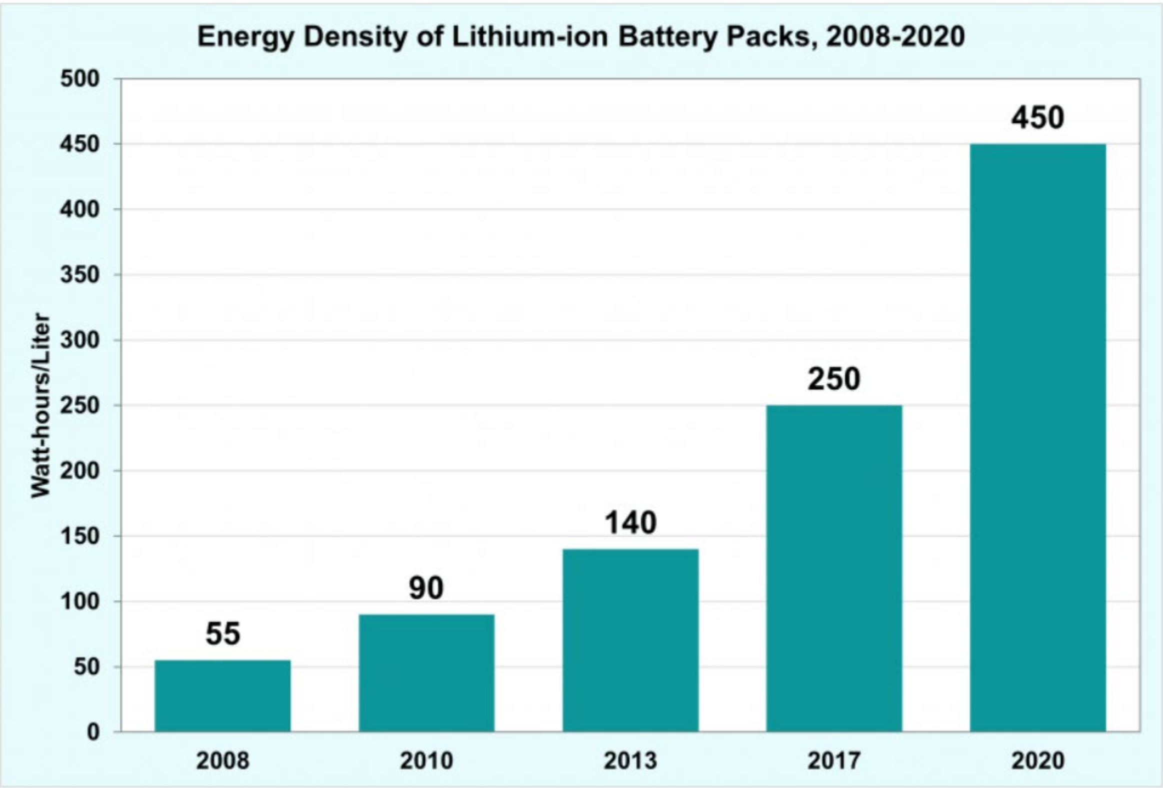
Lithium-Ion Battery Emergency Response Considerations

Objectives

- Battery Basics
- Case Studies
  - Storage
  - Transportation
  - BESS
- Maui Wildfire Case Study

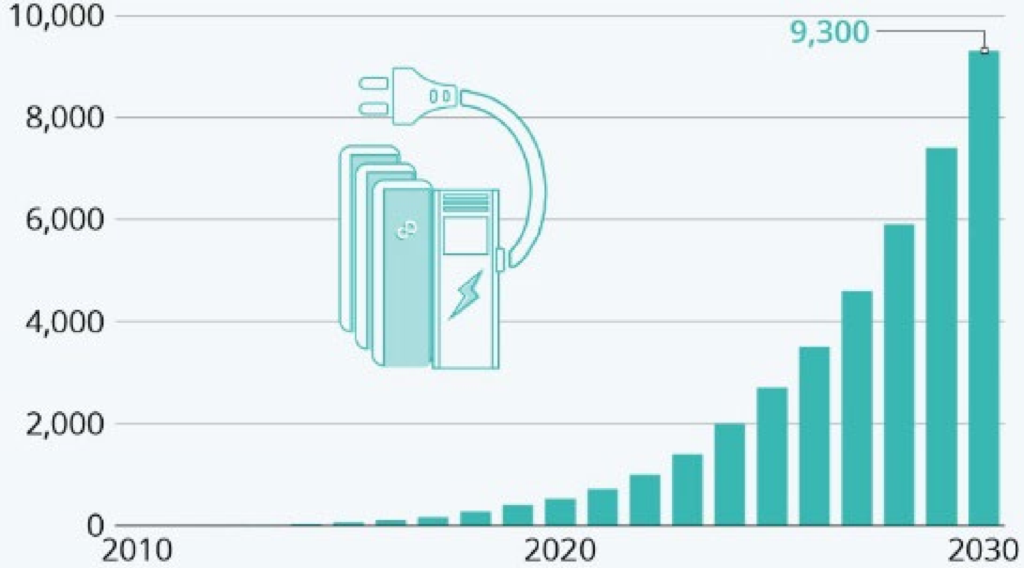
Battery Fires are on the Rise



Source: Nitin Muralidharan, Ethan C. Self, Marm Dixit, Zhijia Du, Rachid Essehli, Ruhul Amin, Jagjit Nanda, Ilias Belharouak, Advanced Energy Materials, *Next-Generation Cobalt-Free Cathodes – A Prospective Solution to the Battery Industry's Cobalt Problem*, January 2022.

High Demand for Lithium-Ion Batteries

Cumulative lithium-ion battery demand for electric vehicle/energy storage applications (in GW hours)



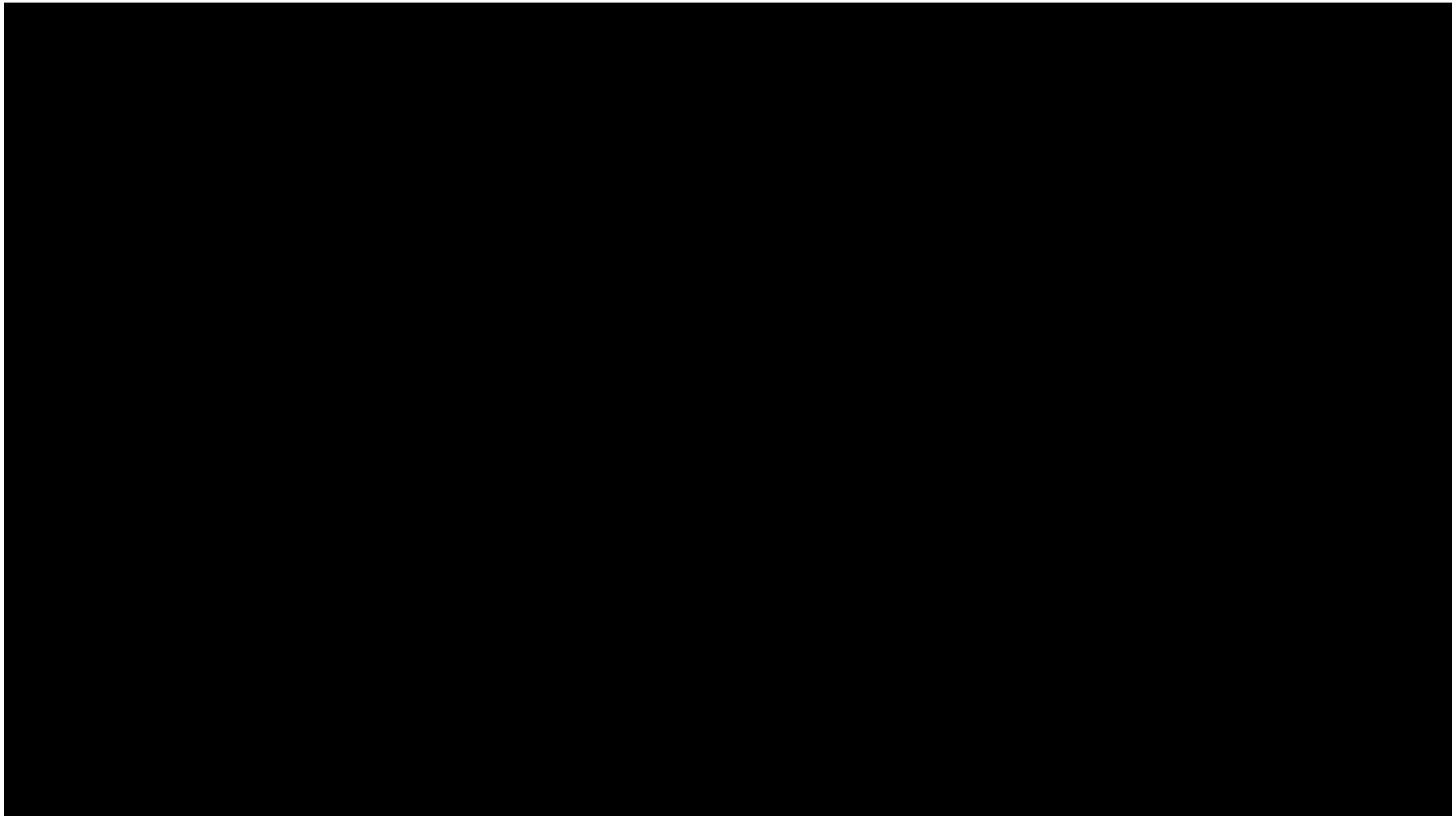
Source: Bloomberg

Changing Response Protocols

- Often advice is to “let it burn”
- Responders may not know LIBs are involved until they arrive
- LIBs may be the cause of the fire or may be impacted by a fire
- Damaged batteries are unpredictable – Rekindle is common
- LIBs create a flammable and toxic atmosphere

LIB Considerations in Firefighting

- Rapid Failure, Overhaul, Toxic Atmosphere, Rekindle, Explosive



BATTERY BASICS

Battery Types

Alkaline
Non-rechargeable

- Stable
- No significant energetic releases
- Consistent energy
- Long-term power
- Loses strength over time
- Long shelf life

Lithium-Metal
Non-rechargeable

- Stable
- Large energy density
- Can provide strong energy surges even after a period of low discharge
- Lithium metal is **extremely water reactive**

Battery Types

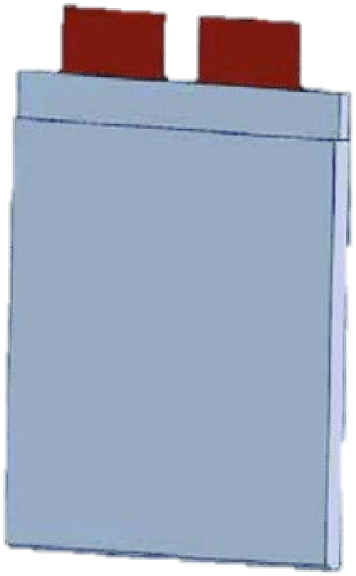
Lead-Acid

- Stable
- Low energy density
- Contains Lead and Sulfuric Acid
- Risk of explosion due to O2 and H2 during charging

Nickel Cadmium (NiCad) & Nickel Metal Hydride (NiMH)

- Rechargeable and stable
- Suffers from ”memory effect”
- Fire can be smothered (METAL-X, Sand, etc.)
- Water application can generate H2

Battery Types



Cylindrical Cell

Prismatic Cell

Pouch Cell

Lithium-Ion Batteries

- Very stable
- High energy density
- Good memory resistance
- Can generate toxic, corrosive, flammable, and explosive gas generation during thermal runaway

