



# End-of-Life Management of Battery Embedded Devices

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Chris Newman  
U.S. Environmental Protection Agency  
Region 5, Chicago  
For: SWAA Product Stewardship Committee  
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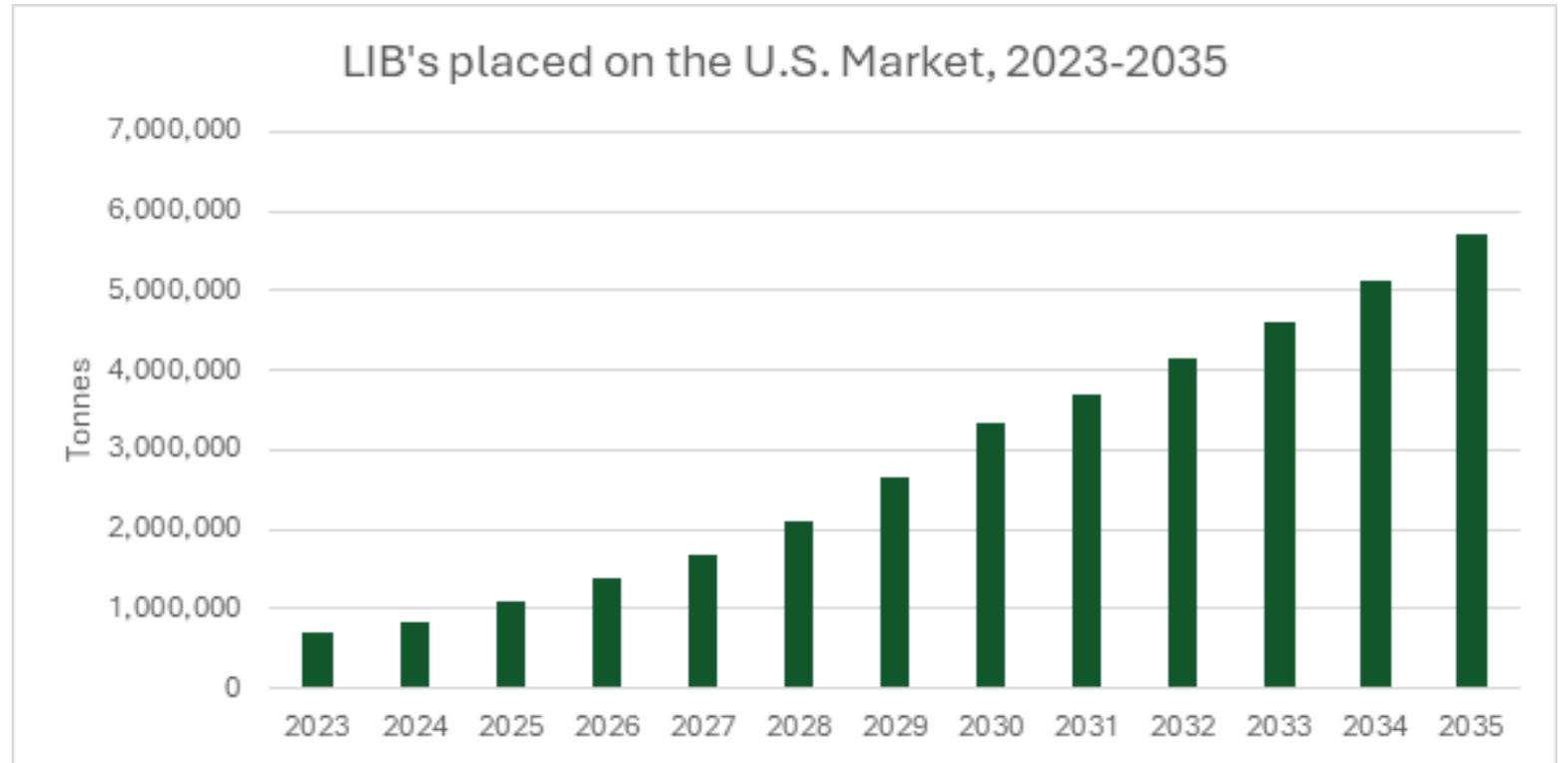
# Why Batteries?

