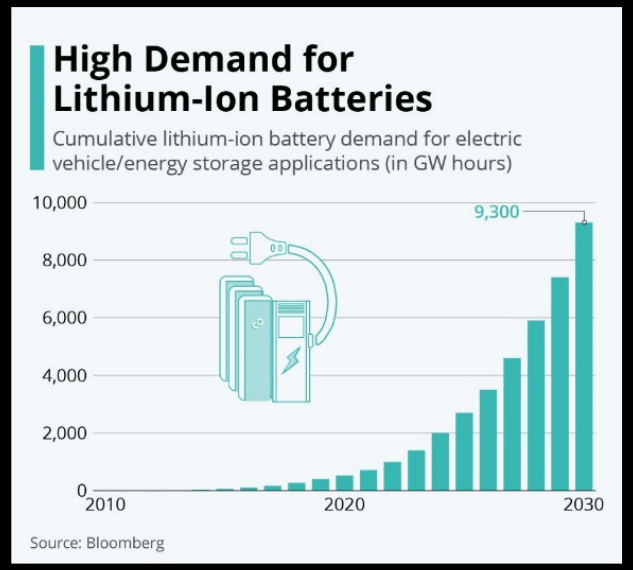
Lithium-Ion Battery Case Study:

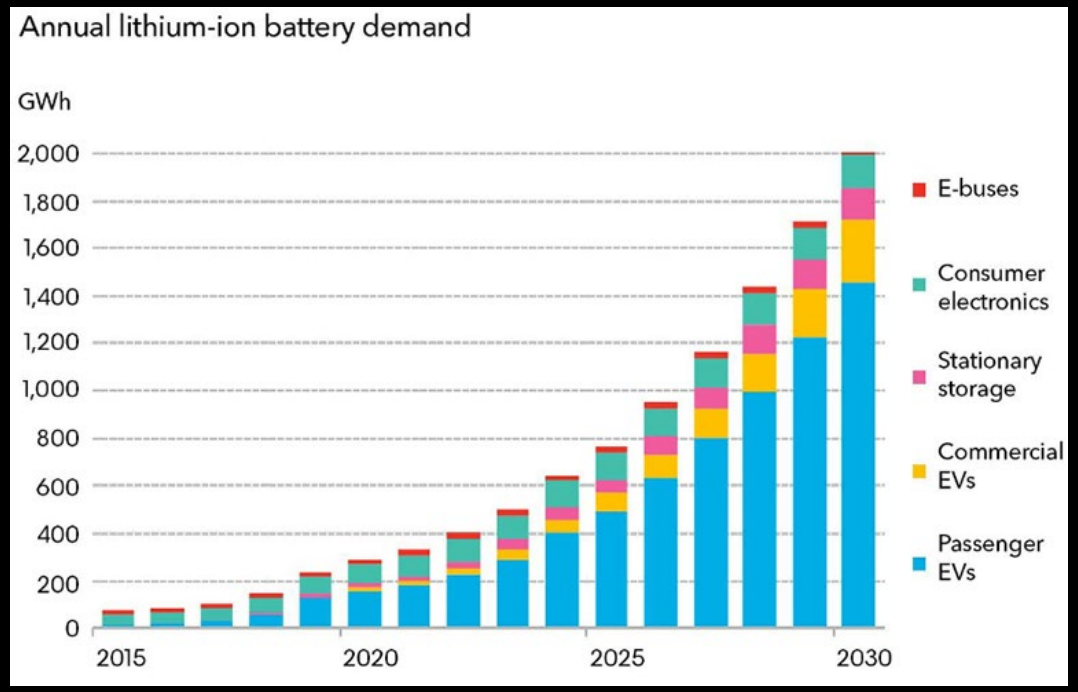
2025 SoCal Wildfires

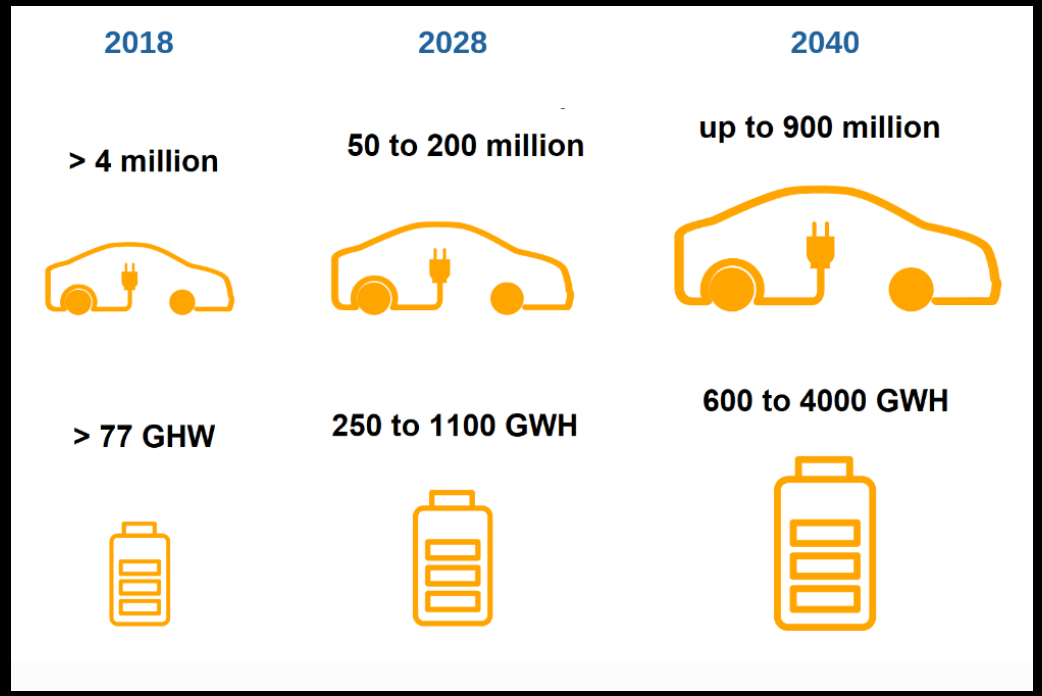
June 2025 – RRT2 Meeting

Trends in Li-Ion Batteries

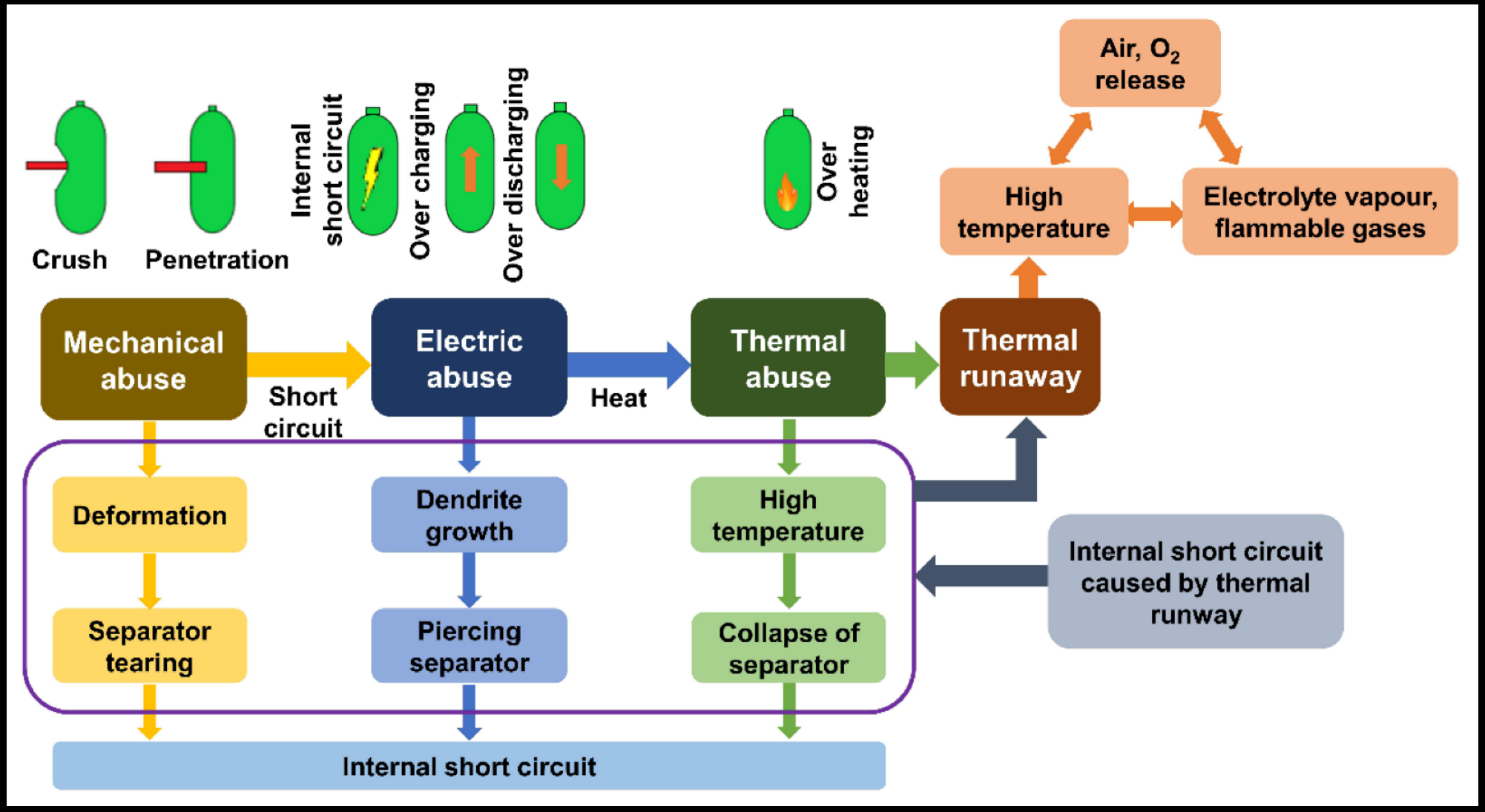


