Battery Reporting Guidance
March 23, 2023

About Me

CONSULTANT

EHS ENGINEER

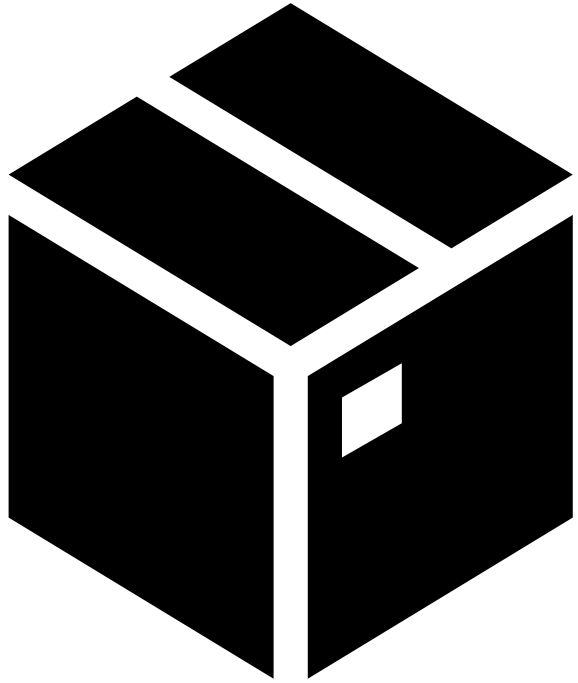
REGULATOR

Hazmat question?

Ring Ring….

…Hello

I've got a hazmat question for you….I've got a box with a hazardous material in it, 55 gal, do I report it?



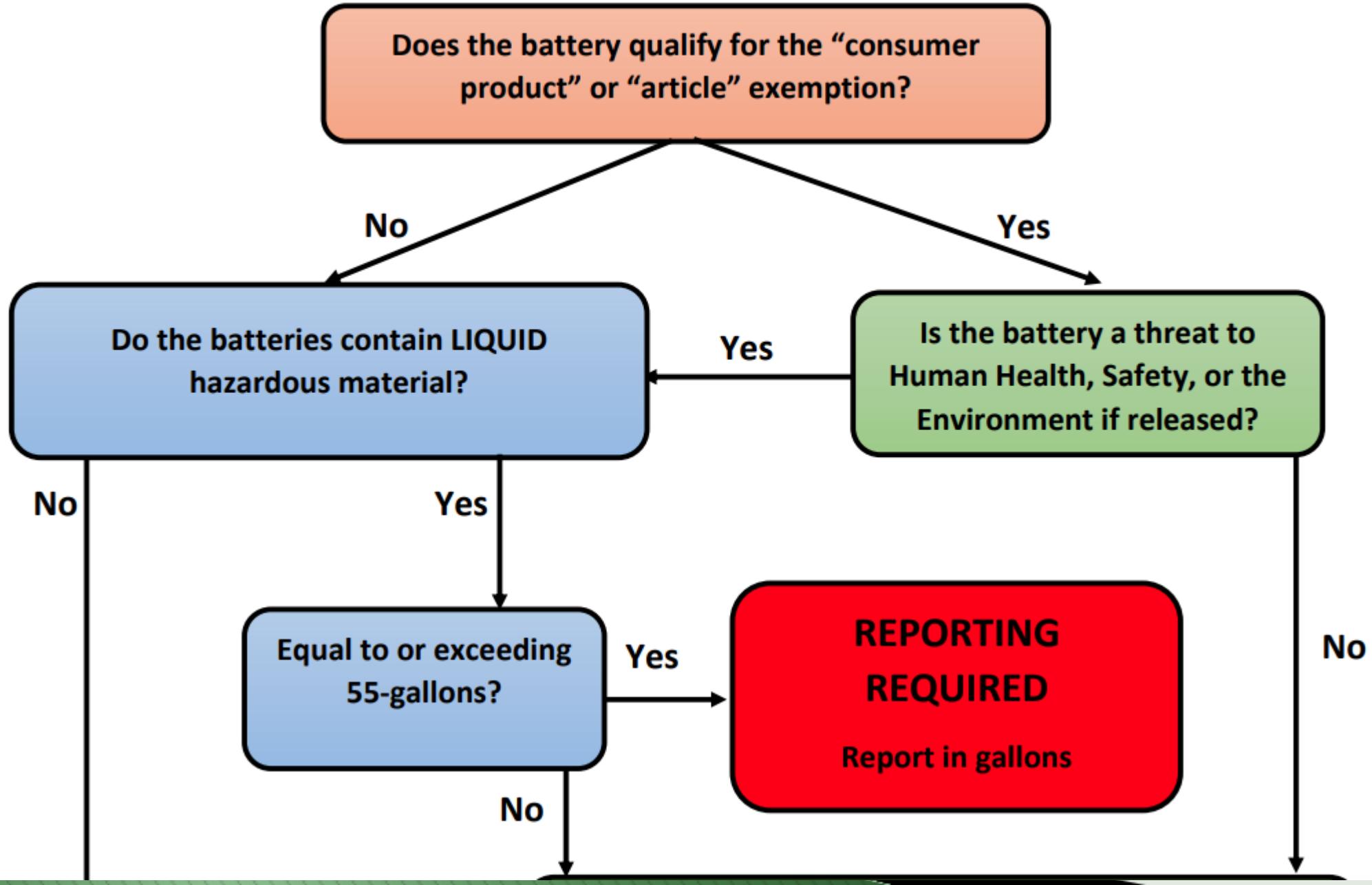
Who knows how to report batteries?

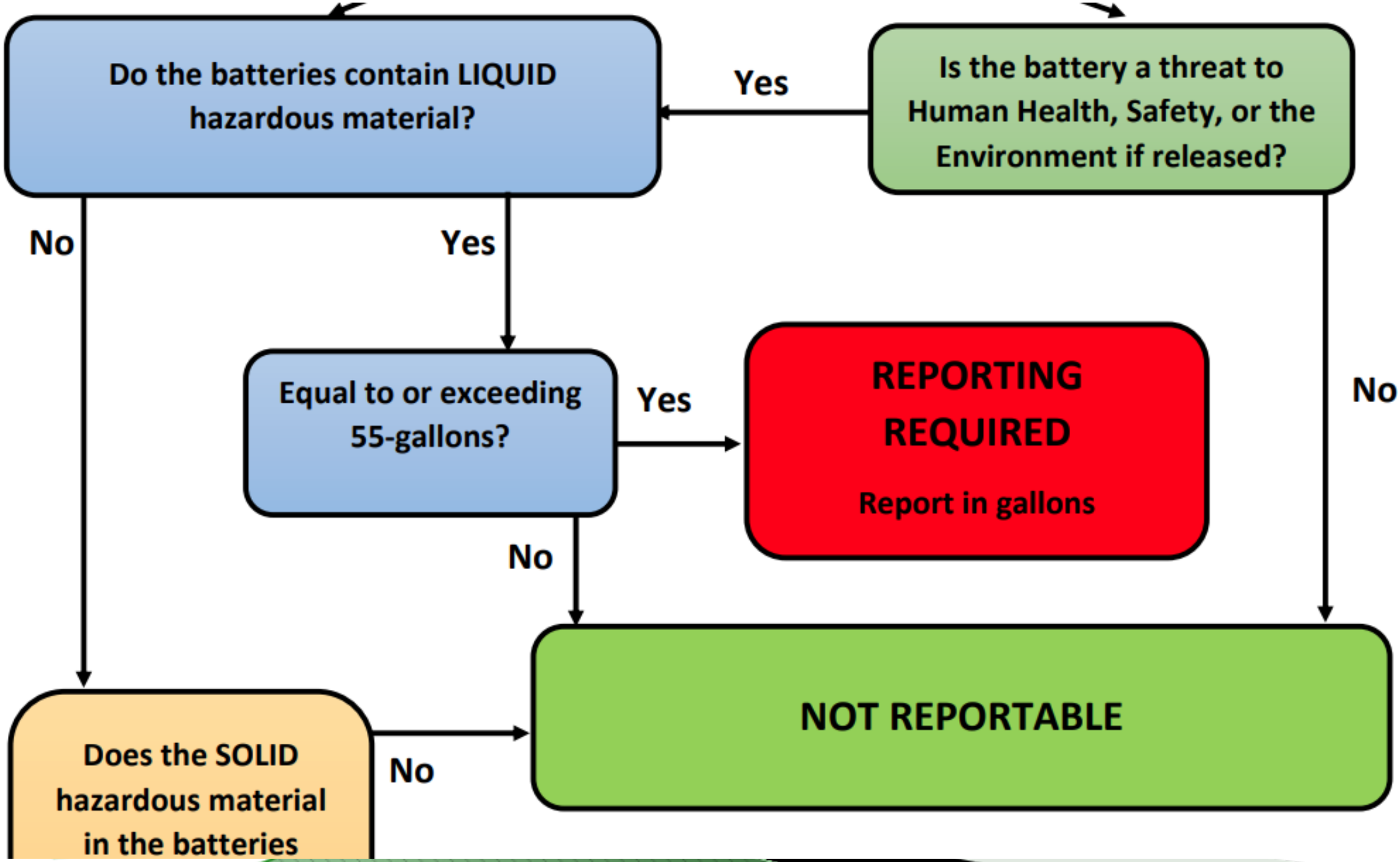
Am I required to report this?

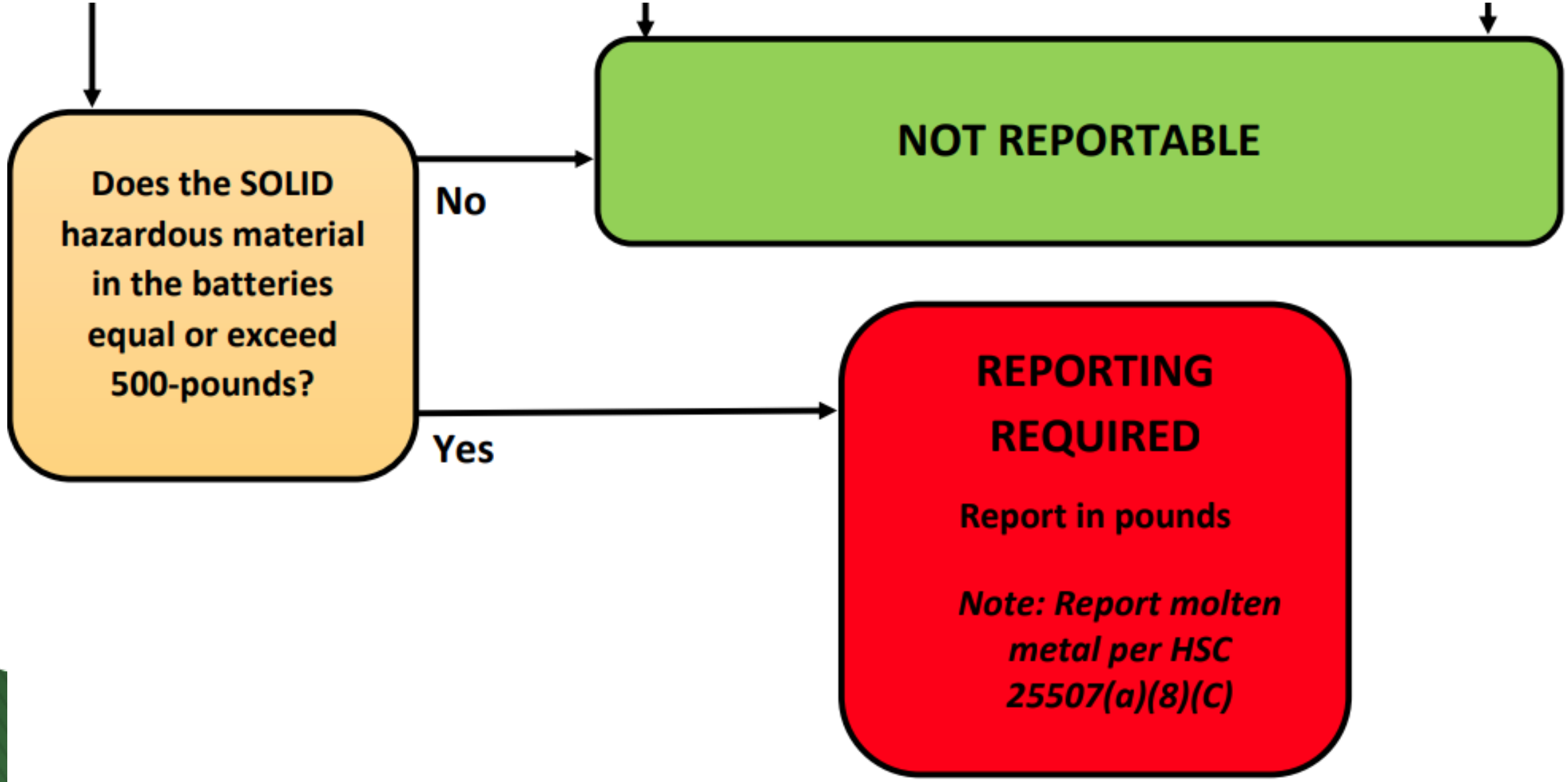
Battery Technology – What am I looking at?

- I don't know what is in this battery – how am I supposed to know how to report it?
- A common sentiment.
- Normally reporting (some research) is still required.
- Provide available information and/or use standard reporting information provided.

