



Rechargeable Battery Management Challenges In Wisconsin

Trying Something Different...

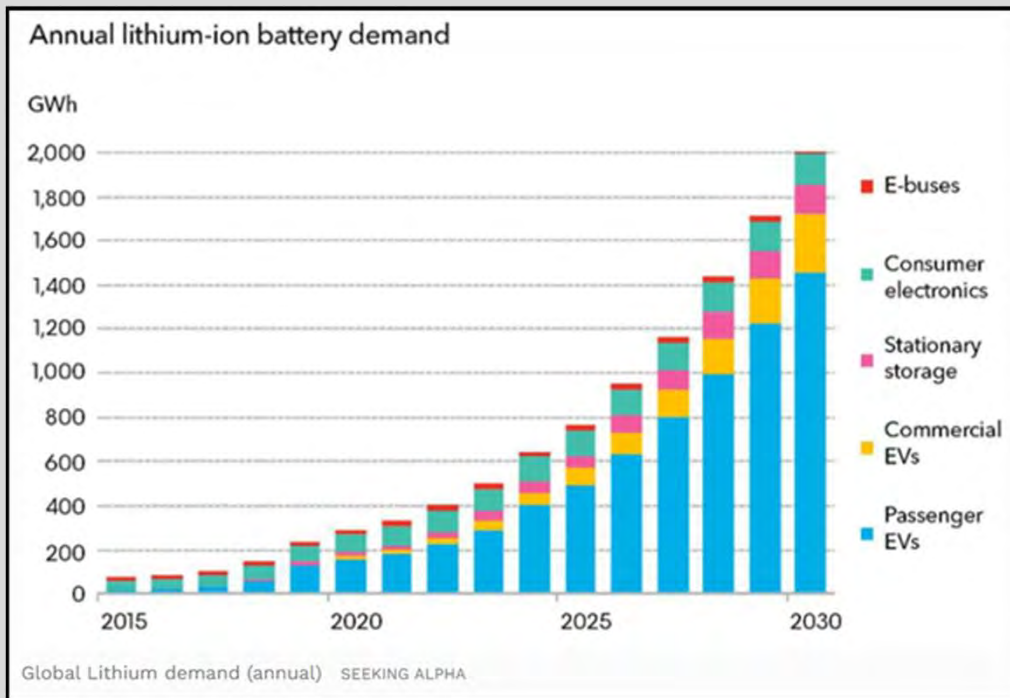


WASTE AND MATERIALS MANAGEMENT STUDY GROUP

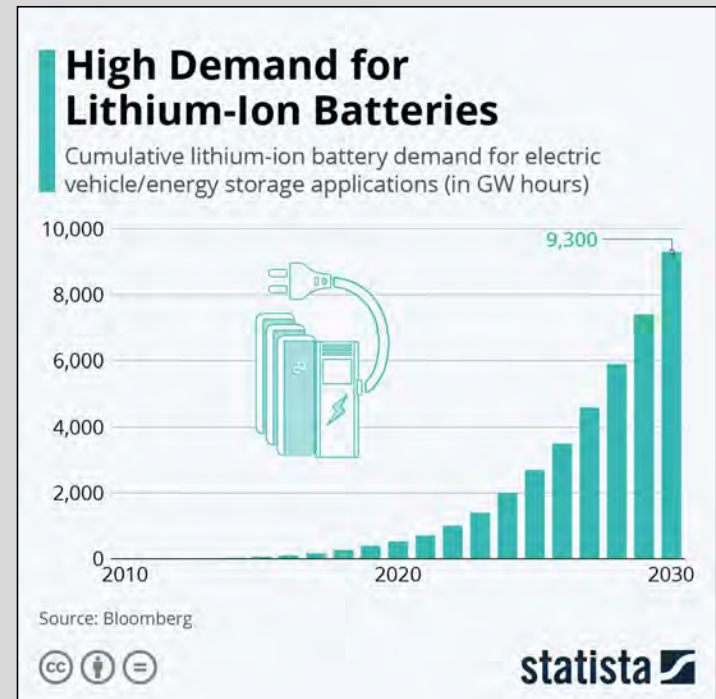


All Rechargeable Batteries:
Emphasis on Lithium

Lithium Batteries and Personal Electronic Devices... They Are Not Going Away



[Manufacturers Are Struggling To Supply Electric Vehicles With Batteries \(forbes.com\)](https://www.forbes.com)



<https://www.statista.com/chart/23808/lithium-ion-battery-demand/>



Ignition Sources



Thermal Runaway Temperatures

Specific Chemistry	Thermal Runaway (Temp.)
lithium nickel manganese cobalt oxide	410 F
lithium cobalt oxide	302 F
lithium manganese oxide	482 F
lithium iron phosphate	518 F
lithium nickel cobalt aluminum oxide	302 F

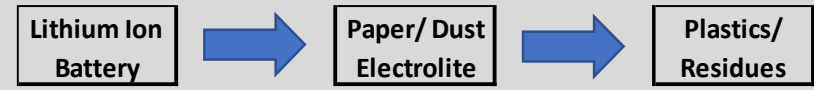
**Data compiled from www.batteryuniversity.com*

Ignition temperature of paper: 421 F – 481 F.

