EV LITHIUM-ION BATTERY RECYCLING IN CANADA: MARKET OPPORTUNITY & SUPPLY-CHAIN ANALYSIS

Project Objective

Assess the scale of EV battery recycling opportunity in Canada, evaluate current infrastructure status, and model recycled metal recovery potential. This analysis demonstrates ability to research emerging industrial markets, structure supply-chain problems with real data, and communicate findings relevant to the circular economy and critical minerals supply.

Market Context

Canada's EV Growth & Battery Waste:

Canada is targeting 100% zero-emission vehicle sales by 2035, with EV registrations growing 48% in 2023 (Electric Mobility Canada, 2025). The battery recycling opportunity is substantial: at least 93,000 EV batteries will need recycling by 2040, rising to 500,000 by 2045 (Lark Scientific, 2025). Currently, approximately 85% of global battery recycling feedstock comes from manufacturing scrap; however, end-of-life EV batteries will dominate after 2035 (Lark Scientific, 2025). Without new investment in recycling infrastructure, Canada's recycling capacity will be exhausted between 2034 and 2038 (UBC Open Library, 2022).

Why Recycling Matters:

Battery recycling recovers critical minerals lithium, nickel, cobalt, and manganese that are essential for new battery production. Recycling reduces CO_2 emissions by 1–2 tonnes CO_2 per tonne of batteries recycled compared to virgin mining (International Center for Automotive Technology [ICCT], 2023; Transport & Environment, 2025). This approach reduces reliance on virgin mining and strengthens supply-chain resilience.

Current Canadian Recycling Landscape (2025).

Facility	Location	Status	Feedstock
Lithion Technologies	Quebec	Commercial (limited scale)	Manufacturing scrap, early end-of-life
Electra Battery Materials	Ontario	Pilot (since 2022)	Manufacturing scrap
Call2Recycle	Multiple provinces	EV program emerging	Household + EV (nascent)

Critical Gap: Canada has no national Extended Producer Responsibility (EPR) framework for EV batteries (Compliance and Risks, 2025). Each province operates independently, creating regulatory fragmentation. EV batteries are explicitly excluded from Ontario's household battery EPR, leaving their fate outside current producer responsibility schemes (Compliance and Risks, 2025).

Metal Content in EV Batteries (NMC Cathode Chemistry)

Typical lithium-ion batteries contain a cathode comprising 25–30% of total battery weight. Within the cathode active material, the following metals are found:

Metal	Typical Content	Recovery Rate	Key Application
Lithium	1.2–2.0%	80%*	Cathode active material
Nickel	12–15%	95%*	Energy density; cost reduction
Cobalt	2–8.5%	95%*	Thermal stability
Manganese	5–15%	90%*	Stabilizer in NMC chemistry

Recovery rates based on EU Battery Regulation targets (2031+) and ICCT (2023) standards

Scenario Model: Single Facility Processing

Assumptions:

- Annual battery input: 10,000 tonnes (approximately 1/12 of Brunp's 120,000-tonne 2024 capacity; CATL, 2025)
- Average metal content: Li 1.6%, Ni 13.5%, Co 5.5%, Mn 10% (based on typical NMC compositions; Ni et al., 2024)
- Recovery rates: Li 80%, Ni 95%, Co 95%, Mn 90% (industry standard per EU Battery Regulation; ICCT, 2023)
- CO_2 benefit: 1.5 tonnes CO_2 avoided per tonne of batteries recycled (midpoint of 1–2t range; ICCT, 2023; Transport & Environment, 2025)

Annual Recovery Output:

Metal	Recovered (tonnes/year)
Lithium	12
Nickel	102
Cobalt	39
Manganese	67

CO_2 Impact: Approximately 1,125 tonnes CO_2 avoided annually

Key Insights

1. Scale is Achievable but Fragmented: A single 10,000-tonne/year facility is technically feasible; Brunp operates at 120,000 tonnes annually (CATL, 2025). Canada's forecasted 93,000 batteries by 2040 could be processed by 9–12 mid-sized facilities (Lark Scientific, 2025), yet regulatory uncertainty delays investment.
2. Capacity Exhaustion Risk is Real: UBC research warns that without new facility builds starting now, Canada will face recycling capacity shortfalls by 2034–2038 (UBC Open Library, 2022). Most EV batteries deployed in 2018–2020 will reach end-of-life between 2028–2030.
3. Best-in-Class Performance is Higher: Brunp achieves 96.5% lithium and 99.6% nickel/cobalt/manganese recovery using proprietary direct recycling technology (CATL, 2025). Canada's facilities are at pilot stage; industry-standard performance (80% Li, 95% Ni/Co) is achievable with current commercial technology but requires investment.

4. Regulatory Fragmentation Blocks Scale: No federal EV battery EPR exists; Ontario excludes EV batteries; British Columbia and other provinces have different rules (Compliance and Risks, 2025). This prevents pan-Canadian collection networks and economies of scale.

Recommendations

1. Establish National EV Battery EPR Framework – The federal government should mandate a producer responsibility scheme for EV batteries, harmonized across provinces, to unblock collection and enable facility planning.
2. Invest in 2–3 Regional Hubs – Site new facilities near high EV adoption areas (BC, ON, QC) with proximity to low-cost electricity and existing OEM/fleet networks.
3. Adopt Technology Targets – Support deployment of advanced hydrometallurgical and direct-recycling methods to achieve ≥95% recovery rates for all metals, following Brunp's example (CATL, 2025).
4. Build Collection Infrastructure – Partner with OEMs, dealerships, fleets, and municipalities to establish battery aggregation and logistics networks.
5. Further Research Priorities:
   - Detailed feedstock forecast by province and year (2025–2050)
   - Capital expenditure and operating cost modeling for a 10,000–50,000 tonne/year facility in Canada
   - Logistics mapping: battery collection hubs → regional recycling facilities
   - Comparative analysis of European (EU Battery Regulation) and Chinese (CATL/Brunp) recycling models
   - Benchmark pricing for recovered materials (Li, Ni, Co) versus virgin supply costs

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