Battery Reporting Flow Chart for HMBP




Is the battery a threat to Human Health, Safety, or the Environment if released?
Yes
Do the batteries contain LIQUID hazardous material?
No
Yes
Equal to or exceeding 55-gallons?
Yes
REPORTING REQUIRED
Report in gallons
No
No
NOT REPORTABLE
Does the SOLID hazardous material in the batteries
No


Does the SOLID hazardous material in the batteries equal or exceed 500-pounds?
No
NOT REPORTABLE
Yes
REPORTING REQUIRED
Report in pounds
Note: Report molten metal per HSC 25507(a)(8)(C)

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Objective

Improve understanding of batteries

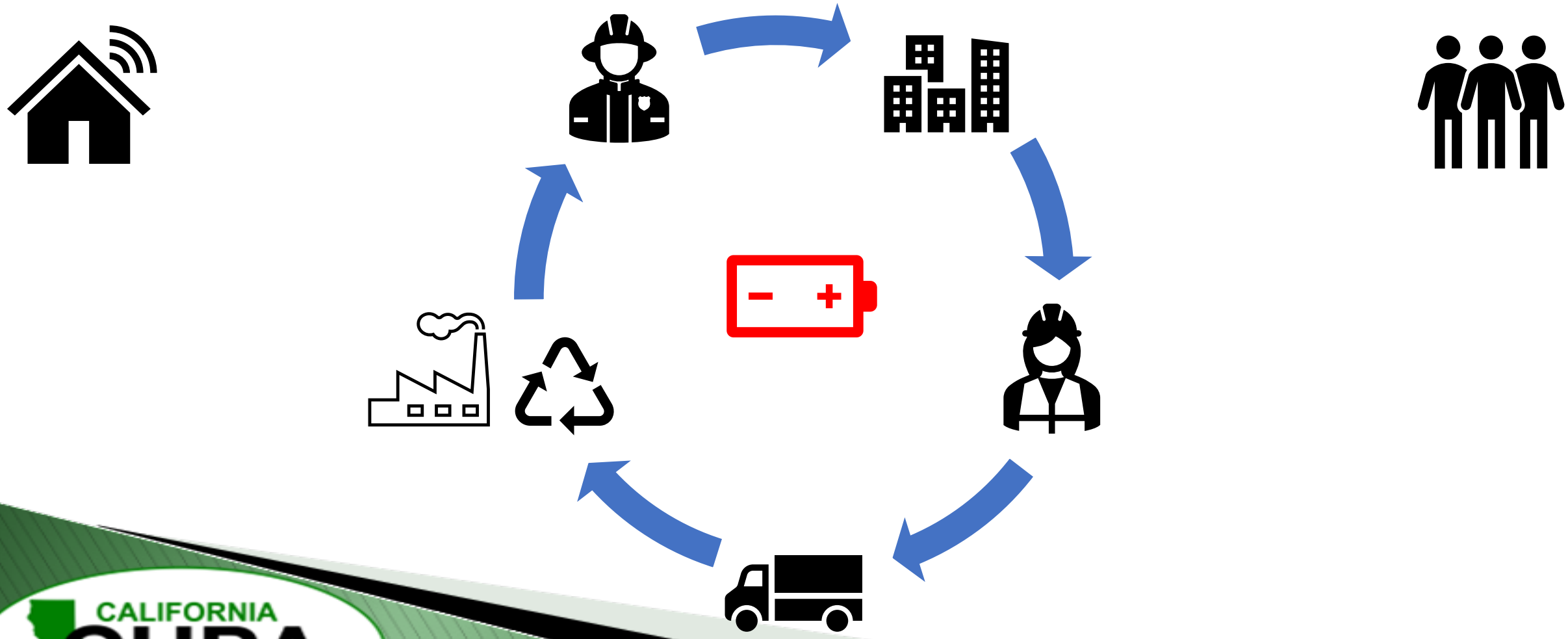
Know where to find batteries – now & future

How to report batteries for the HMBP.

Agenda

1. Context – How it fits together
2. Battery function, contents, and safety
3. Flow chart - How to report batteries

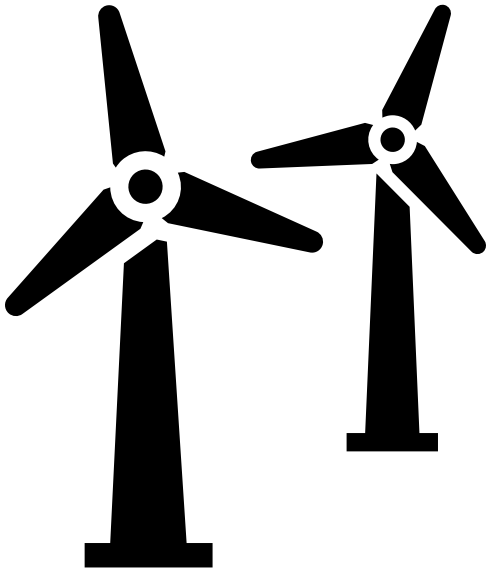
Context: How does this fit together?

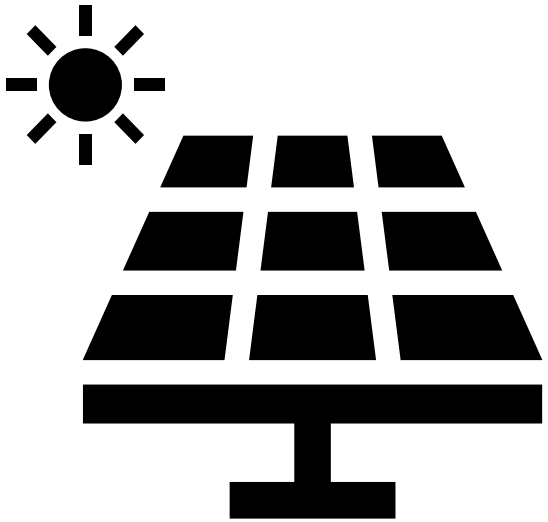


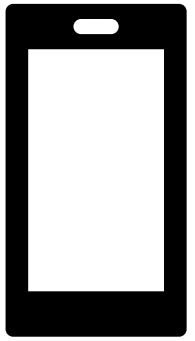
Why More Batteries?

- Expensive
- Resource intensive
- Ethical Issues

Why More Batteries?







Achieve SB100 Goals

- SB 350 → SB 100 2018 - **By 2045**, all retail energy is renewable or zero-carbon sources. **60 percent by 2030.**

- *"Construction of clean electricity generation and storage facilities must be sustained at record-setting rates."*

Why More Batteries?

- SB 350 (2015): increases California's renewable electricity procurement goal to **50 percent by 2030.** This objective will increase the use of Renewables Portfolio Standard (RPS) eligible resources, including solar, wind, biomass, geothermal and others.
- SB 100 "The 100 Percent Clean Energy Act of 2018". **By 2045**, all retail energy with renewable or zero-carbon sources. **60 percent by 2030.**

"Construction of clean electricity generation and storage facilities must be sustained at record-setting rates."

**California Energy Commission*

* 2021 SB 100 Joint Agency Report

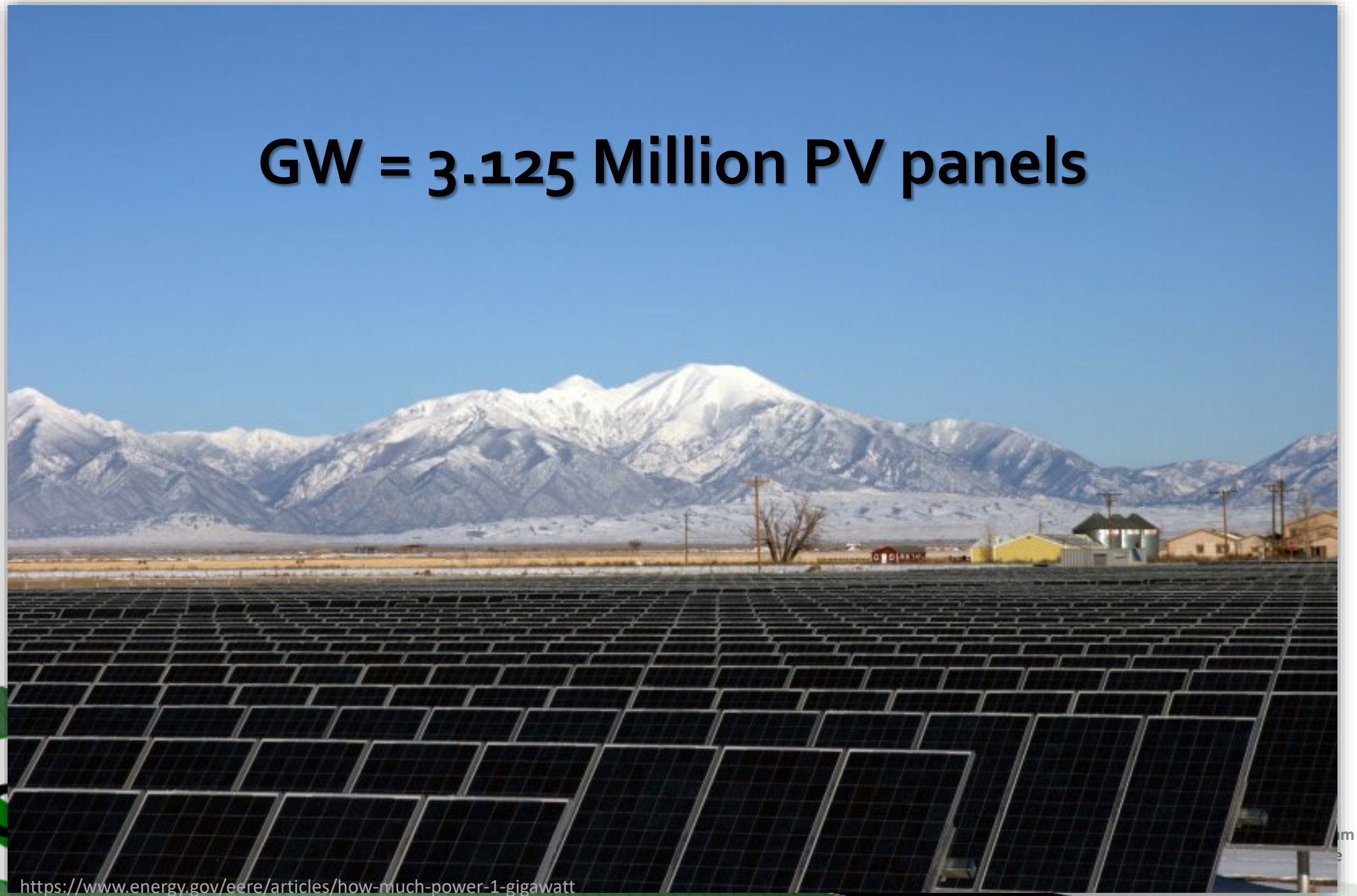
Electrical Scale

- Power = energy / time (units are in Watts = 1 joule/second).
  - Watt measures power – at any given moment.
  - Ex. Grid may demand 40,000 MW, household 1-3 kW
- Watt-hour: electricity used over time: Household uses 29 kWh/Day
- Kilowatt = 1000 watts, kWh (kilowatt-hours)
  - Electricity rate (bill, appliances Ex. 300-400 kWh/yr)
- MW= 1000 kW. GW=1000 MW.
  - Powerplants - hundreds of MW.

Batteries

- Electric cars: 60-200 kWh (or about 3 avg. household days)
- Small facilities: Ex. Co-gen / water treatment 2-4 MW
- BESS facilities: 50-400 MW, 200-1600 MWH
- 2027 CA generated/imported 277,764 GWh

