



# Lithium-Ion Battery Case Study:

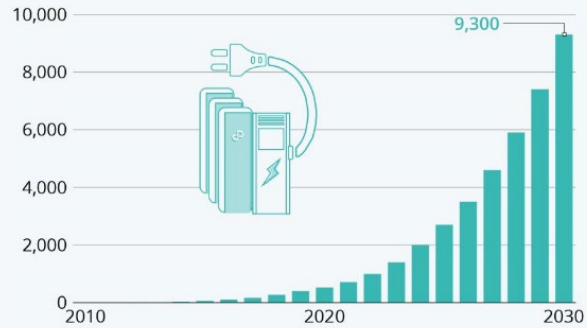
## 2025 SoCal Wildfires



June 2025 – RRT2 Meeting

## High Demand for Lithium-Ion Batteries

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

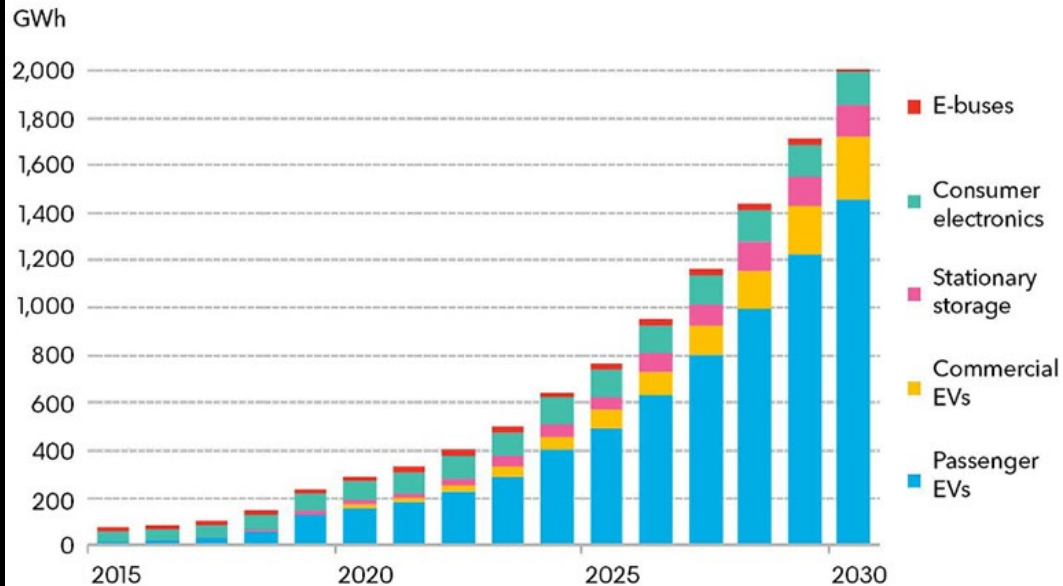


Source: Bloomberg

# Trends in Li-Ion Batteries

- Demand is increasing
- Energy density of batteries is increasing
  - Thermal runaway severity increases
- Production increasing
- Cost per kilowatt hour decreasing
- Products reaching “end of life” increasing