Lithium-Ion Battery Types

18650
18x65mm

2170
21x70mm

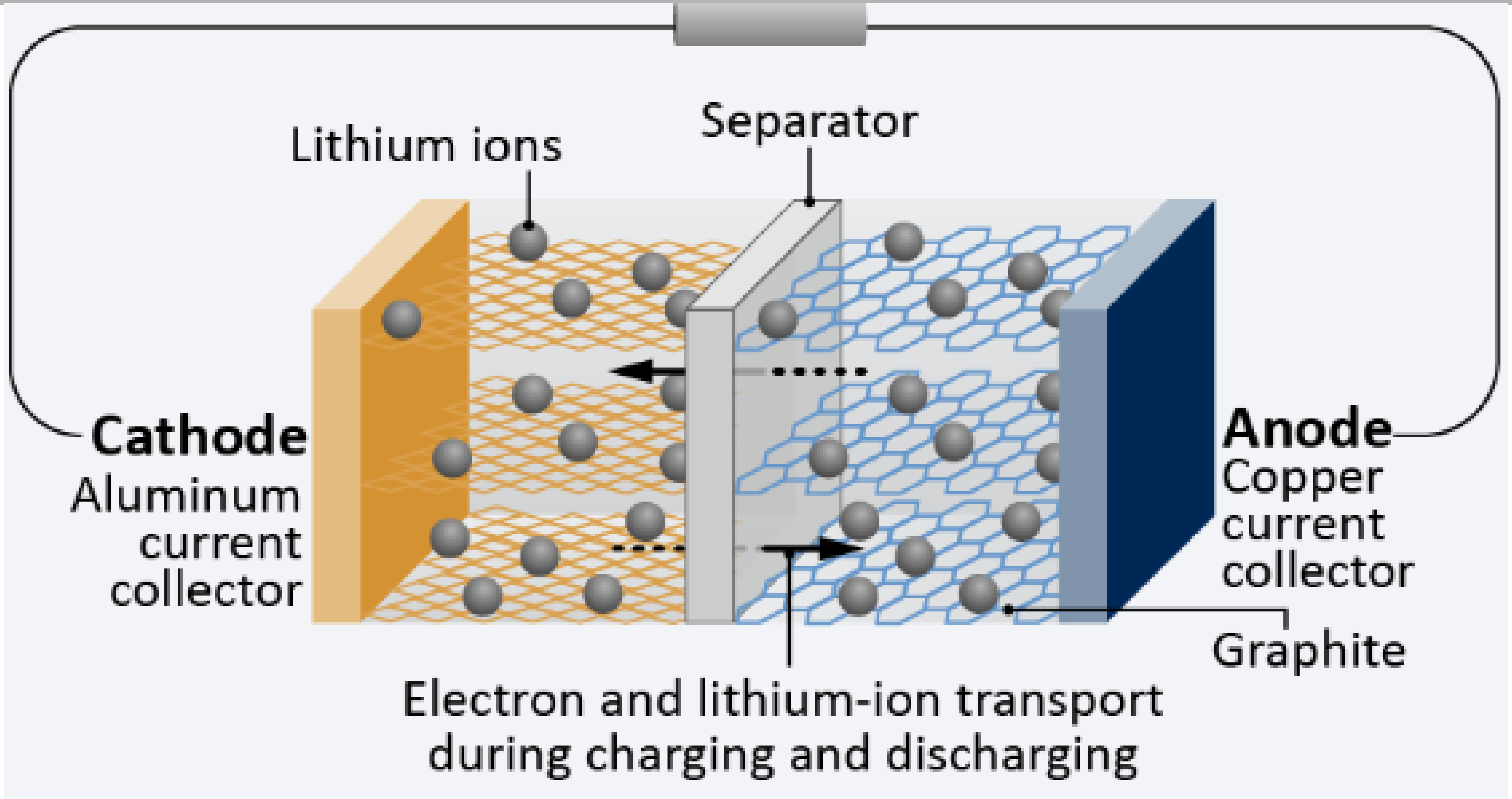
Prismatic
Cell

Pouch
Cell

Cylindrical Cells (18650) are the most common cell in mobility (bikes, scooters, etc.) and are used by electric vehicles with 3000 to 7000 cells

Prismatic and Pouch Cells are found in industrial and consumer electronics, respectively; both are used in electric and hybrid vehicles

Li-Ion Battery Internal

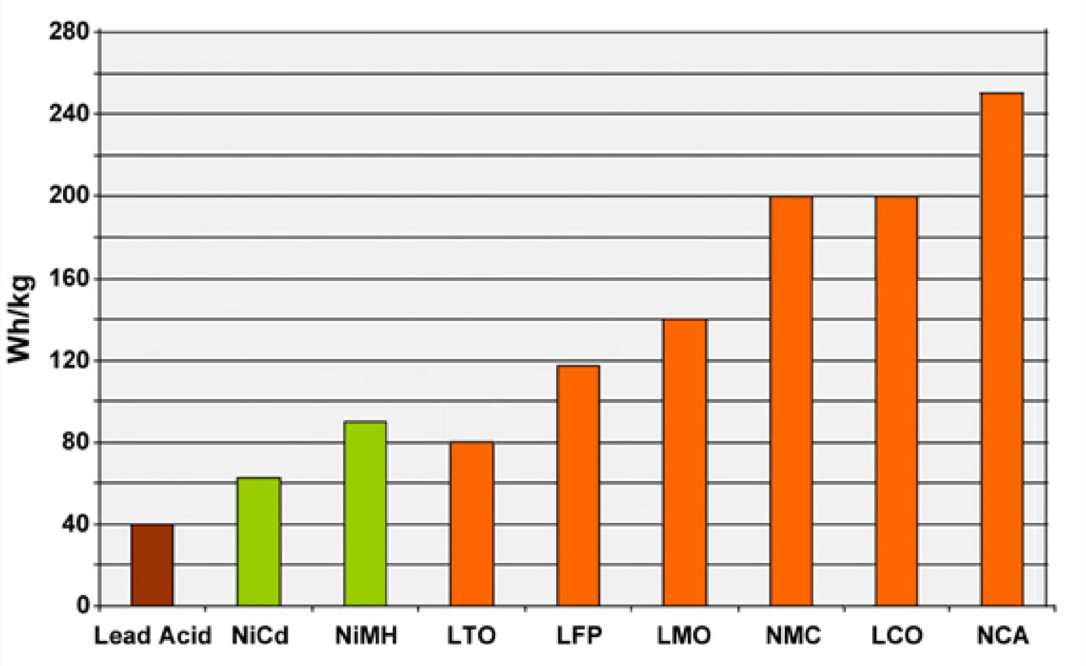


LIB Chemistries

Chemistries cannot always be mixed in recycling

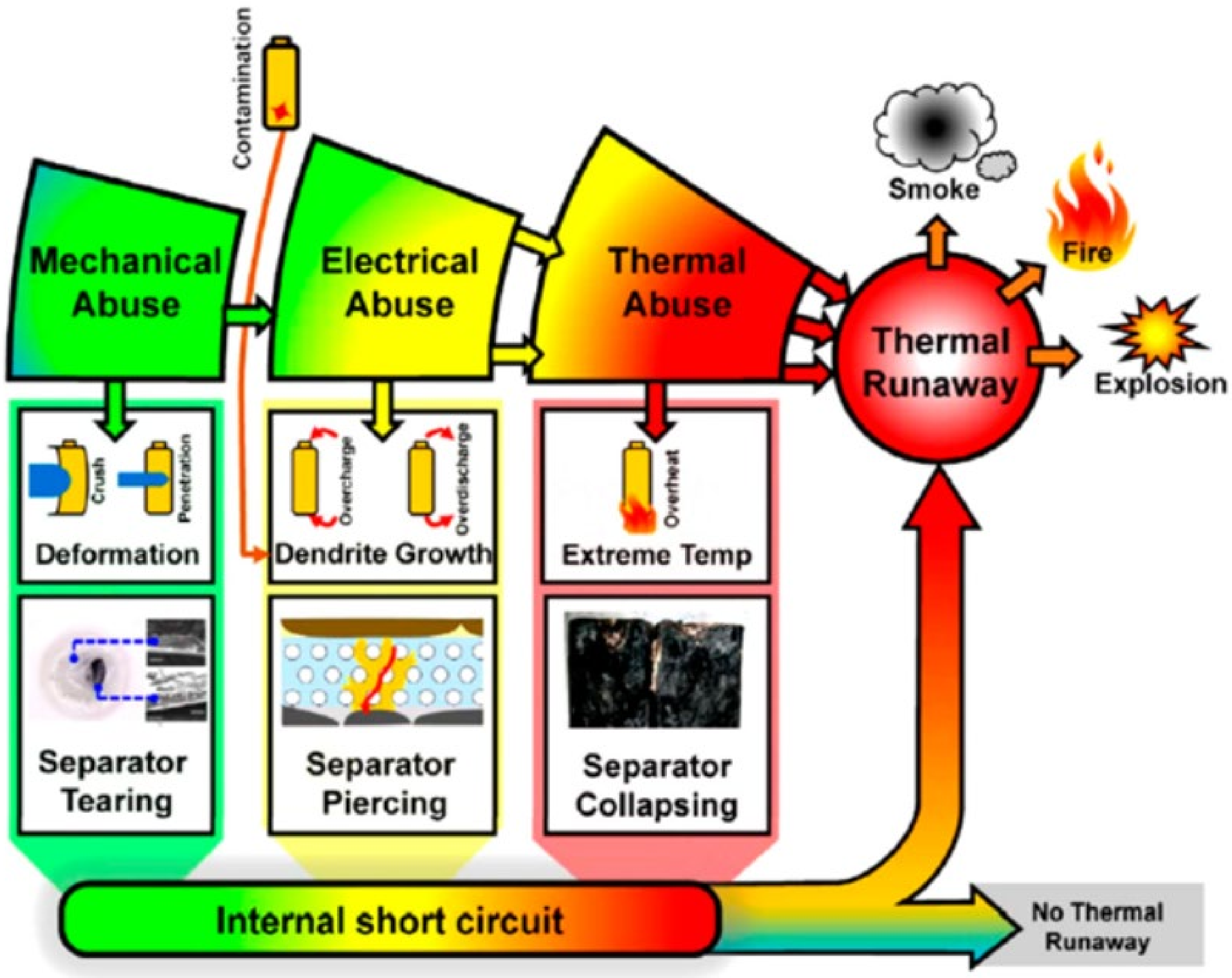
Acronym	Name	Formula
LCO	Lithium Cobalt Oxide	$LiCoO_2$
NCA	Lithium Nickel Cobalt Aluminum Oxide	$LiNiCoAlO_2$
NMC	Lithium Nickel Manganese Cobalt Oxide	$LiNiMnCoO_2$
LMO	Lithium Manganese Oxide	$LiMn_2O_4$
LFP	Lithium Iron Phosphate	$LiFePO_4$
LTO	Lithium Titanate	Li_2TiO_3

Energy Density



Li-Ion Battery Hazards and Failure

Additive Mechanism



Intentional Overcharge of a Scooter Demonstrates Explosive Potential and Gas Production