- Demand is increasing
- Energy density of batteries is increasing
  - Thermal runaway severity increases
- Production increasing
- Cost per kilowatt hour decreasing
- Products reaching “end of life” increasing



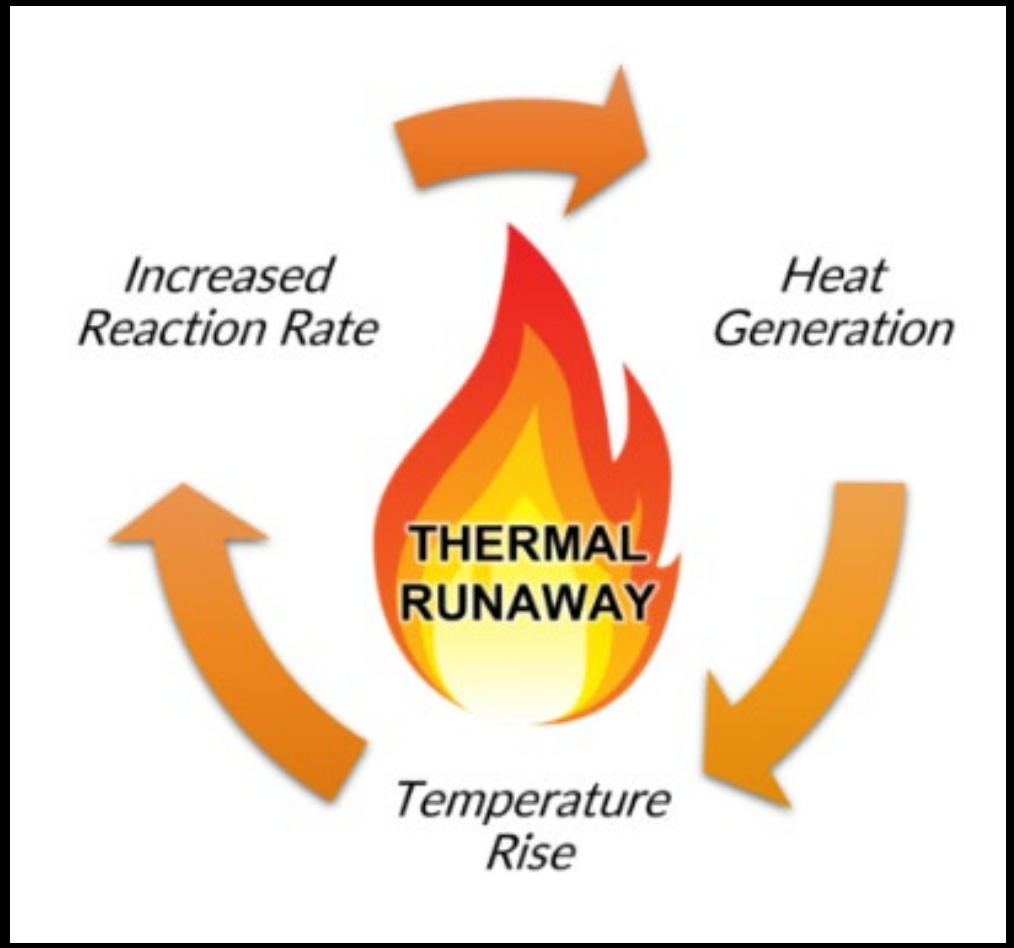


Why do batteries fail?