## Annual lithium-ion battery demand



2018

> 4 million



> 77 GWH



2028

50 to 200 million

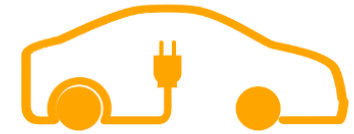


250 to 1100 GWH



2040

up to 900 million

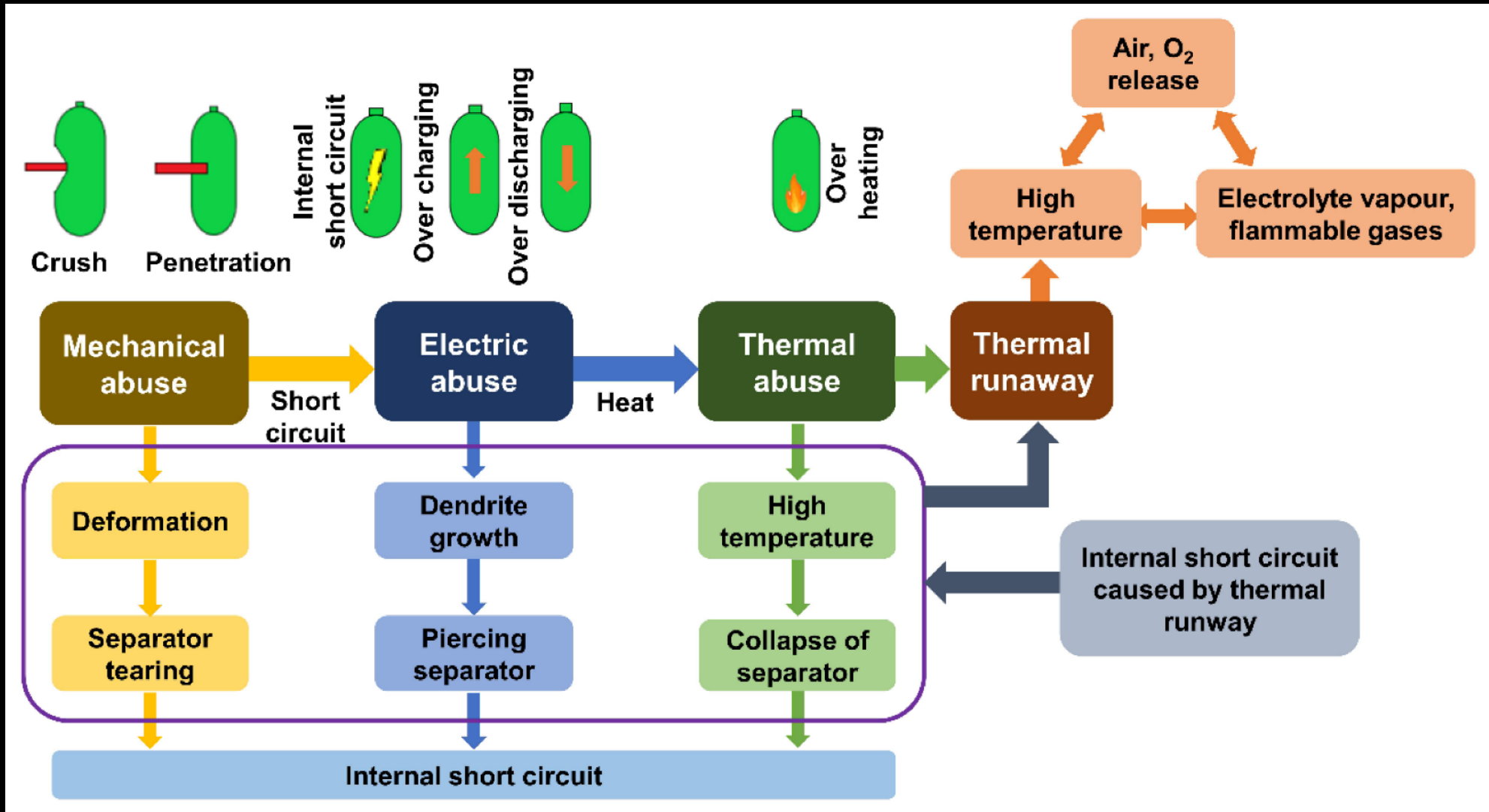


600 to 4000 GWH



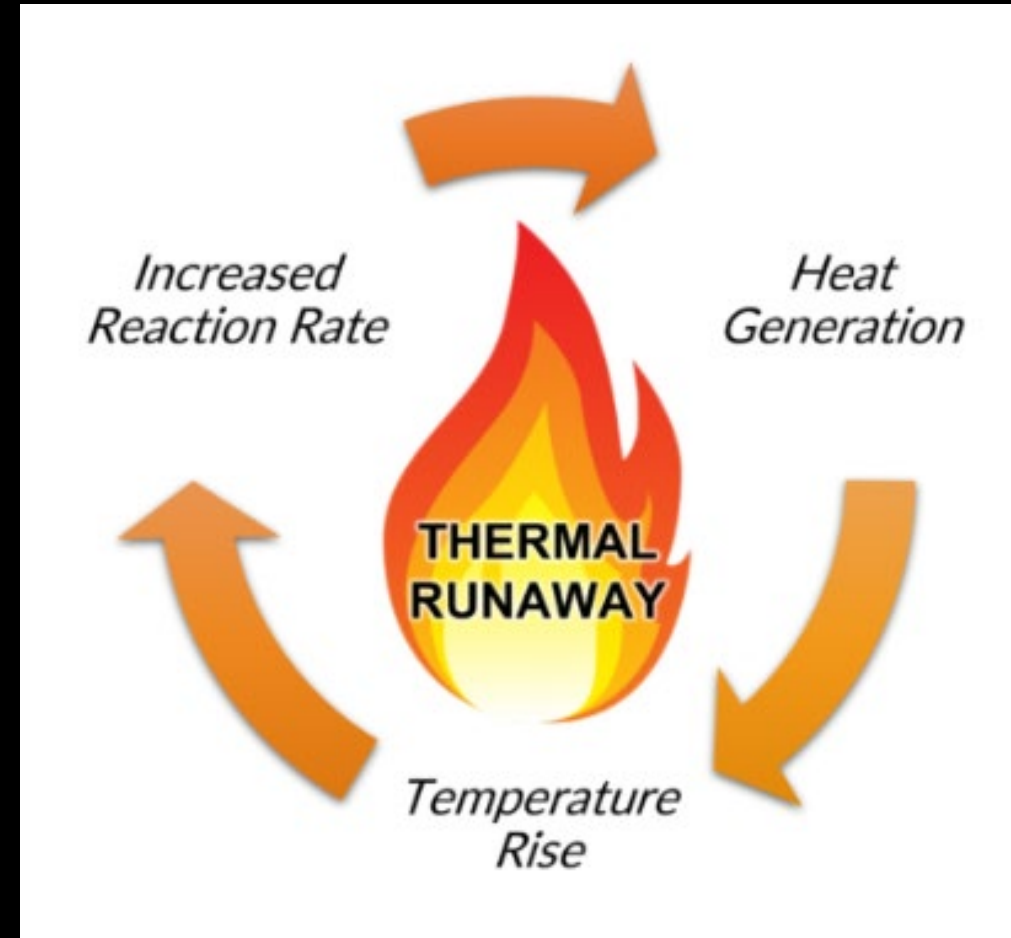


# Why do batteries fail?



# Characteristics of Li-Ion Fires

- Very toxic atmospheres – H, HF, HCN, CO, heavy metals
- Burn temperatures are higher than normal - >2,000°F
- Battery fires can burn without Oxygen – can't smother!
- Explosive potential – Hydrogen Gas
- Thermal Runaway reaction
  - Chemical reaction – rapid degradation
  - Does not require Oxygen
  - Nearly impossible to stop once it starts
  - Rapid event that can propagate to other cells
- Re-ignition is common and cannot be predicted – can happen minutes, hours, days, weeks, months later







## 2023 Maui Wildfires Recap



- First FEMA Mission Assignment for LIB
- Li-ion batteries are unpredictable
- Concerns over safety of personnel and public
- Little to no on-island resources for managing DDR/waste
- Shipping via DDR is cost prohibitive and limited by shipping co.
- Shipping Co. do not like DDRs
- Processing in the field was only option
- How to take DDR Batteries to “Not Batteries”
- Disposal (Recycling)
- Education





# Lithium-Ion Battery Case Study:

## 2025 SoCal Wildfires



June 2025 – RRT2 Meeting





## Legal Disclaimer

The information provided herein is intended for informational purposes only and should not be construed as legal advice, relied upon nor as establishing a professional or contractual relationship with any participants. The actions carried out by the U.S. Environmental Protection Agency (EPA), its contractors, and support staff during Maui and/or SoCal Wildfire Responses were based solely on the knowledge, data, and information available at the time. It is important to note that, during these responses, the behavior of lithium-ion batteries in wildfire scenarios was not fully understood, and any interpretations or conclusions drawn from subsequent analysis may differ from those applied at the time.

