

Emerging Wastes: Lithium-ion Batteries

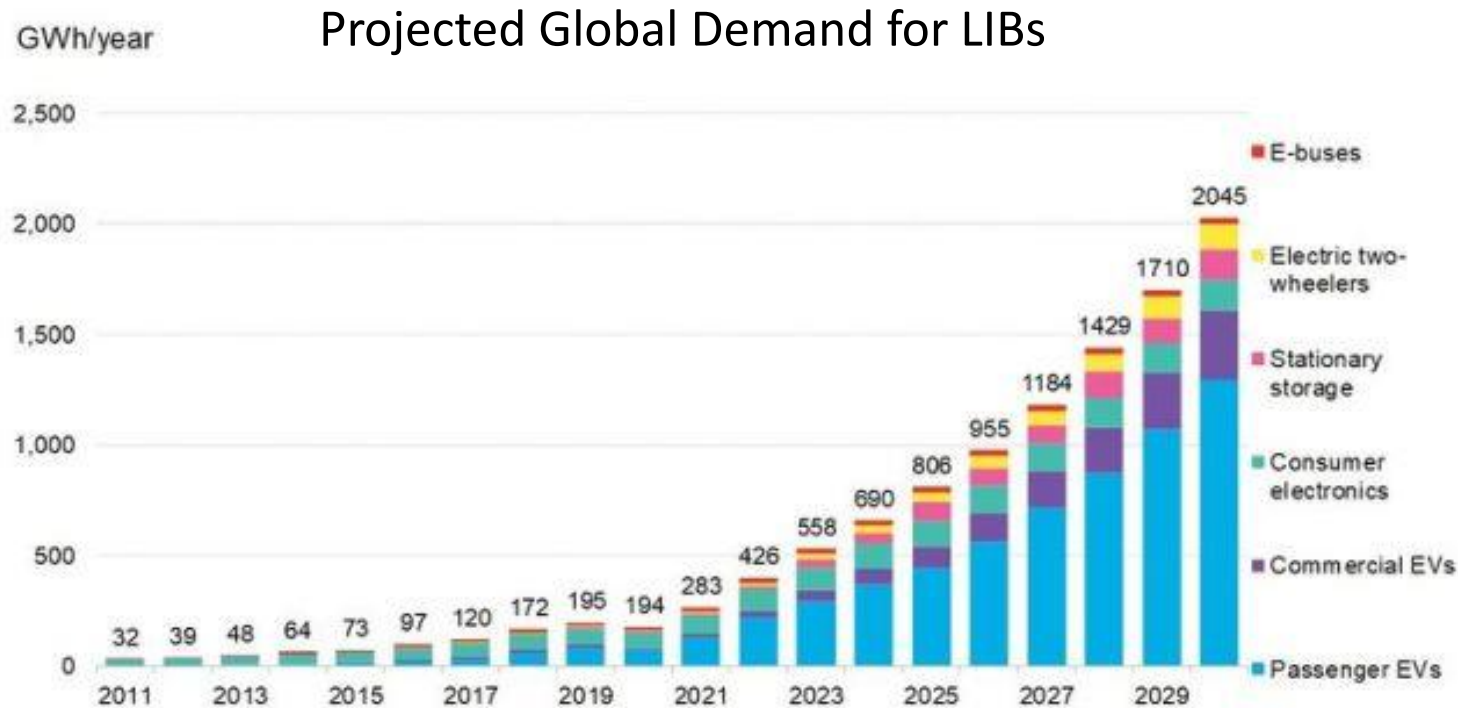
Ohio EPA Materials Management Advisory Council

August 18, 2021

Phoebe O'Connor— EPA ORCR



Background on Lithium-ion Batteries (LIBs)



<https://news.bloomberglaw.com/environment-and-energy/electric-vehicles-to-drive-massive-battery-demand-bnef-chart?context=search&index=3>

- LIBs are in a large, and growing, number of products:
 - Consumer electronics (headphones, cell phones, tablets, etc.)
 - Electric vehicles
 - Energy storage
- LIBs are also a growing component of the waste stream, especially smaller LIBs from consumer devices
- Battery recycling will provide raw material for future battery manufacturing