## Batteries are central to our lives as they:

- Power everything from cars to consumer electronics
- Contain valuable metals that can be extracted and recycled

## Increasing battery collection and recycling will help:

- Recover critical minerals
- Prevent fires by keeping batteries out of municipal waste streams
- Strengthen the domestic battery supply chain

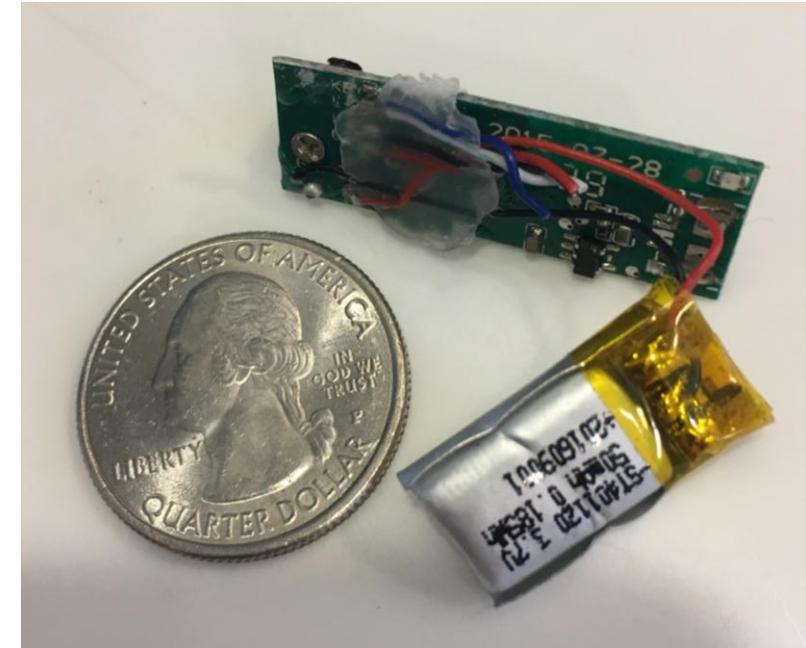


Source: Estimated U.S. Market Share of LIBs for 2023-2035, in Tonnes. *Circular Energy Storage (CES)*.



# Embedded Batteries

- A [2018 report](#) found a sharp increase in the number of products with embedded batteries.
- Battery-embedded devices pose unique hazards in the waste stream
  - Users may not recognize that there is a battery in the device
  - Any label on the battery for proper management will not be visible, and packaging is long gone
  - Battery removal can be difficult, dangerous, and time consuming
- The variety of devices with embedded batteries is growing



# A Unified Message

**DO NOT PUT RECHARGEABLE BATTERIES IN YOUR CURBSIDE TRASH OR RECYCLING BIN!**

For Disposal Options Visit **Call2Recycle.org**

Call2Recycle is now: [thebatterynetwork.org](http://thebatterynetwork.org)

**The Battery Network**

In Partnership With:



**RECHARGEABLE BATTERIES CAN START FIRES!**

**DO NOT PUT THEM IN YOUR TRASH OR RECYCLING BIN!**

TAKE THEM TO A HOUSEHOLD HAZARDOUS WASTE EVENT OR VISIT [CALL2RECYCLE.ORG](http://CALL2RECYCLE.ORG) TO FIND A DROP-OFF LOCATION CLOSEST TO YOU.

[chestercountyswa.org](http://chestercountyswa.org)

**AVOID THE SPARK™**

Be battery safety smart.

**BATTERIES CAN SPARK OR EXPLODE**

They don't belong in recycling or trash.



**LITHIUM-ION BATTERIES DO NOT BELONG IN CURBSIDE CARTS**

**THEY WILL CAUSE FIRES**



**BE A BATTERY HERO**

Put batteries in their place.