The EPA, its contractors, and support staff acknowledge that lessons learned from past responses, emergent data, and evolving regulatory frameworks may inform future actions and decisions related to disaster response efforts. As such, individuals and entities are advised to consult other relevant sources and experts for current information and guidance regarding environmental safety and emergency response protocols. The EPA and presenters of these Case Studies disclaim any liability for actions taken or decisions made based on the information provided herein.



# EPA Mission Stafford Act Response

Palisades Fire

Pacific Palisades

**973**

Structures Damaged  
Residential,  
Commercial and  
Other

**6,837**

Structures Destroyed  
Residential,  
Commercial and  
Other

**12**

Confirmed  
Civilian Fatalities

**3**

Confirmed  
Civilian Injuries

**1**

Confirmed  
Firefighter Injuries

**1,074**

Structures Damaged  
Residential, Commercial and  
Other

**9,414**

Structures Destroyed  
Residential, Commercial and  
Other

**17**

Confirmed Civilian  
Fatalities

**9**

Confirmed Firefighter  
Injuries

Altadena

Eaton Fire

- On January 7, 2025, a fire started in the Pacific Palisades region of Los Angeles.
- Fires quickly spread across multiple areas of the city. More than 57,000 acres of land were devastated (89 square miles).
- Over 200,000 people were evacuated.
- More than 18,000 structures were damaged or destroyed.





# Battery Operations Roadmap

- Battery Identification
- Data Management
- Field Operations
  - Electric Vehicles
  - Energy Storage Systems
  - Other Arrays
- Battery Processing
- Battery Termination
- Disposal





# Reconnaissance

## Los Angeles Wildfires

### Lithium-ion batteries burned by wildfires

The U.S. Environmental Protection Agency (EPA) has been assigned by the Federal Emergency Management Agency (FEMA) to remove lithium-ion batteries affected by the Los Angeles County wildfires.



#### This includes battery:

- recovery
- safe transportation
- processing (de-energizing)
- safe disposal



**Use extreme caution when returning to your property**



Your home may have damaged or destroyed lithium-ion batteries, lithium-ion battery energy storage systems, and electric and hybrid vehicles.

- ✓ **The batteries should be considered extremely dangerous**, even if they look intact.
- ✓ **Lithium-ion batteries can spontaneously re-ignite, explode, and emit toxic gases and particulates even after the fire is out.**

#### Household Items with Lithium-Ion Batteries:



#### Other examples:

- |                            |                               |                  |
|----------------------------|-------------------------------|------------------|
| • Electric/hybrid vehicles | • Home alarms                 | • Scooters       |
| • Electric bikes           | • Power banks or stations     | • Drones         |
| • Hoverboards              | • Game controllers            | • Tablets        |
| • Wheelchairs              | • Home energy storage systems | • Power tools    |
| • Digital cameras          | • Personal mobility device    | • Vaping devices |

#### If you hear a popping, hissing noise, or see smoke or fire:

1. Do not attempt to extinguish or smother the battery.
2. Leave the area immediately.
3. Move upwind at least 330 ft (the length of a football field) and **call 911**.

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- **Do not** touch fire-damaged products with lithium-ion batteries – they can ignite.
- **Do not** start, move, tow, or charge a fire-damaged electric/hybrid vehicles (EV, PHEV, HEV). These will be assessed by EPA hazardous material professionals.
- **Do not** use or start a fire-damaged residential energy storage or house battery. These will be assessed by EPA hazardous material professionals.
- **Do not** enter enclosed spaces with lithium-ion battery products.
  - Gasses and vapors from damaged lithium-ion batteries can build up in enclosed spaces (such as a garage, shed, basement, or closet) and may produce an explosive environment.

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- **DO** call our hotline if you encounter a lithium-ion battery while re-entering your property and/or are unsure if a lithium-ion battery was damaged.



[epa.gov/california-wildfires](https://epa.gov/california-wildfires)

For questions about this work or if you have an electric or hybrid vehicle and/or a battery energy storage system in the burn zone, call the EPA hotline at:

**1-833-R9-USEPA**  
**(1-833-798-7372)**

## Preliminary ID

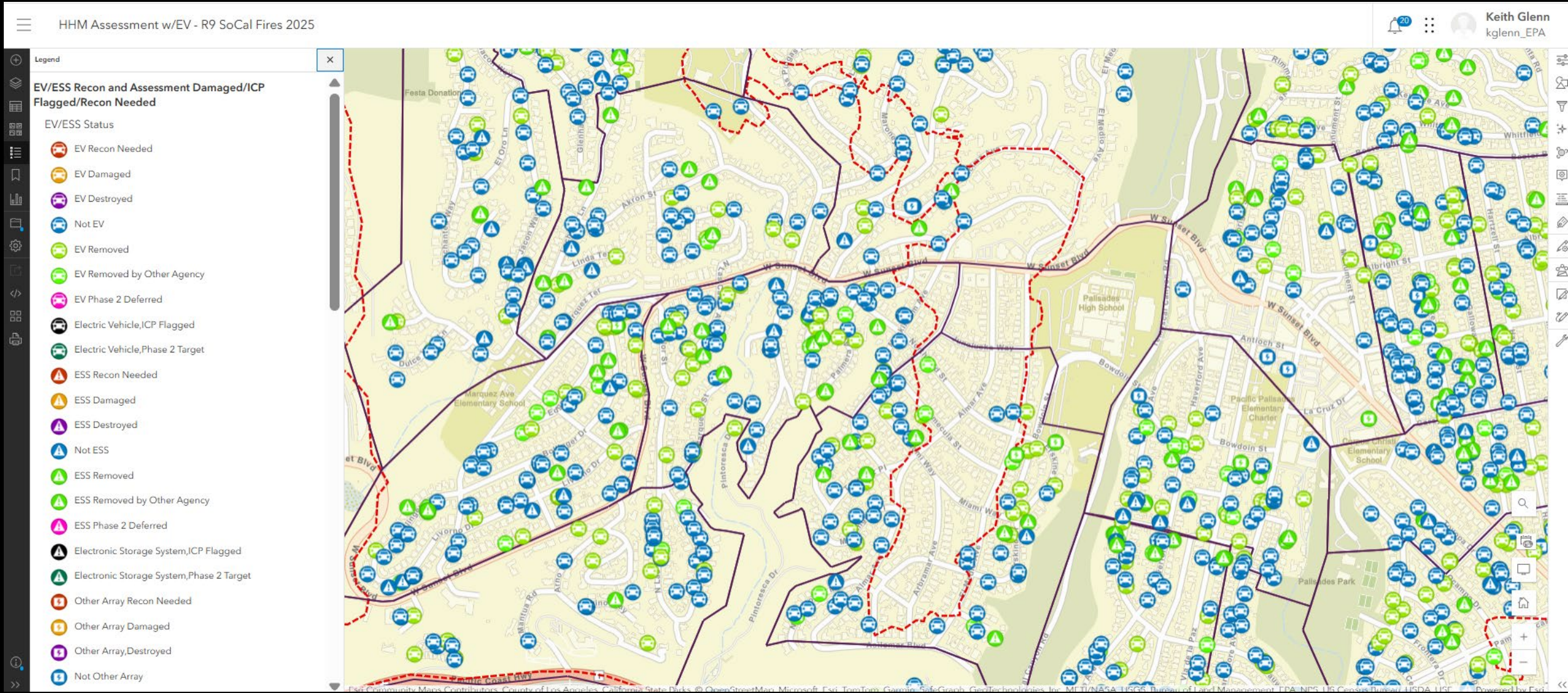
- SARCOPS (Search and Rescue)
- CUPA Teams (Certified Unified Program Agency) – LACoFD
- Recon Teams