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

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Legal Disclaimer

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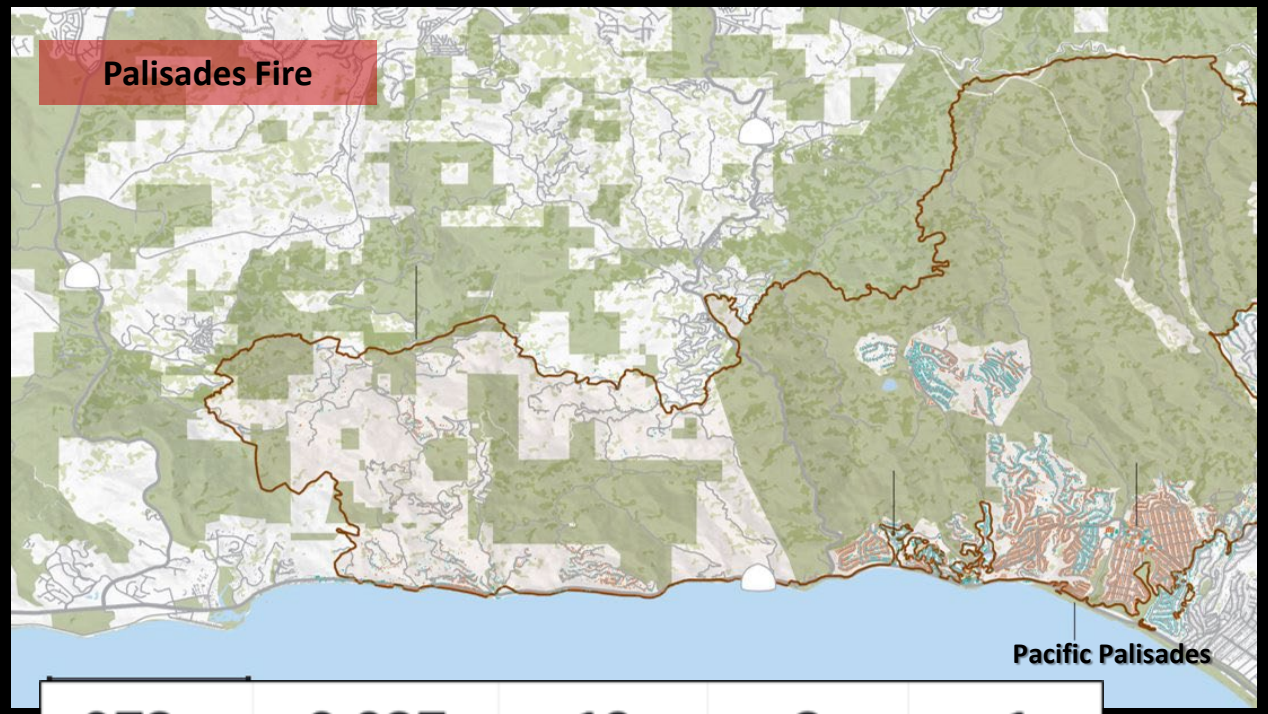
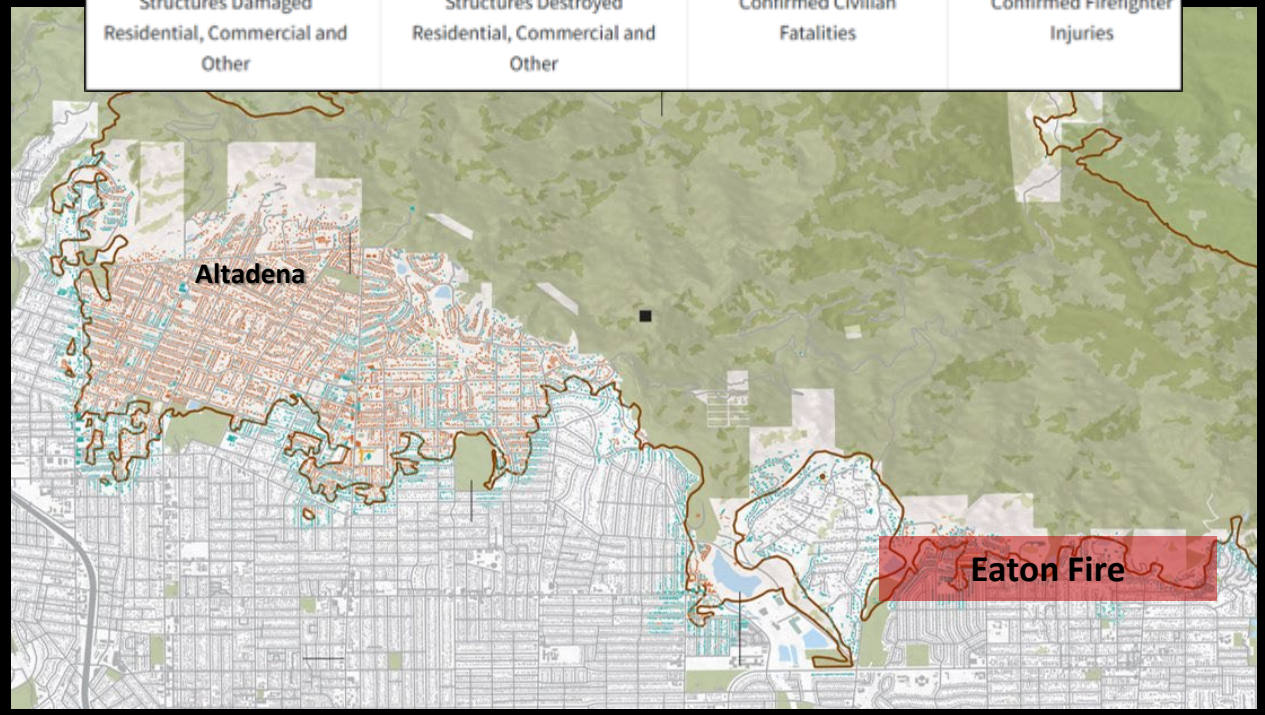
The EPA, its contractors, and support staff acknowledge that lessons learned from past responses, emergent data, and evolving regulatory frameworks may inform future actions and decisions related to disaster response efforts. As such, individuals and entities are advised to consult other relevant sources 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



973	6,837	12	3	1
Structures Damaged Residential, Commercial and Other	Structures Destroyed Residential, Commercial and Other	Confirmed Civilian Fatalities	Confirmed Civilian Injuries	Confirmed Firefighter Injuries

1,074	9,414	17	9
Structures Damaged Residential, Commercial and Other	Structures Destroyed Residential, Commercial and Other	Confirmed Civilian Fatalities	Confirmed Firefighter Injuries



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

January 25, 2025 *epa.gov/california-wildfires* *1-833-798-7372*

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**.