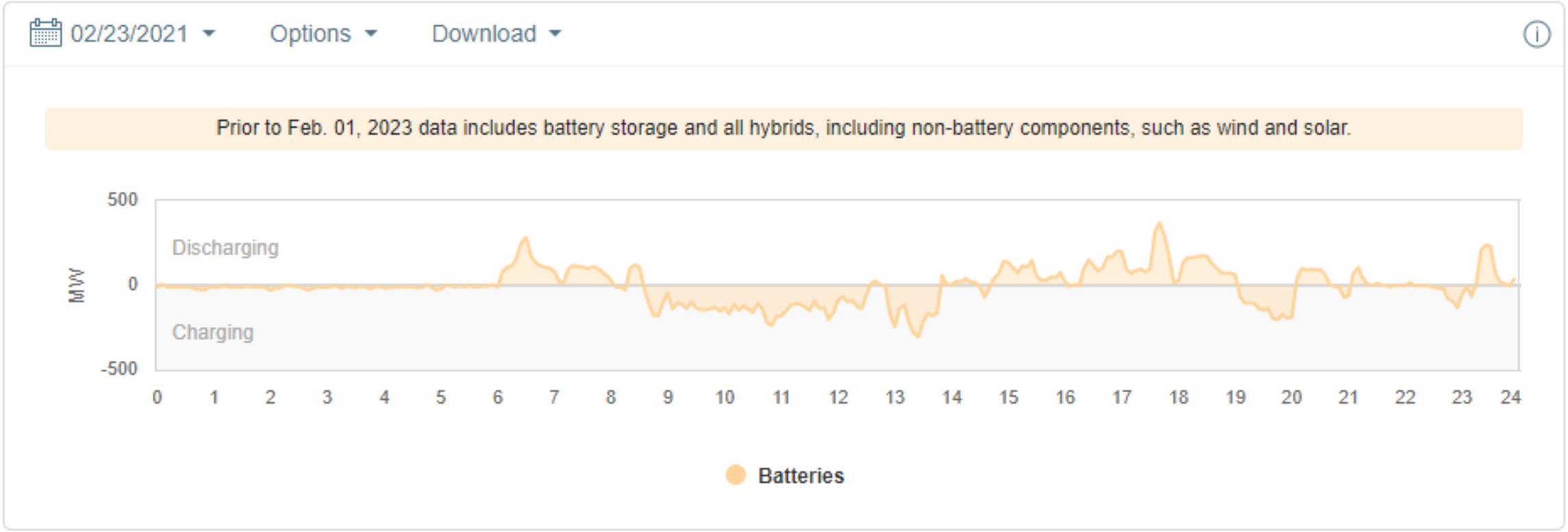
GW = 3.125 Million PV panels



https://www.energy.gov/eere/articles/how-much-power-1-gigawatt

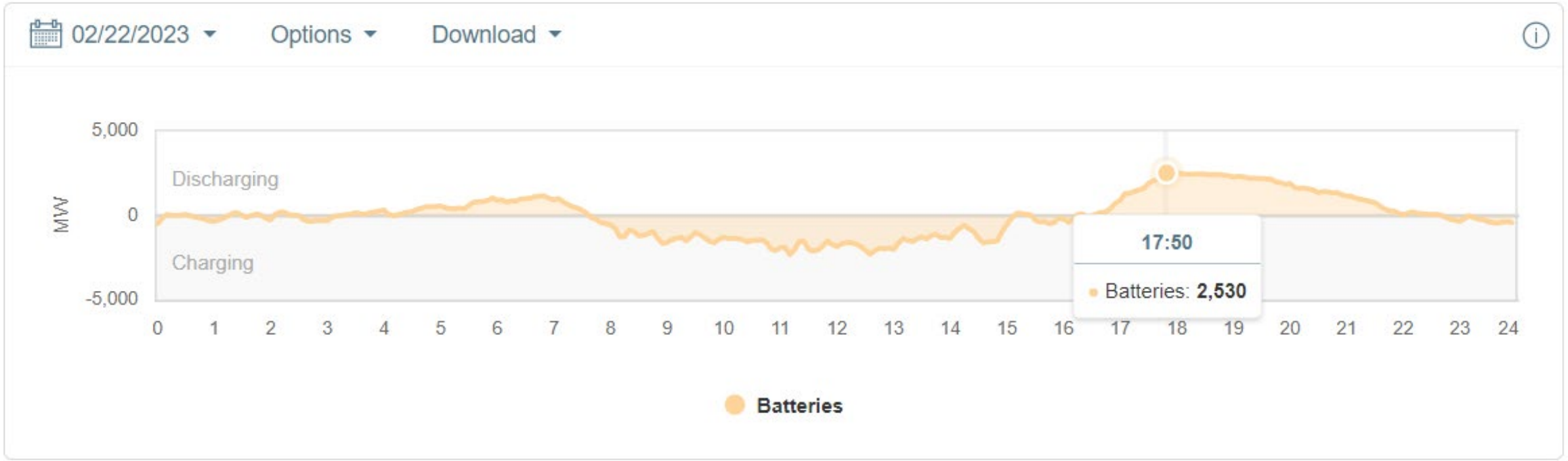
How much do batteries contribute to the Grid?

- 2/23/21 batteries contributed a maximum of 269 MW



How much do batteries contribute to the Grid?

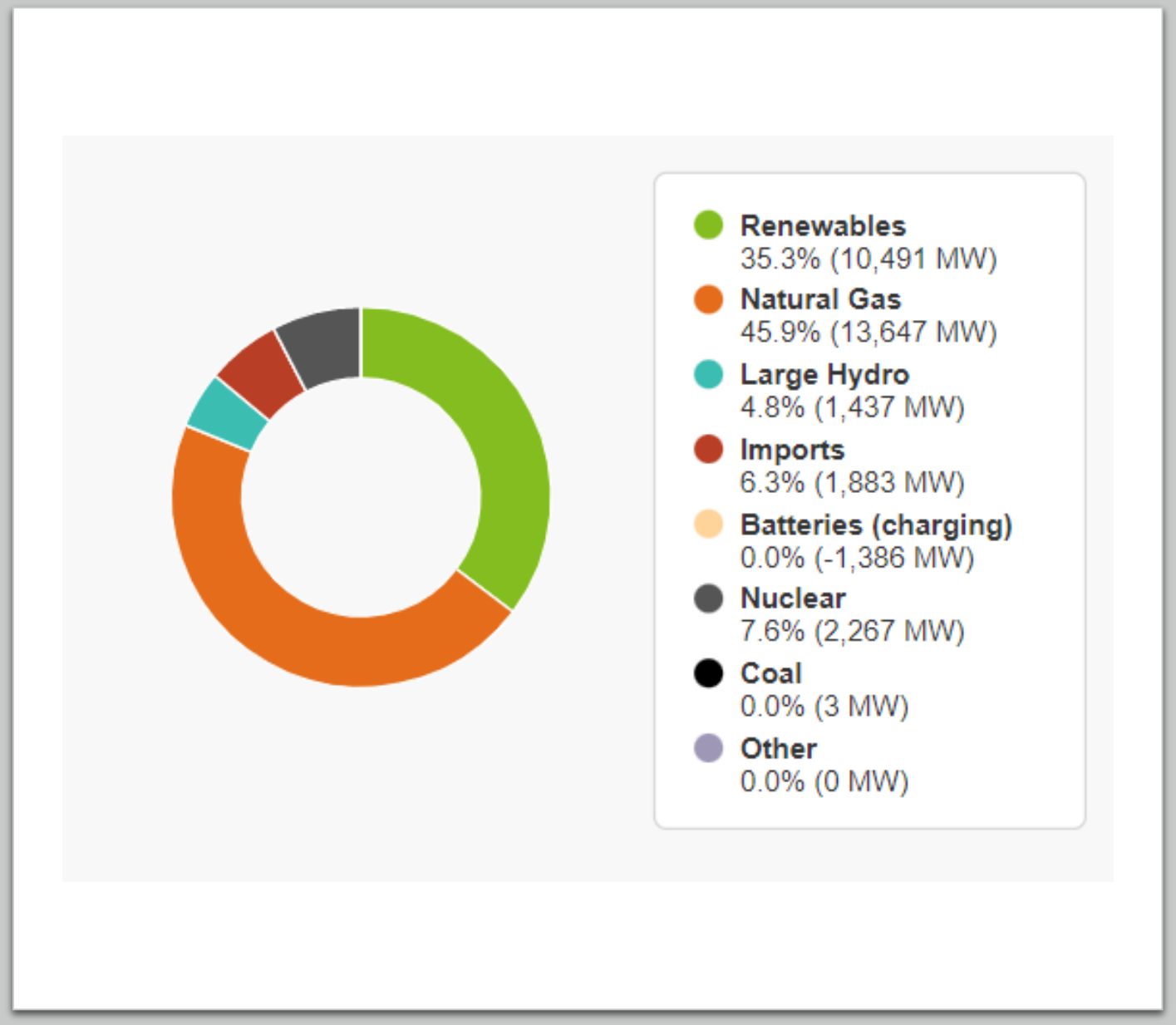
- 2/22/23 batteries contributed a maximum of 2,530 MW



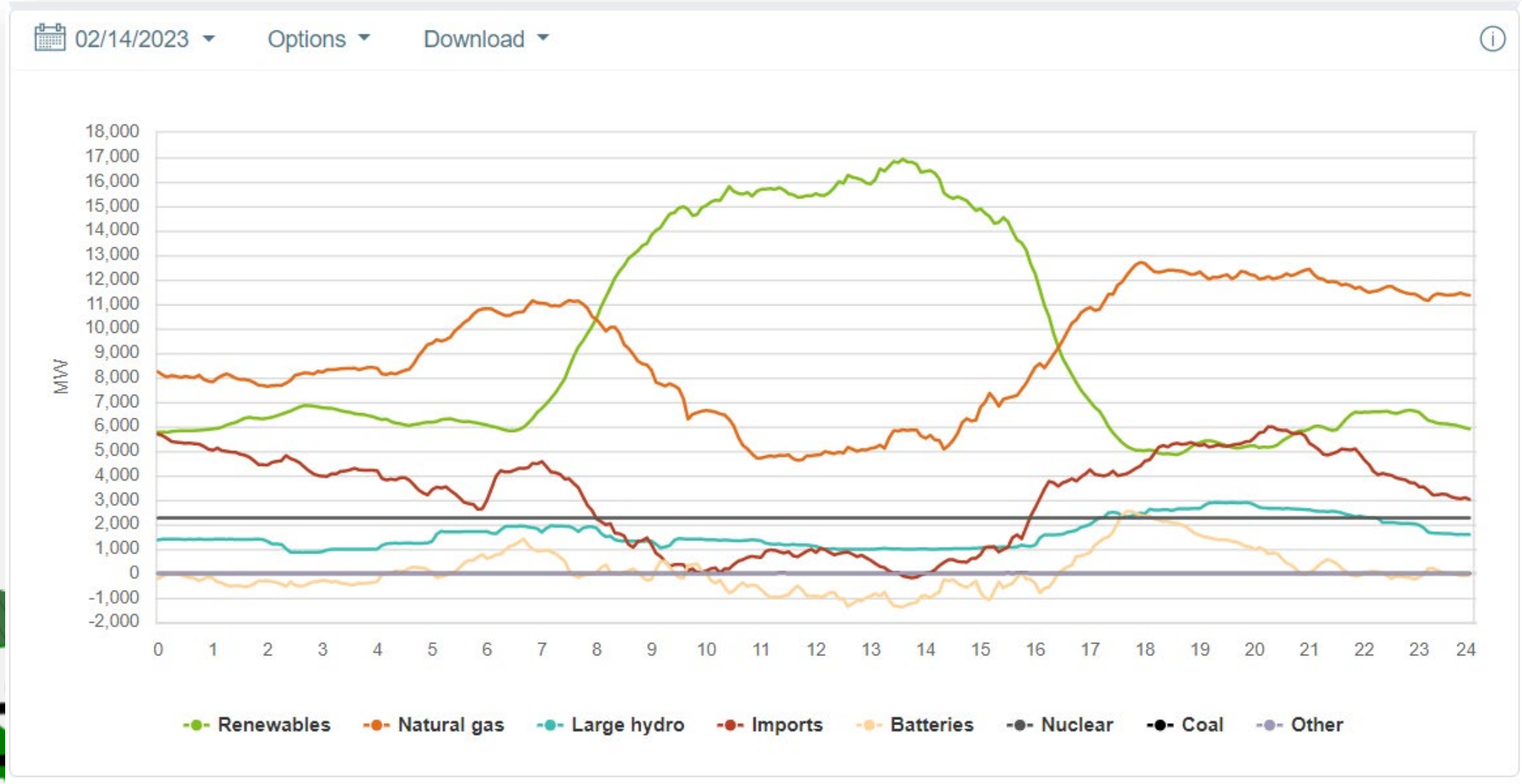
Demand / Supply

(Estimated max at a given time)

- Typical demand: 27-40,000 MW
- Natural gas, 7-20,000 MW (50%)
- Battery contribution : Peak of 2,500 MW (6%)
- Renewables: Peaks 10-20,000 MW. As low as 2000 MW.

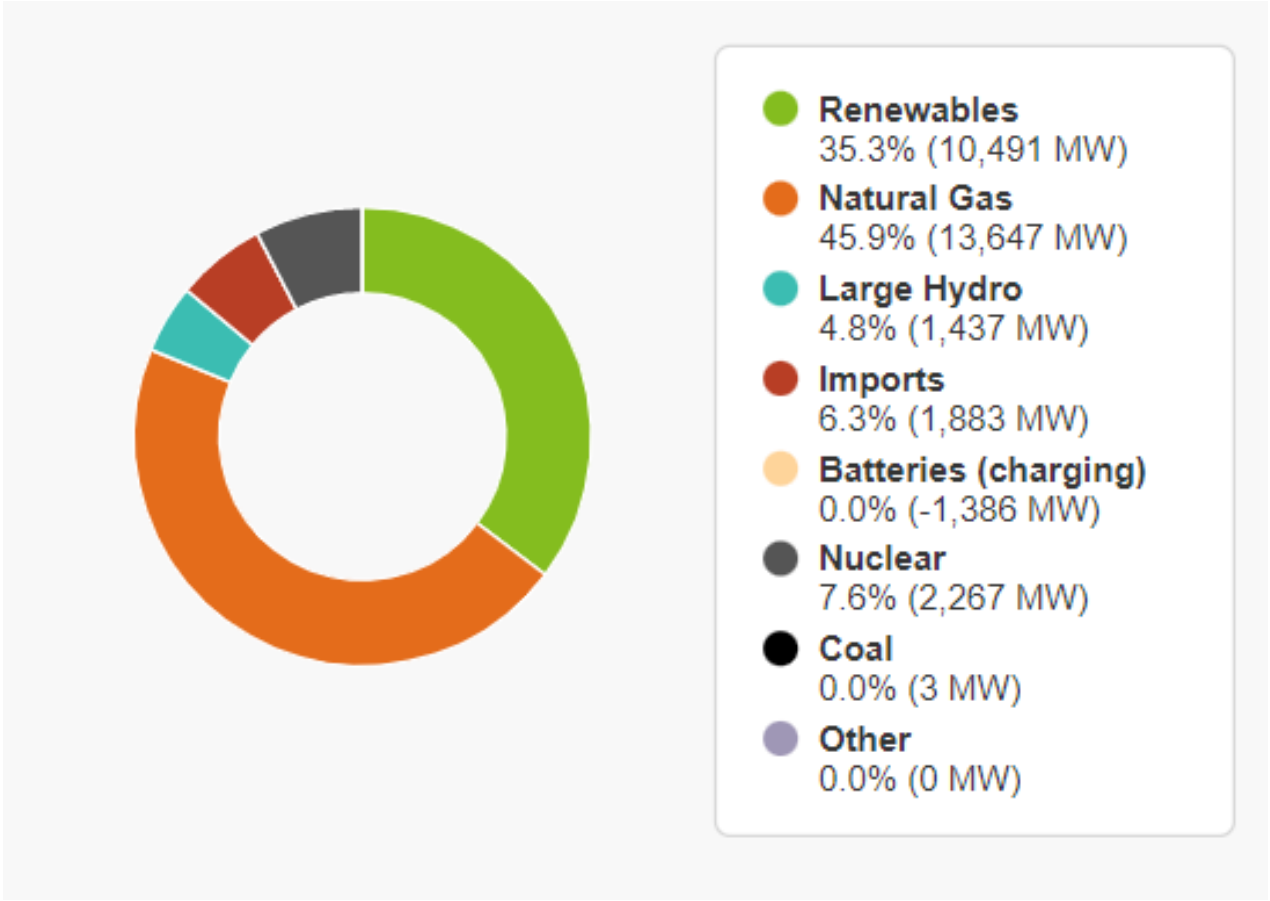


Supply


02/14/2023
Options
Download
MW
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Renewables
Natural gas
Large hydro
Imports
Batteries
Nuclear
Coal
Other

