

# Lithium Battery Safety and Management



Winter Training  
3/6/24



Garbage truck fire in Duluth

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Coordinator

# HHW: Open for batteries?

~~HHW Programs accept all batteries and small battery embedded devices~~

Counties and HHW accept **most** batteries and small battery embedded devices

Public collectors take in 90% of the batteries collected in Minnesota

## Challenges:

- Volume
- Processing
- **Safety**
- Cost



# Volume Observations

- Exponentially increasing volumes
- More battery embedded devices
- More primary AA and AAA lithium
- More 300 Wh and larger batteries
- More damaged batteries



# Fire stats from EPA's 2021 report

- 245 fires reported (2013 -2020)
- **68** took place at MRFs
- **139** at landfills
- **15** in transport
- **23** at other facilities
- Most of these fires (89%) were definitely caused by LIBs, while the remainder were reported as likely caused by an LIB. The most common LIBs noted as the cause of fires were **cell phone batteries, followed by tablet and laptop batteries**

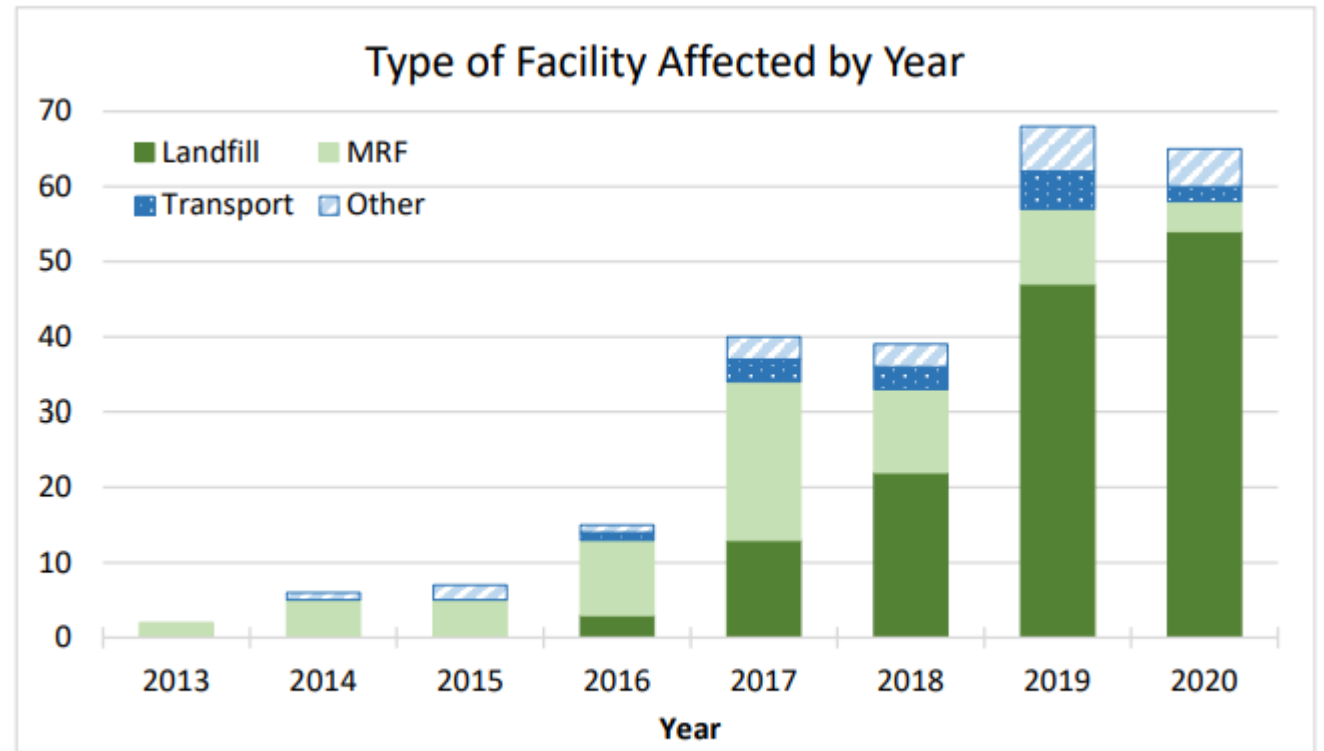


Figure 6: Fires by year and facility category

# Who Regulates Lithium Battery Management?

Lithium batteries are managed under the Universal Waste rule in MN.

