



Best Practices for Mitigating Lithium-ion Battery Fires: Lessons from Edmonton and Path to Future Management

Edmonton

Navigating the Hazards of the Waste Management Lifecycle

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Land Acknowledgement

We acknowledge the original inhabitants of this great land and express our appreciation for their hospitality, for the manner in which they care for the land and for the opportunity we have to create a unified community that is centered around the oneness of humanity.

Presentation Outline

A STRATEGIC PATHWAY: MITIGATING LIB FIRE RISK



The Growing Threat: Where and Why Batteries Ignite

Why Lithium-ion Batteries (LIBs) are a Crisis?

- **Ubiquity:** Powering everything from phones to EVs.
- **The Problem:** Improper disposal into garbage/recycling streams.
- **Consequences:** * Ignition/Explosions during collection and processing.
 - Direct danger to frontline waste workers.
 - Structural damage to critical infrastructure.
- **The Edmonton Case:** The Edmonton Waste Management Centre (EWMC) recorded incidents costing hundreds of thousands in repairs and project delays.

Collection



Blue bags



Black carts



Lithium-ion batteries (LIBs)



Materials Recovery Facility (MRF)



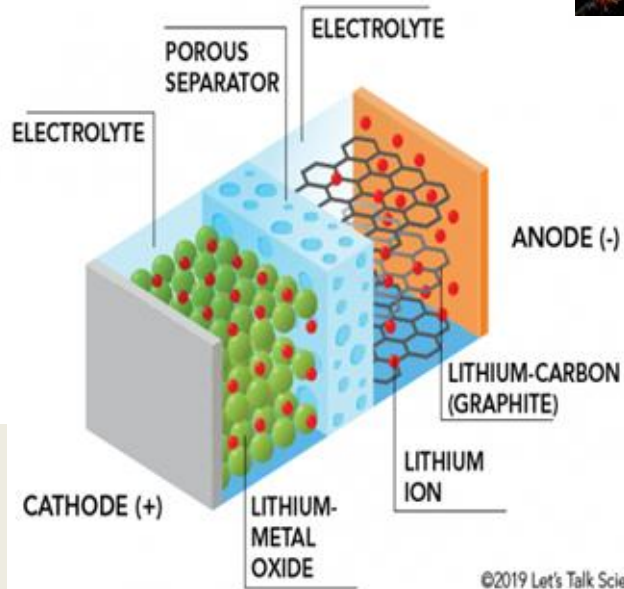
Integrated Processing and Transfer Facility (IPTF)

Construction & Demolition (C&D) Waste Facility



Why Lithium-ion Battery Ignite?