## Other Identification Routes

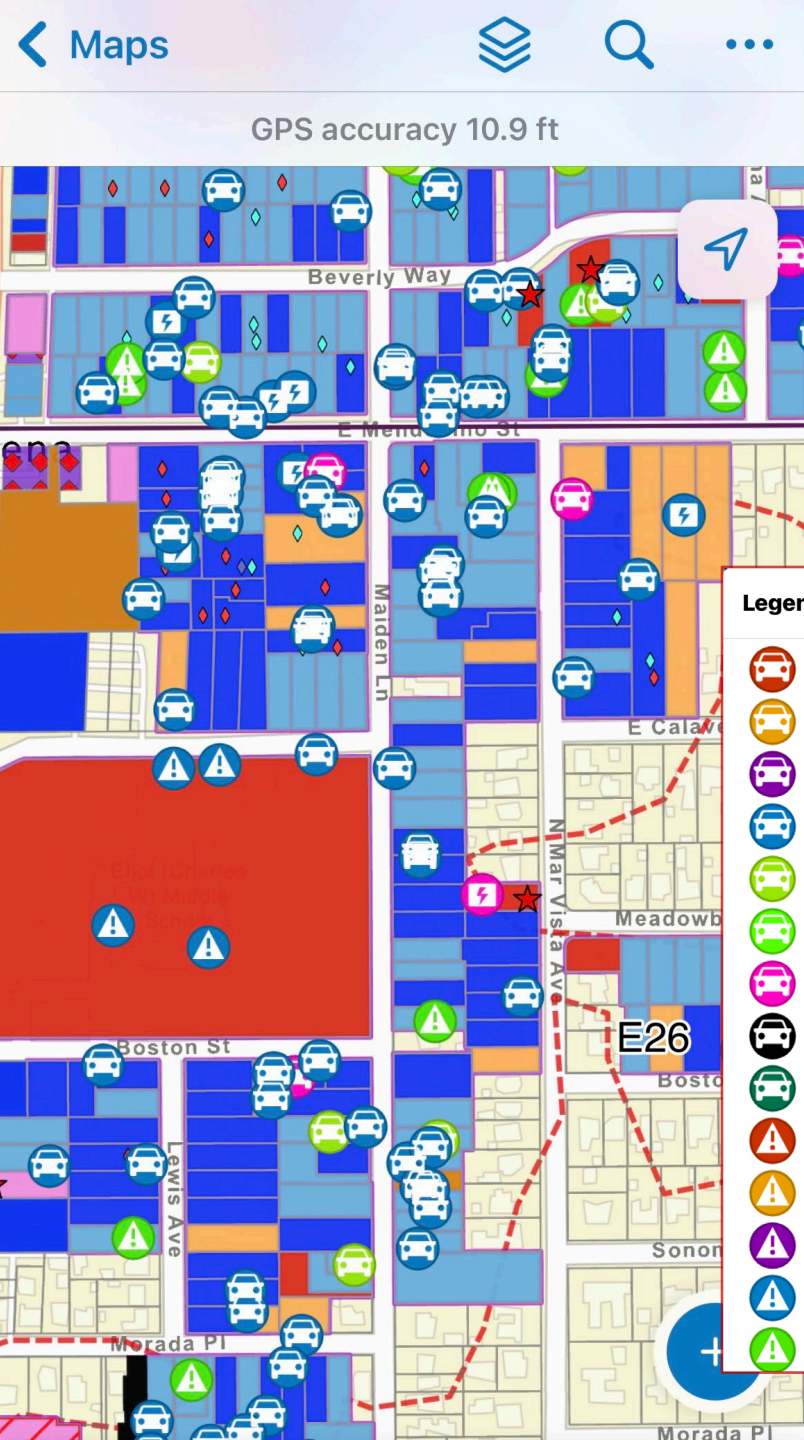
- HHM Referrals
- Local Permits
- EPA Hotline
- Information Requests/SCE – Tesla, Enphase
- Phase II/Army Corps



# Reconnaissance







# Data Management

- All vehicles identified and loaded into mapping system
- EV/Non-EV
- Make/model/year when identifiable
- Photos
- Safety concerns
- Other notes from recon teams



# Battery Recovery Teams

## Teams

- EPA OSC
- Technical Contractor (Air monitoring/Data management)
- Equipment Operator
- 5-6 Hazmat Technicians
- Electrician
- (opt.) LACoFD H&S Officer

## Equipment

- Mini-excavator
- Water buffalo
- Extrication tools
- Hand tools

## H&S

- FR Tyvek, Respirator with combination acid-gas cart., Steel toe/steel shank boots, hard hat, safety glasses
- 75'/330' evac radii