Answer

- From about 250 to 2500 MW
- Of the 40,000 MW demand on the grid, battery use can be about 6%.
- All renewables, can be around 35%



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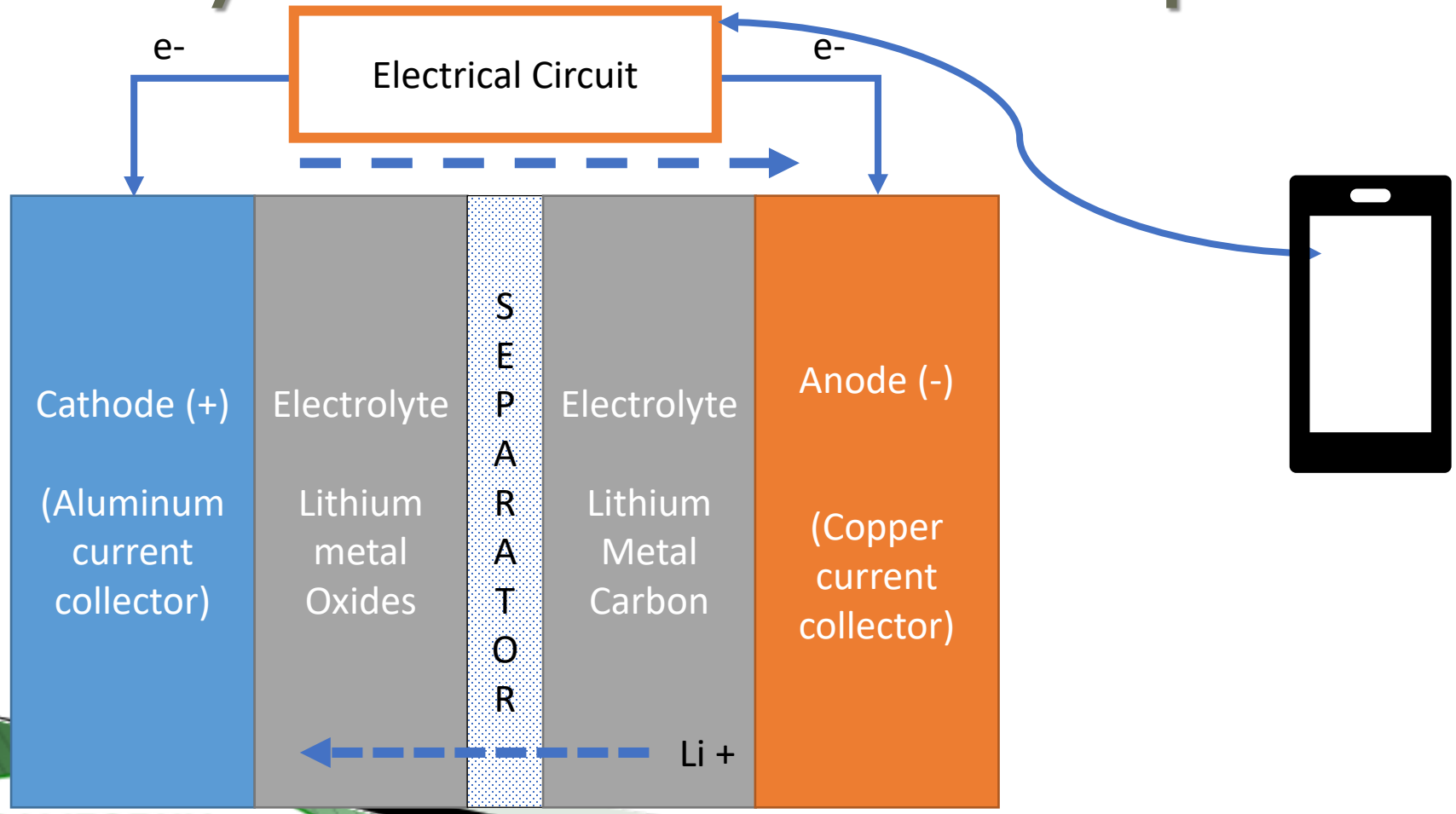
Agenda

1. Context – How it fits together
2. Battery function, safety, types
3. Flow chart - How to report batteries

Battery Function – Li-Ion example



Perspective and Safety

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Battery Safety Features

- Pressure vents
- Shutdown Separator– melts stopping transport of ions.
- Current interruption device
- Anode larger than cathode, reduces potential for short
- Overcharge prevention
- Car battery cooling systems (coolant).

Causes of failures

Why?

- **Heat**: external heat, Fire
- **Mechanical**: Crush, nail penetration
- **Electrical abuse**: Improper charging / discharging
- **Shorts:** Spontaneous internal or external short-circuit, impurities and defects

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Results of Failure

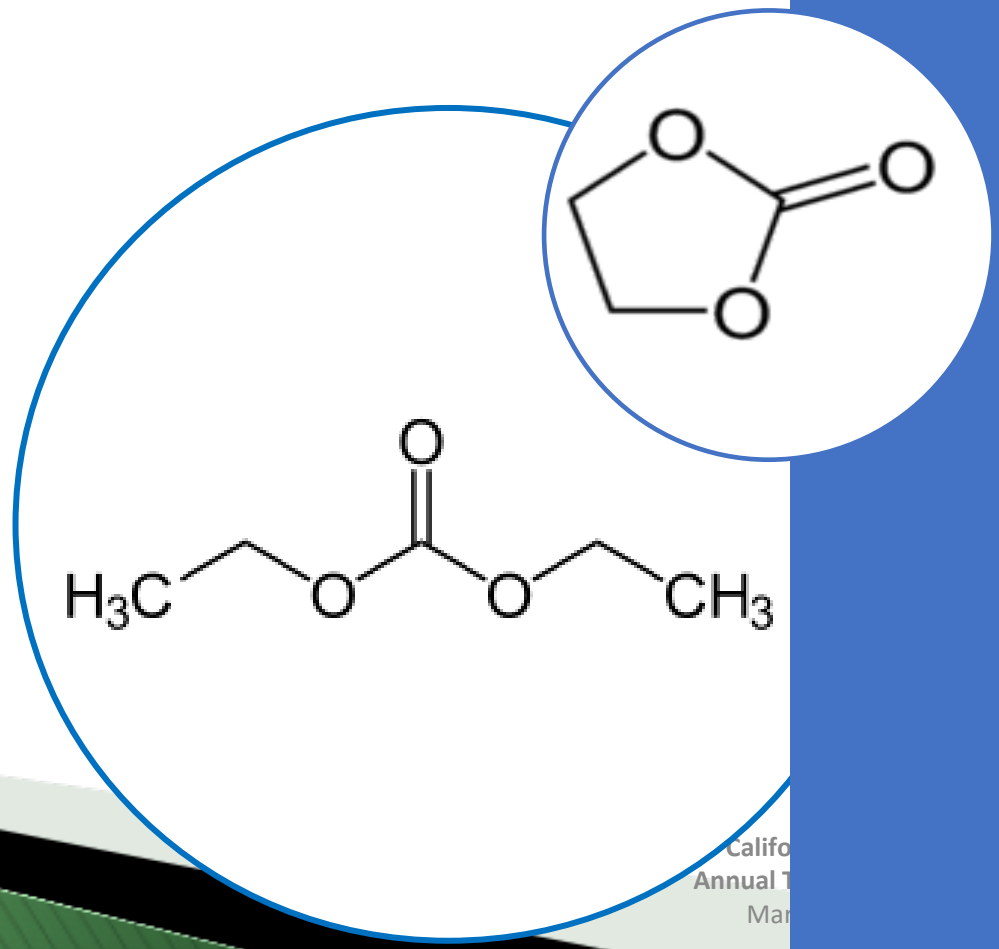
- Short circuit: high current
- Overheat
- Thermal runaway (milliseconds)
  - Smoke detection may be later than thermal runaway.

Combustion

- Combustion reaction Fuel + oxidant. Add a spark → Fire.
- **$C_xH_z + O_2 + (ignition) \rightarrow H_2O + CO_2$**

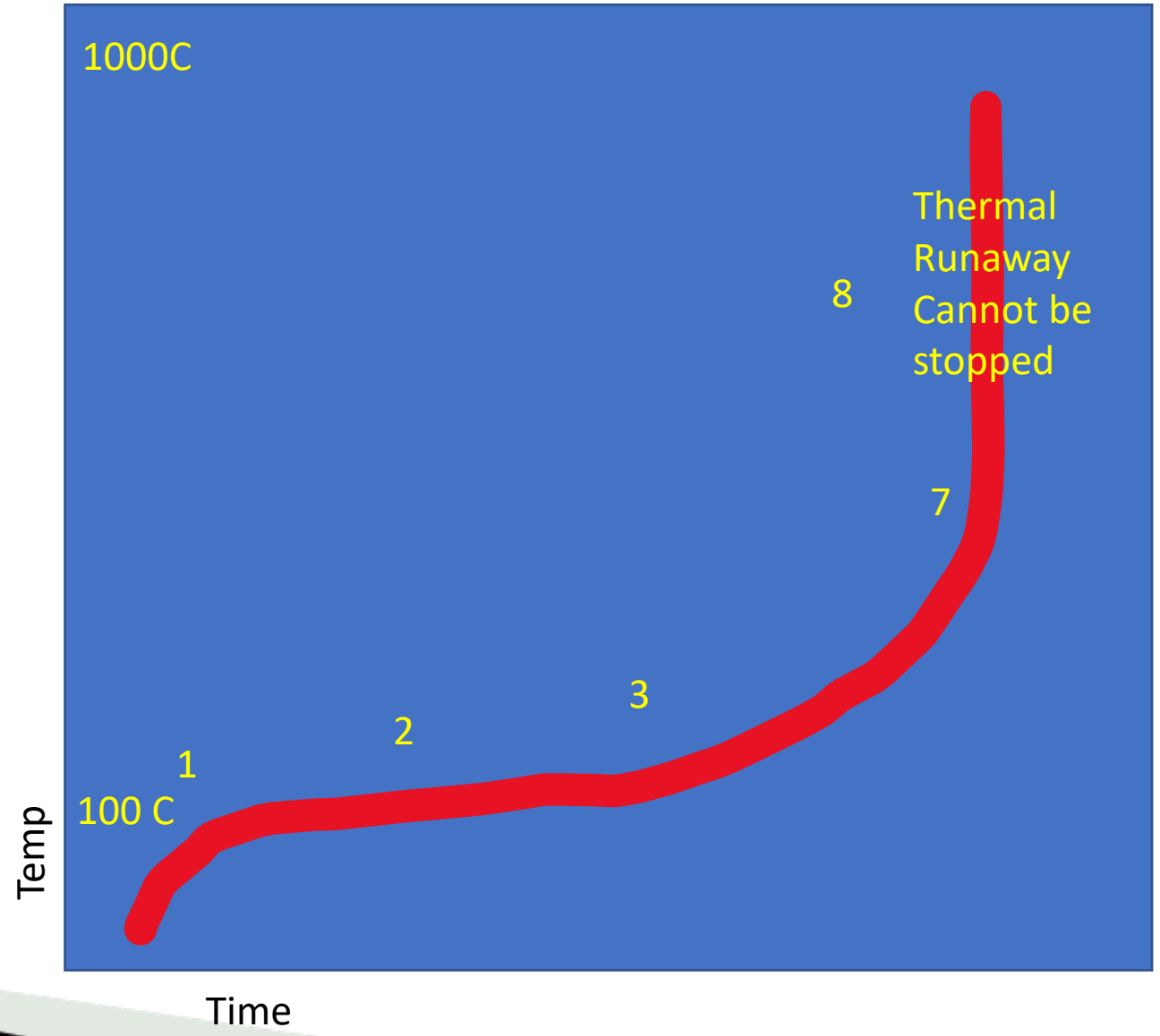
Electrolyte Solvents:

- Ethylene carbonate (EC)
- diethyl carbonate (DEC)
- dimethyl carbonate (DMC)
- ethyl methyl carbonate (EMC)
- LiPF6 salt → Catalyst, produces HF



Thermal Runaway

1. Incident
2. Anode breakdown 70-90 C
3. Separator shutdown melting 130 C
4. Cell Venting 155-165 C
5. Electrolyte degradation
6. Cathode breakdown
7. Short circuit, electrolyte combustion
8. High rate / catastrophic failure



Response to Battery Fires

Tesla Megapack battery caught fire at PG&E substation in California

PUBLISHED TUE, SEP 20 2022•2:43 PM EDT | UPDATED WED, SEP 21 2022•1:35 AM EDT

Lora Kolodny
@LORAKOLODNY

SHARE

"California Highway Patrol closed a section of Highway 1 and redirected traffic away from the facility for hours following the fire."