**Batteries don't belong in the trash or recycling.**



Washington County  
Harrisburg  
RAMSEY COUNTY



# EPA Aligns with and Amplifies this Message



[Home](#) / [Reduce, Reuse, Recycle](#)

## Used Lithium-Ion Batteries



Lithium-ion batteries and devices containing these batteries should **NOT** go in household garbage or recycling bins.

Lithium-ion batteries **SHOULD** be taken to separate [recycling](#) or [household hazardous waste collection points](#).

To prevent fires, tape battery terminals and/or place lithium-ion batteries in separate plastic bags.



# Battery Fires in the Waste Stream

- Fires from improperly disposed batteries can happen anywhere in the management chain and threaten community health and waste management infrastructure.
- EPA published a [report](#) on battery fires in the waste stream in 2021 which found fires trending upward throughout the waste management process including electronics recyclers. Other organizations have also published information:

- Fire Rover
- [Environmental Research and Education Foundation](#)
- [Eunomia](#)



# Battery Fires in the Waste Stream (cont)

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- State, local and Tribal governments:
  - 2024 Association of State and Territory Solid Waste Management Officials (ASTSWMO) [survey](#): most difficult-to-manage material
  - High costs for safe handling: transportation, packaging, staff training
  - Hard to recycle products: vapes, embedded batteries
- Fires at material recovery facilities (MRFs)
  - [National Waste and Recycling Association/ Resource Recycling Systems](#)
  - [NWRA](#) estimates 5,000 fires annually at the 300 U.S. MRFs
  - More than 1% of MRFs experience a catastrophic loss every year. Damage from the average catastrophic fire is \$22 million
  - Insurance rates have increased for MRFs: MRF property insurance rates increased 10-50x from 2017 – 2023.

# Recovery of Critical Minerals

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- When batteries can be collected and recycled instead of improperly disposed, valuable materials stay in the supply chain and can be used to make new batteries.
  - Lithium—28 tons of end-of-life batteries vs. 250 tons of ore or 750 tons of brine
  - Cobalt—5-15 tons of end-of-life batteries vs. 300 tons of ore
- Recycling also uses less energy and water than mining and produces less pollution like sulfur oxide.
- But, chemistries like lithium iron phosphate (LFP) are becoming more common and don't contain high value CMs. There's also low-cobalt chemistries as well. Not all batteries are equally desirable for CM recovery.



# Cost Savings of Using Recycled Battery Minerals

- New science emerging that recycled critical minerals not only saves money and material but can yield better performing batteries.\*

1 ton of battery-grade **lithium** can come from:



1 ton of battery-grade **cobalt** can come from:



Using **recycled materials\*** from spent batteries has potential to **decrease**:



- Costs by **40%**
- Energy use by **82%**
- Water use by **77%**
- SO<sub>x</sub> emissions by **91%**

\*Assumes a direct recycling method

FIGURE 7. Benefits of recycling for lithium-ion batteries. Data from Argonne National Laboratory's ReCell Center, 2019.<sup>33</sup>

\*<https://www.sciencedirect.com/science/article/pii/S2542435121004335>



# Device Design

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- Removeable batteries allow for extended device life and make battery recycling safer and easier
- Right to repair laws addressing repairability have been making headway in some states
- Some manufacturers are already moving toward more removeable batteries



# Embedded Batteries and Hazardous Waste Regulation

- When batteries are hazardous waste, they can be managed as universal waste
  - Universal waste applies to all battery chemistries that would be hazardous waste
- Universal waste is a type of hazardous waste
  - Alternative set of standards
  - If hazardous waste batteries are not managed as universal waste, they must be managed as hazardous waste
- Battery-embedded devices cannot be managed as universal waste but 10 states have universal waste categories for electronics which often includes battery embedded devices
  - Arkansas, California, Colorado, Connecticut, Hawaii, Louisiana, Michigan, Nebraska, New Jersey, and Rhode Island