- **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.

- **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

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)

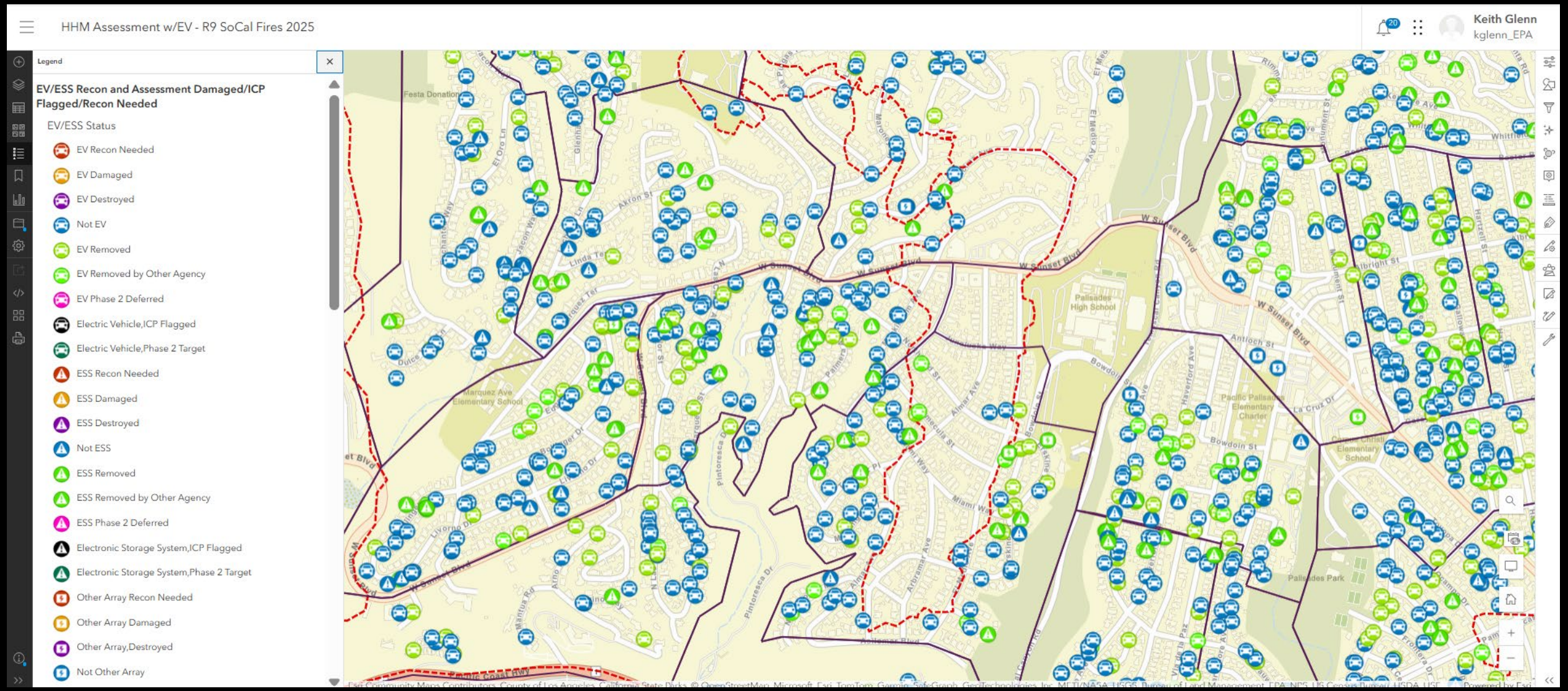
Preliminary ID