"Some residents near the Elkhorn Battery substation at Moss Landing were advised to shelter in place, keeping windows and ventilation systems closed, due to emissions after the fire."
(CNBC)

USA TODAY

Tesla 'spontaneously' catches fire on California highway; 6,000 gallons of water needed to put it out

7 Natalie Neysa Alund, USA TODAY

A Tesla car "spontaneously" burst into flames on a California freeway over the weekend and firefighters used thousands of gallons of water to put it out. According to the Sacramento Metropolitan Fire District, the car's battery caught fire on Jan. 28, 2023 along Highway 50.

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Fires Reported and Statistics

"At least seven people have been injured in a five-alarm fire in the Bronx which required the attention of 200 firefighters. Officials believe the incident stemmed from a lithium-ion battery of a scooter found on the roof of an apartment building.
In 2022, the New York City Fire Department responded to more than 200 e-scooter and e-bike fires, which resulted in six fatalities." CNN 3/9/23

NFPA (2020): 2018, - 4,370 gas / service station fires. Typically about 4-5% caused by ignition of fuel. About half are vehicle fires, 20% caused by ignition of gasoline.

Lithium-ion battery fires are happening more often. Here's how to prevent them

By Samantha Murphy Kelly, CNN Business
Updated 11:40 AM EST, Thu March 9, 2023

Managing Hazards

- Both batteries and fuel have high density of energy.
- A lot of reporting on batteries, but more fires?
- Unclear* (more than before, yes).

Managing Hazards

- Li-Ion battery fires / fire prevention - New / different challenges
  - High intensity / "impossible" to extinguish
  - Toxic gases and other gases, gas build-up explosion
  - Re-ignition

- Different / New Prevention Methods
- Different / New Mitigation Methods – Ex. Brine bath, monitored burn
  - Cell block for small batteries.

Standards:

- NFPA 855: Standard for the installation of stationary energy storage system.
  - NEC: National Electric Code (NFPA 70)
- Battery Standards / Testing:
  - UL 1642: Lithium Batteries
  - UL 1973: Batteries for use in stationary, vehicle aux. power, light electric rail.
  - UL 9540 Energy Storage Systems and Equipment (see webinar 2018)
  - UL 2054 Household and Commercial Batteries

UL 9540A – Battery Certification

- UL 9540A Test Method: Relates to fire propagation: Magnitude, re-ignition, gases.
- Cell level test; module level test; until level test; installation
- Design, spacing, fire protection equipment

Hazards

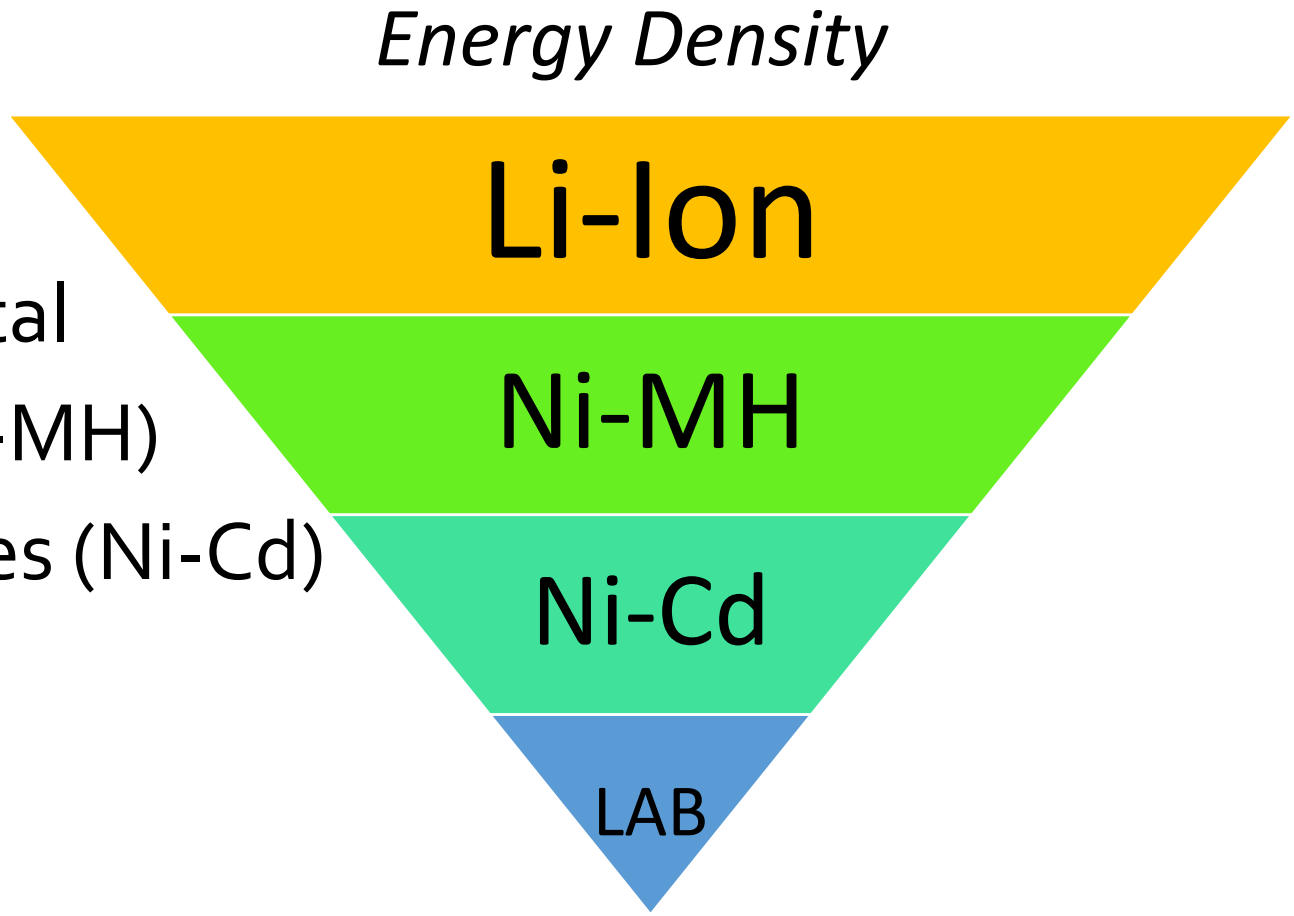
- Fire, Flame jets 2000 F
- Gas build-up → Rupture of battery (flying debris)
- Aerosolized solvents or gases
- Re-ignition hazard
- Stranded Energy: Shocks
- State of charge makes a difference

Gases

- CO, 10-2000 PPM
- CO_2
- H_2, 32%
- Flammable gases / LFL, 8.5%
- HF, 100 PPM
  - phosphoryl fluoride

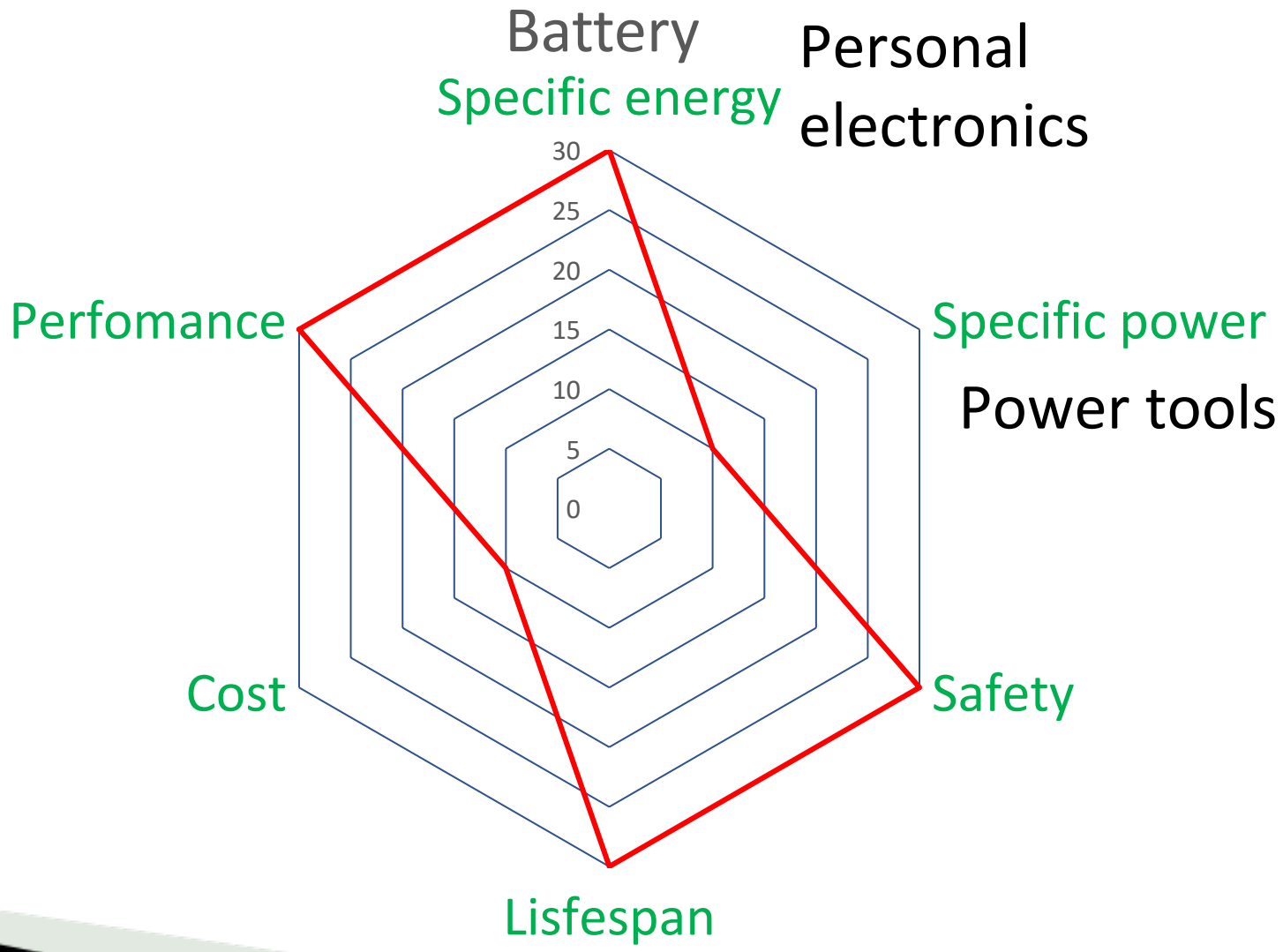
Types of Batteries

1. Lead-acid
2. Lithium Ion, Lithium metal
3. Nickel metal hydride (Ni-MH)
4. Nickel-Cadmium batteries (Ni-Cd)
5. Flow batteries.
6. Other batteries



Characteristics

- **Specific energy:** Watt hours per weight or liters. High specific energy is for long run times with moderate loads.
- **Specific power:** Power or current delivery / load capability. Ex. Power tools need specific power.



Answers

- The most common battery found in auto shops, _____ can release hydrogen gas and cause a fire.
- Thermal runaway is reported in _____ found commonly in cell phones and now electric vehicles.
- The battery used formerly for hybrids was commonly _____.
- Before lithium ion was common _____ was used for many applications in addition to Ni-Mh.

Answers

- The most common battery found in auto shops, lead-acid can release hydrogen gas and cause a fire.
- Thermal runaway is reported in lithium-ion found commonly in cell phones and now electric vehicles.
- The battery used formerly for hybrids was commonly Ni-MH.
- Before lithium ion was common Ni-Cd was used for many applications in addition to Ni-Mh.

Lead-acid

Types

- Flooded acid, valve regulated
- Gell
- AGM: Absorbed Glass Mat

Applications

- Vehicles and other mobile equipment (Starting)
- UPS: Uninterruptible power supplies (telco)
- Other emergency lighting / pumps.
- Deep cycle – discharged and recharged regularly.

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Lead-acid

Chemistry

- Sulfuric Acid (liquid)
- Gel (with silica)
- AGM: Acid absorbed

Spongelike glass mat

- Lead

Increased Safety

Hazards

- Vents gases: Hydrogen, oxygen
- Acid mist during charging / discharging
- Leaking (maintenance required)
- Gel liquification and leaking.
- Pressure / venting gas / explosion
- AGM, less acid.
- Lead = toxic

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HAZARDS

Carcinogen

Sensitizer
Contact
Dermatitis

Toxicity:
Heavy
metals

Skin burns

Hydrogen gas

Fires

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Lithium Ion, Lithium metal

- LFP
- LCO
- LMO
- NMC
- NCA
- LTO

Lithium Iron Phosphate

LFP: Contents

- LiFePO4
- Lithium
- Iron Phosphate
- No cobalt or nickel

Characteristics / Application

- Safety – Thermal stability
- 3.2 volts x 4 = 12.8 volt battery
- Replaces lead-acid deep-cycle batteries.
- Some electric vehicles.