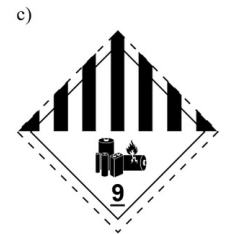
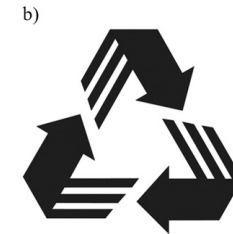
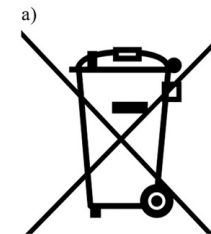
- Fire Code
- DOT: Packing and transport
- OSHA: exposure to gasses or acid
- EPA: working on collection site standards and voluntary labeling



# US EPA- Bipartisan Infrastructure Law

## Current work:

- Improving Safety and Effectiveness of Battery Recycling through Collection Best Practices and Labeling Guidelines
- If you would like to be involved, send Jennifer an email, first meeting is March .
  - Submitting reports Nov. 15, 2023
  - Communication materials for battery producers, consumers, and others on reuse and recycling of critical materials from batteries.



# DOE - Bipartisan Infrastructure law

- Provides grants for recycling infrastructure and collection
- Applied for \$1.5 million for safety equipment for HHW programs
- Will find out results in May
- Meet with DOE in October for negotiations
- Bid out contracts and **deliver supplies fall of 2025**
- **Buy safety supplies and containers now, I will buy the second round—if we get the grant.**



# OSHA



Main focus is inhalation of fumes, burns

- Hydrogen Fluoride is generated by batteries during fires, and it's not good to breathe
- If a battery is “popped” it will off gas for days
- You should not attempt to fight a lithium fire, such that you would need to mask up.
- OSHA compliance is the responsibility of county safety officers



3M™ 6000, 7500 and FF-400 Series Respirator Cartridge:  
Hydrogen Fluoride/Organic Vapors/Acid Gas/P100



# DOT

- Authorize special permit packaging
- Regulate all transport of new, used and embedded batteries
- Dictates HHW's processing and packing operations



Ask your local HHW Expert if you have transport or packing questions!



# Fire code

## International Fire & Building Codes 2024

International adoption → Countries → State adoption; WA state has adopted it

### Requires:

- 2 hour fire wall between battery and other waste stored indoors; or a 2 hour flame cabinet, container spacing
- Fire safety plan; fire detection, alarm and sprinklers
- Setbacks from buildings and property lines;
- 2 hour fire rated outdoor storage and size limits
- Containers stored >5 feet from an exit.
- Exemptions for those with less than 2 55 gal drums of batteries



# SAFETY: Fire

- All battery chemistries can spark/short
- Lithium batteries have a high energy density. Higher watt hour batteries have more potential energy to release if thermal runaway occurs.



How I Repair Swollen Battery in...  
youtube.com

100% REPAIR SWOLLEN BATTERY  
BEST SOLUTION BULGED BATTERY

How To Fix Swollen/Bulged Bat...  
fixsolo.com

HOW TO REPAIR BULGED BATT...  
pinterest.com

How To Fix Swollen/Bulged Bat...  
fixsolo.com

How To Fix Swollen/Bulged Bat...  
fixsolo.com

Swollen Battery Repair - YouTube  
youtube.com

Repair Swollen battery  
Before After

How to repair swollen phone b...  
youtube.com

Top trick 2019, fix swollen pho...  
youtube.com

How To Revive Dead 3.7v Lipo ...  
youtube.com

How to fix a swollen battery

Swollen battery? How to remov...  
youtube.com

How To Fix Swollen Phone Batt...  
youtube.com

# Lithium fires at County Collection Programs

## Washington County HHW



Facility floor



Extinguished Battery



New E-bike Battery

## Carver county:

- After hours fire two days after waste was last accepted;
- Sprinkler head was directly above the battery;
- Cleanup from smoke damage was expensive and interfered with operations
- Lessons were learned, they always are