Recycling LIBs

- Recycling market is growing in the US
- Some North American LIB Recyclers:
 - Retrieiv (Kinsbursky Bros), Lancaster, OH and Trail, British Columbia
 - Li-Cycle, Rochester, NY, and Kingston, Ontario
 - Redwood Materials, Carson City, NV
- Collection and Transportation Companies:
 - Call2Recycle
 - Big Green Box
- Some recyclers have RCRA storage permits (Part B permits)
 - However, some recyclers may have operations that don't need a RCRA storage permit (e.g., recycle without storing)

Recycling LIBs (continued)

- Two main methods for recycling: pyrometallurgy (smelting) and hydrometallurgy (chemical leaching)
- Economically, cobalt is the driver of LIB recycling*
 - Pyrometallurgy recycling yields cobalt and sometimes nickel
 - Manufacturers are seeking effective cobalt substitutes, which could negatively affect recycling market
 - New recyclers are developing hydrometallurgical recycling and other methods to extract lithium and other metals
- Reuse in stationary applications is another option for LIBs at the end of life
- On February 24, 2021, President Biden issued [Executive Order 14017](#), "America's Supply Chains" part of which looks at advanced batteries and critical minerals which will likely increase focus on the need for recycling of batteries
 - LIBs have a few critical minerals in them such as lithium, cobalt, graphite, and manganese

* Source: Harvey, Jan. "Metal recyclers prepare for electric car revolution." Nov. 17, 2017. Reuters

How to Find an LIB Recycling Center

- Consumer or household LIBs may be dropped off at municipal household hazardous waste collection sites, electronics recyclers, or retail store locations
- [Earth 911](#) and [Call2Recycle](#) post resources on their websites to find recyclers near you

The screenshot shows a search interface for finding LIB recycling centers. At the top, there are two input fields: "SEARCH FOR" containing "Lithium-ion Batteries" and "ZIP CODE" containing "44223". A green "SEARCH" button is to the right. Below the search bar, a dark blue header displays the search results: "Recycling centers for 'Lithium-ion Batteries' near '44223'" and a "Within: 25 miles" dropdown menu. A grey banner below the header reads "Rechargeable Batteries Recycling Guide" and includes a link to a "Rechargeable Battery Recycling Guide". Below this, there are four filter buttons: "All Listings", "Map View", "Programs", and "Mail-In". The search results are listed in two entries:

- A** **Lowe's** (2.1 mi. Location)
Materials accepted: Lithium-ion Batteries #2 Plastic Bags #4 Plastic Bags
Cell Phones Lead-acid Batteries - Non-automotive Nickel-cadmium Batteries (330) 920-9280
Nickel-metal Hydride Batteries +2 more 3570 Hudson Dr
Stow, OH 44224
- B** **Summit County Household Hazardous Waste Recycling Center** (2.2 mi. Municipal Location)
Materials accepted: Lithium-ion Batteries Acids Adhesives (330) 374-0383
Aerosol Cans - Full Alkaline Batteries Antifreeze Asbestos +55 more 1201 Graham Rd
Stow, OH 44224
For residents of Summit County only.

Managing End-of-Life LIBs

- 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, best management practices are to tape battery terminals and/or place lithium-ion batteries in separate plastic bags.**



End-of-Life Battery Management and Recycling Challenges

- Education
 - Consumers may be unaware that best practices for batteries include bagging individually and taping terminals
 - Consumers may not know when a battery is embedded inside a device (e.g. headphones, e-cigarettes)
- Logistics
 - Batteries should not be placed in curbside recycling and trash bins, should instead be dropped off at a dedicated recycling or household hazardous waste collection location
 - Sorting can be challenging when batteries are not properly labelled, or are embedded within devices; contamination could occur if sorting is not done properly
- Expense
 - Some battery recyclers charge to accept batteries

Are LIBs Hazardous Waste? What Regulations Apply?

- Most LIBs are likely hazardous due to ignitability and/or reactivity, given the damage case incidents.
 - EPA has not made a blanket statement on this issue.
- EPA recommends managing LIBs as universal waste (UW) and applying the standards found at [40 CFR Part 273](#).
- For LIBs that are HW, a third-party recycling exclusion, called the transfer-based recycling exclusion for hazardous secondary material ([261.4\(a\)\(24\)](#)) can be used to recycle them
 - More info: <https://www.epa.gov/hw/final-rule-2018-definition-solid-waste-dsw-response-court-vacatur>
- For household sources of LIBs, there is the household hazardous waste exclusion ([261.4\(b\)\(1\)](#)) that would likely exclude batteries from hazardous waste regulation, though not all states have this exclusion.