Hi-Tech Matches



Is Equivalent Too



Regulation
vs.
Education



Waste Industry Educational Efforts

Contrasts with

State Statute

Studies Do Not Provide
Complete Picture

Possibly the broadest, most thorough analysis to date.
But not without flaw.

Approach: Scoured the internet for news stories regarding damage to waste facilities due to lithium-ion batteries.


- interviewed locations
- categorized the impacts of the incidents
 - * Injury
 - * Service Disrupted
 - * Monetary Impacts
 - * Emergency Response



An Analysis of Lithium-ion Battery Fires in Waste Management and Recycling



July 2021
Office of Resource Conservation and Recovery
EPA 530-R-21-002



Facilities Affected:

Landfills

Waste Transfer Stations

MRFs

Recycling Transfer Stations

Route Truck

Scrap Yards

Electronic Recyclers

Waste Incinerators

Waste to Energy Plants

Battery Recyclers

Pharmaceutical Drop Off


Library: Battery Drop Box

Problems start occurring.....

As soon as the battery is discarded.

John's Dispos:
7/1/2018
Likely or Defit
Battery Type
Fire Count

Eau Claire G
Unknown
Likely or Def
Battery Type
Fire Count

Pacific Northwest Landfill ⁶⁰		45
June 2017 - December 2020		
Likely or Definite	Definite	Details and Impacts: 
Battery Type	Cell phone battery: 17 Hoverboard size battery: 1 Laptop battery: 6 Remote control airplane battery: 1 Tablet battery: 6 Watch battery: 1 DVD player battery: 1 Unknown LIBs: 91	One landfill consulted for this report noticed an increasing number of LIBs causing fires, so a supervisor began keeping a record of each LIB-caused fire. Over roughly three years, the facility experienced 124 fires known to be caused by LIBs from a variety of devices. Most were extinguished by staff, but a few fires required assistance from firefighters. A representative from the facility indicated that this number of fires is not abnormal for landfills (landfill supervisor, personal communication, 2021).
Fire Count	124	

23
own
factor at
y or

64
to
ied
g

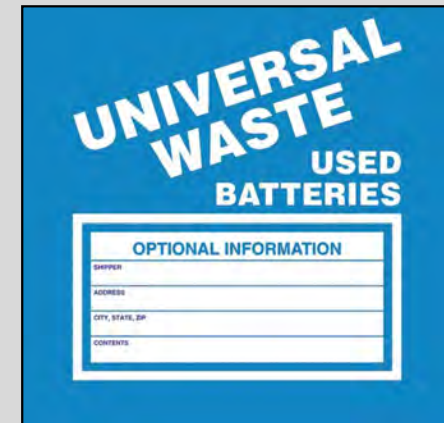
⁶⁰ See [Industry Experience 2](#) for more detailed information. The landfill supervisor who provided data for this facility requested that the facility remain anonymous, given negative public perceptions regarding landfill fires. We believe that the public benefit of including the detailed data this landfill provided justifies withholding the name of the landfill.

Compliance with Regulations

Universal Waste Rules



- Universal Waste Batteries: NR673
 - Compatible with waste
 - Rigid Container
 - Labeled as “Universal Waste - Batteries”, “Used Batteries”, or “Waste Batteries
 - Accumulation Start Date
 - Removed from site within 1 year
 - Employee Training Requirements





DOT Hazardous Material Regulations (HMR)

- 49 CFR 173.21 – Forbidden materials and packages
 - “Unless otherwise provided in this subchapter, the offering for transportation or transportation of the following is forbidden:”
 - **49 CFR 173.21(c)**
 - Electrical devices, such as batteries and battery-powered devices which are likely to create sparks or generate a dangerous evolution of heat, unless packaged in a manner which precludes such an occurrence.

This is important when preparing lithium ion and lithium metal batteries for transport but applies to all rechargeable batteries.

Used Batteries Destined for Recycling

Preparation Requirements

- Terminals of rechargeable batteries and alkaline batteries greater than 9 volts need to be covered (to prevent 1 - dangerous evolution of heat; 2 - short circuits; and 3 - damage to terminals) – **172.102(c)(1)(130)(b)**



Hazardous Material Proper Shipping Name

- Batteries sorted by chemistry (check for proper shipping name **172.101**)
 - Batteries, dry, sealed, NOS (alkaline),
 - Batteries, dry, sealed, NOS (NiCd or NiMH)
 - UN3480 Lithium ion batteries, 9
 - UN3490 Lithium metal, 9
 - damaged*



§ 172.101 Purpose and use of hazardous materials table.