## Battery box fire, Hennepin Library



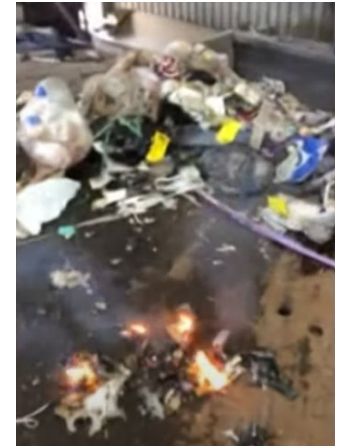
# Fire data from HHW and SW facilities

I would like to collect this data if you would like to provide it.

It could be helpful for legislation

## HHW:

- Frequency of sparking (daily, weekly, monthly)
- % damaged upon arrival
- Number of smaller LB fires (didn't trigger alarms or FD response)
- Number larger LB fires (triggered alarms/FD response)
- Device or battery types that commenced thermal runaway (screen, vape, battery pack, cell, other).



## SW:

- All fires requiring FD response or that trigger a deluge system;
- Confirmed LB fires
- Location and cause of fire

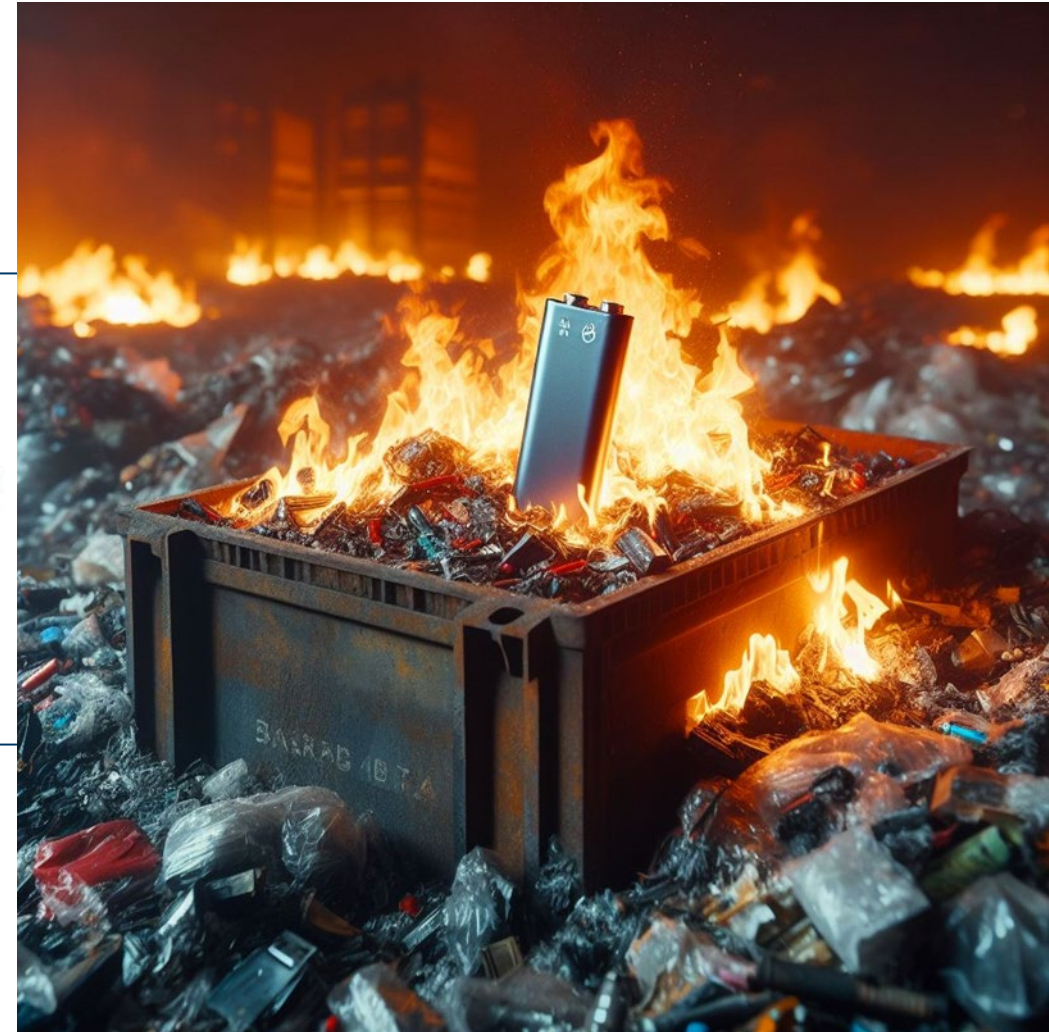


# Lithium battery handling at SW facilities

## Have:

- a plan
- fire suppression supplies
- a safe storage container and location

Sarah Lerohl will train you at the end of the month



“scoop, isolate and smother”