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

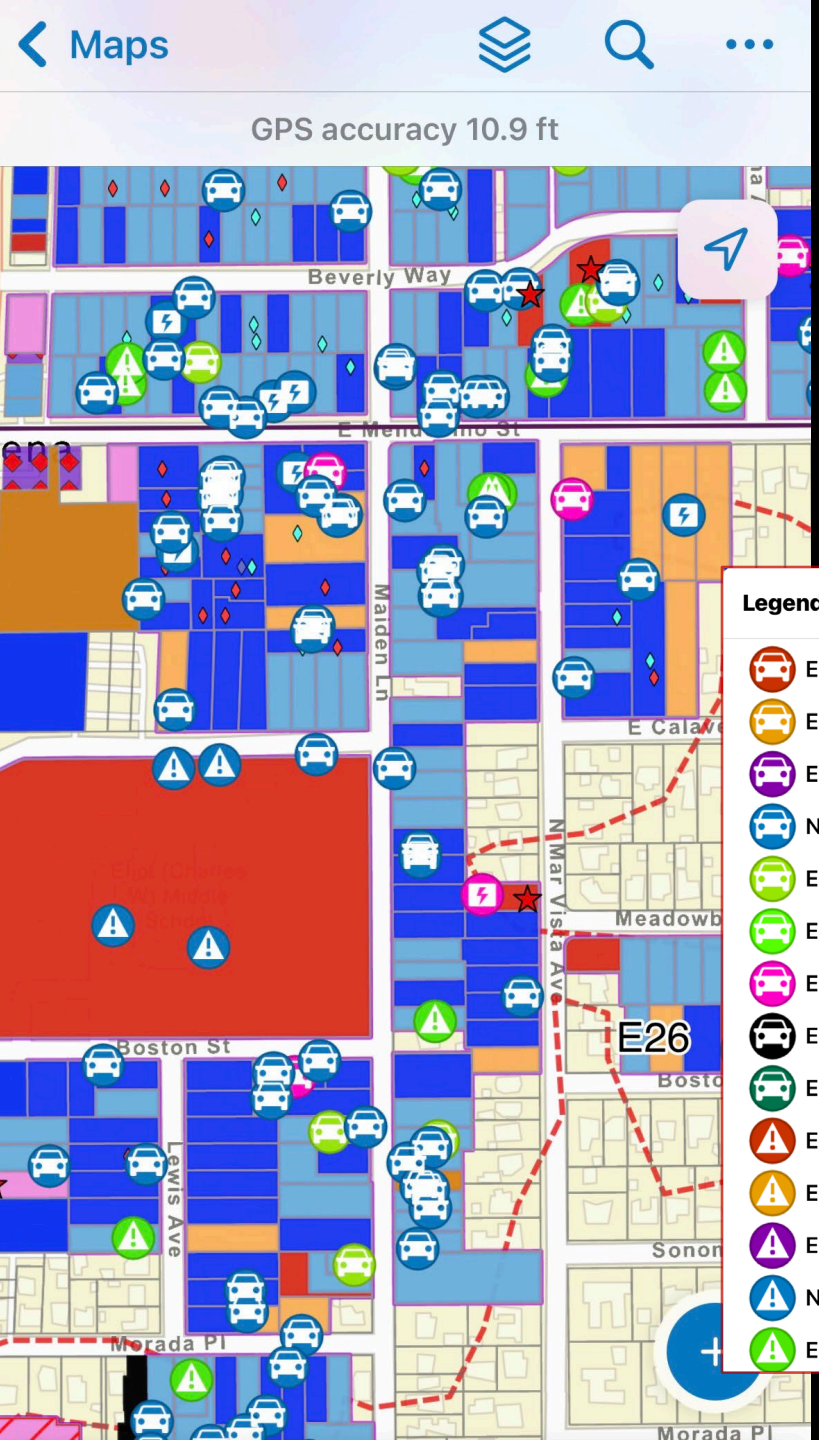
Other Identification Routes

- 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

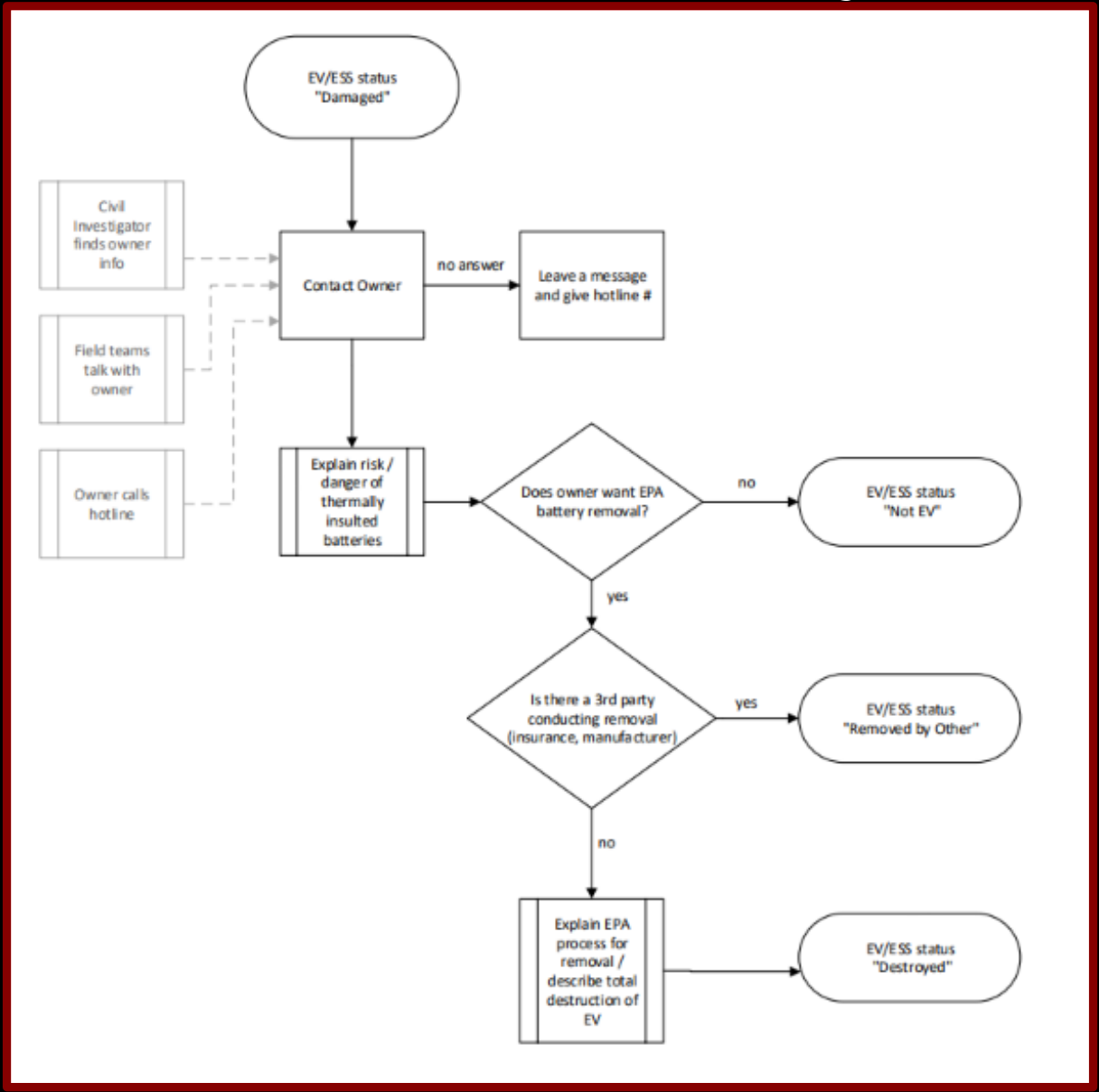
Primary Hazards:

- 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

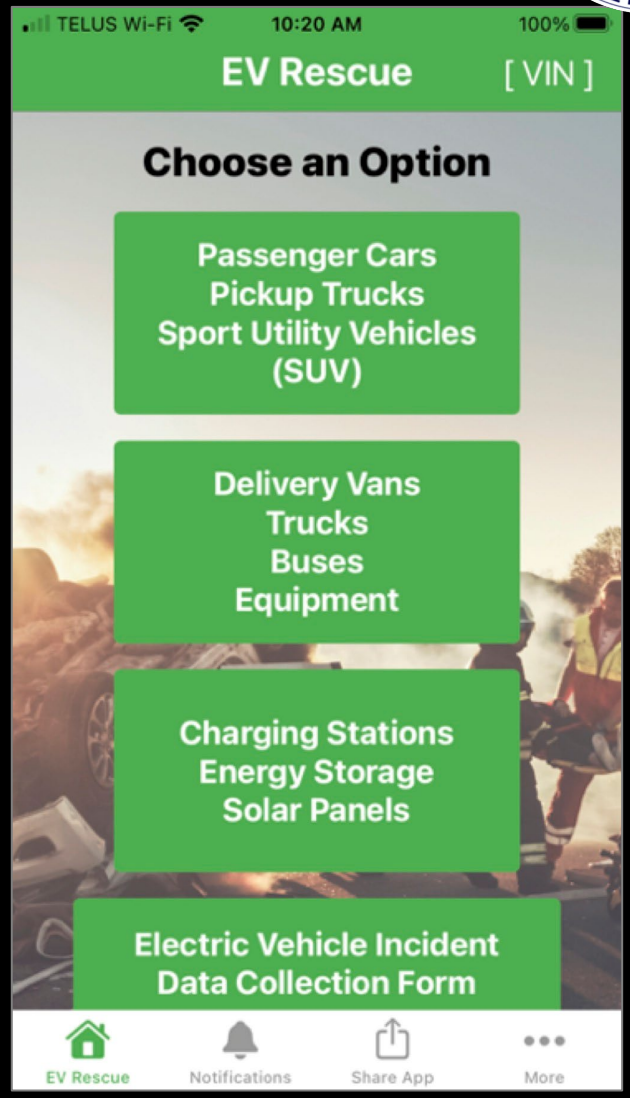


- Use of Civil Investigators
- Work with local authorities
- Contact Owner
- Explain hazards
- Make a determination
- Data Management input / Documentation

Battery Recovery – Partially & Undamaged

Battery Recovery – Partially & Undamaged

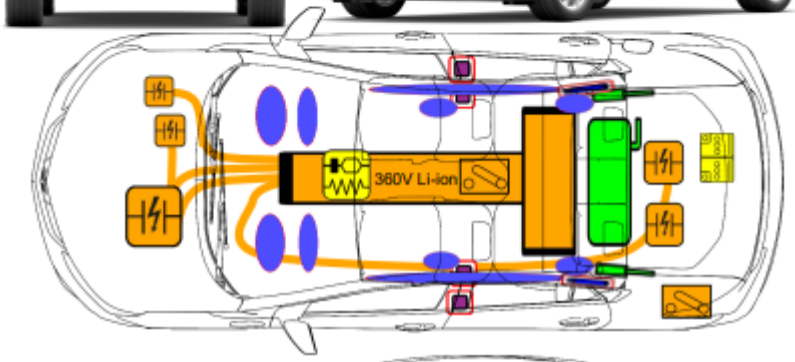
Electric Vehicle Response Resources

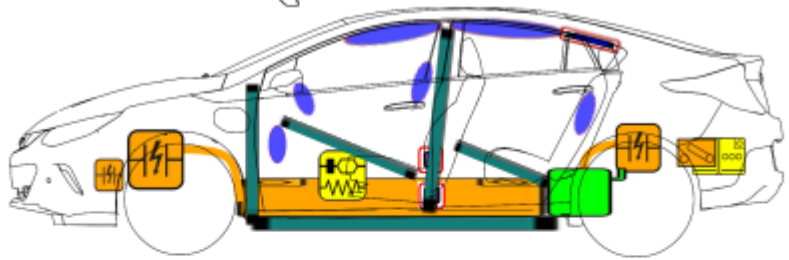


GM

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

RSN - 1G1-201601 (V03)

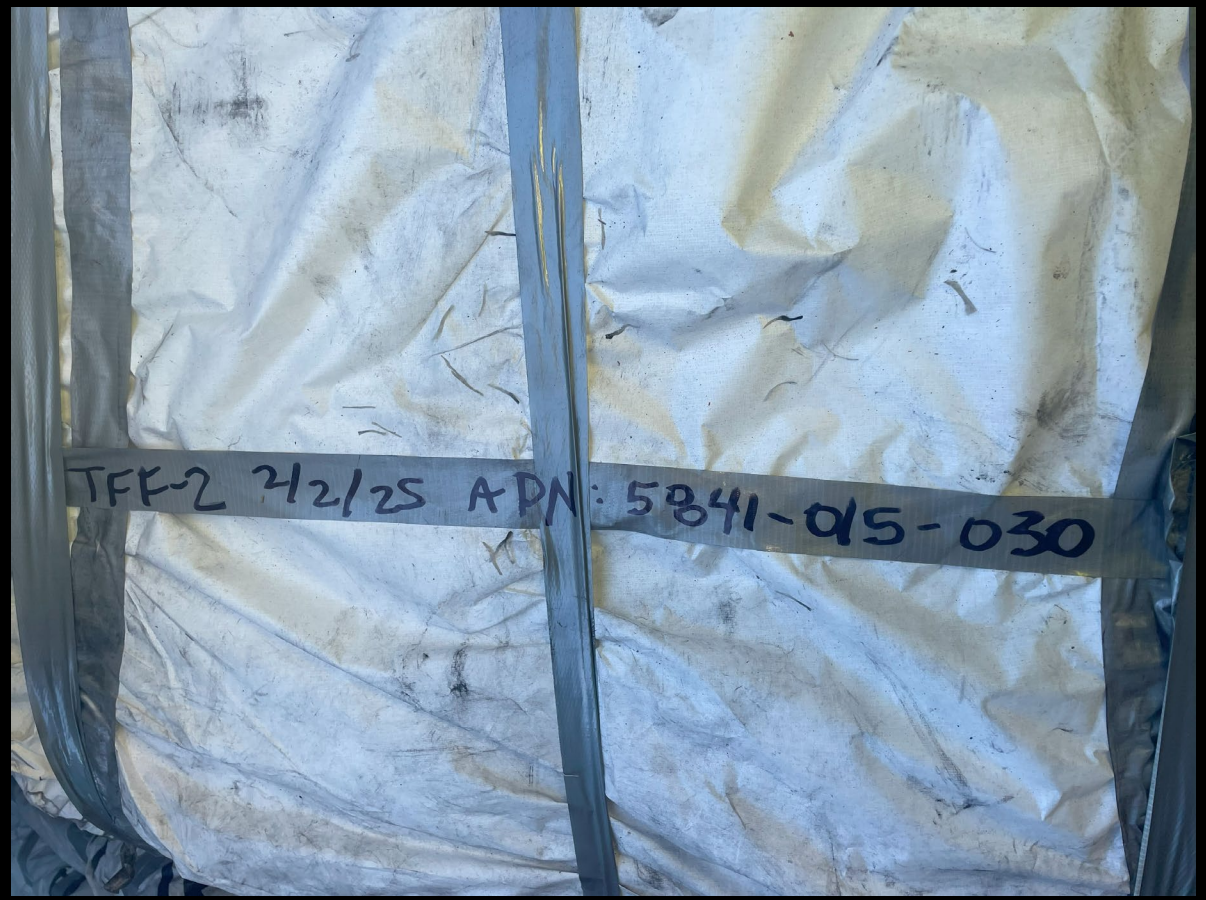
Battery Recovery – Partially & Undamaged