# Proposal to Revise Universal Waste

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- Adjust the universal waste regulations to address the safety concerns associated with managing EOL LIBs, while still promoting LIB recycling
  - New category specific to lithium batteries, separate from the existing broad UW batteries category
  - Housed within the existing UW program (i.e., it should feel familiar)
  - Consider other waste management challenges specific to lithium batteries
  - More information at: <https://www.epa.gov/hw/improving-recycling-and-management-renewable-energy-wastes-universal-waste-regulations-solar>
- EPA intends to harmonize the new standards with existing BMPs and other regulations (e.g., DOT Hazardous Materials Regulations) where possible



# Take Aways

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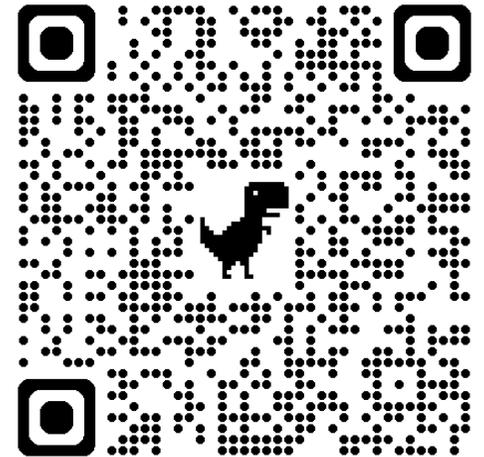
- Consumer awareness of batteries, battery embedded devices, and options for recycling are all critical to increase proper management of batteries
- A unified message amplified across US communities to keep battery embedded devices out of curbside waste and household recycling can reduce fires and risks to communities and municipal workers
- Advances to product designs to allow removability and recyclability of batteries can help address the problem



# Battery Collection Best Practices Toolkit

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- EPA's web-based [Battery Collection Best Practices Toolkit](#) compiles nationwide battery collection resources.
- Built under IIJA to help state, Tribal, and local governments create or improve programs with practical, safe, eco-sound materials that maximize reuse.
- Resource types include case studies, educational materials, how-to guides, reports, standards, tip sheets, webinars, and webpages with information on regulations and recycling initiatives.
- EPA also offers a [Model Recycling Program Toolkit](#) for all recyclables.



# Battery Collection Best Practices Toolkit

**Battery format**

Large Format (Motive) **Reset**

Large Format (Stationary Storage)

Mid-Format

Small Format

**Resource Type**

Case Study **Reset**

Educational Material

How-to Guide

Report

Standards

Tip Sheet

Webinar

**Focus Area**

End-of-Life Management **Reset**

Fire Management

Fire Prevention

Hazardous Waste

Permitting and Siting

Recycling

Storage

Transportation

**Community Characteristics**

All **Reset**

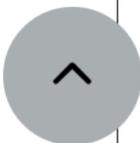
Tribal

Show 10 entries

**Export to Excel**

Search:

Title	Description	Organization	Battery Format	Resource Type	Focus Area	Community Characteristics
<a href="#">Leading the Charge: Marion County's Battery Collection and Recycling Program</a>	Case study that highlights battery collection and recycling in Marion County, focused on the challenges and successes of an established curbside collection and drop-off program. and the importance of	U.S. Environmental Protection Agency	Mid-Format; Small Format	Case Study	Collection Sites; Education/Outreach	All



# Other IIJA Projects

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- EPR framework for batteries
  - In coordination with the Department of Energy
  - Will provide a suggested framework for national cohesiveness for battery extended producer responsibility
- Voluntary Battery Labeling Guidelines
- Battery Collection Best Practices Tool Kit
- <https://www.epa.gov/electronics-batteries-management>



# Contact

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Chris Newman  
Land, Chemicals, and Redevelopment Division  
U.S. EPA, Region 5  
[newman.christopherm@epa.gov](mailto:newman.christopherm@epa.gov)  
312-353-8402