# Lithium battery handling at HHW facilities

**Store batteries  
away from  
flammables**

**Have a plan and  
equipment**



Is it feasible to get all batteries sorted and taped each day?

Where do you store unprocessed batteries?

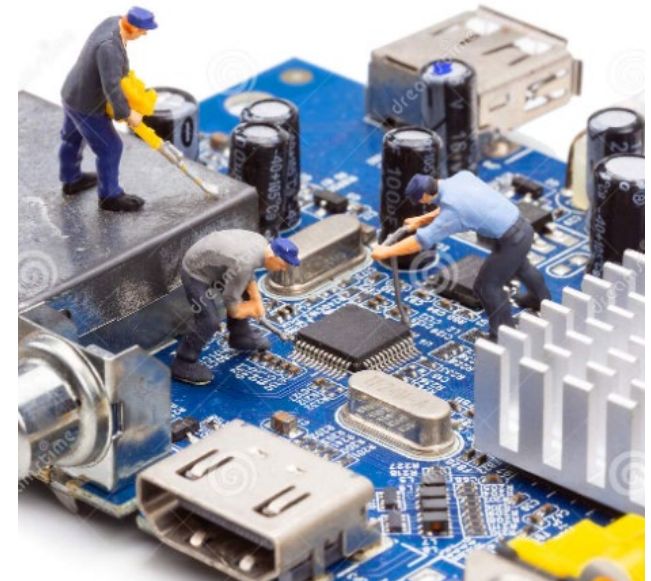
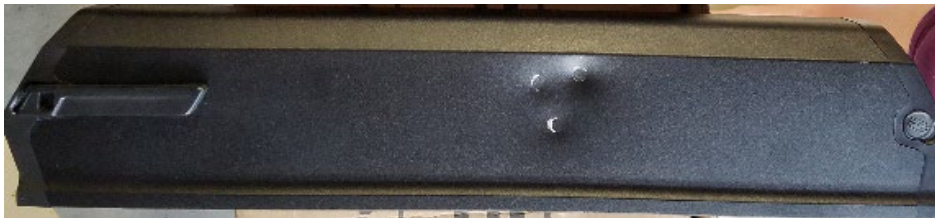
HHW guidance 1/23 and HHW Battery SOP address battery management and safety



# Accepting and Processing batteries

## DO NOT DISASSEMBLE EMBEDDED BATTERIES INSIDE YOUR HHW FACILITY!

- Touch them when they come in (wearing gloves) to check for warm batteries.
- Sort and tape all lithiums ASAP.
- Sort and tape in a safe location that won't get you trapped in a room if something goes into thermal runaway.
- Have fire suppression supplies immediately available when sorting and taping batteries
- Keep batteries dry and away from heat sources.
- C2R boxes have built in fire suppression, close them.





