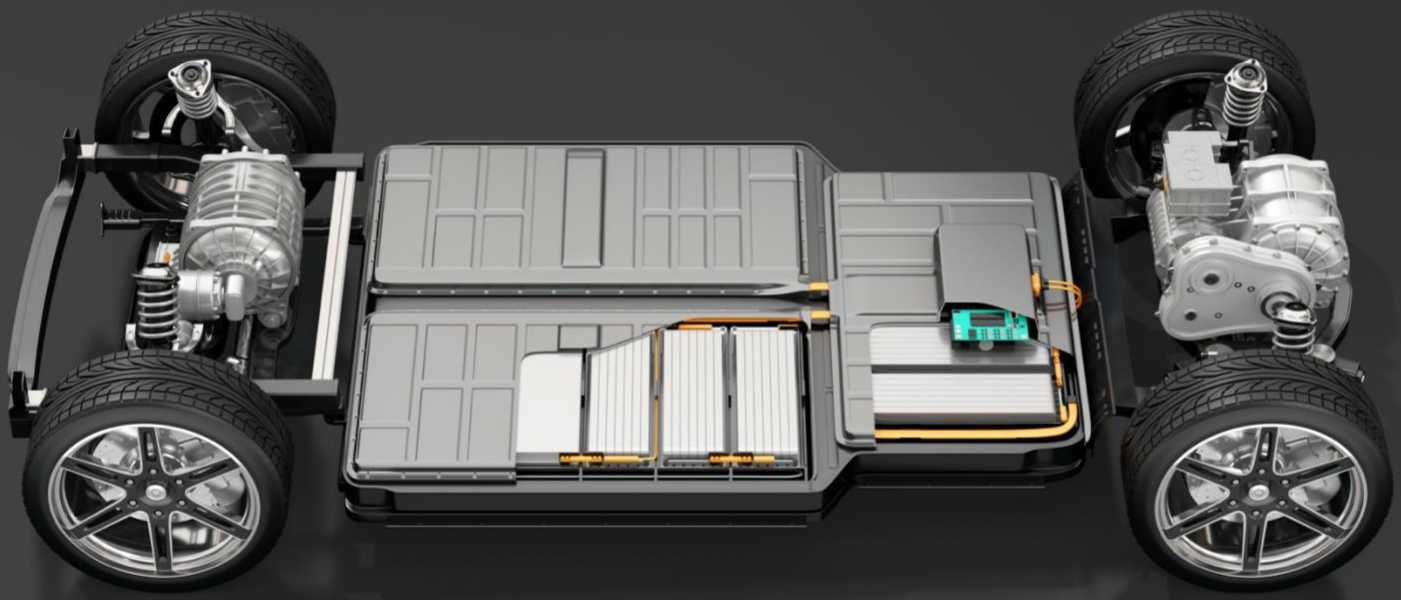


Conclusions and Key Takeaways

- The need for integrated CE strategies for EV batteries in North America is a core imperative, given the extraordinary growth in new battery markets over the coming decade. Current R&D, production, recycling and service infrastructure needs to be a radically overhauled to be prepared to sustainably manage the volumes of batteries entering the market.
- The potential return on investment for an EV CE in North America is projected to be very high, as are the costs of not taking these issues seriously. Momentum is starting to build and various promising models are being developed to address parts of the puzzle, but substantial energy and capital needs to be invested to realize the benefits of a coordinated effort.
- To address the prohibitive cost of transportation, specific investments are essential in regional hub and spoke collection and processing infrastructure, and associated supply chains.
- Overcoming the current reality of siloed elements in the supply chain (from miners to OEMS, designers, importers, dealers, consumers and governments) must be a priority in order to develop more integrated mutually supportive strategies. Investment in collaborative platforms that bring together key actors and regions in Canada and US must be a priority.
- A key element necessary to enable better supply chain integration is reliable, strategically focused data on battery materials and product conditions. Expanded adoption of tools like Battery Passports will be important to optimizing re-use and recycling.
- Repurposing and second-life strategies and options are a fundamental part of realizing the full CE value potential for EV batteries. Further investments are needed in economic and legal models, technology and design for safety and adaptability as well as consumer education on options and opportunities.

Resources and Reports Referenced in the Session Chat

- Electric Autonomy's battery supply chain series
- Circular Economy: Decoupling Prosperity from Consumption. See Horasis session with David McGinty of PACE and others:
- Propulsion Québec study on extended producer responsibility for end-of-life electric vehicle battery management
- The Canadian Minerals and Metals Plan
- The Automotive Recyclers of Canada (ARC)
- Research study on reuse and recycling of batteries employed in electric vehicles prepared for API by Kelleher Environmental -
- Metal Tech Alley recycling car and lithium ion batteries programs in Trail, BC
- CA Li-Ion EV Battery Recycling Advisory Committee
- The European Commission's proposal for a Regulation on batteries and waste batteries
- SPI's recent report, *Primary Materials in the Emerging Circular Economy*



Contact:
Alan Young,
Senior Advisor – Minerals Sector
Circular Economy Leadership Canada
alanyoung@merg.ca