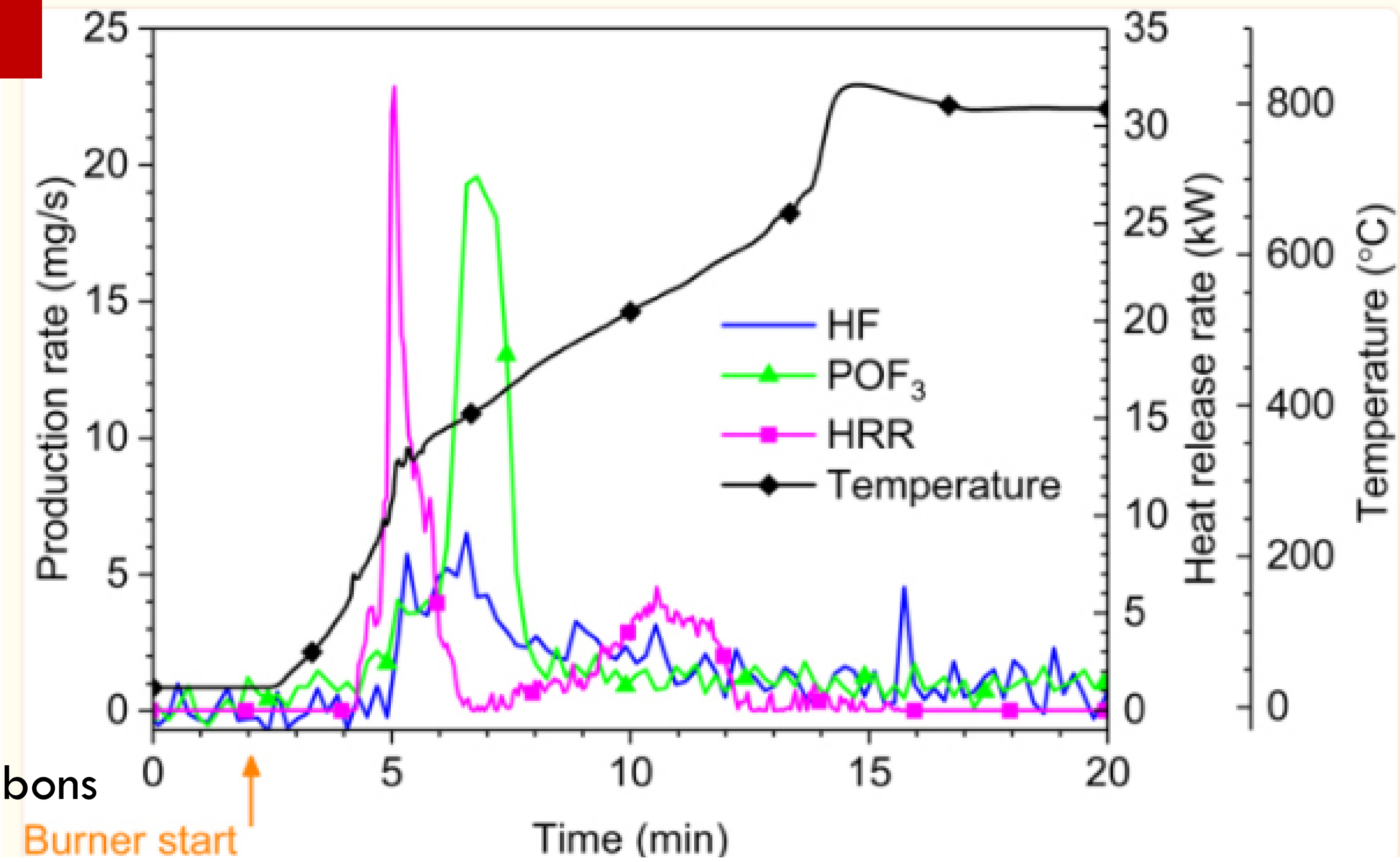
Thermal Runaway and Propagation

Macro Propagation

Li-Ion Battery Toxic Vapors

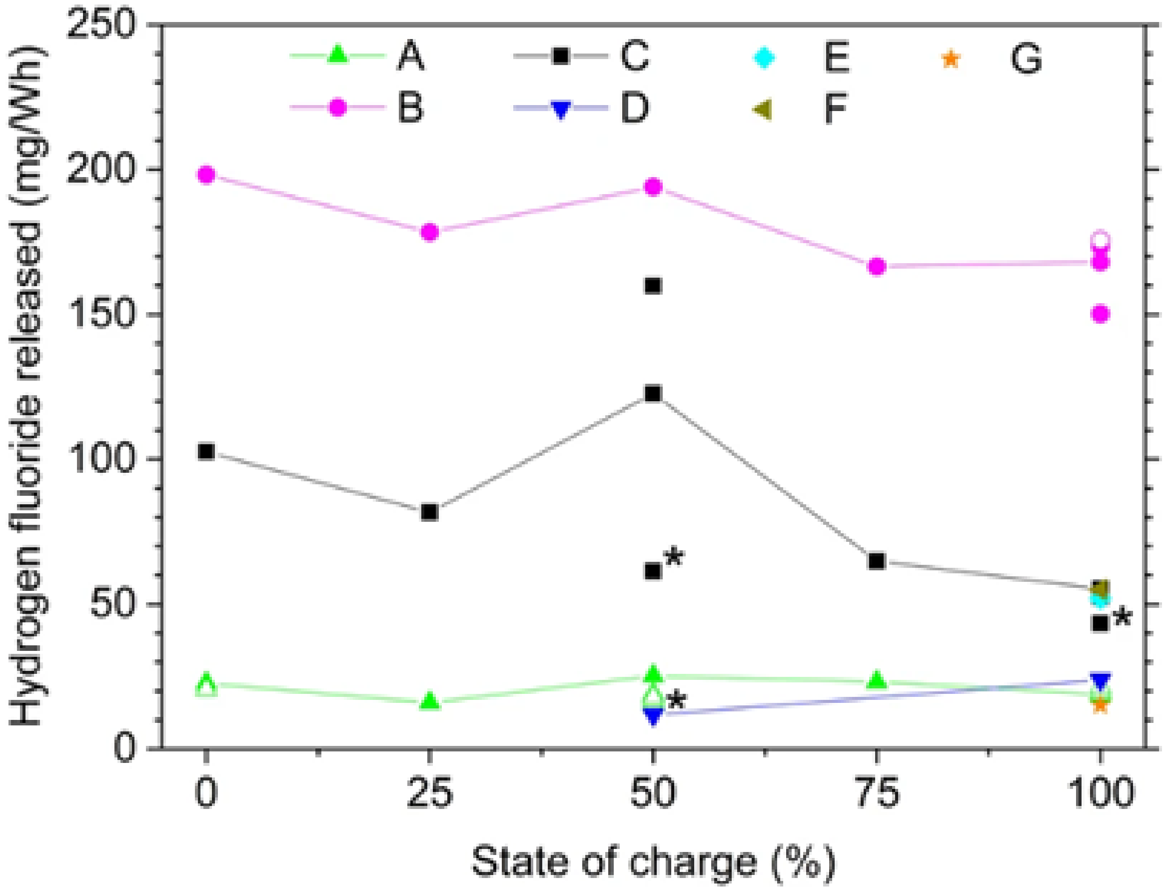
Toxic Vapors

- Hydrogen (30%-50%)
- Carbon Monoxide
- Hydrogen Fluoride
- Hydrogen Chloride
- Hydrogen Cyanide
- Phosphoryl Fluoride
- Organic Solvent Droplets
- Ethane, methane, and other hydrocarbons



Source: Toxic fluoride gas emissions from lithium-ion battery fires. Larsson F, Andersson P, Blomqvist P, Mellander BE. Sci Rep. 2017 Aug 30;7(1):10018. doi: 10.1038/s41598-017-09784-z. Erratum in: Sci Rep. 2018 Mar 22;8(1):5265. PMID: 28855553; PMCID: PMC5577247.

Li-Ion Battery Toxic Vapors



Vapor Production

6,000 L/kWh of vapors can be released during battery failure

Electrolyte is flammable, usually contains lithium hexafluorophosphate (LiPF6) or another Li-salt with fluorine

HF can be generated at 20-200 mg/Wh

- Electric Vehicle (100 kWh)

  600k L of vapor with **2-20kg of HF**

- Energy Storage System (3 MWh)

  16M L of vapor with **60-600kg of HF**

Source: Toxic fluoride gas emissions from lithium-ion battery fires. Larsson F, Andersson P, Blomqvist P, Mellander BE. Sci Rep. 2017 Aug 30;7(1):10018. doi: 10.1038/s41598-017-09784-z. Erratum in: Sci Rep. 2018 Mar 22;8(1):5265. PMID: 28855553; PMCID: PMC5577247.

Not a Normal Fire!

- Very toxic atmospheres
- High burn temperatures
- Can burn without Oxygen **(can't smother!)**
- Explosive potential **(hydrogen gas)**
- Thermal Runaway reaction
  - Chemical reaction – rapid degradation
  - Nearly impossible to stop once it starts
  - Could happen in seconds or days
- Re-ignition is common

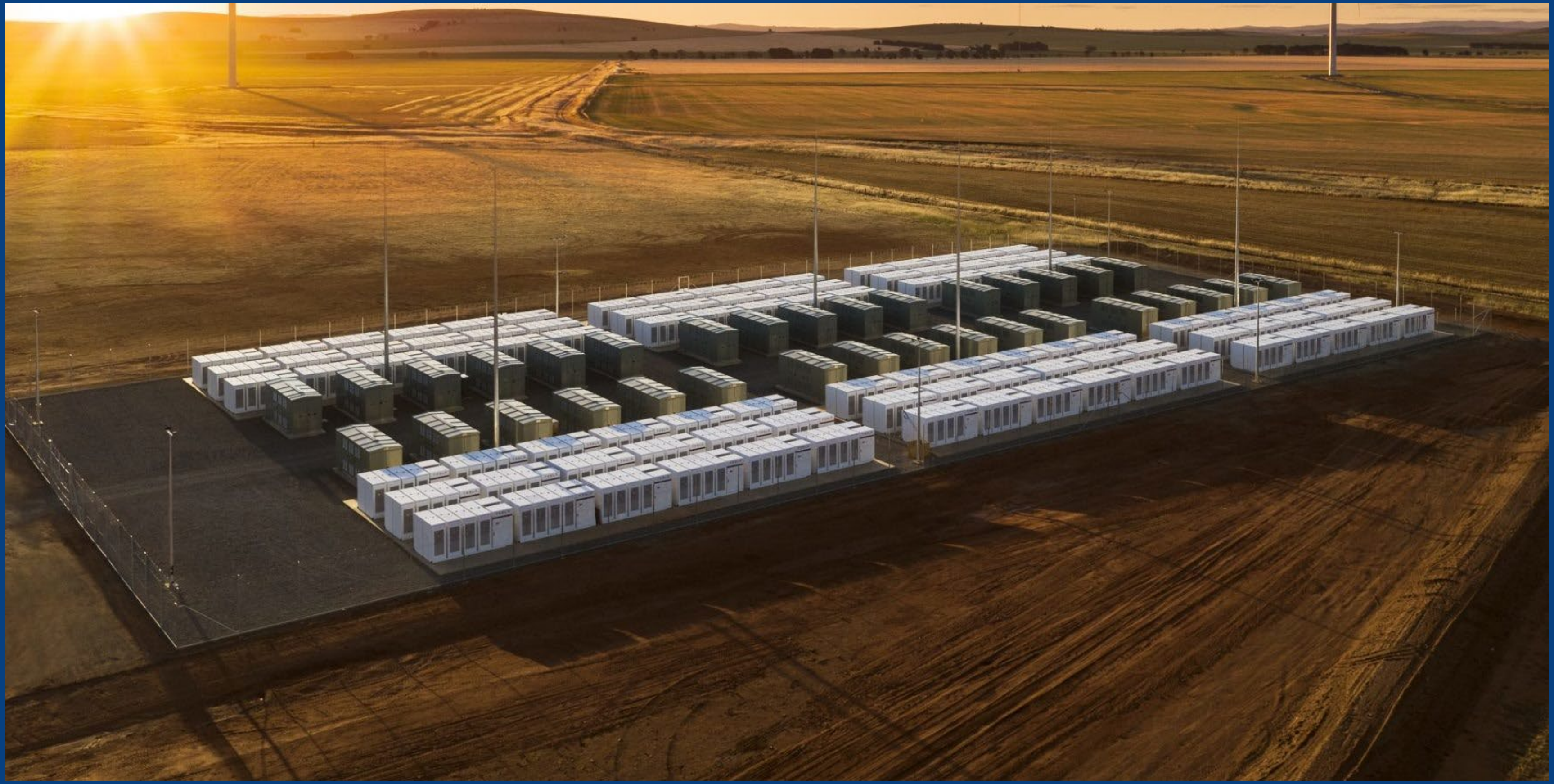
  minutes to months later!

Three Primary Presentations of LIB

Energy Storage Systems

Electric Vehicles

Micro-mobility



Battery Energy Storage System (ESS)


KEY TAKEAWAYS FROM APS EXPLOSION REP
SEVERAL VALLEY FIREFIGHTERS HURT IN 2019 BLAST
abc 15
ARIZONA

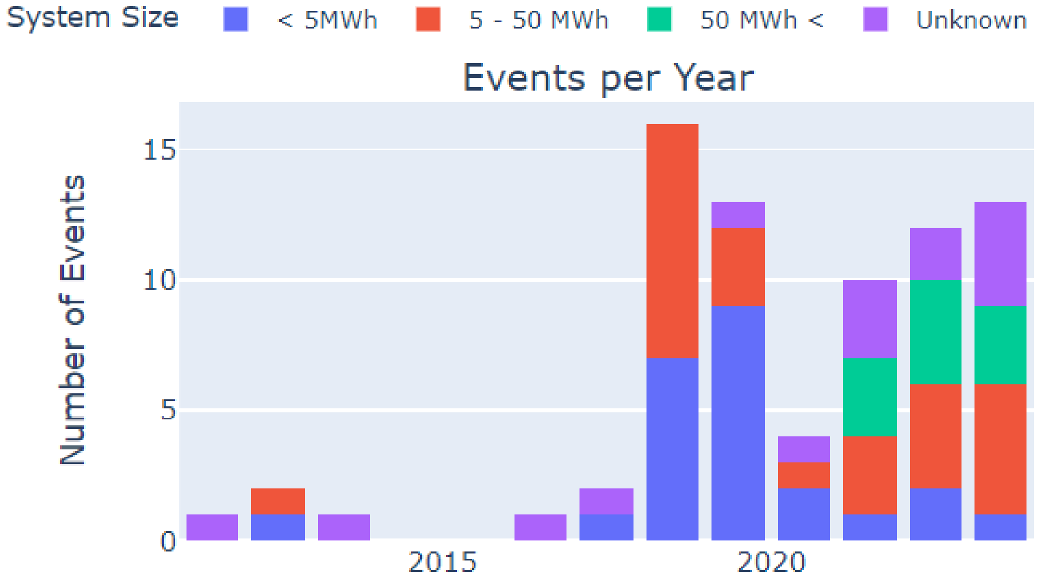
Energy Storage System (ESS)

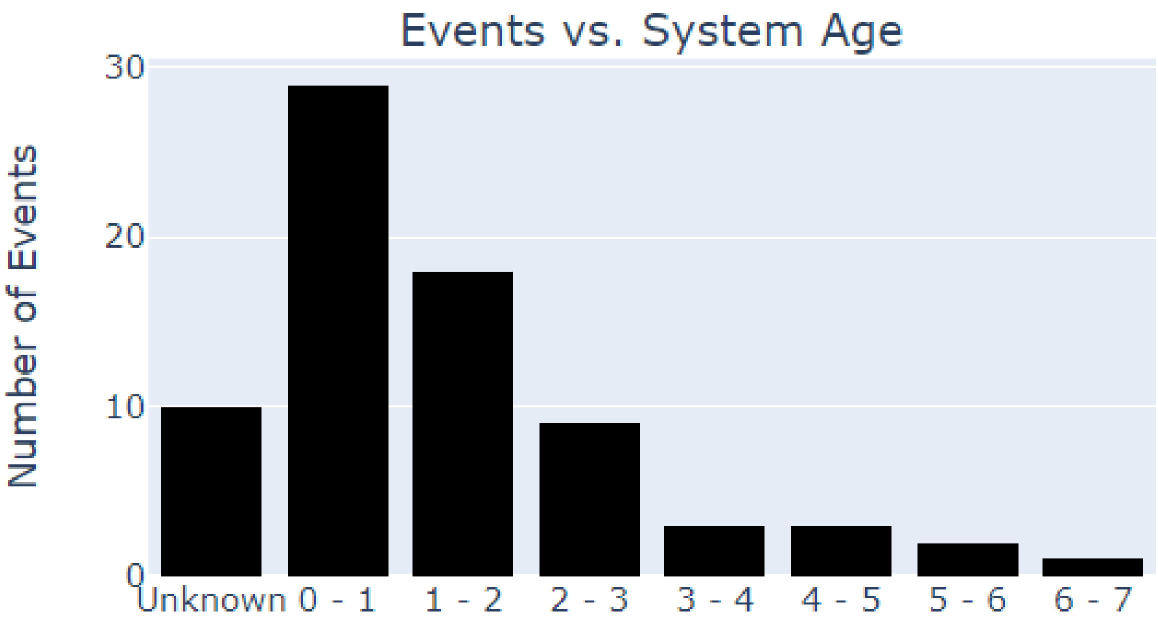
- Very large systems
- Multiple racks of batteries
- New regulations for fire safety
  - NFPA 855 (2019)

    Addresses safety measures including spacing and fire suppression
  - UL 9540 & 9540A (2022)

    Standard test method for evaluating thermal runaway in BESS

BESS – Failure Events





Source: storagewiki.epri.com/index.php/BESS_Failure_Event_Database

ESS USES

One or more batteries store energy, which can then be used at a later time.