# The fire extinguisher debate:

- Lithium (primary) batteries contain foil lithium. These batteries are water reactive. A Class D extinguisher is required, if you use an extinguisher. They cost nearly twice as much as a fire suppression kit.
- Lithium-ion batteries contain lithium salts and are not water reactive: use ABC.
- Remember: you are not a fire fighter just because you had fire extinguisher training
- I recommend a fire suppression kit because they work best.
- Your safety and your staff's safety is #1, get people out and call 911

[Thermal runaway](#) occurs when the heat generation within the battery cell exceeds the heat dissipation capacity.



**Wall Mounted High-Watt Hour fire suppression Kit**  
**\$965**

# General Supplies - Containers

DDR Boxes: \$110; **no cost** to those who use C2R's HH collection program in MN



If you have a small fire and you have the box nearby, put the pad over the fire

Integrated fire protection



No Sorting or Taping option!

\$1,500 (+ shipping) for 4 drums



**OneDrum**

1. Pour a layer of CellBlockEX<sup>®</sup> into the bottom of a drum
2. Add a layer of batteries (mixed chemistries are ok)
3. Add more CellBlockEX
4. Repeat for up to five layers

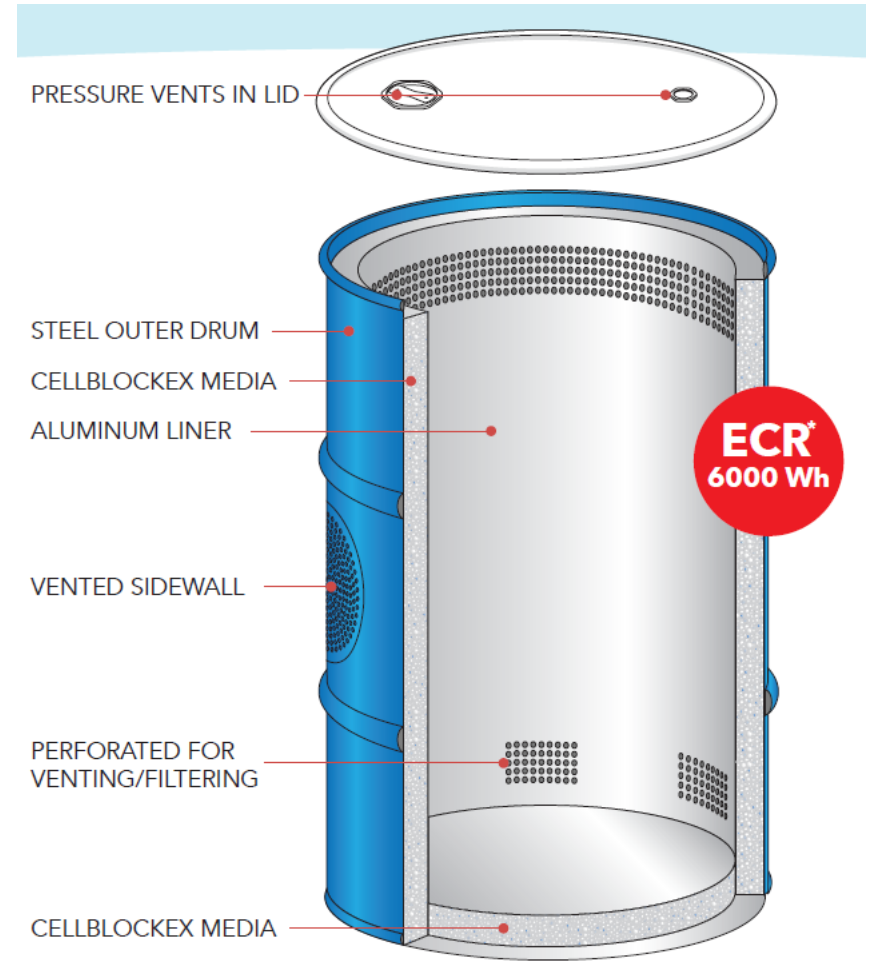
OneDrum is not covered by our law

# Storage containers with fire suppression

- CellBlock MAX drum
- Use for storage of unsorted
- Storage inside SW facilities
- Transport from events
- Reusable—use til you have a fire