# Battery Recovery - EV





# Battery Recovery - EV





# Battery Recovery - EV





# Battery Recovery - EV





# Battery Recovery - ESS





# Battery Recovery - ESS

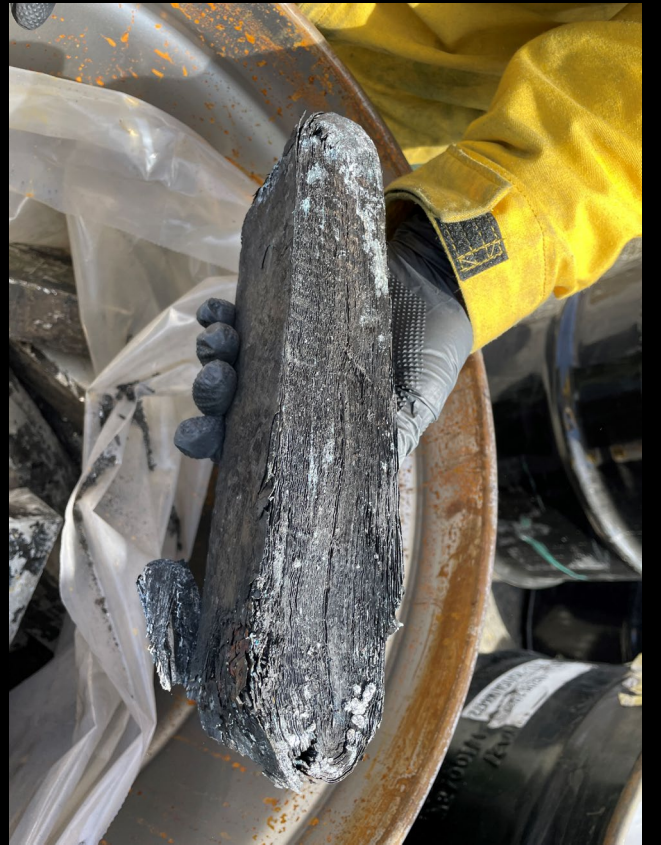




# Battery Recovery - ESS











# Battery Recovery – Partially & Undamaged

Primary Hazards:

Thermal Runaway

Offgassing

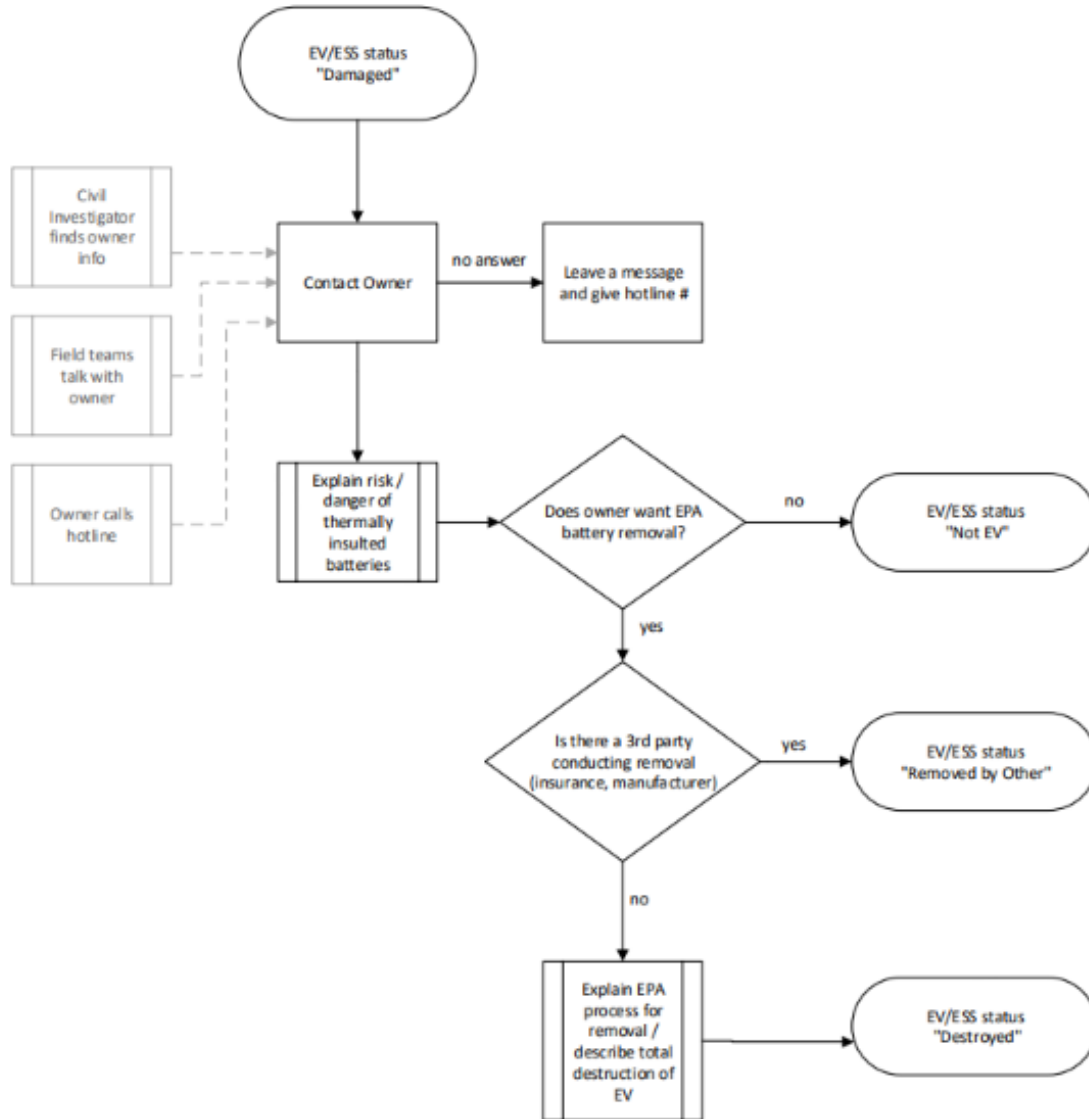
60°C (140°F) – Temperature exposure level where we begin to see thermal impact to batteries

EPA developed an adjudication process to work with residents and determine who would be handling units that were only slightly damaged in the fire (EPA, DOT, insurance, other)