Assists in load leveling and grid support, helping to balance fluctuations in electricity demand throughout the day and reduce congestion on the grid.

Improves power quality by smoothing out voltage fluctuations that may otherwise disrupt equipment operations.

Electricity stored typically comes from:

- Wind
- Solar
- Grid connection

COMPONENTS OF A BESS

A battery system. It contains individual battery cells that convert chemical energy into electrical energy. The cells are arranged in modules that, in their turn, form battery packs.

A battery management system (BMS). A BMS ensures the safety of the battery system. It monitors the condition of battery cells, measures their parameters and states, such as state-of-charge (SOC) and state-of-health (SOH), and protects batteries from fires and other hazards.

An inverter or a power conversion system (PCS). This converts direct current (DC) produced by batteries into alternating current (AC) supplied to facilities. Battery energy storage systems have bi-directional inverters that allow for both charging and discharging.

An energy management system (EMS). This is responsible for monitoring and control of the energy flow within a battery storage system. An EMS coordinates the work of a BMS, a PCS, and other components of a BESS. By collecting and analyzing energy data, an EMS can efficiently manage the power resources of the system

DIFFERENCE BETWEEN MP1 vs MP2

** reported by Fisher Engineering*

Megapack 1

- Cylindrical NMC
- 12,000 cells per module
- 9540A Testing:
  - Cascading thermal runaway of all cells
  - Flames observed outside cabinet
  - Consumed entire cabinet
  - Manual hoselines not required to stop cabinet to cabinet spread

Megapack 2

- Prismatic LFP
- 336 cells per module
- 9540A Testing:
  - 1 cell propagation
  - No evidence of sustained flaming
  - No flames observed outside cabinet
  - Manual hoselines not required to stop cabinet to cabinet spread

BESS Fires - Tactical Considerations

Response

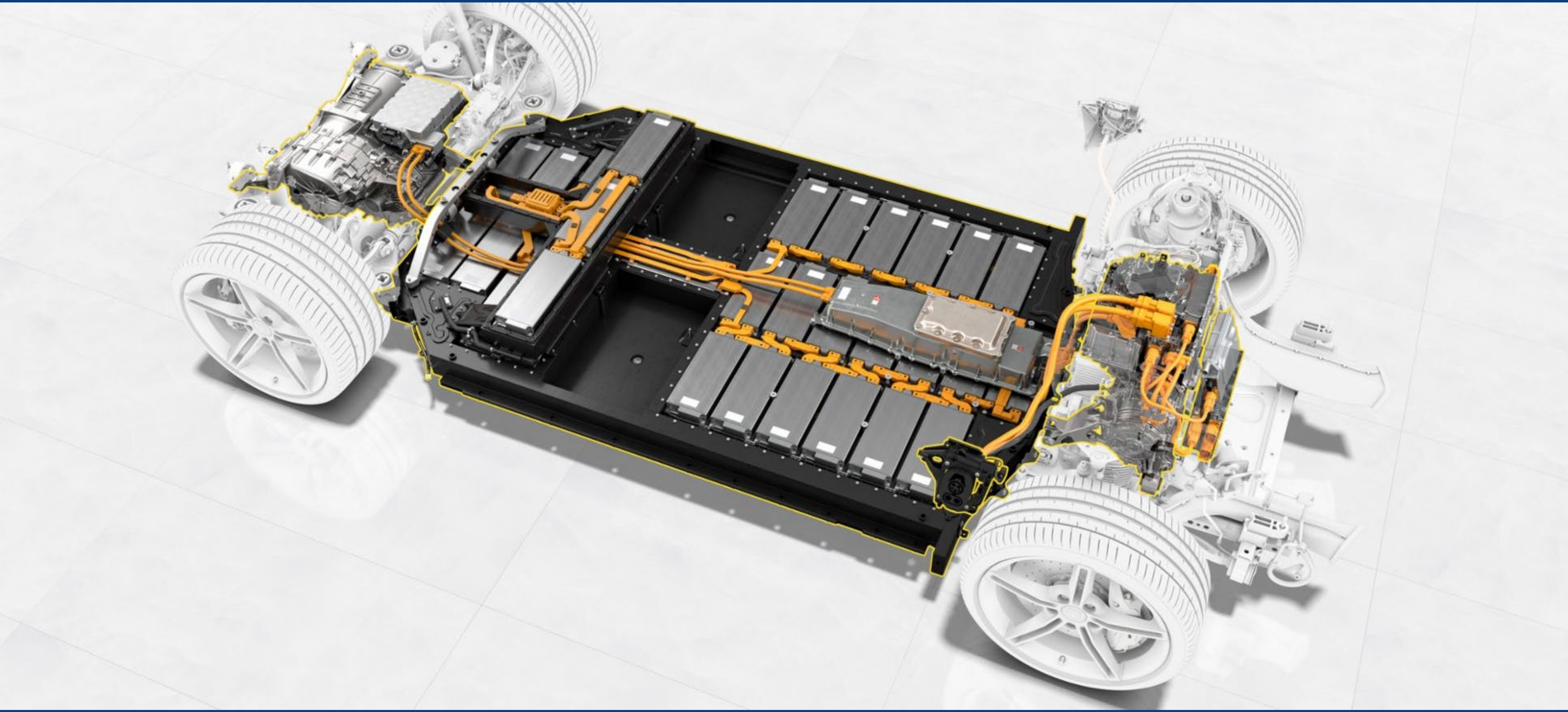
- Determine if batteries involved
- Shutoff/isolate
- Do not approach or access

Life safety

- Structural Fire Gear and SCBA
- Evacuate/Shelter-in-Place
  - Distances presume HF:
    - initial 100m
    - then protect 0.3-1.8km based on wind

Incident Management

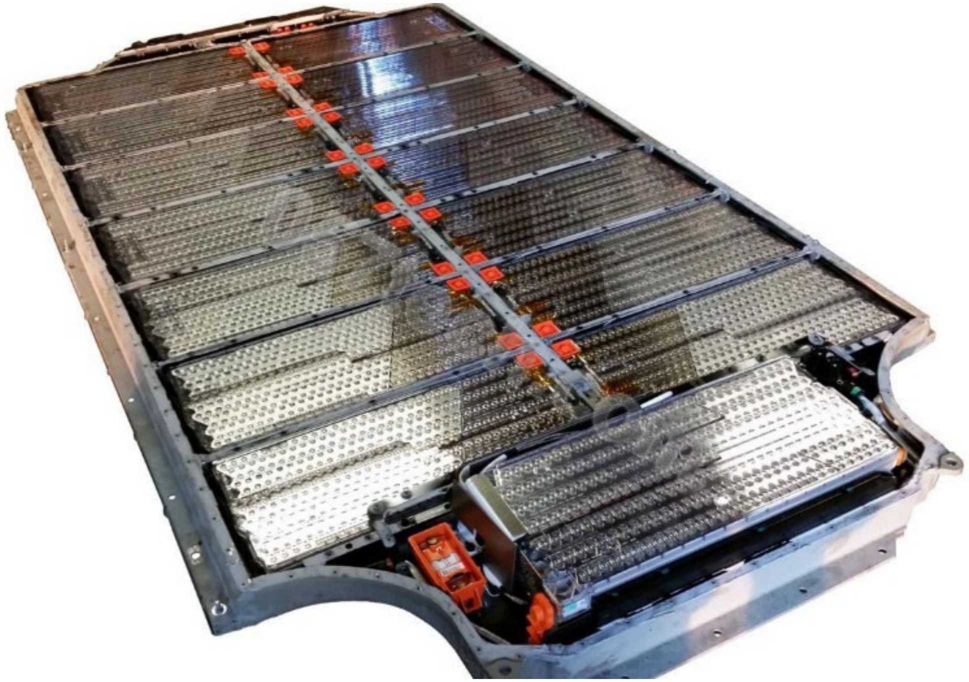
- Let it burn (hour or days)
- Prevent propagation, protect exposures
- Use low GPM
- Runoff: minimize, contain or redirect



Battery Electric Vehicles (BEV)

BEV – Different Battery Packs

GM Battery Pack
Pouch Cells



Tesla Battery Pack
Cylindrical Cells

BEV Damage

LIB Location: Usually under the vehicle

Battery-involved fire?

- White smoke
- Hissing/popping sounds

Offensive firefighting:

- Water for cooling – thousands of gallons!
- Apply up into battery

Defensive firefighting:

- Let it burn & protect exposures
- Store 15m from exposures
- **Rekindle can occur days or weeks later!**

Tesla – Cylindrical Cell Batteries

18650 cell generation

LOTS of water required to extinguish

BEV Fires - Tactical Considerations

Response

- Determine if batteries involved
  - Most EV fires **do not** involve LIBs
- Refer to vehicle-specific ERG

Life safety

- Structural Fire Gear and SCBA
- Rescue, check for victims
- Chock wheels
- Evacuate/Shelter-in-Place
  - Distances presume HF: initial 100m

Incident Management

- Non-LIB – normal vehicle fire
- LIB – let it burn
- **No foam**
- Stay away from high voltage battery

Lists of ERGs are at

NFPA.org

EnergySecurityAgency.com

BEV – Emergency Response Guide

United States Environmental Protection Agency
EPA
Region 4 Emergency Response

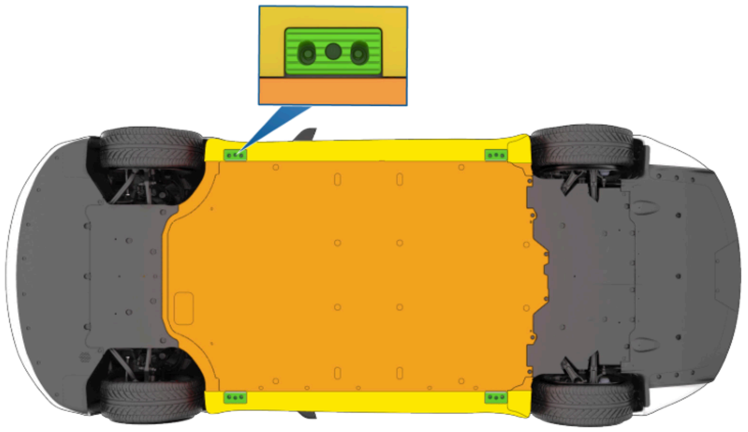
STABILIZATION / LIFTING POINTS

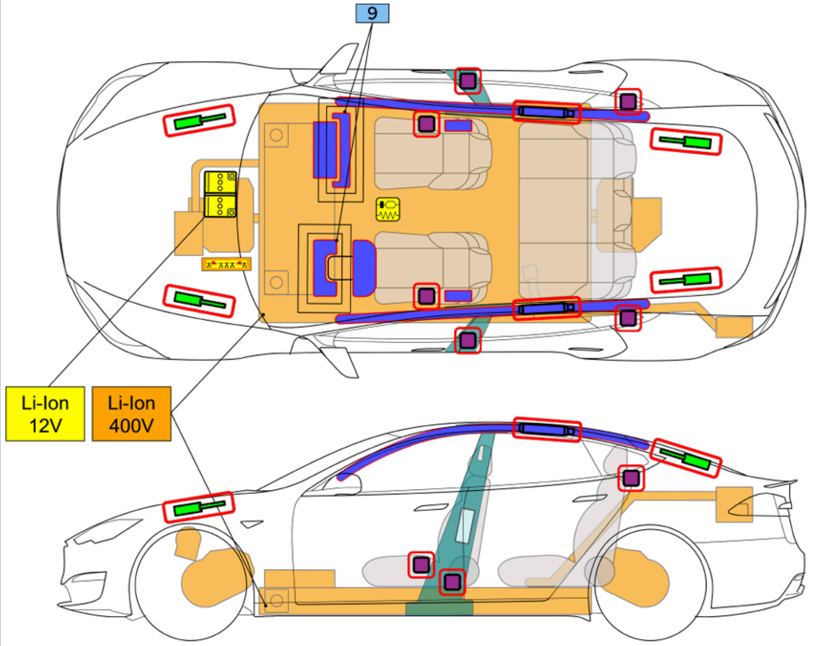
The high voltage battery is located under the floor pan. A large section of the undercarriage houses the high voltage battery. When lifting or stabilizing Model S, only use the designated lift areas, as shown in green.

⚠ **WARNING** Be careful to not damage the battery pack while stabilizing / lifting the vehicle.

⚠ **WARNING** The vehicle should be lifted or manipulated only if first responders are trained and equipped at the technician level per the applicable country's national fire training requirements and are familiar with the vehicle's lifting points. Use caution to ensure you never come into contact with the high voltage battery or other high voltage components while lifting or manipulating the vehicle.

⚠ **WARNING** DO NOT USE THE HIGH VOLTAGE BATTERY TO LIFT OR STABILIZE MODEL S.