- Low specific energy vs. others
- Not best in cold weather

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Lithium Cobalt Oxide

LCO

- Cobalt oxide cathode
- Graphite carbon anode
- Lithium plating
- Some include nickel, manganese, aluminum

Characteristics / Application

- High specific energy: Personal electronics (becoming less popular)
- Low specific power, not for high load
- Short lifespan (fast charging and low temps)
- Thermal stability: Low

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Lithium Manganese Oxide

LMO

- Lithium Manganese Oxide cathode

Characteristics / Application

- Fast charging. High discharge.
- Power tools, medical instruments, electric or hybrid vehicles.
- Higher current than LCO.
- LMO- lifespan / cycles.

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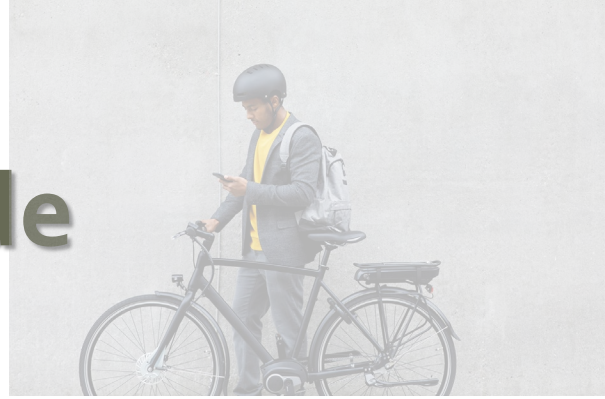
Lithium Nickel Manganese Cobalt Oxide



NMC

- May contain lithium nickel manganese cobalt oxide
- Nickel, high specific energy.
- Manganese: Stability

Characteristics / Application

- Energy density. Lifecycle. Lower cost. Higher stability than LCO.
- Power tools, medical instruments, electric or hybrid vehicles and e-bikes.
- Chemistry can vary to match needs for capacity, load, battery life.
- Lower voltage than cobalt.

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Lithium Nickel Cobalt Aluminum Oxide

NCA

- Nickel, high specific energy. More nickel, more energy density (up to 90%). LG.
- Nickel = toxicity
- Cobalt = toxicity

Characteristics / Application

- Highest specific energy. Long lifespan.
- Tesla batteries, less common with other auto manf.
- Could be less safe as compared with other li-ion chemistries. Expensive.

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Lithium Titanate

LTO

- Lithium titanite anode, not graphite.
- Similar to LMO or NMC cathode.

Characteristics / Application

- “Safer”
- Long lifespan. Fast charging.
- EV, charging stations, UPS, renewable storage, telco.

- Low energy density (less energy per weight).
- Expense

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Future / Other lithium

Types

- Solid state: Instead of liquid or polymer, electrolyte is solid. Possibly safer due to less concerns with liquid.
- Lithium sulfur
- Lithium air

Future

- Requires further research, development, and scaling.

Nickel Cadmium (Ni-Cd)

Nicd

- Nickel oxide hydroxide
- Metallic cadmium

Applications

- Used prior to Li-Ion as rechargeable.
- Emergency radios, med equip. cameras, airlines.
- Durable and long shelf life
- Can lose capacity if not charged / discharged properly.

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Nickel Metal Hydride NiMH

NIMH

- Nickel
- Many different metal compounds (rare earth and nickel, cobalt, manganese or aluminum.)

Applications

- Rechargeable batteries. Hybrid cars.
- Often found in the smaller sizes to replace alkaline batteries (AA, AAA).
- Used instead of li-ion for safety and voltage.
- Higher capacity than NiCd.
- Limited life

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Other Nickel Batteries

Types

- NiFe, nickel iron
- NiZn, nickel zinc
- NiH, nickel hydrogen (gas)

Applications

- NiH performed best for satellites.

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Flow Batteries

Contains

- Ex. Zinc bromide chemistry
- Acid sulfur, vanadium salt, graphite plates.
- Tanks of liquid electrolyte (similar to a fuel cell). Use of pumps. Positive and negative electrode, membrane, ion exchange.

Applications

- Commercial / industrial applications
- Utility scale
- *Anaergia's Rialto Bioenergy Facility: 2 MWh in California: Biogas cogen. In use in Japan and Europe.*
- Possibly longer lifespan.
- Expensive, corroding membranes

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Sodium Sulfur Na-S

- Limited applications
- Molten Salt, 3000C+
- High energy and power density, a long lifetime, and stable operation under extreme ambient conditions.

- Corrosion issues
- Highly flammable and explosive

25th California Unified Program
Annual Training Conference
March 20-23, 2023


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BREAK TIME!


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Examples

- Renewable energy storage
- Grid flexibility & Stability
- Consumer electronic devices
- Utilities and infrastructure

Common Battery Locations Before:

- Auto shops / Car parts
- Shops repair other equipment (forklift, airports)
- Battery manufacturer/retailer
- Recycling facilities
- Data centers - Uninterruptable power supply
- Cell sites
- Waste household batteries - collections

Common Battery Locations After:

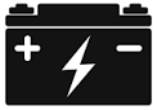
- (BESS) "Energy Storage" facilities
  - Residential
  - Commercial on-grid / off-grid: Govt., hospital, universities, resorts, and
  - Micro-grid scale
  - Utility grid scale
  - *Why – backup/ UPS, cost management, storing clean energy etc.*
- Electronic equipment sales /manufacturers: Ex. E-bike/scooter sales
- Mobile power units

BESS

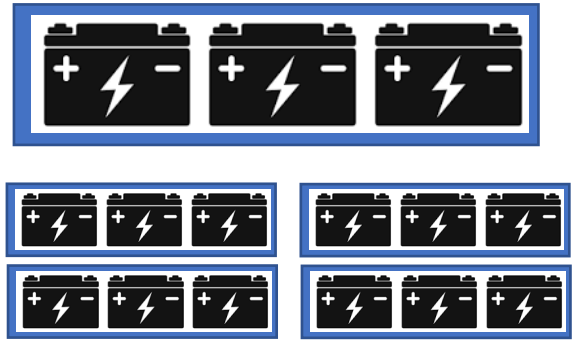
- Residential: KWh
- Commercial:
  KWh-MWh

Grid Scale:
  MWh-GWh

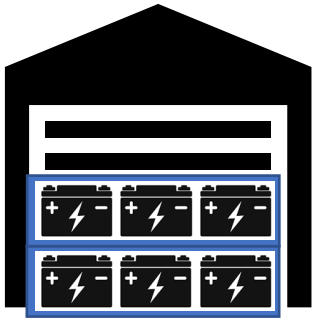
Cell — Single battery



Module — Group of batteries
Rack



Unit — Unit
Installation



BESS – 6 Grid-Scale Examples

- AES Alamitos Energy, 100 MW, Long Beach, 2020
- Vistra, Moss Landing, Monterey County, 400 MW, 8/2021
- NextEra Blythe BESS, 63 MW, Riverside County, 8/2021
- Gateway BESS, 50 MW , San Diego, 7/2021
- PG&E Elkhorn Battery, Moss Landing, 182.5 MW, Monterey CA, 4/2022
- SCE – AMERESCO, 537.5 MW / 2.15 GWH, 3 at existing SCE substations (nearly complete)

BESS Facilities

- PG&E's Elkhorn Battery, Moss Landing, Monterey CA

POWER Engineering

Gas Renewables Coal Nuclear O&M Energy Storage Hydrogen Emissions Webcasts About

Energy Storage

Fire reported at PG&E's Elkhorn battery storage facility

At 8:30 a.m. PST, the North County Fire District told us the fire was active but "de-escalating" The department is asking nearl

Kevin Clark
9.20.2022

Share This Article

(This April 2021 drone image provided by Pacific Gas and Electric Company (PG&E) shows Tesla Megapack system in Moss Landing, Ca., that is now operational. (PG&E via AP).)

Follow @KClark_News

A fire broke out at PG&E's Elkhorn Battery energy storage system in Moss Landing, California, on September 20.

PG&E told Bloomberg the fire involved a single Tesla Megapack. The battery storage facility in Monterey County was disconnected from the grid, and the incident has not triggered any blackouts, the utility said. No injuries have been reported.

At 8:30 a.m. PST, the North County Fire District said the fire was active but "de-escalating." The department asked nearby residents to shelter in place. The fire also shut down a stretch of California Highway 1

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Home > Tesla > Cybertruck > News

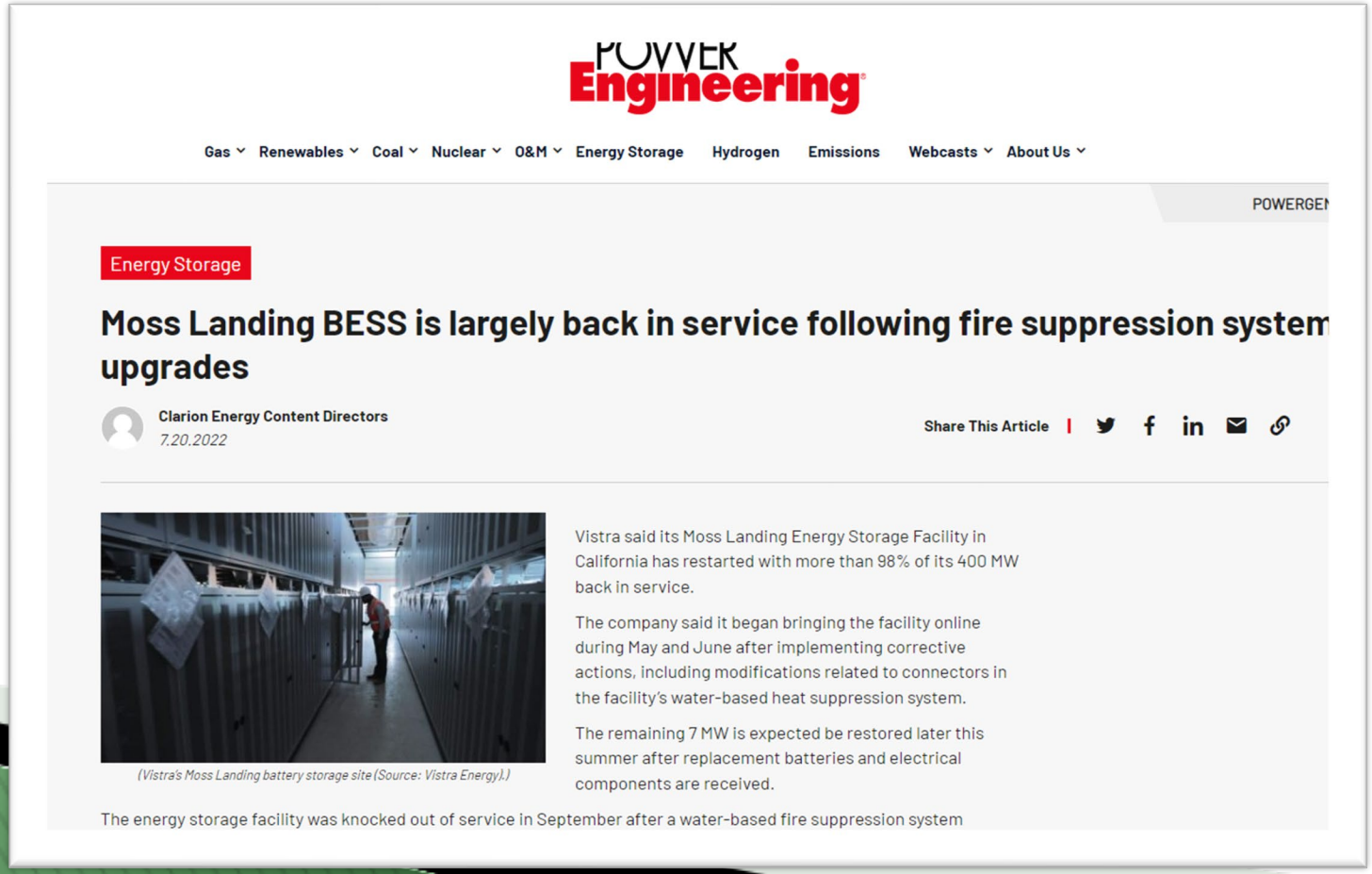
PG&E Commissions Its Moss Landing Elkhorn Battery: 256 Tesla Megapacks

A Tesla Cybertruck appeared at the official event.

BESS Facilities

- Vistra, Moss Landing, Monterey County 400 MW / 1600 MWh.
- Vistra proposed location:
  - Morrow Bay
  - 600 MW / 2,400 MWh of Lithium-ion Batteries

Planned: 750 MW/3,000 MWh,



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Energy Storage

Moss Landing BESS is largely back in service following fire suppression system upgrades

Clarion Energy Content Directors
7.20.2022

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(Vistra's Moss Landing battery storage site (Source: Vistra Energy).)

Vistra said its Moss Landing Energy Storage Facility in California has restarted with more than 98% of its 400 MW back in service.

