



Implementing Effective Battery End-of-Life Processes

Objective

Establish a streamlined and cost-effective process for managing end-of-life BEV batteries, including evaluation, disposal, and storage management.

Justification

As an early adopter of battery-electric vehicles in 2012, Agnico Eagle's Macassa Mine had to establish its own in-house battery team, since services like BaaS did not yet exist. Managing disposal of the large volumes of used cells and packs posed significant operational, environmental, and regulatory challenges.

For instance:

- High-discharge activities (e.g., uphill hauling) shorten battery life due to heat, while improved practices have doubled battery life in some cases (from 8 months to 2–3 years).
- Batteries retired when amp-hour capacity drops to 60–70%.

The mine has faced challenges such as:

- Determining when to replace a cell, module, or pack.
- Costs for adapting second-life deterred past efforts.
- High recycling costs (\$3–4/lb.).
- Storage issues, leading to the creation of a “graveyard.”



Implementation

Three steps were used to navigate battery disposal effectively:

1. **Establish an Evaluation Process:** Identify what end-of-life looks like for your operation
 - When is the battery no longer able to complete a cycle or activity vs. when a battery faulty.
2. **Navigating End-of-Life:** Optimize recycling and disposal costs by evaluating providers.
 - Breaking down battery packs to lower voltage states reduces hazards and costs (including for transportation and storage).
 - Understand your options for recycling with the OEMs (original equipment manufacturers). Compare recycling costs across providers.
3. **Storage Management:** Develop clear guidelines for long-term storage to mitigate risks.
 - Be prepared to allocate dedicated resources to manage the “battery graveyard.”

Progress to Date

Macassa has implemented a full-time position dedicated to battery decommissioning and repurposing usable cells where possible. Although engineering costs have hindered second-life applications, ongoing storage efforts provide flexibility for future uses. Challenges persist with international shipping due to regulatory barriers.

Update: Macassa is now exploring a Battery-as-a-Service (BaaS) model, shifting some end-of-life responsibilities to the OEM.