Symbols	Hazardous materials descriptions and proper shipping names	Hazard class or Division	Identification Numbers	PG	Label Codes	Special provisions (§ 172.102)	(8)			(9)		(10) Vessel stowage	
							Packaging (§ 173.***)			Quantity limitations (see §§ 173.27 and 175.75)		Location	Other
							Exceptions	Non-bulk	Bulk	Passenger aircraft/rail	Cargo aircraft only		
	Batteries, dry, sealed, n.o.s.					130							
	Lithium ion batteries <i>including lithium ion polymer batteries</i>	9	UN3480		9	388, 422, A54, A100	185	185	185	Forbidden	35 kg	A	
	Lithium metal batteries <i>including lithium alloy batteries</i>	9	UN3090		9	388, 422, A54	185	185	185	Forbidden	35 kg	A	

Used Batteries Destined for Recycling

Special Lithium Battery Markings

Lithium Cells and Batteries – 49 CFR 173.185

- **Exceptions for recycled batteries** - 173.185(d) refers to 173.185(c)
- **Battery Size limitations for highway**
 - Lithium metal: up to 25 grams of lithium
 - Lithium Ion: up to 60 Wh per cell or up to 300 Wh per battery
- **Packaging**
 - Any sturdy packaging with cover that withstands 1.2-meter drop test
- **Markings**
 - (see markings to the right)
- **Package Weight Restrictions**
 - Not to exceed 66 lbs. gross weight



****Gross Weight Not to Exceed 66 pounds****

*** DOT HazMat
Employee Training!**

3 General Categories:

- 1) General Awareness
- 2) Function Specific
- 3) Safety/Security

Training Frequency

- Initial employment
- Every 3 years thereafter



DOT Training
Brochure



Regulation
(Cornell Law School)



UW System Info

**UN/DOT Approved
DF 12 Gallon Pail**



Lithium Ion Batteries

(Preparing Lithium Ion Packaging)

- 1) **'Universal Waste - Used Batteries' Label**
Regulatory Citing: NR 673
Must Include:
-the words 'Universal Waste: Used Batteries'
-an Accumulation Start Date
- 2) **Non-Hazardous Waste Label**
Regulatory Citing: 49 cfr 172.2
Must Include:
-Shipper Name
-Shipper Address
-Contents: Use the following shipping name:
UN3480 Waste Lithium Ion Batteries, 9, II
- 3) **Lithium Battery Label**
Regulatory Citing: 49 cfr 172.447
Must Include:
-the proper size, colors, symbol, & hazard class
- 4) **Lithium Battery & Cell Marking**
Regulatory Citing: 49 cfr 173.185(c)(3)
Must Include:
-Appropriate UN number (UN3480)
-Telephone number for additional information
- 5) **Air/Vessel Forbidden**
Regulatory Citing: 49 cfr 173.185(c)(1)(iv)
Must Include:
-Required Verbiage: "LITHIUM BATTERIES -
FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL"
- 6) **HMR Internal Drum Number**
Regulatory Citing: NA
Must Include:
-drum number

Lithium Ion Batteries

Preparing Lithium Ion Batteries

1. Separate Lithium Ion batteries. Look for key word:
 - lithium ion
 - Li-Ion
 - INR, ICR, or similar
 - Battery dimensions: ex. '18650'
2. Batteries must be rated < 300 watt-hours*
3. Batteries must be individually bagged; terminals taped; or terminals coated with non-conductive material.
4. Batteries will be placed in a DOT/UN approved plastic twelve gallon pail.
5. Net weight of container and batteries can be no greater than 66 pound.



420 watt-hours!

Ego Battery, 7.5 Ah,
Li-Ion, 56V DC...



Should a waste that
is considered a DOT
hazardous material
be allowed to be
landfilled?



Isn't Government Exempt From DOT HMR?

(d) *Functions not subject to the requirements of the HMR.* The following are examples of activities to which the HMR do not apply: (49 CFR 171.1(d))

(5) Transportation of a hazardous material in a motor vehicle, aircraft, or vessel operated by a Federal, state, or local government employee solely for noncommercial Federal, state, or local government purposes.

(49 CFR 171.1(d)(5))



DOT Interpretation letters involving 49 CFR 171.1(d)(5):

Interpretation Letter Reference No. 18-0071:

“...if a government entity (e.g., APHIS) contracts a third party to transport a hazardous material on their behalf, the government exception would no longer apply and government operations would be categorized as transportation for commercial purposes and subject to the HMR.”