How LIBs Enter the Waste Stream

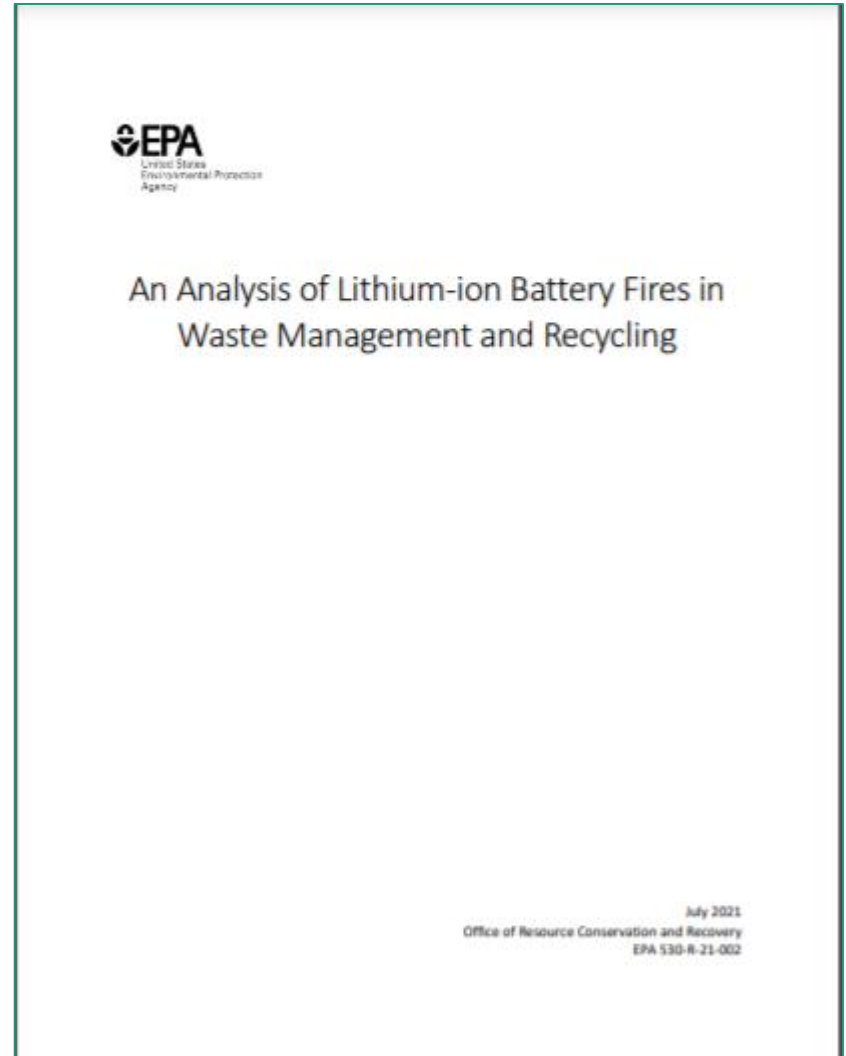


Conflicting symbols on an LIB

- Municipal solid waste and recycling facilities are not designed to receive LIBs
 - Symbols can be confusing for consumers: chasing arrows with a crossed-out garbage can imply that batteries should go to municipal recycling (i.e., curbside blue bin recycling)
- Many batteries are mistakenly sent for disposal or recycling with household trash
- LIBs may also still be inside devices when disposed in household trash and recycling
 - Consumers not aware that the device contains a battery