# Battery Recovery – Partially & Undamaged Adjudication Process



Use of Civil Investigators

Work with local authorities

Contact Owner

Explain hazards

Make a determination

Data Management input / Documentation



# Battery Recovery – Partially & Undamaged





# Battery Recovery – Partially & Undamaged





# Electric Vehicle Response Resources



The screenshot shows the NFPA website's "EMERGENCY RESPONSE GUIDES" section. At the top is the NFPA logo and a search bar. Below the logo is a navigation menu with links: "About NFPA", "For Professionals", "Education and Research", "News and Articles", "Membership", and "Events". The main heading "EMERGENCY RESPONSE GUIDES" is displayed over a background image of an electric vehicle charging cable. Below this, a paragraph states: "NFPA actively maintains a collection of Emergency Response Guides from alternative fuel vehicle manufacturers. These guides are free to download." A "REFINE BY" sidebar on the left lists vehicle manufacturers with checkboxes: Acura (1), Alfa Romeo Tonale (1), Audi (1), Autocar (1), Automobili Pininfarina (1), Azure Dynamics (1), Battle Motors (1), and Bentley (1). A "+ Show more" link is at the bottom of the list. The main content area shows "Results 1-12 of 79" and a "Sort by: Title Ascending" dropdown. Below this, three vehicle logos are displayed: Acura, Alfa Romeo Tonale, and Audi. Each logo is accompanied by the text "TOPICS: EMERGENCY RESPONSE" and the specific guide title: "Acura Emergency Response", "Alfa Romeo Tonale", and "Audi Emergency Response".

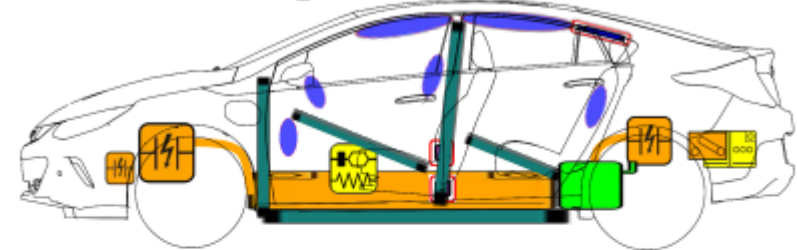
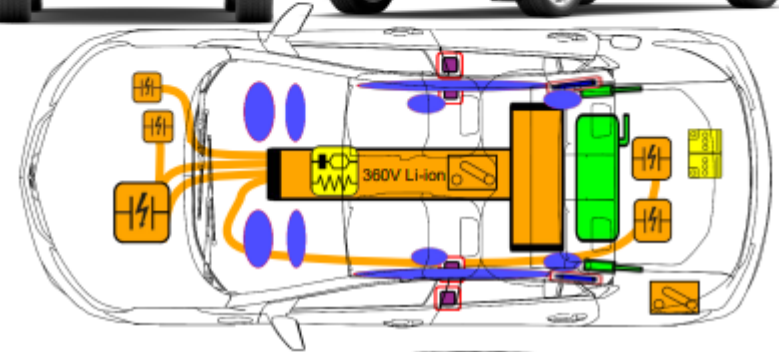
The screenshot shows the "EV Rescue" mobile app interface. At the top, the status bar shows "TELUS Wi-Fi", "10:20 AM", and "100%". The app title "EV Rescue" and a "[ VIN ]" placeholder are in the top green bar. Below the title is a section "Choose an Option" with four green buttons: "Passenger Cars Pickup Trucks Sport Utility Vehicles (SUV)", "Delivery Vans Trucks Buses Equipment", "Charging Stations Energy Storage Solar Panels", and "Electric Vehicle Incident Data Collection Form". The bottom navigation bar includes icons for "EV Rescue", "Notifications", "Share App", and "More".





Chevrolet Volt  
5 Door Hatchback  
2016

First Responder  
Rescue Sheet



	Air Bag		Stored Gas Inflator		Seat Belt Pretensioner		SRS Control Unit		
			Gas Strut/Preloaded Spring		High Strength Zone				
	Battery Low Voltage				Fuel Tank				
	High Voltage Battery Pack		High Voltage Power Cable		High Voltage Disconnect				Ultra Capacitor, High Voltage