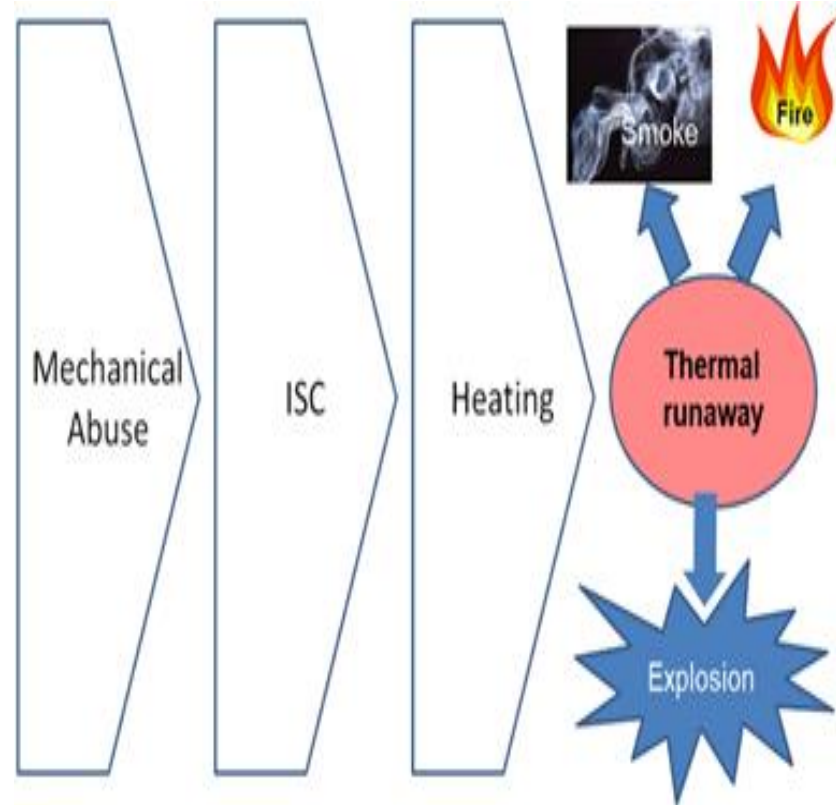
Short circuit once broke



Copper (Co)

Cobalt (Co)
Nickel (Ni)

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The Fire Problems

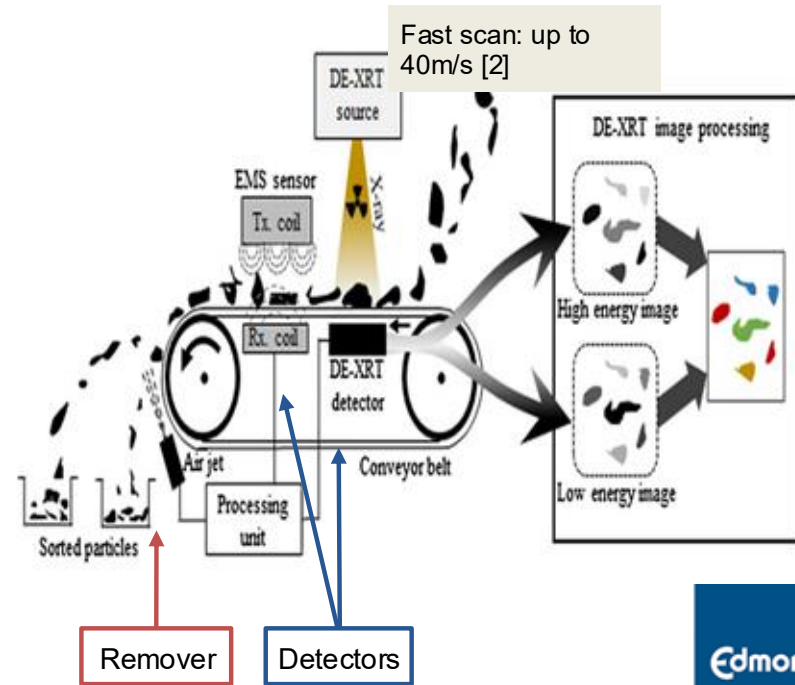
- Safety issue
- Economic loss
 - Equipment
 - Production
- Environmental issue