Airbag	Stored gas inflator	Seatbelt pretensioner	SRS Control Unit	Pedestrian protection active system
Automatic rollover protection system	Gas strut/ pre-loaded spring	High strength zone	Zone requiring special attention	
Battery low voltage	Ultra capacitor, low voltage	Fuel tank	Gas tank	Safety valve
High voltage battery pack	High voltage power cable/component	High voltage disconnect	Fuse box disabling high voltage system	Ultra capacitor, high voltage
Cable cut				

BEV Fire - Tactical Considerations
Inside or Underground

FSRI and UL Fire R&D, 2022

Hazards from Lithium-ion Battery Thermal Runaways in Residential Garages

Simulated gas mixture from a 18kWh residential ESS in thermal runaway, consisting of CO, CO_2, H_2, and CH_4

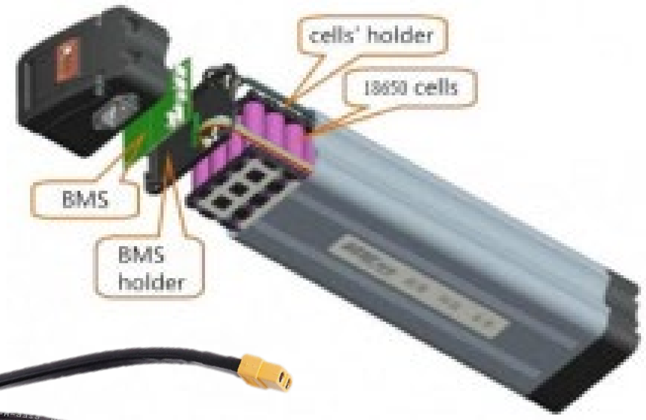
Other Battery Electric Vehicles

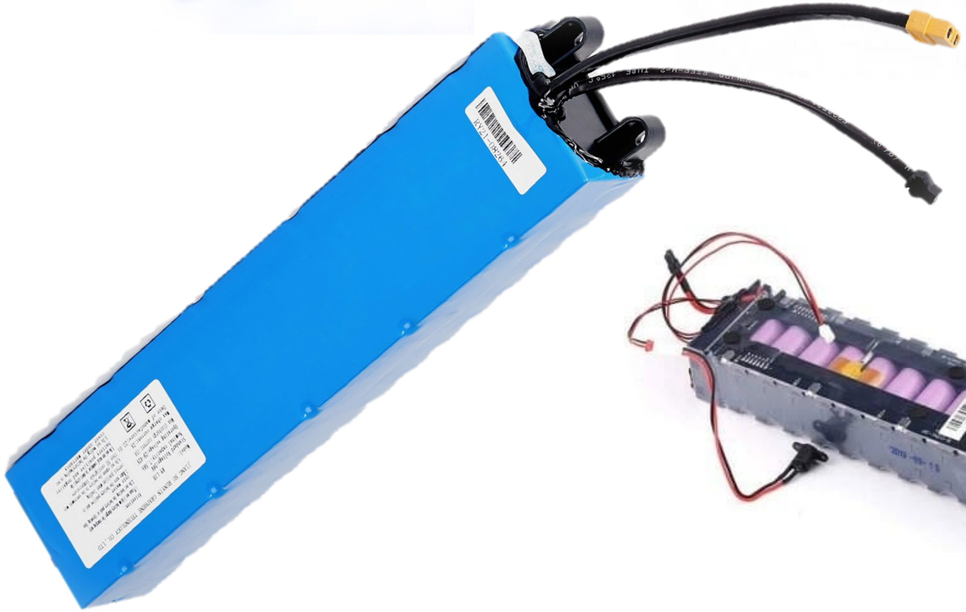
Micro-Mobility Devices

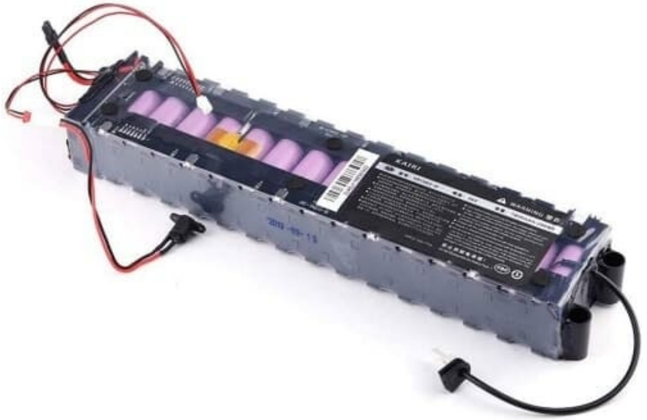
Micro-Mobility Devices

- Largest number of LIB incidents
- FDNY LIB micro-mobility fires
  - 44 in 2020
  - 220 in 2022
- Public exposure concerns
  - Stored and charged inside occupied residences and businesses
  - Stored near entry and exit ways
  - Can ignite with little-to-no warning
  - **Rekindle is likely**

Micro-Mobility Devices







(i) Electric Unicycle

(ii) Egret (kick electric scooter)

(iii) Electric Scooter

(iv) Three-wheeler Electric Scooter

(v) Electric Mobility Cart

(vi) Electric Bike (bicycle)

(vii) Hoverboard

(viii) Segway

(ix) Electric Caster Board

Micro-Mobility - Tactical Considerations

Response

- Treat uninvolved LIB as UXO
- Outdoors – allow device to burn
- Indoors – attack residential fire

Life safety

- Structural Fire Gear and SCBA
- Rescue, check for victims
- Evacuate
  - Distances presume HF: initial 100m

Overhaul

- Wear SCBA
- Move LIB to safe location
- De-energize LIB

Case Studies

Lakes Parkway Fire Response

Lakes Parkway Fire Response

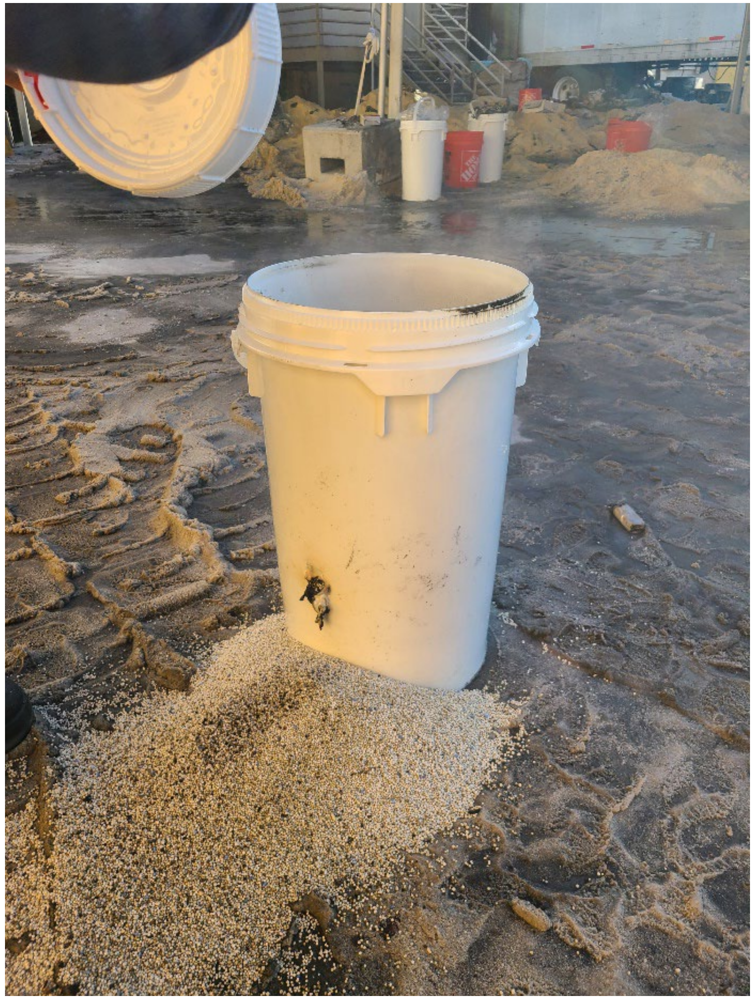
- Fire Department responded to facility, twice, three days apart and requested EPA assistance

Damaged Batteries are Unpredictable

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EPA
REGION 4 EMERGENCY RESPONSE

First Fire of the Day – recently packaged bucket

Technically not a Fire?


Second Fire of the Day – bucket packaged 5 days ago

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EPA
REGION 4 EMERGENCY RESPONSE

Aftermath

- Approximately 20 buckets were damaged during the second fire
- The bucket that caught fire had been packaged approximately 5 days ago and not been touched/moved for 4 days

Stop Work

Primary Goal:

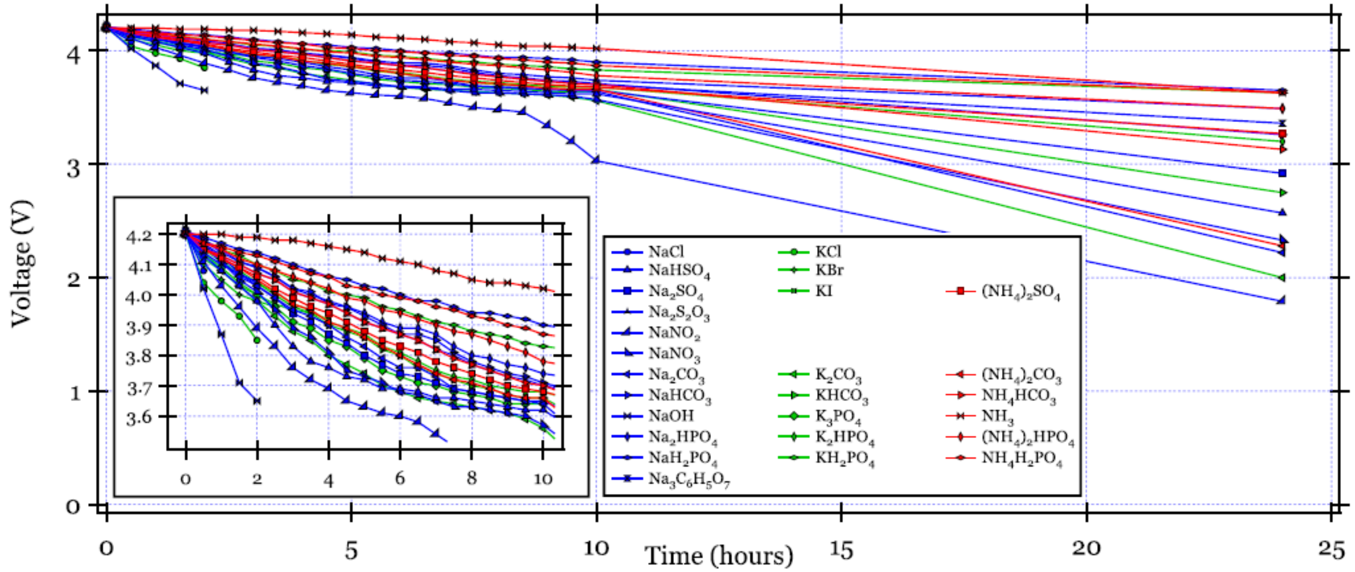
- Stop calling the Fire Department

Secondary Goals:

- Stop having fires
- Find a way to safely package/ship/dispose of the DDR batteries

De-energizing Batteries

Recycling facilities regularly mentioned that prior to shredding they "soak" the batteries in salt water prior to shredding TO REDUCE EXPLOSIONS during the shredding process.



Battery De-energizing Test

- Saltwater solution – Approximately 0.5% NaCl
- 1 lb NaCl per 25 gallons water
- Soak from 3 days to 3 months
- Potentially toxic and flammable gases similar to plastic fires released during combustion
- 24-hour results indicated full discharge of test batteries

Runoff/Brine Solution Sample Results

- TCLP results for RCRA metals have been non-detect for disposal
- Studies show other metals may be present in high concentrations

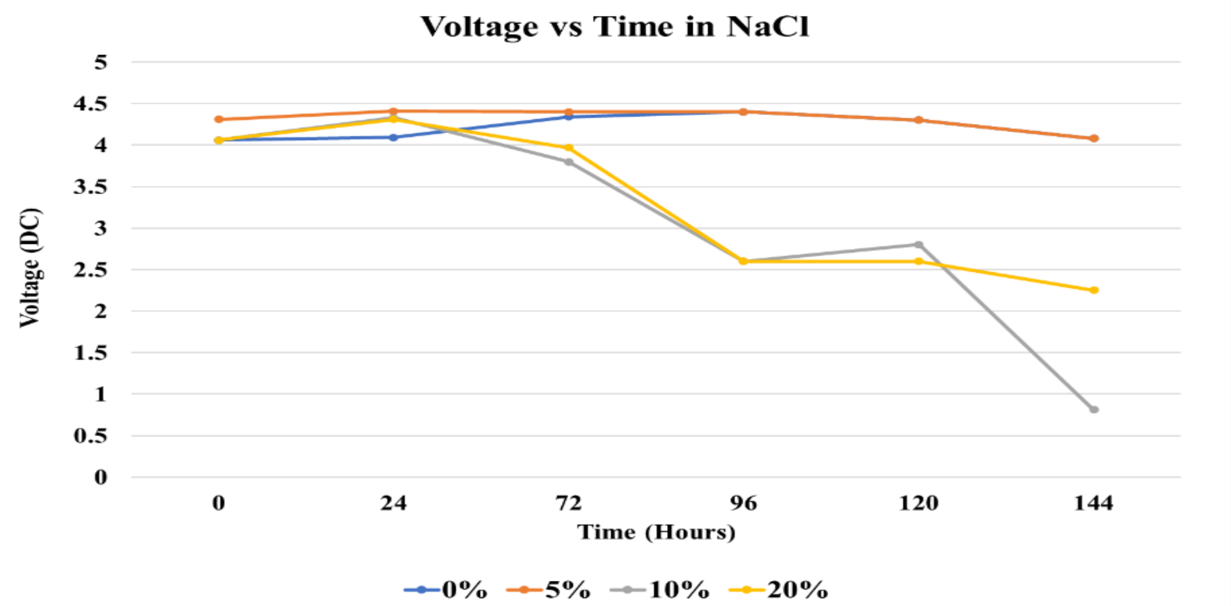
Brine solution and runoff water are likely to be non-hazardous but should be disposed of at a POTW if possible.