# Battery Recovery – Partially & Undamaged





# Battery Recovery – Partially & Undamaged





# Battery Recovery – Partially & Undamaged



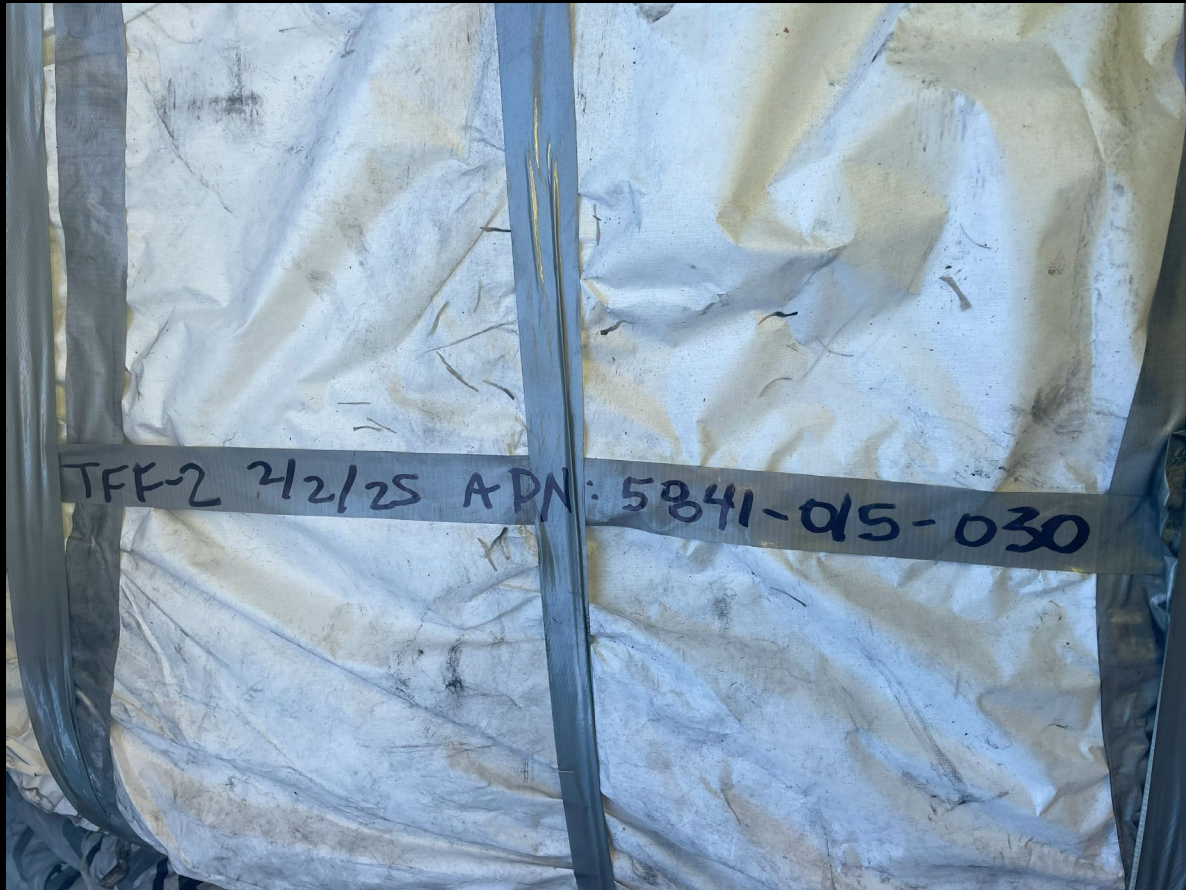


## Battery Recovery – Partially & Undamaged





# Battery Transport

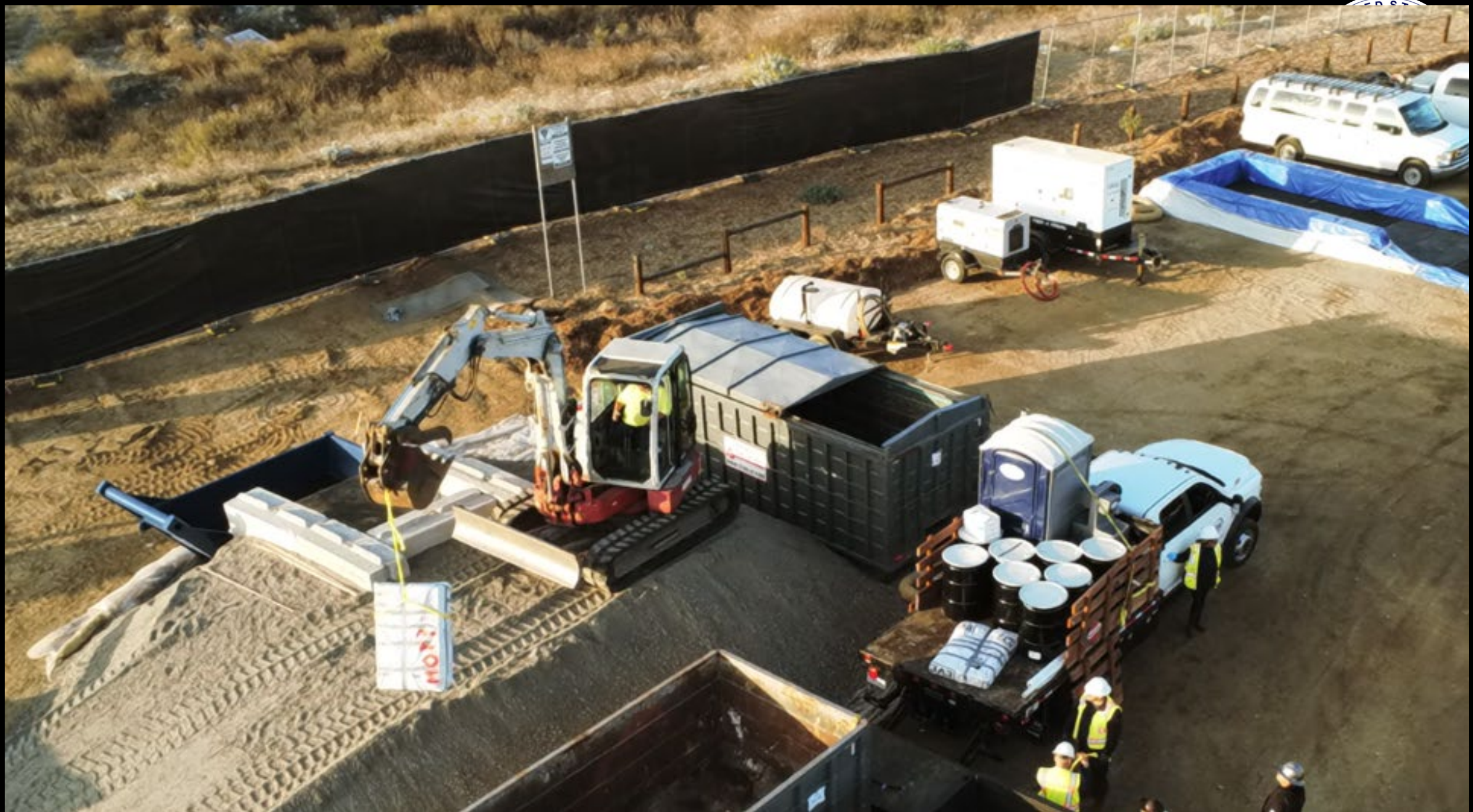




# Staging











# Battery Processing

## Types of Batteries

NiMH

Lithium Ion

Cylindrical

Prismatic

Pouch

## Processing

Brine Bath – Baking Soda and NaCl

Vibratory Roller

Shredder/Excavator







## Battery Processing - Brining





# Battery Processing – Smash Pad





## Battery Processing – Smash Pad





# Battery Processing - Crushing





## Battery Processing - Shredding





# Battery Processing - Shredding







## Final Product





# Disposal







# Disposal



Processed battery material is no longer considered Hazardous Waste

In Maui – sent via vented cubic yard boxes to a recycling facility

In CA – First attempt at bulk disposal using roll-offs.