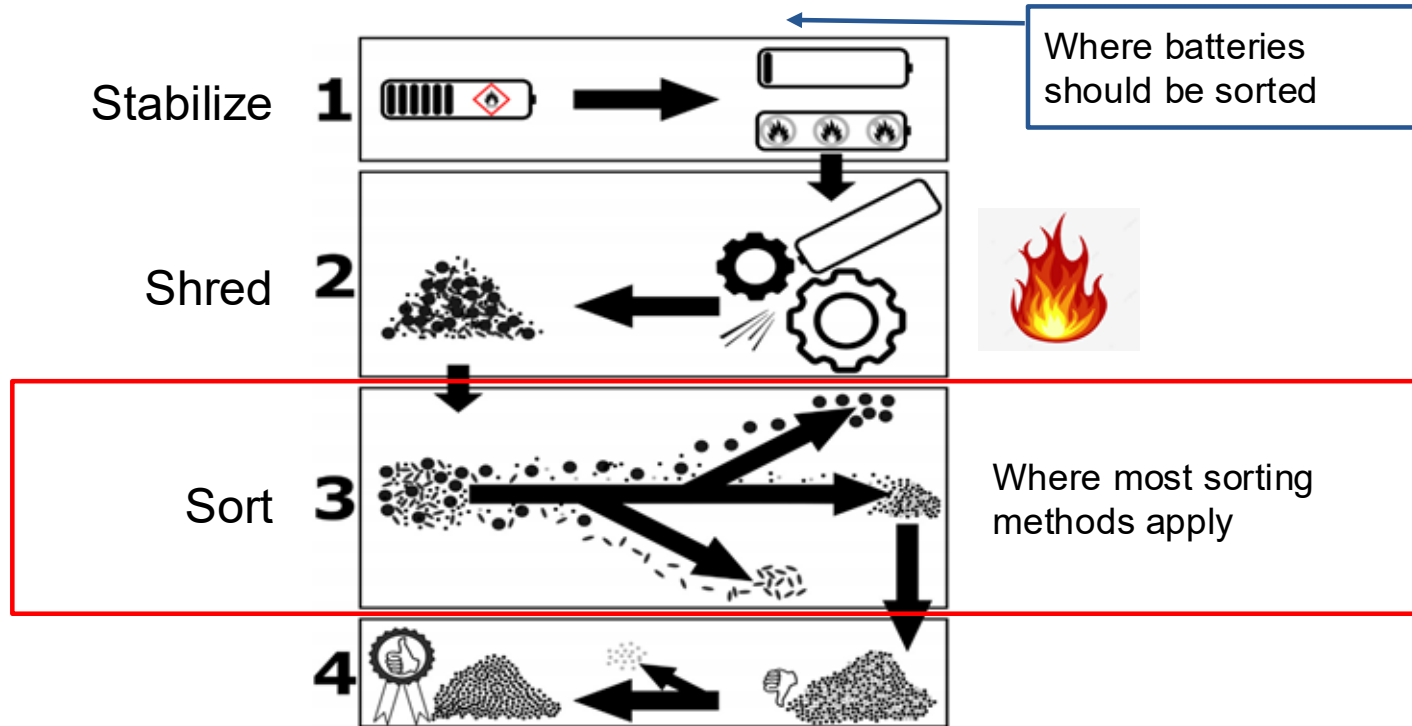
Waste Sorting Methods

- Direct sorting
 - E.g.: size-based, gravity, floatation, eddy current separator
- Indirect sorting (sensor based)
 - Detect first
 - then remove
- Labour based

Indirect Waste Sorting



The Application Gap in Battery Sorting



The Three Stages of Risk Mitigation - 1

Strategy 1 – The Disposal Stage

- **The Challenge:** Low public compliance with hazardous waste protocols.
- **Root Causes:**
 - Lack of awareness regarding "hidden" batteries.
 - Insufficient incentives to visit EcoStations or retail drop-offs.
- **Solution:** Prioritizing public education and making "Circular Economy" disposal easier for the average citizen.

The Three Stages of Risk Mitigation - 2

Strategy 2 – Collection and Processing

- **Current Reality:** Reliance on manual sorting.
- **The Risks:**
 - Inefficiency: Human eyes often miss batteries buried in bags.
 - Safety: Manual handling of unstable batteries is high-risk.
- **Recommendations:** * Adopting solid waste association operational guidelines.
 - Standardizing how "hot loads" are handled on tipping floors.

The Three Stages of Risk Mitigation - 3

Strategy 3 – The Infant Fire Stage

- **Goal:** Detection before the "Point of No Return."
- **Advanced Technologies:**
 - **Thermal Cameras:** Identifying heat signatures before visible smoke appears.
 - **Gas Sensors:** Detecting chemical off-gassing from failing cells.
 - **Automated Water Cannons:** Rapid, targeted suppression to prevent fire spread.
- **The Benefit:** Minimizing downtime and preventing catastrophic facility loss.