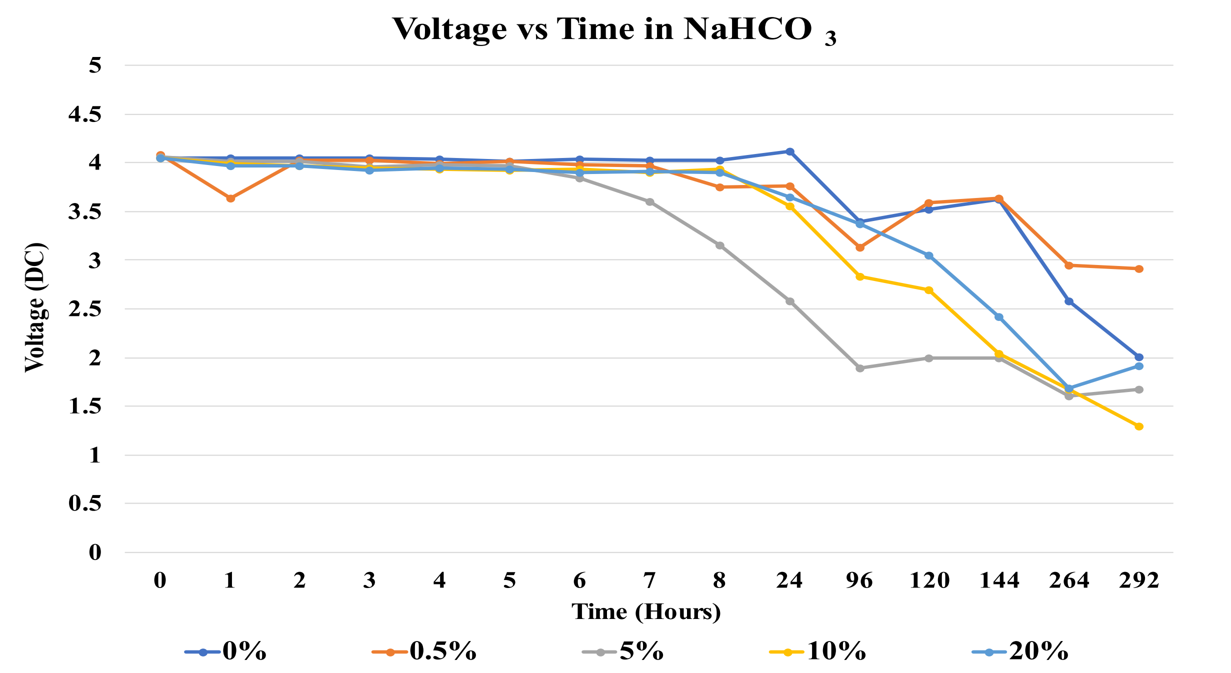
Table 13

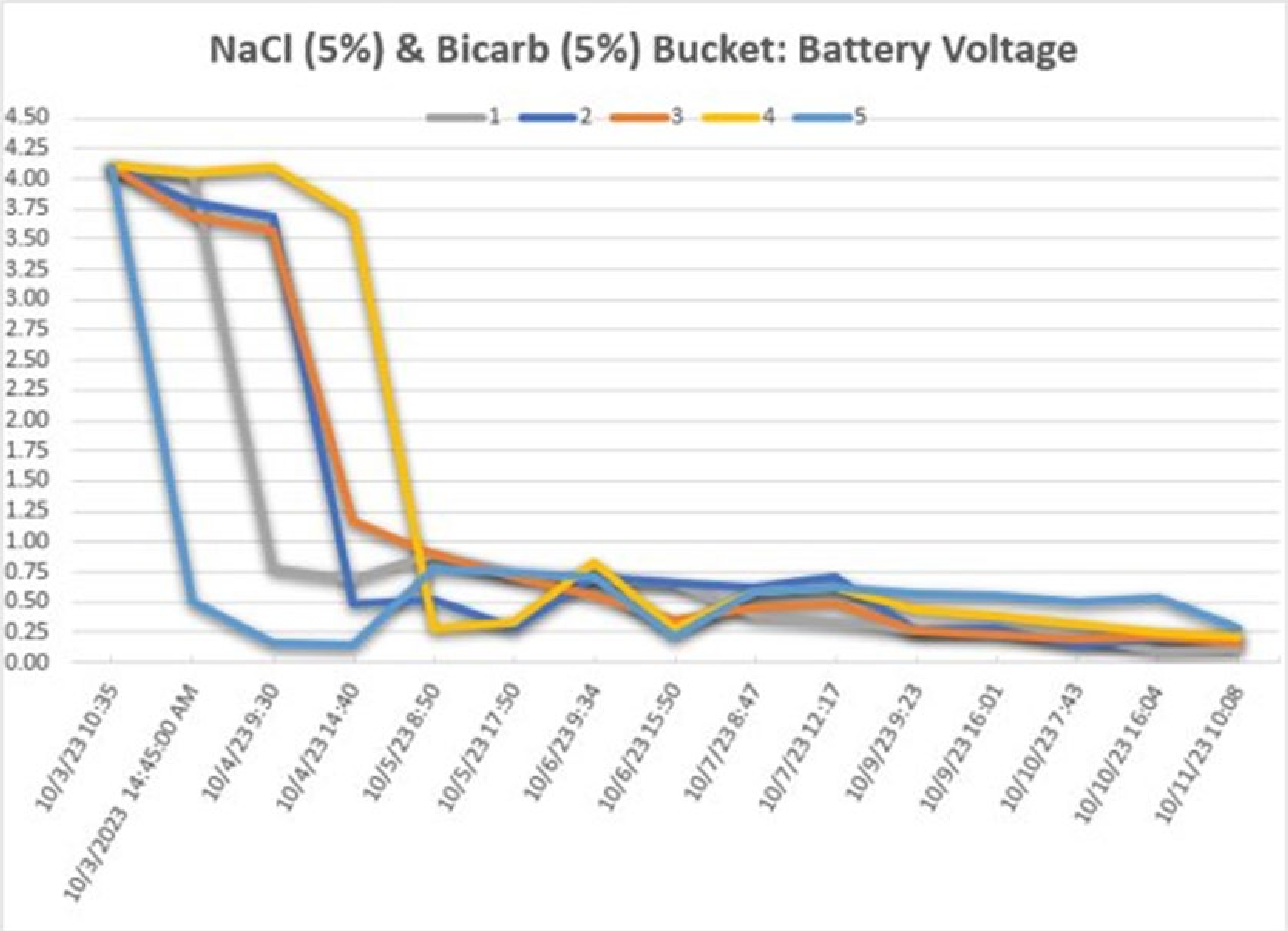
Comparison of contamination of sprinkling and storage water with limit and background levels.

Contaminant/ Parameter	Unit	Sprinkling water	Storage water	Process water	Drinking water limit values (1)	Industrial effluent limit value (2)
pH value	-	8.2	12.3	8	6.8 - 8.2	6.5 - 9.0
Chloride	mg/l	2	22	3	250	n.s.
Sulphate	mg/l	34	98	2	250	n.s.
Nitrate	mg/l	2	< 1	< 1	40	n.s.
Phosphate	mg/l	<1	< 1	< 1	1	n.s.
Fluoride	mg/l	8	330	< 1	1.5	n.s.
PAH (c)	µg/l	0.001 (a) 0.36 (b)	0.02 (a) 0.02 (b)	0.001 (a) < 0.001 (b)	0.1	n.s.
Benzo[a]pyrene	µg/l	< 0.001 (a) 0.07 (b)	0.004 (a) 0.01 (b)	< 0.001 (a) < 0.001 (b)	0.01	n.s.
Nickel	µg/l	36000 (a) 48400 (b)	55000 (a) 181000 (b)	< 700	20	2000
Cobalt	µg/l	36000 (a) 46000 (b)	50000 (a) 181000 (b)	< 400	n.s. (≤ 70)	500
Manganese	µg/l	36000 (a) 44000 (b)	53000 (a) 199000 (b)	< 1300	50	n.s.
Lithium	µg/l	7000 (a) 2200 (b)	1460000 (a) 31000 (b)	< 1300	n.s. (≤ 40)	n.s.

R9 Field Brine Experiments: 12th St Warehouse Fire → Duke Sauce







Field Brine Experiments: Analytical Results from Maui Brines, Sludges and Battery Materials

Early Maui Brine and Battery Material Analytics

Sample Number 09/27/2023		NaCl 20%	NaCl 6% Bicarb 5%	NaCl 6%	Bicarb 1%	Brined Battery Material	Unbrined Battery Material
Matrix		Liquid	Liquid	Liquid	Liquid	Solids	Solids
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
pH		7.19	8.68	7.79	9.83		
Parameter	Reg Limits	Result	Result	Result	Result	Result	Result
CAM 17-TTLC Target Analyte List metals (EPA 6010B/7470A)							
Aluminum		2,100	2,400	3,700	16,000	32,000	22,000
Antimony	500	ND	ND	**0.097**	**1.9**	ND	**12**
Arsenic**	500	ND	**0.012**	**0.017**	**0.15**	**160**	**66**
Barium	10,000	**0.079**	**0.035**	**0.062**	**4.8**	**3.0**	**9.7**
Beryllium	75	ND	ND	ND	ND	ND	ND
Cadmium**	100	ND	ND	ND	ND	ND	**38**
Calcium		110,000	21,000	58,000	17,000	ND	ND
Chromium**	2,500	ND	ND	ND	ND	**35**	**11**
Cobalt	8,000	**0.24**	**0.085**	**0.15**	**0.73**	**38,000**	**16,000**
Copper	2,500	ND	**0.077**	**0.12**	**3.3**	**110,000**	**410,000**
Iron		4,600	5,200	2,300	5,400	960	4,500
Lead	1,000	ND	**0.21**	ND	**0.11**	**82**	**150**
Magnesium		93,000	36,000	34,000	11,000	ND	ND
Mercury	20	ND	ND	ND	ND	ND	ND
Molybdenum**	3,500	ND	ND	ND	**0.087**	ND	ND
Nickel	2,000	**0.78**	**1.5**	**0.63**	**3.2**	**90,000**	**100,000**
Potassium		360,000	77,000	110,000	38,000	470	1,000
Selenium	100	ND	ND	ND	ND	ND	ND
Silver	500	ND	ND	ND	ND	**5.6**	**8.4**
Sodium		76,000,000	20,000,000	27,000,000	3,400,000	ND	ND
Thallium	700	ND	ND	ND	ND	**83**	**120**
Vanadium**	2,400	ND	**0.036**	ND	**0.065**	ND	ND
Zinc	5,000	**1.5**	**0.38**	**1.4**	**2.8**	**260**	**570**
CAM 17-STLC Target Analyte List metals (EPA 6010B/7470A)							
Antimony	15					ND	**6.2**
Arsenic**	5.0					**1.3**	**28**
Barium	100					**0.65**	**5.3**
Cadmium**	1.0					ND	**18**
Chromium**	5.0					ND	**5.3**
Cobalt	80					**120**	**270**
Nickel	20					**1,700**	**750**
Silver	5.0					ND	**2.5**
Thallium	7.0					ND	**52**
Zinc	250					**2.1**	**280**
TCLP Target Analyte List metals (EPA 6010B/7470A)							
Arsenic**	5.0					ND	ND
Barium	100.0					ND	ND
Cadmium**	1.0					ND	ND
Chromium**	5.0					ND	ND
Lead	5.0					ND	ND
Mercury	0.2					ND	ND
Selenium	1.0					ND	ND
Silver	5.0					ND	ND

Yellow = exceedances, red = common fire contaminants, blue = common battery constituents
**** = Analytes seen in Hawaii data set but NOT the San Diego data set, indicating potential wildfire contaminants**

Battery Brine and Crushing Area Soil Analytics Post Phase 1

Sample ID 12/01/2023		Brine Solution 1	Brine Solution 2	Brine Solution 3	Brine Sludge 1	Brine Sludge 2	Brine Sludge 3	Battery Crushing Area 1	Battery Crushing Area 2	Battery Crushing Area 3
Matrix		Water	Water	Water	Sludge	Sludge	Sludge	Soil	Soil	Soil
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
pH		9.0	9.2	9.2	9.7	9.9	9.5	8.4	9.1	9.2
Parameter	Reg Limits	Result	Result	Result	Result	Result	Result	Result	Result	Result
TCLP Target Analyte List metals (EPA 6010B/7470A)										
Arsenic	5.0	ND	ND	ND	ND	ND	ND	**0.081**	ND	ND
Barium	100.0	ND	ND	ND	**0.42**	**0.25**	**0.16**	**0.77**	**0.55**	**0.38**
Cadmium	1.0	ND	ND	ND	**0.14**	**0.086**	**0.034**	ND	ND	ND
Chromium	5.0	ND	ND	ND	**0.16**	**0.16**	**0.13**	ND	ND	ND
Lead	5.0	ND	ND	ND	ND	ND	ND	**11**	ND	ND
Mercury	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Reactivity (SW-846 Ch7 9012A/Mod 9034)										
Reactive Cyanide	250	ND	ND	ND	ND	ND	ND	ND	ND	ND
Reactive Sulfide	500	ND	ND	ND	ND	ND	ND	ND	ND	ND

Exceedance for lead in Battery Crushing Area Sample likely due to high presence of lead in Pre-Staging area sampling event (see Staging Area Sample Table). Potential fire contaminant.