Battery Recovery – Partially & Undamaged

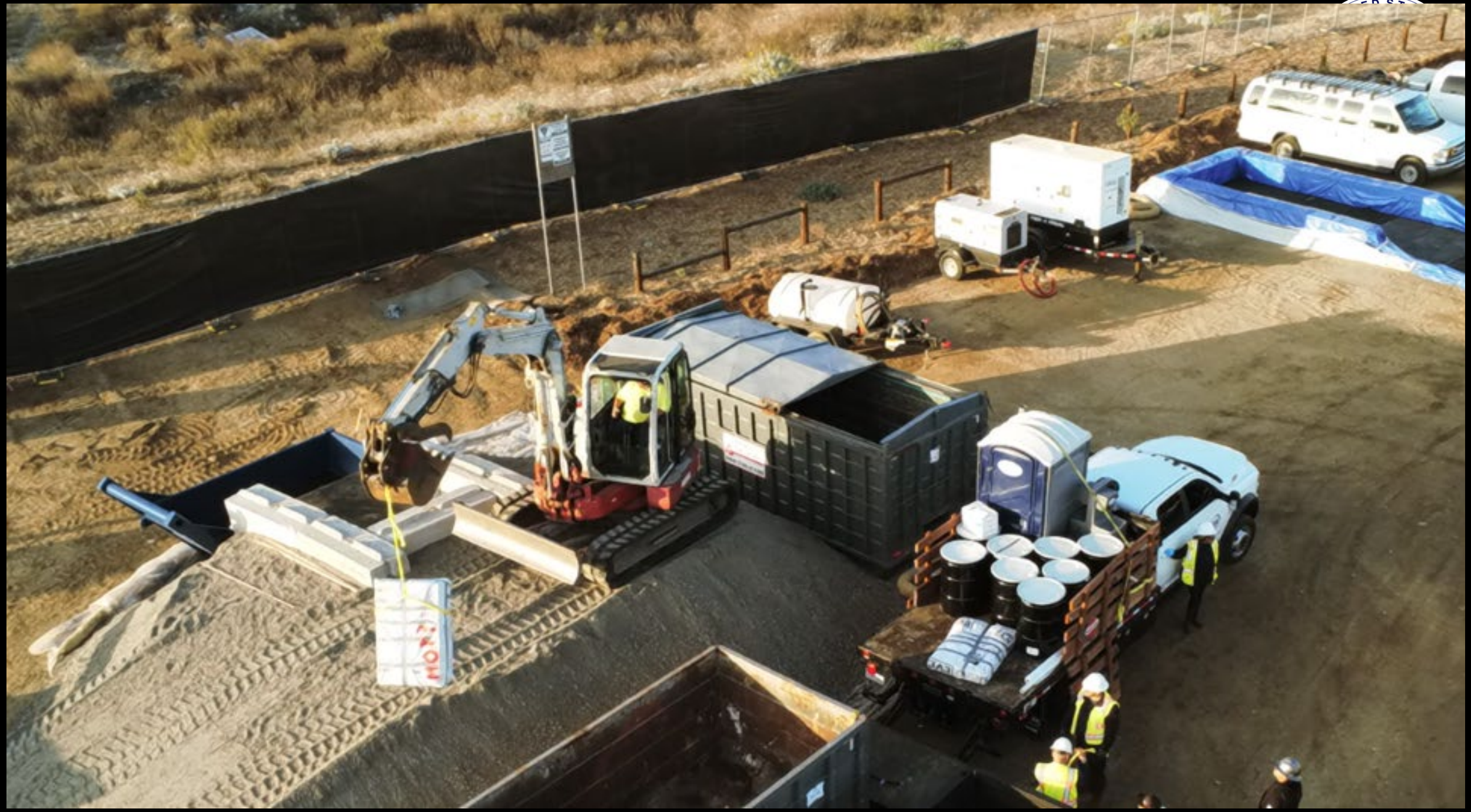
Battery Recovery – Partially & Undamaged

Battery Recovery – Partially & Undamaged

Battery Transport



Staging



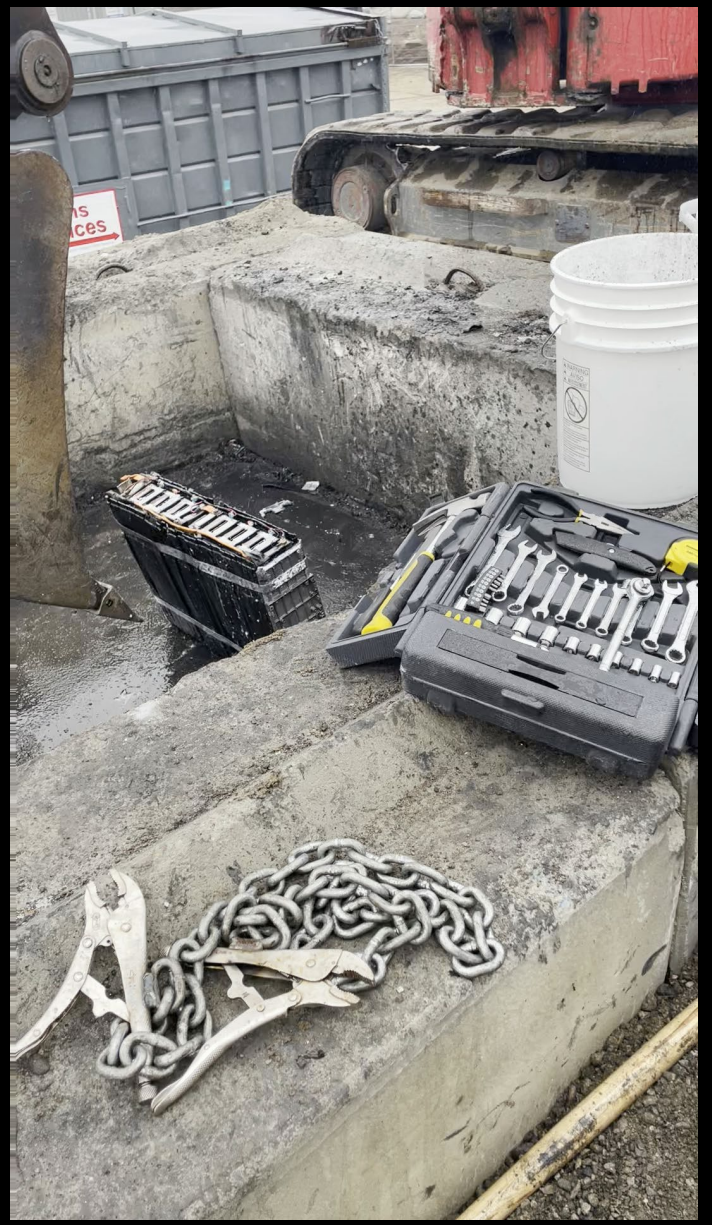
Battery Processing

- 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_2 accumulation/LEL.
- Disposal through Clean Harbors to a facility in Utah.