~\$750 for a 55;  
\$730 for a 30



# Storage containers with fire suppression



Drum plugs for steel drums  
5-6 gal \$130; 20-30 gal  
\$220  
They sit on top of the  
batteries in the container

DDR Li-Ion Recycling Steel Drum 55G;  
132 lbs; \$1,350 includes recycling



Large DDR Li-Ion Battery Recycling Pail (5G) Kit  
11 lbs; \$160 includes recycling fee

# Suppression kits and blankets



Wall Mounted High-Watt Hour fire suppression Kit  
\$965

3/7/2024

Large/heavy blankets for a tip floor



-  1 Lightweight Lithium-Ion Battery Fire Containment Blanket- 15' x 15' \$1,255.00
-  1 Lightweight Lithium-Ion Battery Fire Containment Blanket- 10' x 10' \$779.00
-  1 Heavy Duty Lithium-Ion Battery Fire Containment Blanket- 5' X 6' \$855.00

# CellBlockEX fire suppressant

- Fire suppressant granules, like dippin dots to put in containers for fire suppression
  - \$2,500/pallet of 50 bags
  - Use in metal drums

Look for test data and UL and other listings for supplies. I looked at CellBlock because they have this information readily available online, while most have nothing



High heat gloves \$65/pr



# Storage Cabinets

- 2 hour fire rating
- 2 drums
- Uline \$4,000



Part # 912020 - 2-Drum 2-Hour Fire-Rated Outdoor Safety Locker \$15,000 U.S. Chemical storage  
Weight: 1821 Lbs. Outside Dimensions: 71"L x 42"D x 77.5"H



# Temperature Sensor for battery storage cabinets/areas

- Works if WiFi is available within 300'
- Battery operated; doesn't require power or modem
- Sends a message; alarm sound of your choice to your phone when the temp exceeds your set point

## RTD Temperature Sensor — Wi-Fi OTA

B80-200-OTA

Utilize wireless OTA technology and monitor temperatures between -200°C to 200°C (328°F to 392°F) for every application.