Arsenic and Cadmium presence may also be due to fire contaminants. Barium presence in sludge samples and crushing areas may be due to cross contamination or spillage, but levels are well below action levels.

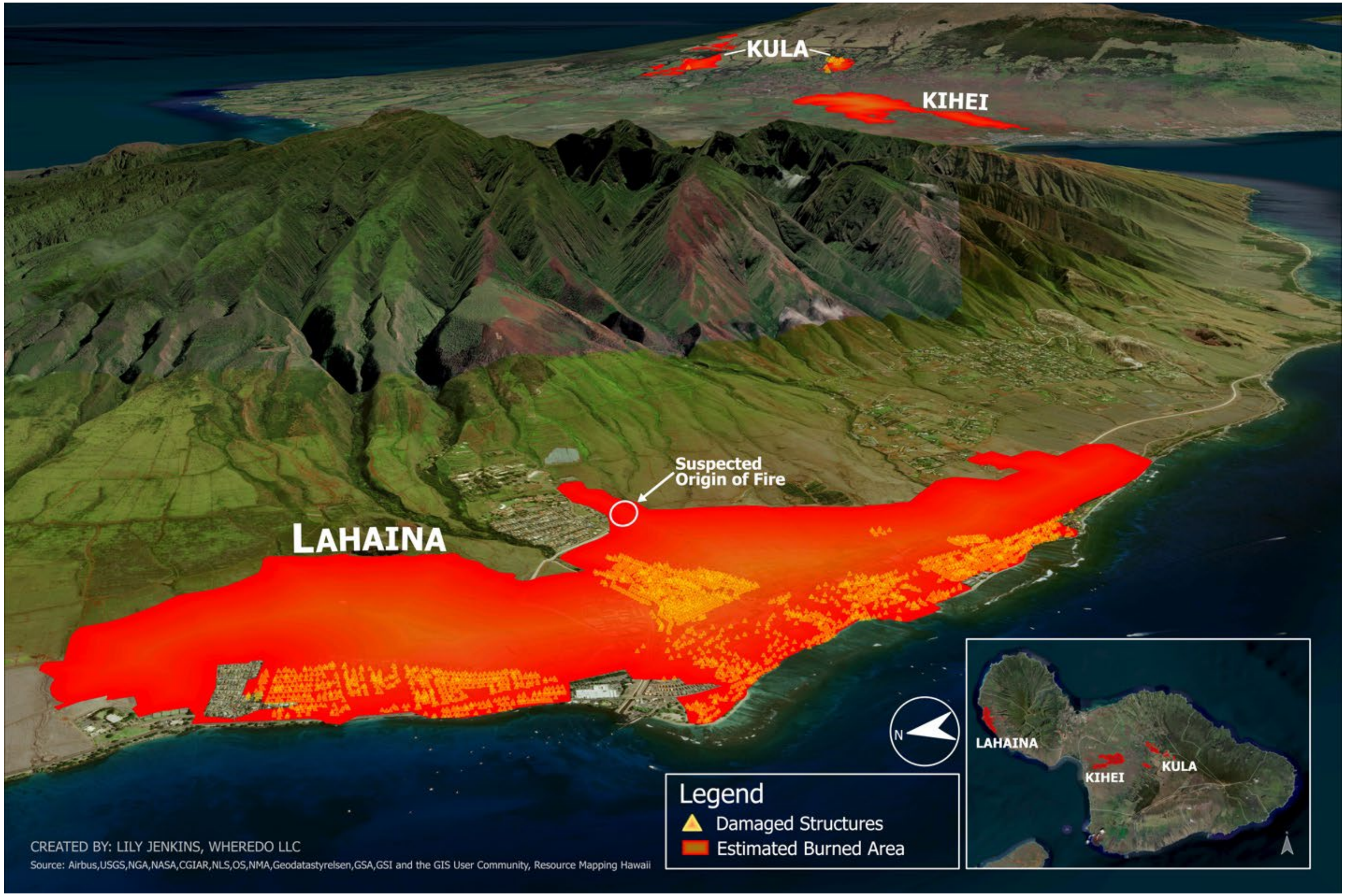
TRANSPORTATION INCIDENTS

I-15 Freeway Closure - July 2024

I-75 Explosion – June 29, 2024

NATURAL DISASTER RESPONSE

Maui Waste Determination and Transportation



MAUI WILDFIRE - INTRODUCTION AND BACKGROUND

Mission Assignment Operations conducted under ESF-10

- MAs: Household Hazardous Waste Removal including Residential BESS; Commercial Hazardous Waste Removal; Electric Vehicles; 505 Front Street Dewatering; Submarine Lead-Acid Batteries.

Unique challenge presented by location

- No “on-island” disposal options
- Shipping DDR Batteries not accepted by shipper
- Limited equipment on-island

Disposal (Recycling) challenges

- Develop the process for identification of battery chemistries
- Processing batteries to maintain recycling viability
- Shipping batteries in a way facility can receive

PRESENTATION OF DDR IN THE FIELD

Primary Sources:

- Battery Energy Storage Systems (Powerwalls)
- Electric Vehicles (Cars, go-carts, golf carts)

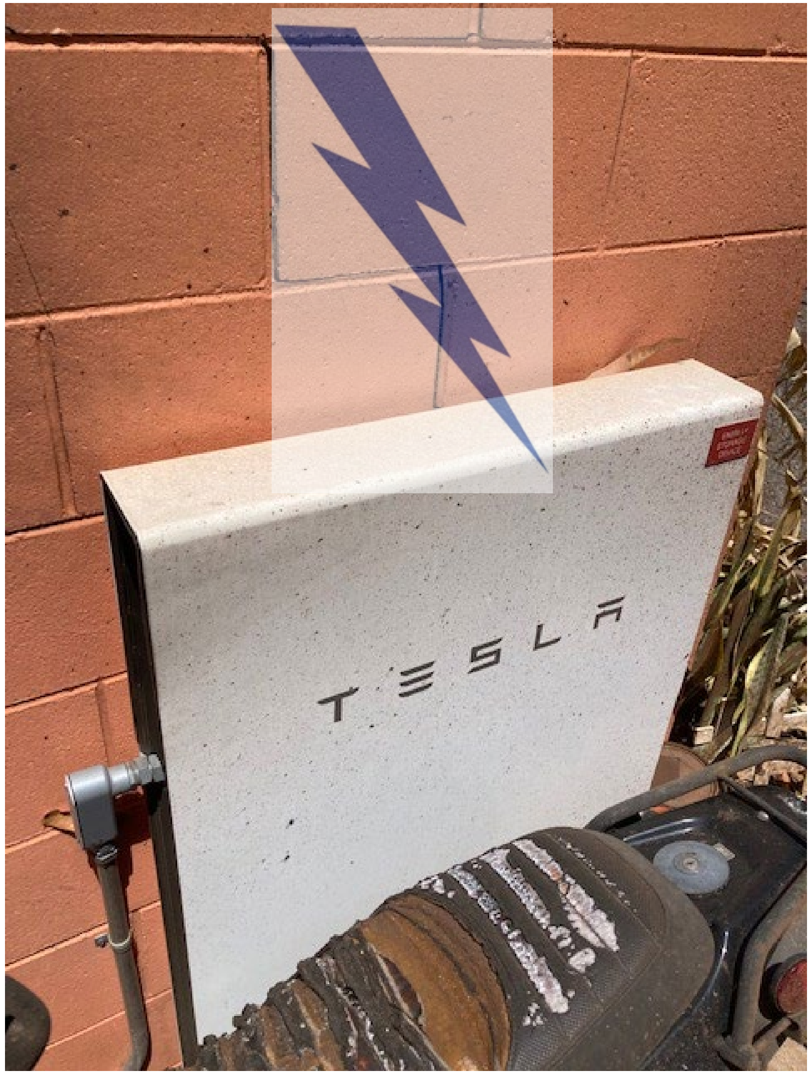
Secondary Sources:

- Limited mobility devices (bikes, scooters)
- Power tools
- Computers

Trained assessment teams to identify

Developed a collection, transport, and processing technique

"POWERWALLS" (RESIDENTIAL BESS)



ELECTRIC VEHICLES

To gain an understanding of battery type, important to know:

- Make
- Model
- Year
- Option

This was a luxury if available.

*No resources on-island for investigating battery health

*Limited or No Technical Reference Support From Manufacturers/Dealers

REMOVAL/RECOVERY OF "POWERWALLS" (RESIDENTIAL BESS)

REMOVAL/RECOVERY OF "POWERWALLS" (RESIDENTIAL BESS)

3-"Lau Lau"

Tyvek/FB

4-Buffalo Convoy

Relo-Staging

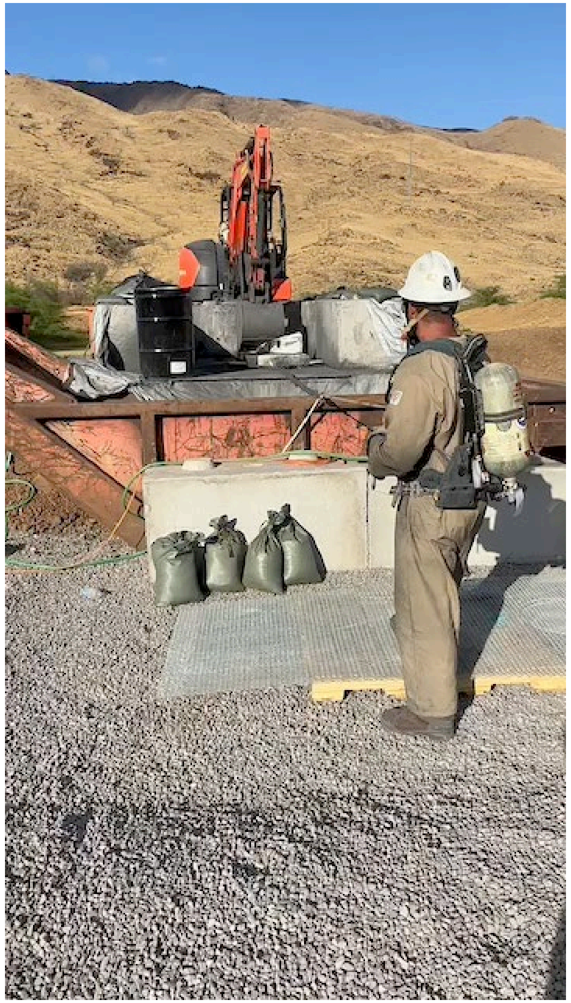
REMOVAL/RECOVERY OF BURNED ELECTRIC VEHICLE BATTERIES