- Air monitoring investigation determined that ventilation was necessary for transportation due to H<sub>2</sub> accumulation/LEL.
- Disposal through Clean Harbors to a facility in Utah.





# Health and Safety

## Primary Concerns

Electrocution

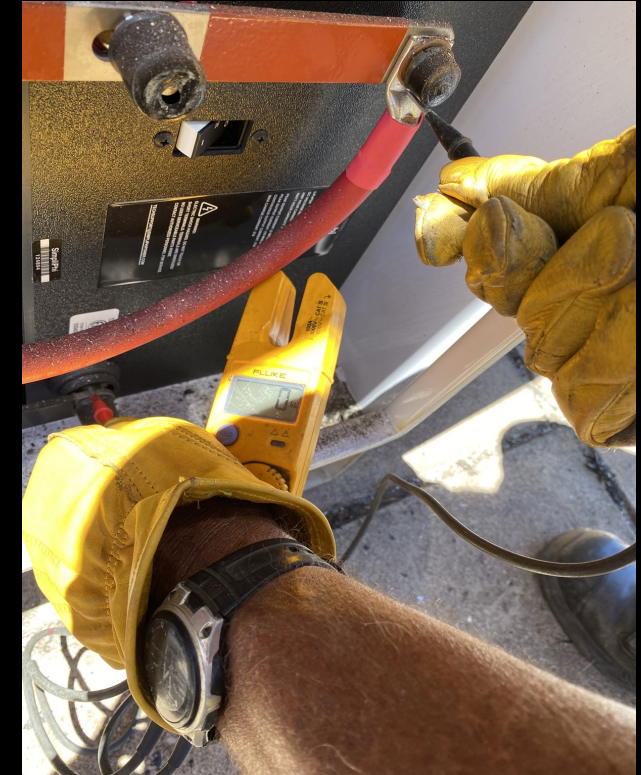
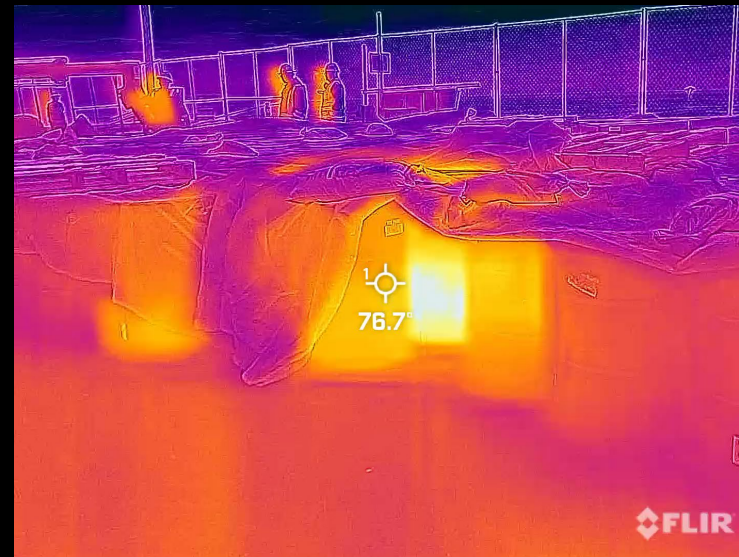
State of Charge

Projectiles, Fire, Explosions

Extraction in Field

Processing at Staging

Exposures







## Air Monitoring

Biggest concerns are  $H_2$  gas, HF, and metals. Respirators mandatory during battery processing operations.

- AreaRae
- Dustrak
- SPM Flex (HF – Mineral Acid)
- SPM Flex (HCN)

**\*\***  $H_2$  is cross-sensitive with CO, so standard suite of sensors were used and adjusted.







## Statistics

### SoCal vs. Maui Battery Processing

Increased quantity of recon/recovery teams & staging areas  
Larger staging/processing – frac tanks, equipment, smash pad  
More processing capacity  
Smaller footprint per staging area  
Use of shredders  
Better understanding of batteries; lessons learned from Maui  
Willingness to expand beyond our knowledge and try new methods



### Maui Wildfires

~1,200 properties  
~400 targets  
~98 vehicles & 150 ESS locations  
30 tons (est) batteries processed  
90-day timeframe  
Hundreds of personnel

### SoCal Wildfires

~18,000 properties  
>5,000 ESS & EV targets  
~645 vehicles & 420 ESS locations  
500 tons (est)  
28-day timeframe  
1,700 independent personnel



# Challenges

- Expedited timeline
- Obtaining personnel and resources
- Training personnel in batteries
- Not in my back yard (NIMBY)
- Topography
- Volume of material
- Separate geographical locations
- Natural disasters (landslides)

CALIFORNIA  
Heavy mudslides and flooding shut down PCH, sweep vehicle and firefighter into ocean





A satellite image of a tropical cyclone, showing a distinct eye and spiral cloud bands over a dark blue ocean. The image is partially obscured by a black text box in the top right corner.

# Opportunities for Concern

- Lack of regulations and guidance
- Energy and political initiatives
- Increase in EVs and energy storage systems
- Battery farming
- Weather pattern changes
- Disposal challenges & expense
- Points of recycling
- Education
- Challenges at local response level



# Multi-Agency Involvement

## Education

- Trainings
- Outreach
- TTX



## Large Disasters/Stafford Act

- Floods
- Fires
- Terrorism to network

## Sites

- Battery recycler
- Independent modifier/entrepreneur
- Repair shop
- BESS network
- Vape shop
- Transportation sector
- Battery farmer
- Accumulator
- Illegal dumping
- Ocean vessels



# Battery Energy Storage System (BESS)

**Residential**



**kWh**

**Commercial**



**kWh - MWh**

**Utility-Scale**



**MWh - GWh**



# Cargo ship carrying EVs catches fire off Alaska coast

● USA TODAY









2025-06-03 03:42:11

Channel10







## Resources

[www.epa.gov/california-wildfires](http://www.epa.gov/california-wildfires)

[response.epa.gov/R2LIBResources](http://response.epa.gov/R2LIBResources)

[response.epa.gov/R4LithiumIonBatteryOutreach](http://response.epa.gov/R4LithiumIonBatteryOutreach)

Future OSC LIB Guidance Document







## Questions?



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