Interpretation Letter Reference No. 14-0101:

“...a state agency, such as a state university, that transports hazardous materials for its own use, using its own personnel and vehicles, and is not engaged in transportation in commerce is not subject to the HMR. **However, if the university transports hazardous materials using a commercial carrier, such as a contractor or a contract or common carrier, it is subject to the requirements of the HMR”.**

Advancements in Battery
Technology & Increased
Lithium Use

Advancing Lithium Technology

- Surpassing 300 watt*hours
- Less exemption; More Regulation



Devices with Sealed or Built In Lithium Batteries

- Lithium battery not easily removed
- Transportation Complications
- Electronic Recycling Complications



Disposal Options

Battery Disposal Option Issues

- Specialty Businesses

- Problem: Population Centered; Regulatory Awareness

- Recycling Center or Collection Program

- Problem: Properly stored?; Regulatory Awareness

- Call2Recycle

- Problem: Built-in batteries in vaping devices; Accessed through institutions

- Household Hazardous Waste Programs

- Problem: Sporadic availability; Disposal/Recycling expenses are NOT Clean Sweep Grant eligible (batteries, vaping, etc.)

Battery Metals:
Scarcity and
National Security Issues?

AUSTRALIA AND CHILE IN THE FRONT ROW

Countries with major Lithium production and reserves



<https://www.volkswagenag.com/en/news/stories/2020/03/lithium-mining-what-you-should-know-about-the-contentious-issue.html>



source: USGS 2019

production (in 1,000t) ●

● reserves (in 1,000t)

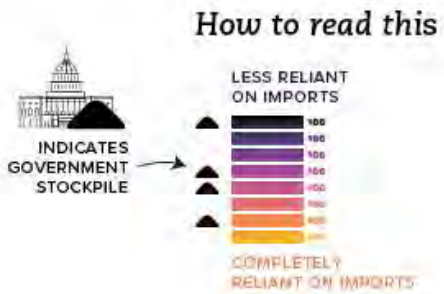
THE 35 MINERALS CRITICAL TO U.S. NATIONAL SECURITY

This draft list of minerals deemed essential to the economic and national security was released Feb 16, 2018



“...our nation's mission [is] to reduce our vulnerability to disruptions in the supply of critical minerals. Any shortage of these resources constitutes a strategic vulnerability for the security and prosperity of the United States.”

—Dr. Tim Petty, Assistant Secretary of the Interior for Water and Science



Critical Minerals List

Mineral	Net Exporter / Net Import Reliance	Example Uses
HAFNIUM	NET EXPORTER	Nuclear control rods, alloys, ceramics
HELIUM	NET EXPORTER	MRIs, lifting agent, research
BERYLLIUM	14% NET IMPORT RELIANCE	Alloying agent in aerospace and defense industries
MAGNESIUM	47% NET IMPORT RELIANCE	Furnace linings for manufacturing steel and ceramics
GERMANIUM	50%* NET IMPORT RELIANCE	Fiber optics, night vision applications
LITHIUM	50%* NET IMPORT RELIANCE	Batteries
TUNGSTEN	50%* NET IMPORT RELIANCE	Used in wear-resistant metals

HELIUM

The Federal Helium Reserve is the world's only sizable long-term storage facility for crude helium. In recent years, the U.S. has become the world's major source of helium as global demand has risen sharply.

In the summer of 2017, an embargo of products from Qatar caused a temporary shortage of Helium.

ALUMINUM

U.S. production of primary aluminum decreased for the fifth consecutive year and is now at its lowest level since 1951.



<https://www.visualcapitalist.com/35-minerals-critical-security-u-s/>

Table 2.1. Critical mineral commodity summaries.—Continued

[Commodities are listed alphabetically. Supply chain considerations were utilized in the selection process, meaning a commodity is included if any step in its supply chain is deemed problematic. Information in this table is from U.S. Geological Survey (2017, 2018, variously dated)]

Mineral commodity	Summary
Lithium	Lithium can be recovered from hard-rock deposits and brines. Lithium demand is expected to grow substantially because of its use in rechargeable batteries, particularly for electric vehicles. Lithium hydroxide also is used for cooling water chemistry control in pressurized water reactors and may be required in some advanced concept nuclear reactors (molten salt). The U.S. import reliance is moderate, but increasing foreign consumption in addition to U.S. demand growth has driven a substantial exploration boom.



<https://pubs.usgs.gov/of/2018/1021/ofr20181021.pdf>

“The U.S. import reliance [*on lithium*] is moderate, but increasing foreign consumption in addition to U.S. demand growth has driven a substantial exploration boom”.

Thank You!

Questions?

Trying Something Different...