The company said it began bringing the facility online during May and June after implementing corrective actions, including modifications related to connectors in the facility's water-based heat suppression system.

The remaining 7 MW is expected be restored later this summer after replacement batteries and electrical components are received.

The energy storage facility was knocked out of service in September after a water-based fire suppression system

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AES Alamitos, Long Beach

- 100 MW / 400 MWh

Crimson Energy

- Long Beach, CA
- 250 MW/1,400 MWh

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NEWS

Crimson Energy Storage 350MW/1,400MWh battery storage plant comes online in California

By Andy Colthorpe

October 18, 2022

Americas, US & Canada Grid Scale Business, Policy, Technology

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LS Power-Gateway Energy Storage System

- San Diego
- Lithium-ion
- 250 MW

Power Technology

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LS Power-Gateway Energy Storage System, US

Carmen

The LS Power-Gateway Energy Storage System is a 250,000kW energy storage project located in San Diego, California, US.

The electro-chemical battery energy storage project uses lithium-ion as its storage technology. The project was announced in 2020.

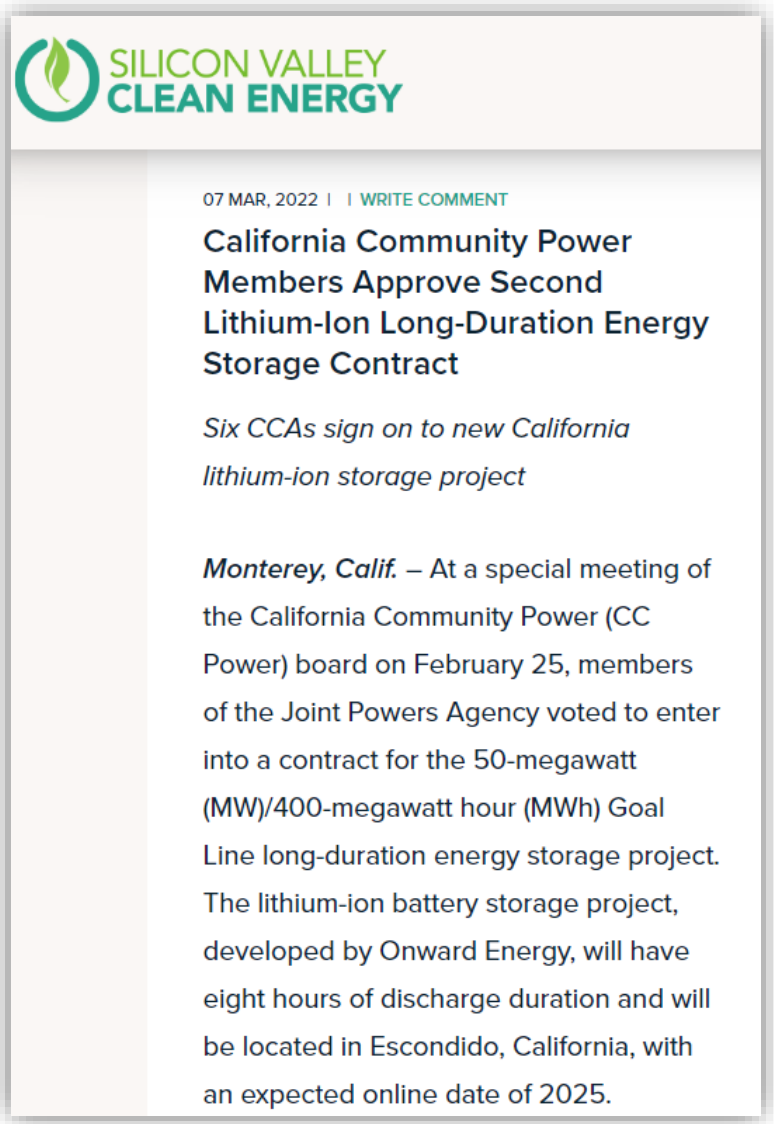
Lithium Ion BESS Upcoming PG&E - 9

Project name	Output/Capacity	Location	Timeline
Beaumont Energy Storage	100MW/400MWh	Beaumont, Riverside County	August 2023
Edwards Sanborn Energy Storage (Solar + Battery)	169MW/676MWh	Mojave, Kern County	August 2023
Canyon Country Energy Storage	80MW/320MWh	Santa Clarita, LA County	October 2023
MOSS350	350MW/1400MWh	Moss Landing, Monterey County	August 2023
Inland Empire Energy Storage	100MW/400MWh	Rialto, San Bernadino County	April 2024
Corby Energy Storage	100MW/400MWh	Vacaville, Solano County	June 2024
Kola Energy Storage	275MW/1,100MWh	Tracy, Alameda County	June 2024
Nighthawk Storage	300MW/1,200MWh	Poway, San Diego County	June 2024
Caballero Energy Storage	99.7MW/398.8MWh	Nipomo, San Luis Obispo County	June 2024

Microgrids and CCA

- Borrego Springs Demonstration 2019. SDG&E . 3 Lithium Ion battery (substations). 0.25-1 MW. These installations may include hydrogen fuel cell power generation.
- California CCA (community choice aggregator) : Nov. 2022 data
  - 21 storage projects completed through 2022
  - 75 planned through 2026.

CCA	Project Name	Technology	Capacity (MWh)	County	Online Year
Clean Power Alliance	Rexford	Solar + Storage	960.0	Tulare	2024
Clean Power Alliance	Desert Quartzite	Solar + Storage	600.0	Riverside	2025
San Diego Community Power	Viking Energy Park	Solar + Storage	600.0	San Diego	2023
East Bay Community Energy	Oberon	Solar + Storage	500.0	Riverside	2024
MCE	Golden Fields	Solar + Storage	375.0	Kern	2025
CleanPowerSF	IP Aramis	Solar + Storage	300.0	Alameda	2025
Silicon Valley Clean Energy	Baldy Mesa	Solar + Storage	300.0	San Bernardino	2024
East Bay Community Energy	Tumbleweed	Standalone Storage	200.0	Kern	2024
San José Clean Energy	Tumbleweed	Long-Duration Storage	123.0	Kern	2026



SILICON VALLEY CLEAN ENERGY

07 MAR, 2022 | | WRITE COMMENT

California Community Power Members Approve Second Lithium-Ion Long-Duration Energy Storage Contract

Six CCAs sign on to new California lithium-ion storage project

Monterey, Calif. – At a special meeting of the California Community Power (CC Power) board on February 25, members of the Joint Powers Agency voted to enter into a contract for the 50-megawatt (MW)/400-megawatt hour (MWh) Goal Line long-duration energy storage project. The lithium-ion battery storage project, developed by Onward Energy, will have eight hours of discharge duration and will be located in Escondido, California, with an expected online date of 2025.

https://svcleanenergy.org/

Agenda

1. Context – How it fits together
2. Battery function, safety, and types
3. Flow chart - How to report batteries

UPAAG Approved

CalEPA
California Environmental Protection Agency

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UNIFIED PROGRAM
ADMINISTRATION AND
ADVISORY GROUP (UPAAG)

HAZARDOUS MATERIALS BUSINESS PLAN (HMBP)
STEERING COMMITTEE

HAZARDOUS MATERIALS BUSINESS PLAN (HMBP)
TECHNICAL ADVISORY GROUP

BATTERY REPORTING GUIDANCE

FOR

UNIFIED PROGRAM AGENCIES

Edition:
March 10, 2022

UPAAG Adopted Date:
March 10, 2022

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TAG Established Work Group

- CUPA / Fire representatives from across the state

HansenRooks, Summer	Orange County
Helm, Apollonia (Polly) and Erin Thomas	San Mateo County
Keene, Matt	Sacramento County
Kirby, Lee	Downey Fire
Matt Stueber	Ventura County
Whittle, Jim	Shasta County
James Pawlonek, John Wallace, and Nritya Hosamane	Riverside County
Resources	
Darwin Cheng	OC Health, Env. Health
Frederick Chun	Santa Clara Fire

Reviewed Current Status

- What types of hazardous materials? Solid? Liquid?
- What types of hazards? Uses? Facilities?
- HM Definitions
- HMBP/ EPCRA / Fire Code reporting
- Jurisdictions with lower reporting thresholds

Result

- *Provide guidance: A framework to support current and future reporting of all kinds of batteries.*

25th California Unified Program
Annual Training Conference
March 20-23, 2023

Fire Jurisdictions

- California Code of Regulations, Title 24 California Building Standards Code, Part 9 - 2022 California Fire Code.
  - Chapter 2: Definitions
  - Chapter 12: Energy System
- Telecom: NFPA 76 Standard for the Fire Protection of Telecommunications Facilities

Fire Code Guidance

Table 1207.1.1 Energy Storage Systems (ESS) Threshold Quantities

*50 gal lead-acid battery equivalent to 70kWh

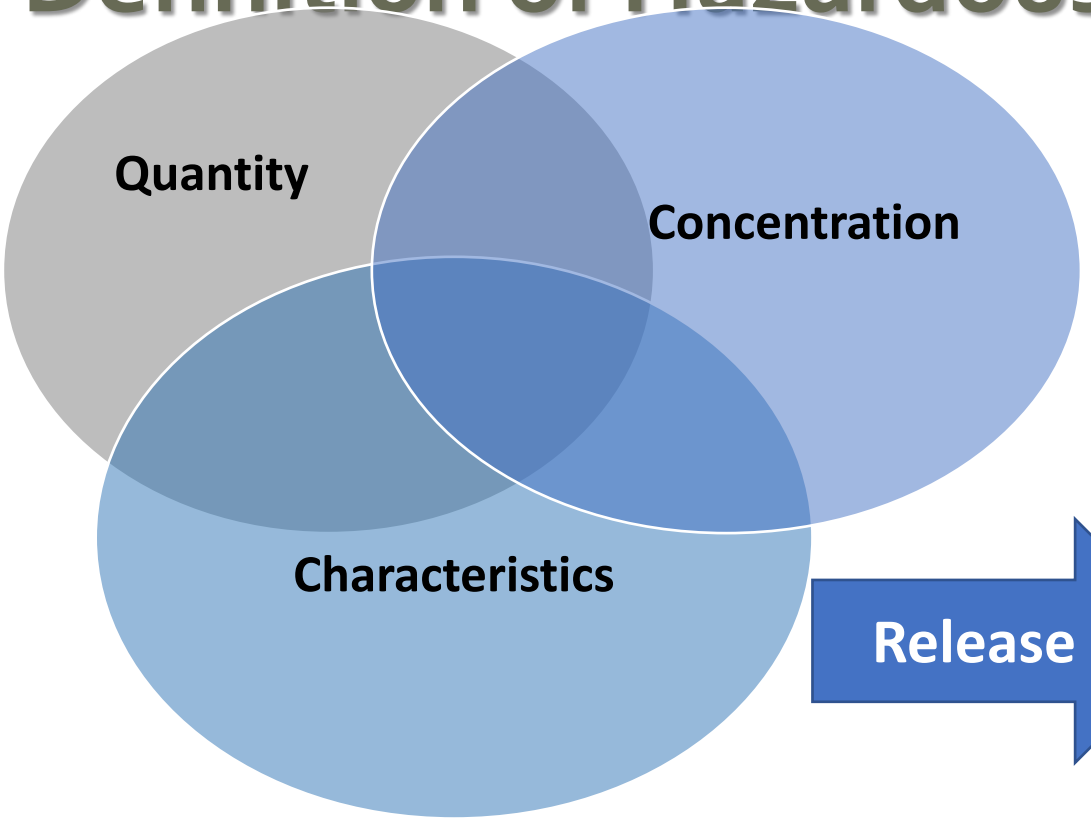
Battery Technology	Capacity
Flow batteries	20 kWh
Lead acid, all types	70 kWh
Lithium-ion	20 kWh
Nickel metal hydride	70kWh
Nickel cadmium (Ni-Cd)	70 kWh
Other battery technologies	10 kWh
Other electrochemical ESS tech	3kWh

California Fire Code Table 1206.2
Battery Storage System Threshold Quantities

Critical Issues

- Hazardous Material definition, 25501(n)
- What is included and what is exempted?
  - "Article" by definition
  - "Consumer Product" by definition.