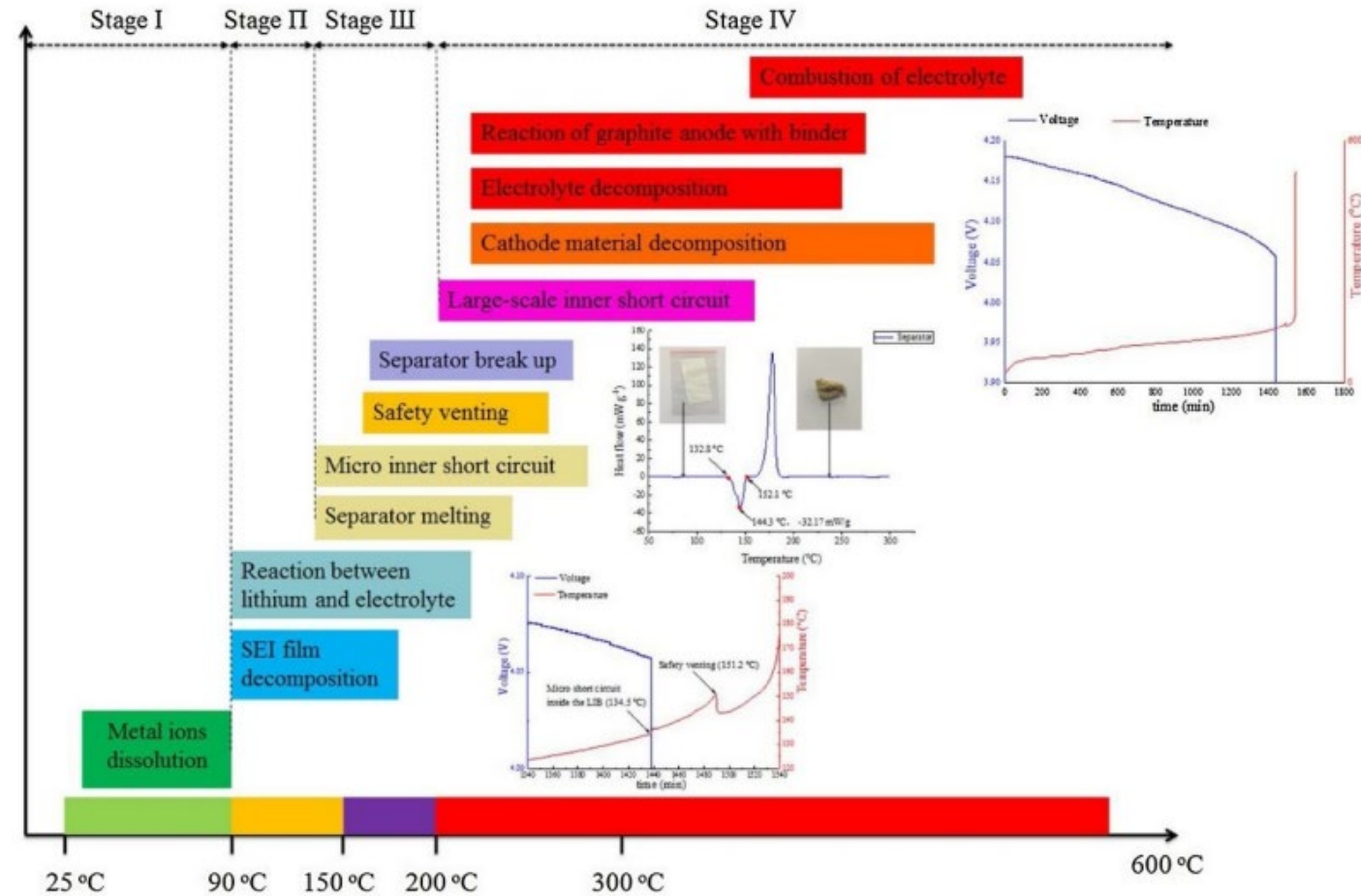


# Storage: Temperature concerns

Operational temperature range for a LB:  
-20 °C to 60 °C or -4 °F to 140 °F

Higher or lower temps decrease performance and can lead to irreversible damage and thermal runaway

At temperatures above 80 C, ~176°F the SEI layer begins to break down and then all hell breaks loose



Contact these folks for an explanation of this chart:

Citation: Tran, M.-K.; Mevawalla, A.; Aziz, A.; Panchal, S.; Xie, Y.; Fowler, M. A Review of Lithium-Ion Battery Thermal Runaway Modeling and Diagnosis Approaches. *Processes* **2022**, *10*, 1192. <https://doi.org/10.3390/pr10061192>

# Storage: Temperature concerns

- It is safe to store batteries outside in MN
- Some folks store batteries on their loading docks for safety; this is perfectly acceptable, but control access and shade
- A battery laying on top of a landfill shouldn't go into thermal runaway
- But why did my phone battery puff up when I had it on the dash of the car?
- The temperatures in a car in the sun can cause items in the car to reach 180-200 °f; whereas the air doesn't get that hot.

# Recycling and Disposal – Costs continue to increase

- State E-waste contractor currently charges \$1.24/lb to recycle embedded battery devices—won't take vape devices. Single use and embedded are not accepted by Call 2 Recycle
- 2022 rates