Health and Safety

<u>Primary Concerns</u>

Electrocution

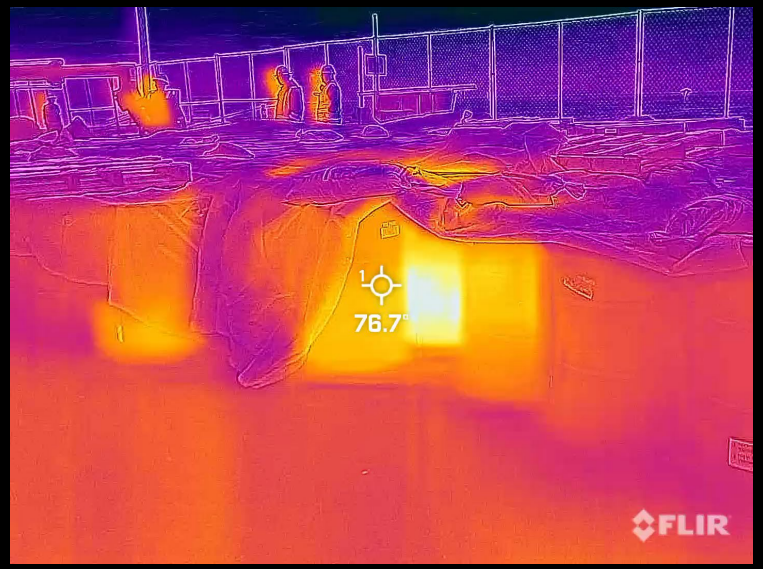
State of Charge

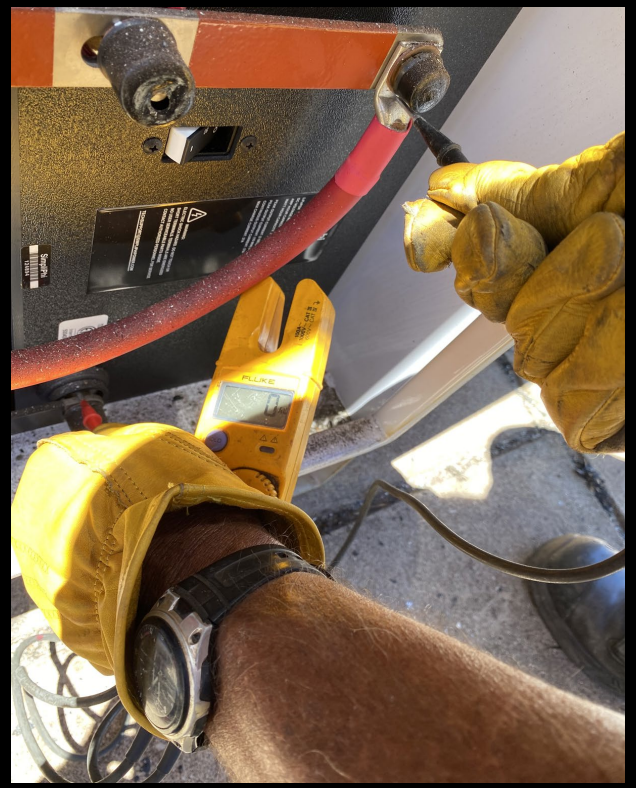
Projectiles, Fire, Explosions

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

<u>SoCal vs. Maui Battery Processing</u>

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

<u>Maui Wildfires</u>

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

<u>SoCal Wildfires</u>

~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 bad yard (NIMBY)
- Topography
- Volume of material
- Separate geographical locations
- Natural disasters (landslides)

The New York Times

The New NIMBY Battle Over the Waste From the L.A. Fires

Federal and state officials say the temporary sites for processing hazardous waste pose no threat, but residents are worried about their air and water.

CALIFORNIA

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

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)

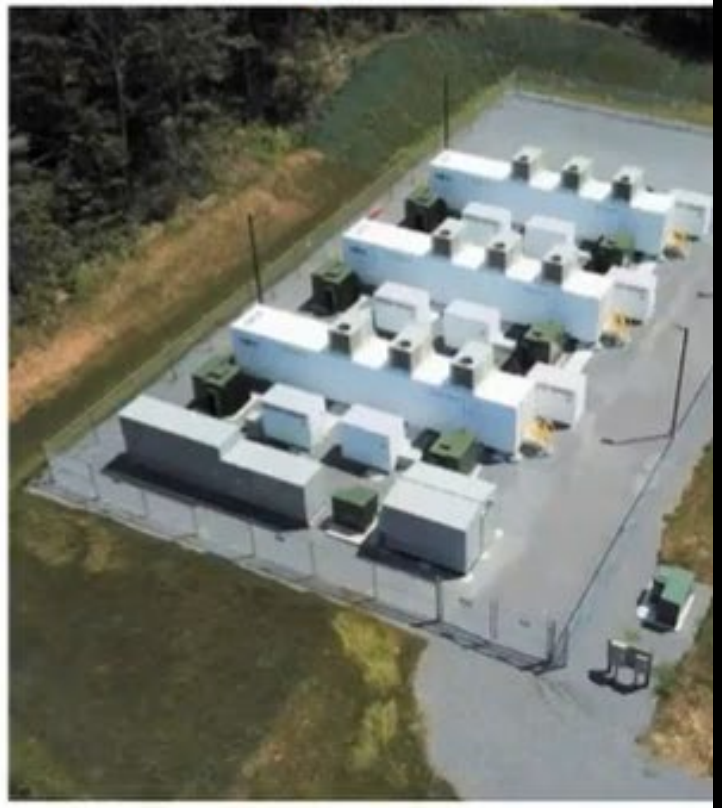
Residential

kWh

Commercial

kWh - MWh

Utility-Scale



MWh - GWh


DVIDS / REUTERS
USA TODAY
Cargo ship carrying EVs catches fire off Alaska coast
USA TODAY
C O S C O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Resources

www.epa.gov/california-wildfires

response.epa.gov/R2LIBResources

response.epa.gov/R4LithiumIonBatteryOutreach

Future OSC LIB Guidance Document

Questions?

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