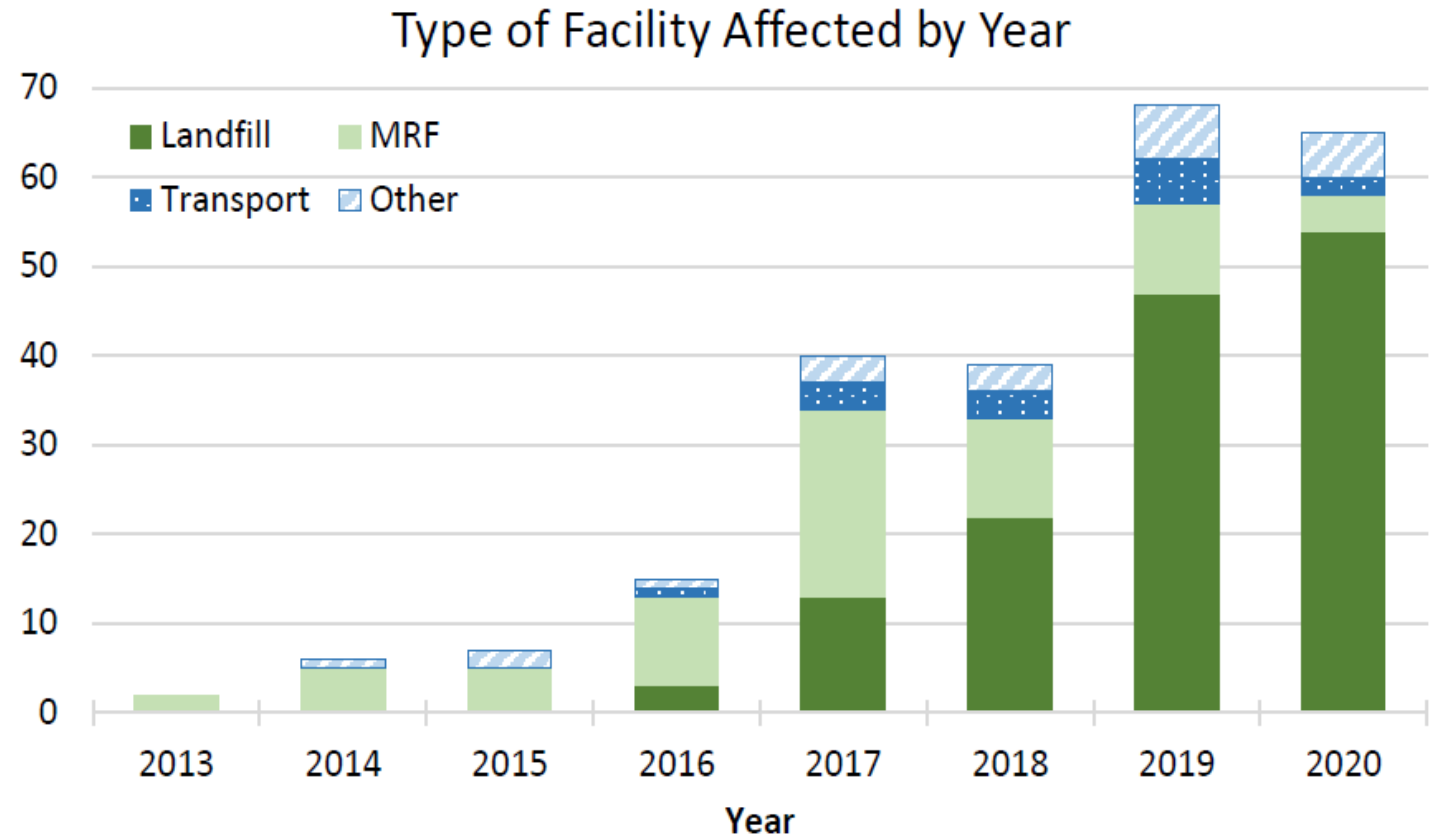
EPA Battery Report

- EPA recently published a report on LIB fires at waste management facilities
- Report lists incidents of fires caused by lithium-ion batteries and analyzes the impacts
- Report is available at the [EPA website](#)





Fires at Waste Management Facilities

- EPA recently released a report on fires caused by LIBs at waste management facilities
- The analysis showed LIB-caused fires are increasingly being reported by news sources
- 64 facilities saw 245 fires between 2013-2020