Batteries		
Alkaline/zinc carbon batteries	gross lb.	\$ 0.90
Alkaline/zinc carbon batteries	gross lb.	\$ 0.23
Button battery, mixed, no lithium	5 gallons	\$ 511.78
Sealed Lead Acid batteries	gross lb.	\$ 0.30
Lead acid batteries (vehicle)	gross lb.	\$ 0.30
Lithium ion batteries	gross lb.	\$ 5.62
Lithium ion batteries	gross lb.	\$ 5.62
Damaged lithium ion batteries	net lb.	\$ 23.57
Lithium Hydride batteries	gross lb.	\$ 5.80
Lithium Hydride batteries	gross lb.	\$ 5.80
E-Cig / Vape Pen / Lithium Batteries in Devices	5 gallon container	\$ 129.38
Nickel-cadmium / Nickel metal hydride batteries	gross lb.	\$ 0.96
Mercury oxide batteries (button battery)	gross lb.	\$ 6.02
Silver oxide batteries (button battery)	gross lb.	\$ 7.60

**Veolia:** direct incineration of vapes; recycle or incinerate others.

## Batteries

Alkaline/zinc carbon batteries	gross lb.	\$ 0.85
Button battery, mixed, no lithium	5 gallons	\$ 456.89
Sealed Lead Acid batteries	gross lb.	\$ 0.26
Lead acid batteries (vehicle)	gross lb.	\$ 0.26
Lithium ion batteries	gross lb.	\$ 5.23
Lithium ion batteries	gross lb.	\$ 5.23
Lithium Hydride batteries	gross lb.	\$ 10.46
Lithium Hydride batteries	gross lb.	\$ 10.46
Nickel-cadmium / Nickel metal hydride batteries	gross lb.	\$ 1.02
Mercury oxide batteries (button battery)	gross lb.	\$ 5.60
Silver oxide batteries (button battery)	gross lb.	\$ 7.43

**Clean Harbors:** do not accept damaged lithium batteries; direct ship others to Retrieval.

# VAPES update

Bill to make all vape batteries removable may be introduced by RECA and smoking cessation groups.

The UK and others have banned non-refillable vapes—All mfg's now have refillable cartridges  
All single use are rechargeable



- Batteries from vapes must be incinerated
- The number of batteries wasted in the US could power 8,000 EVs



# Consistent Statewide Education

*BE A BATTERY*  
**HERO**  
Put batteries in their place.  
**Batteries thrown  
in the trash or  
recycling may  
cause fires.**

**Find a drop-off  
site near you.**



Washington  
County

Hennepin

RAMSEY COUNTY

...and assistance  
from  
manufacturers,  
retail, local and  
state government  
and our private  
trash haulers and  
waste processors

## KEEP BATTERIES OUT OF RECYCLING AND WASTE CARTS

757943



Here's why.

Batteries pose a safety hazard for our workers as they can cause fires in our trucks and recycling facilities. Never dispose of batteries in your waste or recycling carts.

Instead, safely recycle batteries in the following ways.

- Check State, City or County websites, or local retailers for battery recycling drop off locations.

Thank you.

Waste Management

[RecycleOftenRecycleRight.com](http://RecycleOftenRecycleRight.com)



# Battery and E-waste Laws

- Existing laws are old and don't provide adequate coverage
- E-waste law was introduced by RECA
- Battery law may be introduced this or next week
- They are different

# Proposed Battery Law

- covers all chemistries except alkaline
- covers embedded devices
- includes a disposal ban
- good collector language
- labeling and education
- convenience standard
- indemnification for downstream liability
- discuss embedded device collection and high energy “gaps”



# Flashlight from 1973 with a NiCd

...also the year I learned about battery memory





# Thank you!

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**MINNESOTA POLLUTION  
CONTROL AGENCY**

# PFAS product management

Recommended disposal	PFAS-containing Product
<b>Normal solid waste</b>	Carpets/Rugs Cookware Cosmetics and personal care products Dental floss Food packaging Juvenile products<describe or delete? Menstruation products Textile furnishings Upholstered furniture Water resistant fabrics
<b>Household Hazardous Waste Program</b>	Aerosol propellant-based cleaners and air fresheners Fabric, upholstery, and carpet stain prevention treatments and cleaners Waxes and polishes for floors, furniture, and vehicles Dishwashing rinse aids Glass and hard surface cleaners Ski wax