Looking Forward: 2026 and Beyond

The Evolving Landscape

- **Increased Volume:** The rise of Electric Vehicles (EVs) and E-bikes is escalating the LIB volume in the waste stream.
- **Integrated Management:** Moving toward ARMA (Alberta Recycling Management Authority) and national recycling strategies.
- **Urgency:** The 2021 findings are more relevant today as the "battery-powered world" expands

The Path Forward (Part 1) – Policy & Extended Producer Responsibility (EPR)

Shifting Responsibility to the Source

- **Implementation of EPR (2025-2026):** Alberta is transitioning to a framework where producers (manufacturers/retailers) are responsible for the entire lifecycle of their products.
- **ARMA Integration:** Working with the Alberta Recycling Management Authority (ARMA) to standardize "Hazardous Special Products" (HSP) collection.
- **The "Battery Passport":** A move toward digital tracking for larger batteries (EVs and industrial storage) to ensure they are diverted from municipal waste streams before they ever reach a garbage truck.
- **New Regulations:** Anticipating updated 2026 federal laws that categorize spent LIBs as a distinct hazardous waste class to mandate stricter handling and labeling

The Path Forward (Part 2) – AI and Next-Gen Sorting

Automating Detection in the Waste Stream

- **AI-Powered Vision Systems:** Replacing manual sorting with deep-learning cameras that can identify the distinct shapes and brands of batteries on a fast-moving conveyor belt.
- **Robotic Separation:** Using high-speed robotic arms to "pick" batteries out of the stream, removing the human element from the potential "blast zone."
- **X-Ray & Multispectral Imaging:** Detecting batteries hidden inside sealed bags or "dead" electronic devices that traditional visual inspection would miss.
- **Smart Tipping Floors:** Installing floor-level sensors that detect chemical "off-gassing" or localized heat spikes as soon as a collection truck dumps its load.

The Path Forward (Part 3) – The "Second Life" Economy

From Waste to Resource

- **Hydrometallurgical Recovery:** Transitioning from "burning" old batteries (pyrometallurgy) to chemical baths that recover up to 90% of lithium, cobalt, and nickel with lower emissions.
- **Second-Life Applications:** Identifying batteries that are no longer fit for EVs but still hold enough capacity for stationary "Solar-to-Grid" storage.
- **Closed-Loop Manufacturing:** Creating a "Made-in-Alberta" supply chain where recovered minerals are sold back to battery manufacturers, reducing the need for virgin mining.

The Path Forward

'THE EVOLUTION OF BATTERY MANAGEMENT: A STRATEGIC TIMELINE (2021-2030)

2021: INITIAL STUDY



EDMONTON'S ALARM BELL

- Municipal fire study focused on EWMC
- Addressed immediate operational costs & safety risks
- Initiated R&D for automated battery separation

2026: IMPLEMENTATION PHASE



EPR & AI DEPLOYMENT

- Full Provincial EPR framework active for all batteries (ARMA/Call2Recycle)
- AI-powered vision and robotic sorting deployed in major facilities
- E-bike and EV battery pre-sorting protocols established

2030: FULLY CIRCULAR ECONOMY



RECOVERY & 'MADE-IN-ALBERTA' SUPPLY CHAIN

- 95%+ recovery of critical minerals via hydrometallurgy
- EV battery passports standard; 'Second Life' stationary storage common
- Close-loop manufacturing; reduced reliance on virgin mining
- Municipal waste streams effectively pre-sorted and fire-safe

Summary & Actionable Steps

Key Takeaways

The Price of Inaction:

LIB fires are high-cost liabilities threatening both worker safety and critical infrastructure.

A "Swiss Cheese" Defense:

Mitigation requires layered defense—Upstream (education), Midstream (sorting), and Downstream (suppression).



The Future is Integrated: Adapting to rising EV volumes requires leveraging EPR policies and next-gen automated AI sorting.

Actionable Steps for 2026

- **Audit Current Infrastructure:** Ensure thermal cameras are actively integrated with automated water suppression.
- **Lobby for Policy:** Support the enforcement of EPR and ARMA integration to reduce the municipal financial burden.
- **Public Awareness 2.0:** Shift public messaging from "Don't Throw it Away" to "Bring it to the Retailer" (take-back programs).
- **Invest in R&D:** Pilot detection-robotics and early-sorting technologies to protect workers and equipment.

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