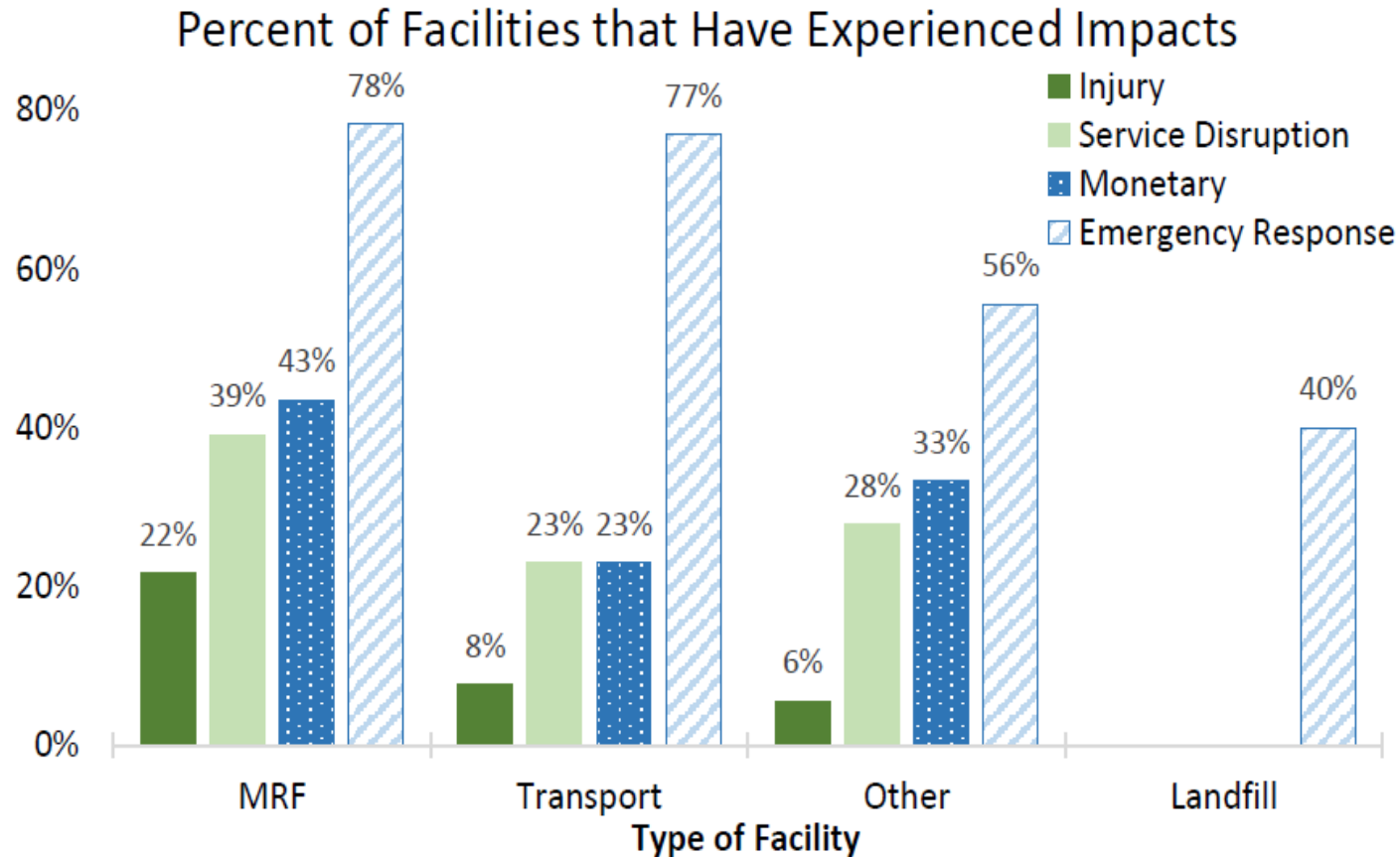
Fires at Waste Management Facilities, cont.

Example table from the Battery Report:

FedEx Truck, Jackson Township, OH		31
6/5/2017		
<i>Likely or Definite</i>	Definite	<i>Details and Impacts:</i>  
<i>Battery Type</i>	Lithium metal batteries	A box truck filled with LIBs being sent for recycling caught fire while on the road, seriously damaging the vehicle. The fire department responded, and the turnpike was closed for several hours (O'Hara, 2017).
<i>Fire Count</i>	1	

Report found 20 fires in Ohio caused by LIBs at waste management facilities, including a MRF and a garbage truck.