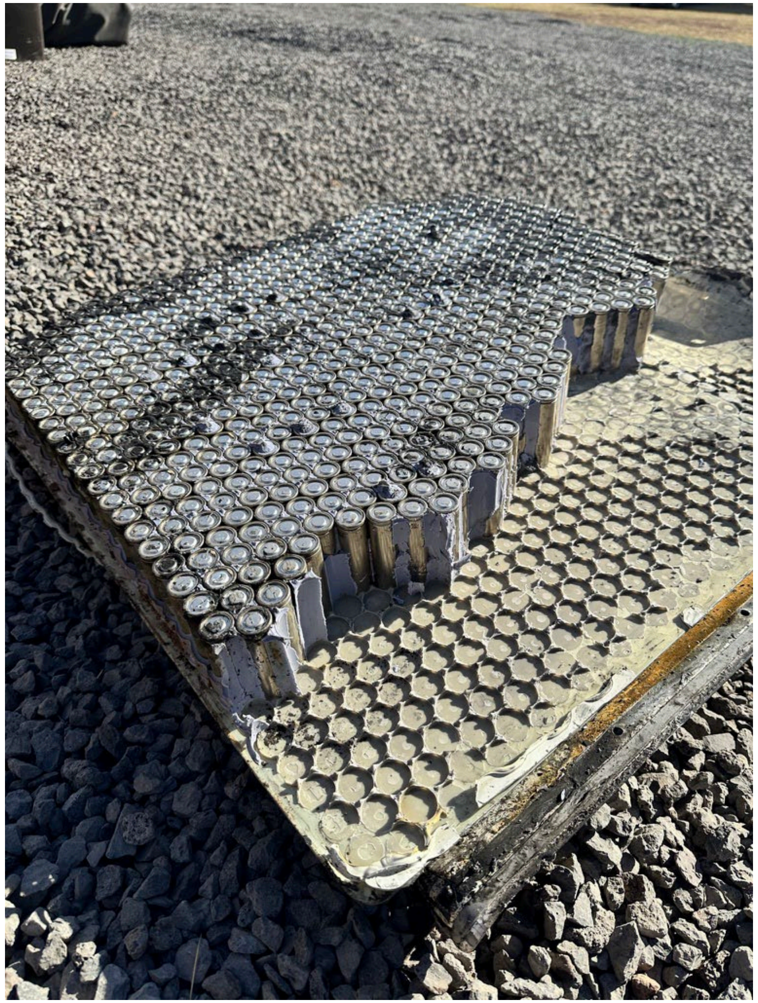
Electric Vehicle - Battery Removal Ops

EV-Battery Removal Ops/Processing

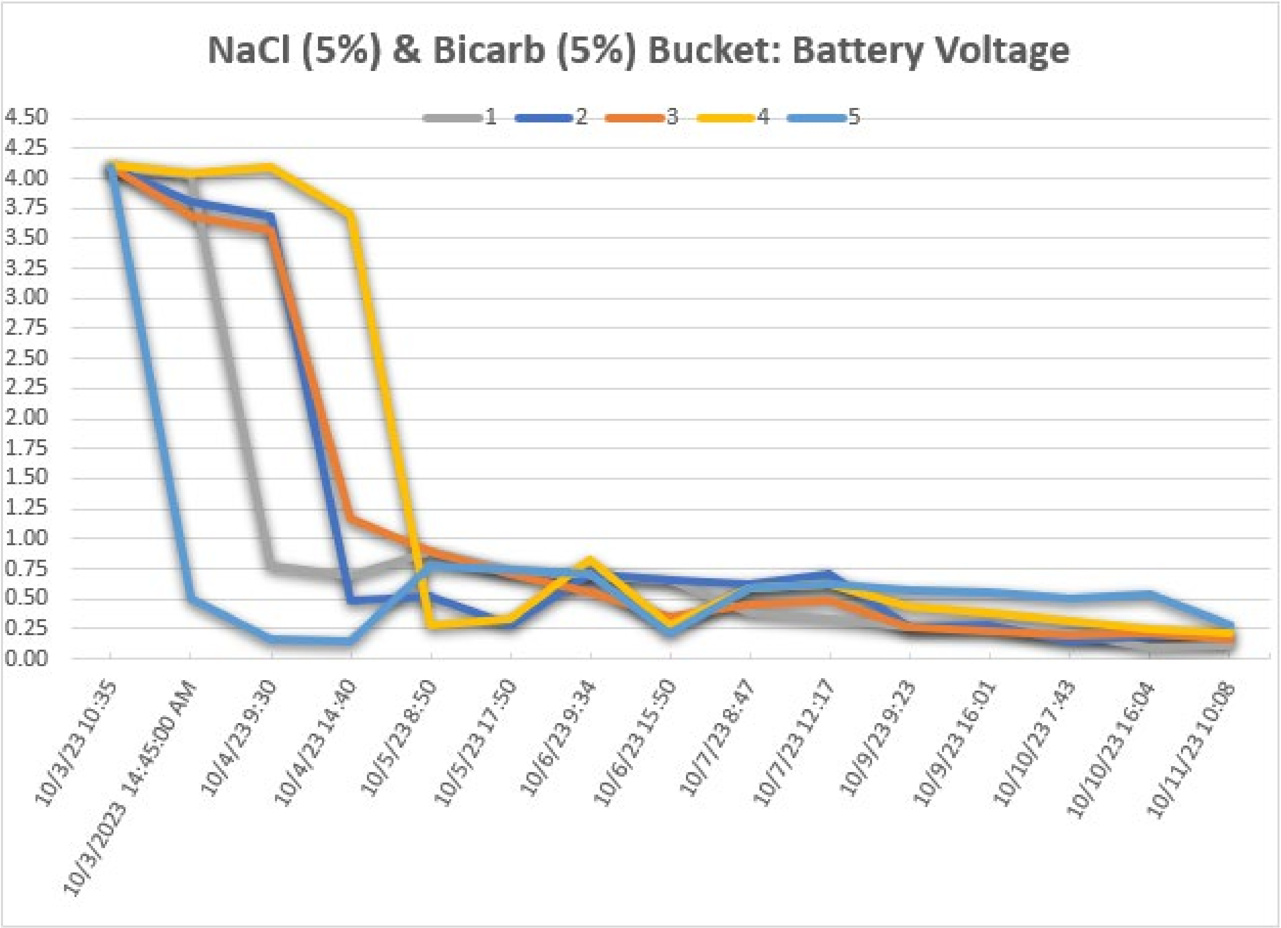
4-Harvest

BATTERY PROCESSING – DE-ENERGIZING





BATTERY PROCESSING – DE-ENERGIZING



Waste Determination and Transportation

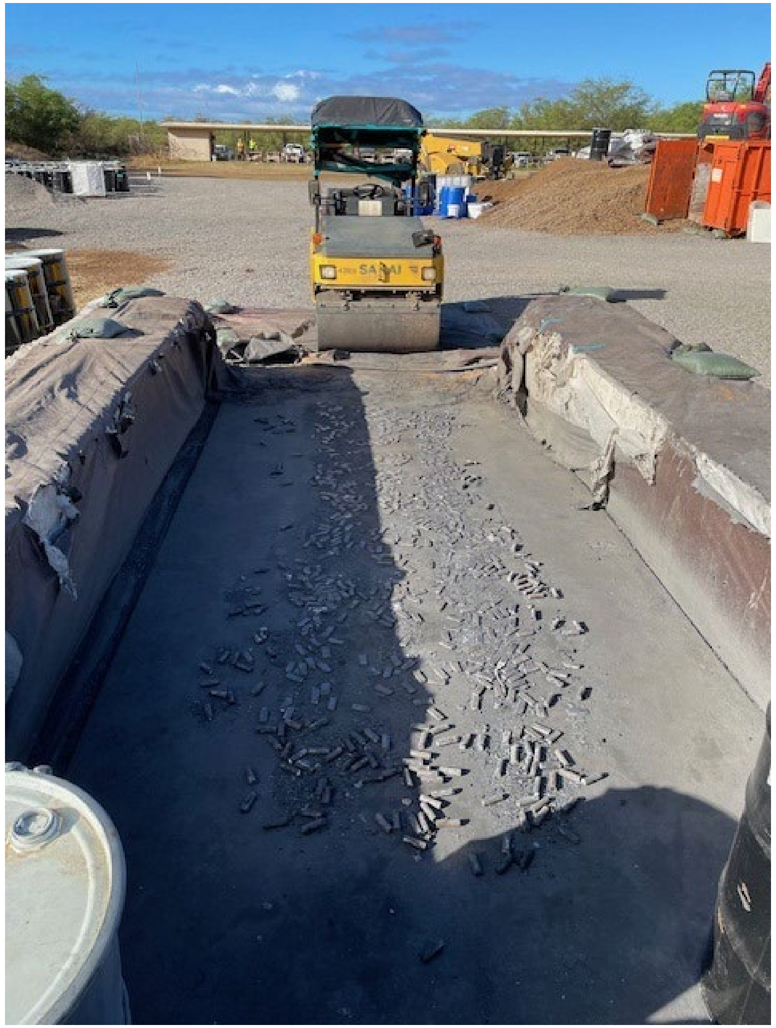
- Actions (Maui)
  - Crush/destroy/de-construct (No longer meets definitions)
    - 40 CFR 273.9

      Battery means a device consisting of one or more electrically connected electrochemical cells which is designed to receive, store, and deliver electric energy. An electrochemical cell is a system consisting of an anode, cathode, and an electrolyte, plus such connections (electrical and mechanical) as may be needed to allow the cell to deliver or receive electrical energy. The term battery also includes an intact, unbroken battery from which the electrolyte has been removed.

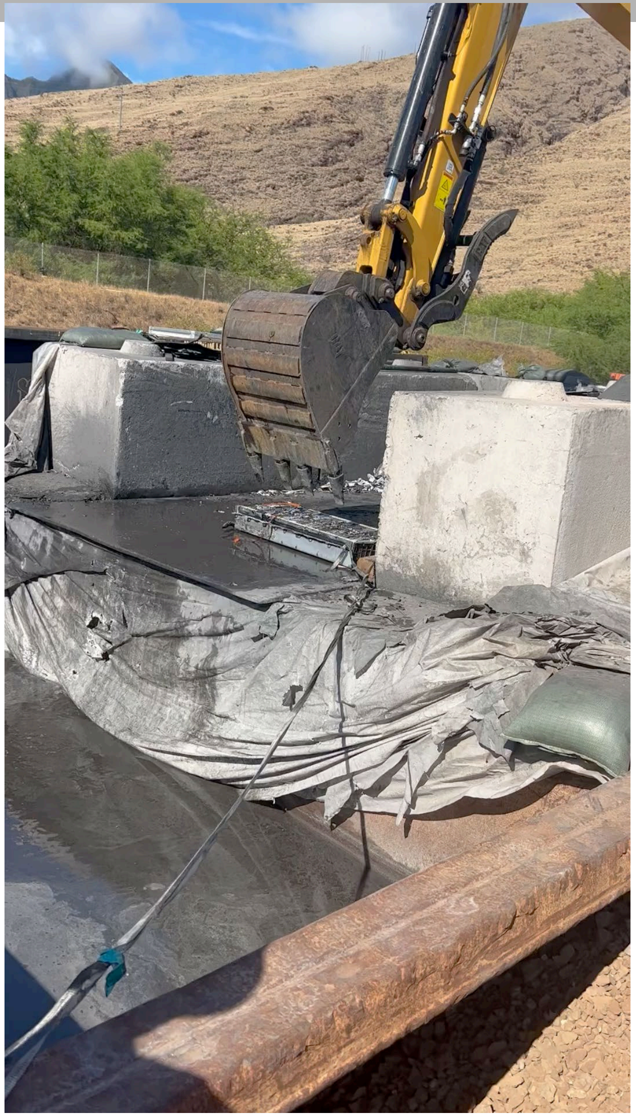
    - 49 CFR 171.8

      Lithium ion cell or battery means a rechargeable electrochemical cell or battery in which the positive and negative electrodes are both lithium compounds constructed with no metallic lithium in either electrode. A lithium ion polymer cell or battery that uses lithium ion chemistries, as described herein, is regulated as a lithium ion cell or battery.

BATTERY PROCESSING – CRUSHING



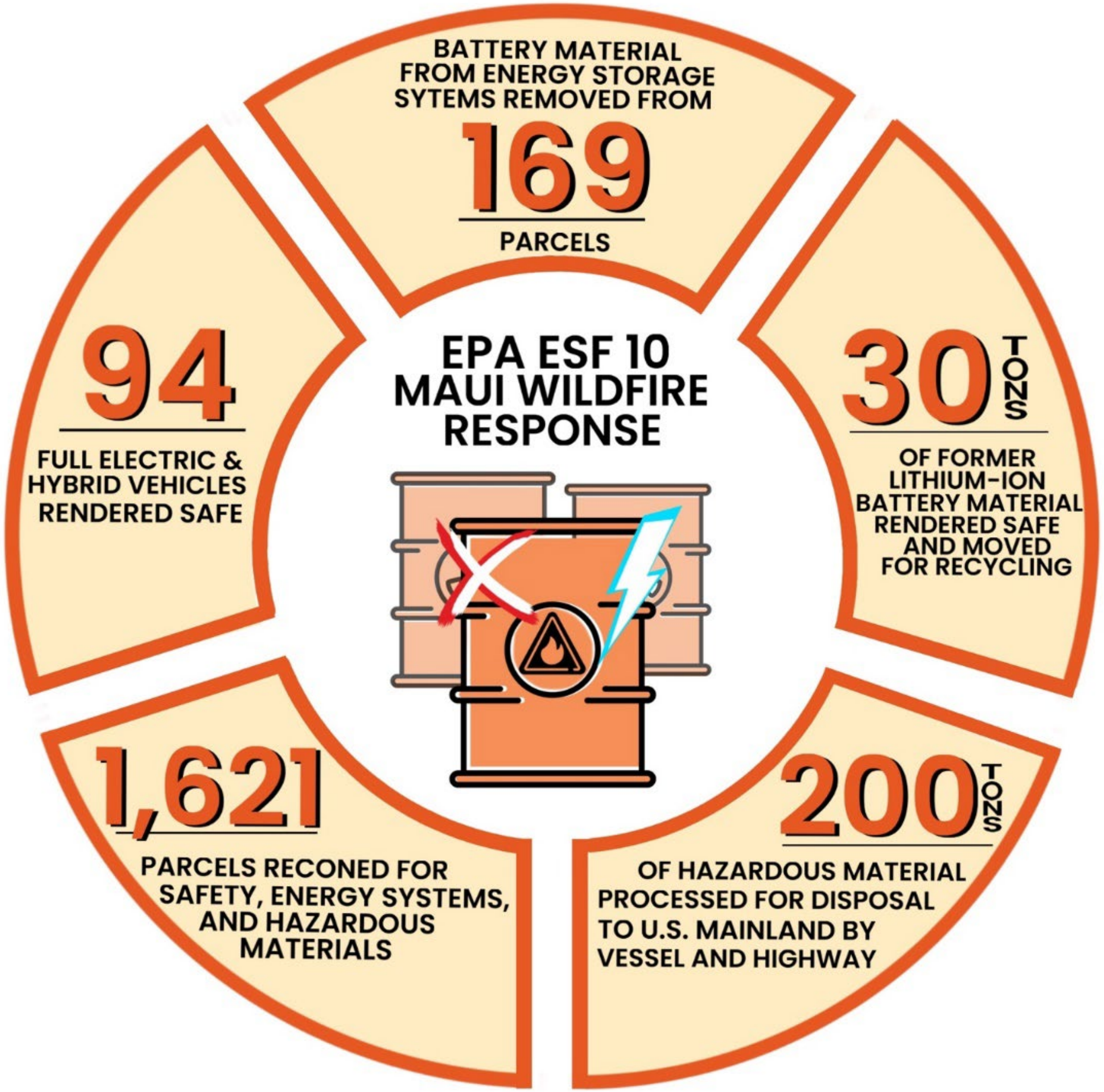
BATTERY PROCESSING



BATTERY PROCESSING – PACKAGING

Carrier to West Coast to Recycler

Waste Determination and Transportation



Helpful Links

- response.epa.gov/R4LithiumIonBatteryOutreach
- https://www.phmsa.dot.gov/lithiumbatteries
- https://www.epa.gov/recycle/used-lithium-ion-batteries

Questions