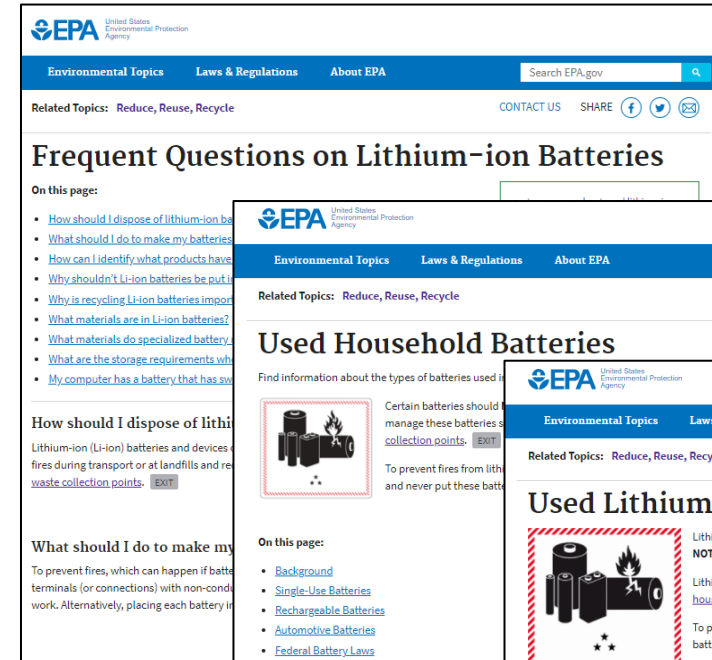
Fires at Waste Management Facilities, cont.



- The impacts of these fires are vast, including:
 - Injuries
 - Disruption of waste collection services
 - Monetary impacts
 - Emergency response from local fire departments, EMTs, and other personnel
- The most common impact is an emergency response from local fire departments
- Impacts are seen most often at MRFs, followed by waste transportation vehicles

EPA Used Battery Webpages

- New battery webpages under www.epa.gov/recycle:
 - Used LIBs
 - <https://www.epa.gov/recycle/used-lithium-ion-batteries>
 - Used household batteries
 - <https://www.epa.gov/recycle/used-household-batteries>
- Frequent questions on LIBs
 - <https://www.epa.gov/recycle/frequent-questions-lithium-ion-batteries>



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Frequent Questions on Lithium-ion Batteries

On this page:

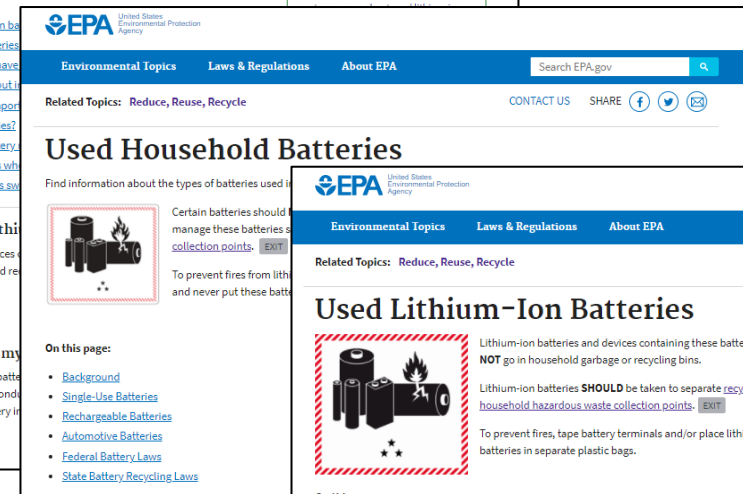
- [How should I dispose of lithium-ion batteries?](#)
- [What should I do to make my batteries safer?](#)
- [How can I identify what products have lithium-ion batteries?](#)
- [Why shouldn't Li-ion batteries be put in the trash?](#)
- [Why is recycling Li-ion batteries important?](#)
- [What materials are in Li-ion batteries?](#)
- [What materials do specialized battery recycling facilities use?](#)
- [What are the storage requirements for lithium-ion batteries?](#)
- [My computer has a battery that has swollen. What should I do?](#)

How should I dispose of lithium-ion batteries?

Lithium-ion (Li-ion) batteries and devices containing these batteries should be recycled or taken to household hazardous waste collection points. NEVER put them in the trash or recycling bins.

What should I do to make my lithium-ion batteries safer?

To prevent fires, which can happen if battery terminals (or connections) with non-conductive materials are shorted together, place each battery in a separate plastic bag.



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Used Household Batteries

Find information about the types of batteries used in household products.

Certain batteries should be recycled or taken to household hazardous waste collection points. NEVER put them in the trash or recycling bins.

To prevent fires from lithium-ion batteries, tape battery terminals and never put these batteries in the trash or recycling bins.

On this page:

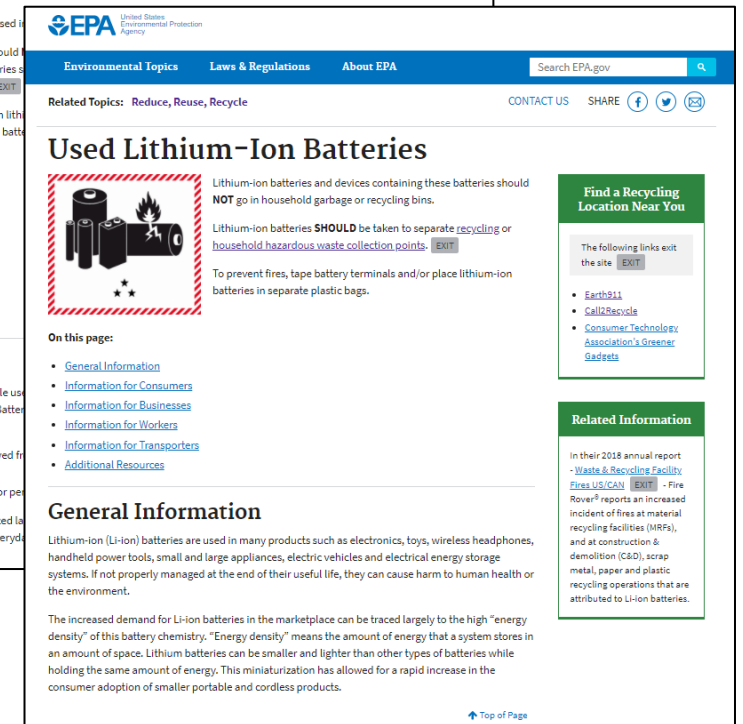
- [Background](#)
- [Single-Use Batteries](#)
- [Rechargeable Batteries](#)
- [Automotive Batteries](#)
- [Federal Battery Laws](#)
- [State Battery Recycling Laws](#)

Background

Every year in the United States, millions of single-use and rechargeable batteries are used and recycled or disposed of in the trash. Batteries come in many shapes, sizes, and types to fit their use.

- Single-use batteries can generally be removed from the device.
- Rechargeable batteries may be removable or not removable from the device.

The increased demand for batteries can be traced largely to the high "energy density" of this battery chemistry. "Energy density" means the amount of energy that a system stores in an amount of space. Lithium batteries can be smaller and lighter than other types of batteries while holding the same amount of energy. This miniaturization has allowed for a rapid increase in the consumer adoption of smaller portable and cordless products.



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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.

On this page:

- [General Information](#)
- [Information for Consumers](#)
- [Information for Businesses](#)
- [Information for Workers](#)
- [Information for Transporters](#)
- [Additional Resources](#)

General Information

Lithium-ion (Li-ion) batteries are used in many products such as electronics, toys, wireless headphones, handheld power tools, small and large appliances, electric vehicles and electrical energy storage systems. If not properly managed at the end of their useful life, they can cause harm to human health or the environment.

The increased demand for Li-ion batteries in the marketplace can be traced largely to the high "energy density" of this battery chemistry. "Energy density" means the amount of energy that a system stores in an amount of space. Lithium batteries can be smaller and lighter than other types of batteries while holding the same amount of energy. This miniaturization has allowed for a rapid increase in the consumer adoption of smaller portable and cordless products.

Find a Recycling Location Near You

The following links exit the site:

- [Earth911](#)
- [Call2Recycle](#)
- [Consumer Technology Association's Greener Gadgets](#)

Related Information

In their 2018 annual report "Waste & Recycling Facility Fires US/CAN" - Fire Rover® reports an increased incident of fires at material recycling facilities (MRFs), and at construction & demolition (C&D), scrap metal, paper and plastic recycling operations that are attributed to Li-ion batteries.

Thank you!

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