Definition of Hazardous Material



Release

"Hazardous material"

Includes (n)(2)(A)-(E), for example:

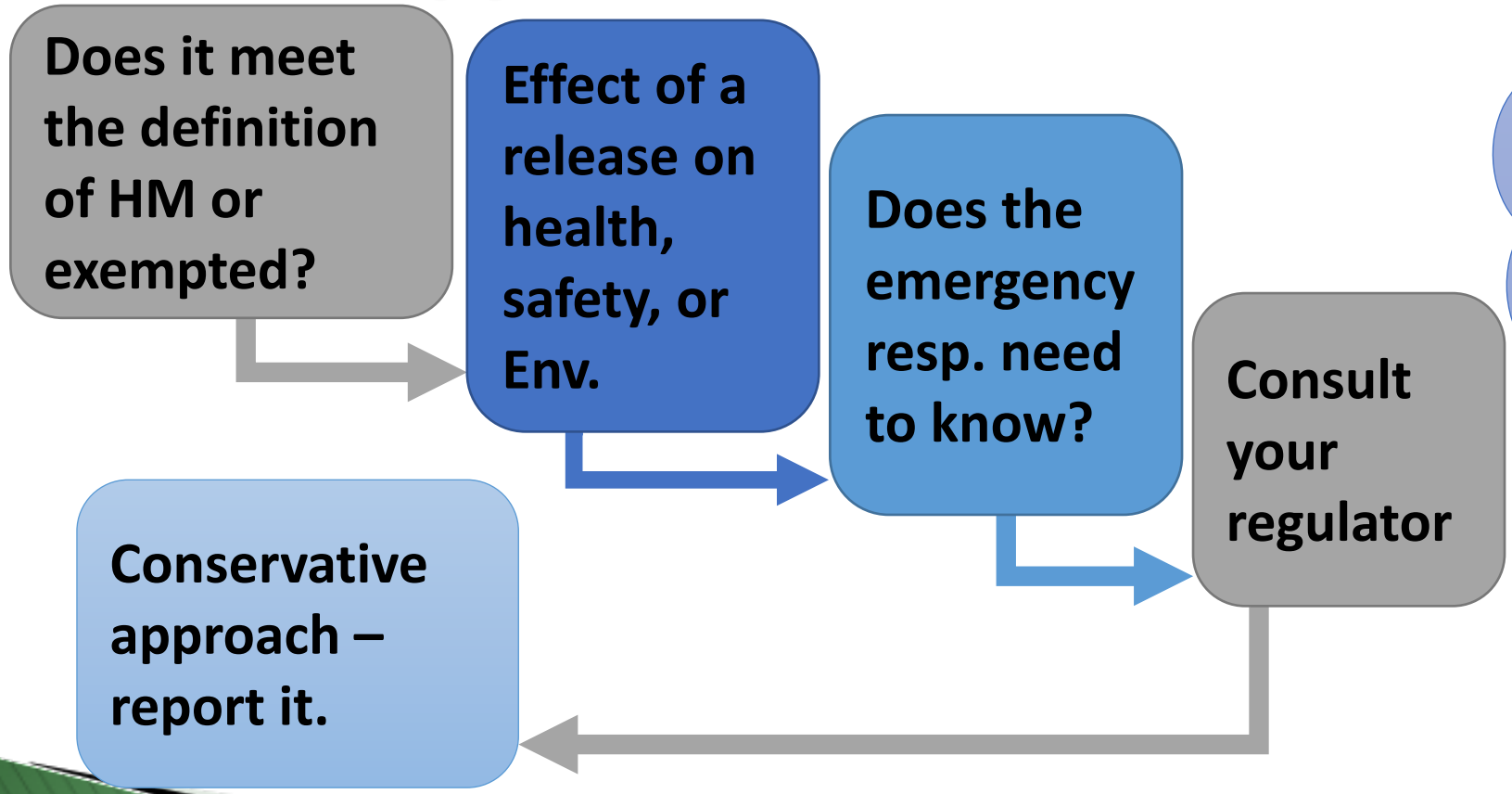
a) Required to have SDS

b) Hazardous Waste

c) On DOT table

The quantity, concentration, or physical or chemical characteristics, pose a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. Definitions: HSC 25501 (n)(1)

Sensible approach



Consider:

1. **Nature of business.**
2. **Proximity to people or sensitive sites.**
3. **Potential damage that the hazardous material may cause.**

[CCR Title 19 2650-2660]

[HSC 25503]

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Exemptions

Does the battery qualify for the “article” or “consumer product” exemption?

(1st question on the flow chart)

"Article"

Technical data sheet: "this item is an "article". According to HazCom, NO SDS REQUIRED. By definition, "Article" is not a hazardous material (HSC 25501(n)(2)) because it is not required to have an SDS under Haz. Com.

FACILITY / MANUFACTUER

KEY CRITERIA: "under normal conditions of use does not release … a hazardous chemical and does not pose a physical hazard or health risk to employees" (1910.1200(c)). These items do not meet the definition of an "article": Lead-Acid battery, Lithium-ion battery.

OSHA

Hazard Communication standard in CFR 1910.1200(b)(6)(v)

EPCRA Reporting

YES. This applies to chemicals required to have SDS under HCS. No lead-acid batteries and lithium-ion batteries are not "articles" according to OSHA in the HCS.

considered "articles", OSHA has determined, similar to lead-acid batteries, that lithium ion batteries are not considered "articles" and are subject to the OSHA HCS regulations. Although these batteries are sealed, they have the potential to leak, spill or break during normal conditions of use and in foreseeable emergencies causing exposure to chemicals. Thus, since owners / operators of facilities are required to prepare or have an MSDS for lithium ion batteries, they must complete MSDS Reporting and Tier II Reporting if the applicable reporting thresholds in 40 CFR Part 370.10 are met or exceeded.

Consumer products are exempt.

household purposes, or is present in the same form and concentration as a product packaged for distribution and use by the general public (40 CFR 370.13(c)(1)). This exemption would not apply to any large commercial type batteries that are not available for purchase

Lithium Ion Batteries – EPCRA Reporting (EPA.GOV) (7/30/2020)

Updated Consumer product definition: HSC 25501(j), 25507(b)(5)

- "Consumer product" means a commodity that is used for personal, family, or household purposes, or that is present in the same form, concentration, and quantity as a product prepackaged for distribution to a consumer for personal, family, or household purposes. A product that is not sold for personal, family, or household use is not a "consumer product."
- Inside a retail establishment + Direct sale to end user

Updated Consumer product definition: HSC 25501(j), 25507(b)(5)

- Does not apply to:

Manufacturing or separate warehouse / distribution center with no direct sales to consumer.

- HMIS / NFPA 3 or 4 at greater than 165 g / 1500 lbs / 600 CF
- Or poses a significant potential hazard (at 55 g / 500 lbs/200 CF), UPA may require reporting

DOT HM Table

- Definition, 25501 (n)(2)(A)-(E) also includes the hazardous material table: (C) Listed in 49 CFR
  - Batteries, dry, containing potassium hydroxide solid, electric storage
  - Batteries, dry, sealed, NOS (used for Batteries, nickel-metal hydride)
  - Batteries, wet, filled with acid, or filled with alkali, or non-spillable
  - Lithium-ion batteries including lithium-ion polymer
  - Lithium metal batteries including lithium alloy batteries

49 CFR 172.101 Haz. Materials Table

Entering Data - Guidance

- Title 27 – lead acid batteries
- Example using the flow chart.

Title 27 Lead-Acid Battery Reporting

27 CCR § 15186.1

§ 15186.1. Standard Descriptions for Chemical Inventory Reporting.

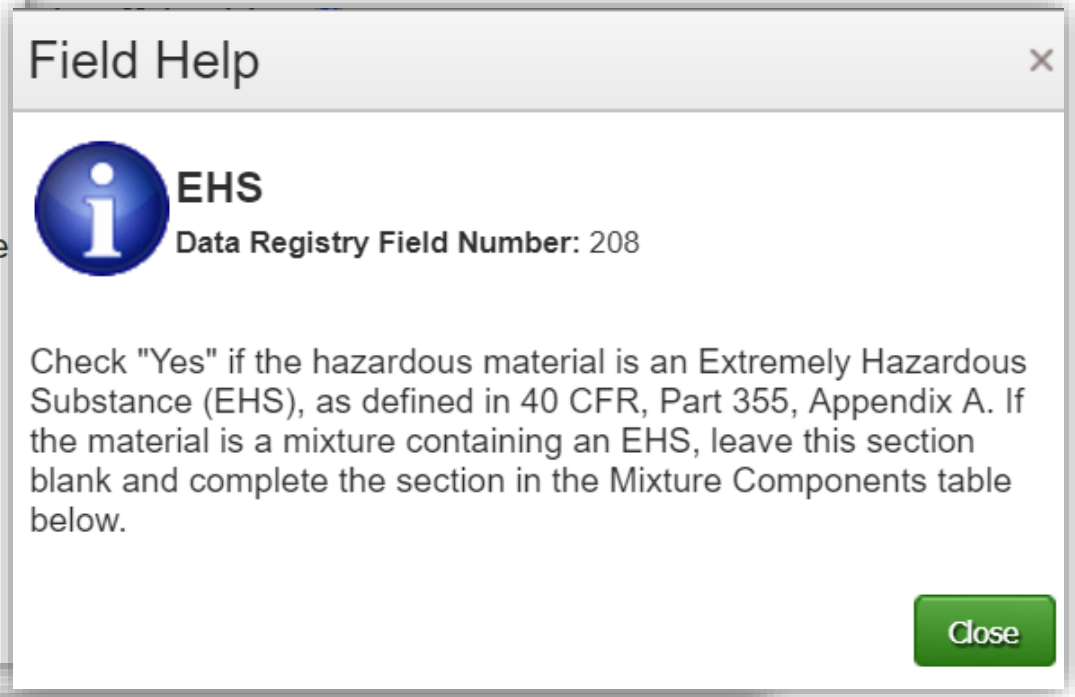
a) A handler shall report lead acid batteries as part of a chemical inventory submission using the standard descriptions and values contained in the CERS Chemical Library (template CCL-06669) as follows:

(1) Data element 205, Chemical Name, is “Lead Acid Batteries”.

(2) Data element 206, Trade Secret, is “No”.

(3) Data element 207, Common Name, is “Lead Acid Batteries”.

(4) Data element 208, EHS, shall be left blank.



(18) Data element 226, Hazardous Component 1 Percent by Weight, is “40”.

(19) Data element 227, Hazardous Component 1 Name, is “Sulfuric Acid”.

(20) Data element 228, Hazardous Component 1 EHS, is “Yes”.

(21) Data element 229, Hazardous Component 1 CAS #, is “7664-93-9”.

Entering Data - Scenario

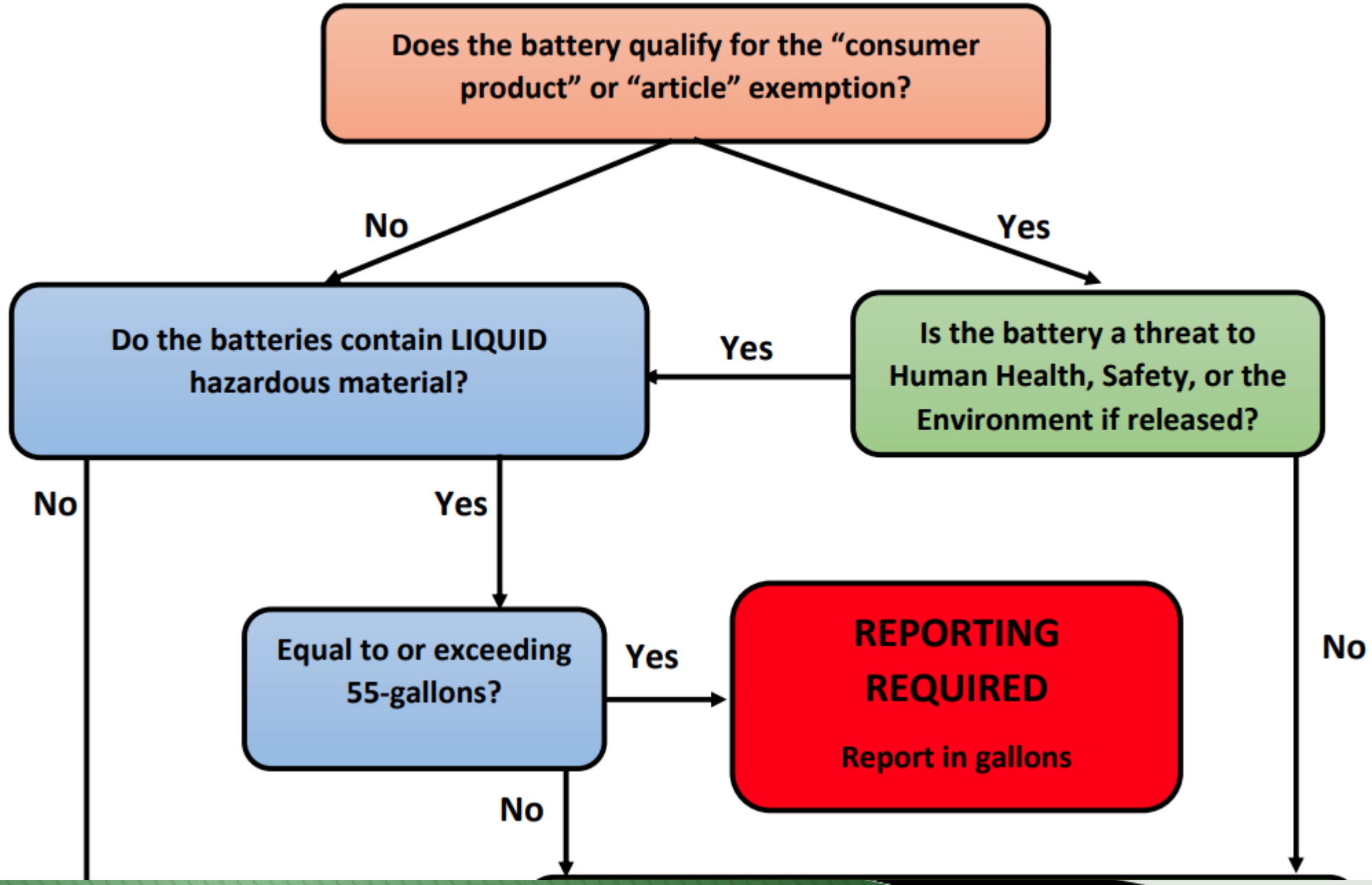
- Large facility with Li-ion batteries. Lithium Iron Phosphate.
- Has a SDS with hazard warnings. Industrial use.
- Over 500 lbs of batteries.

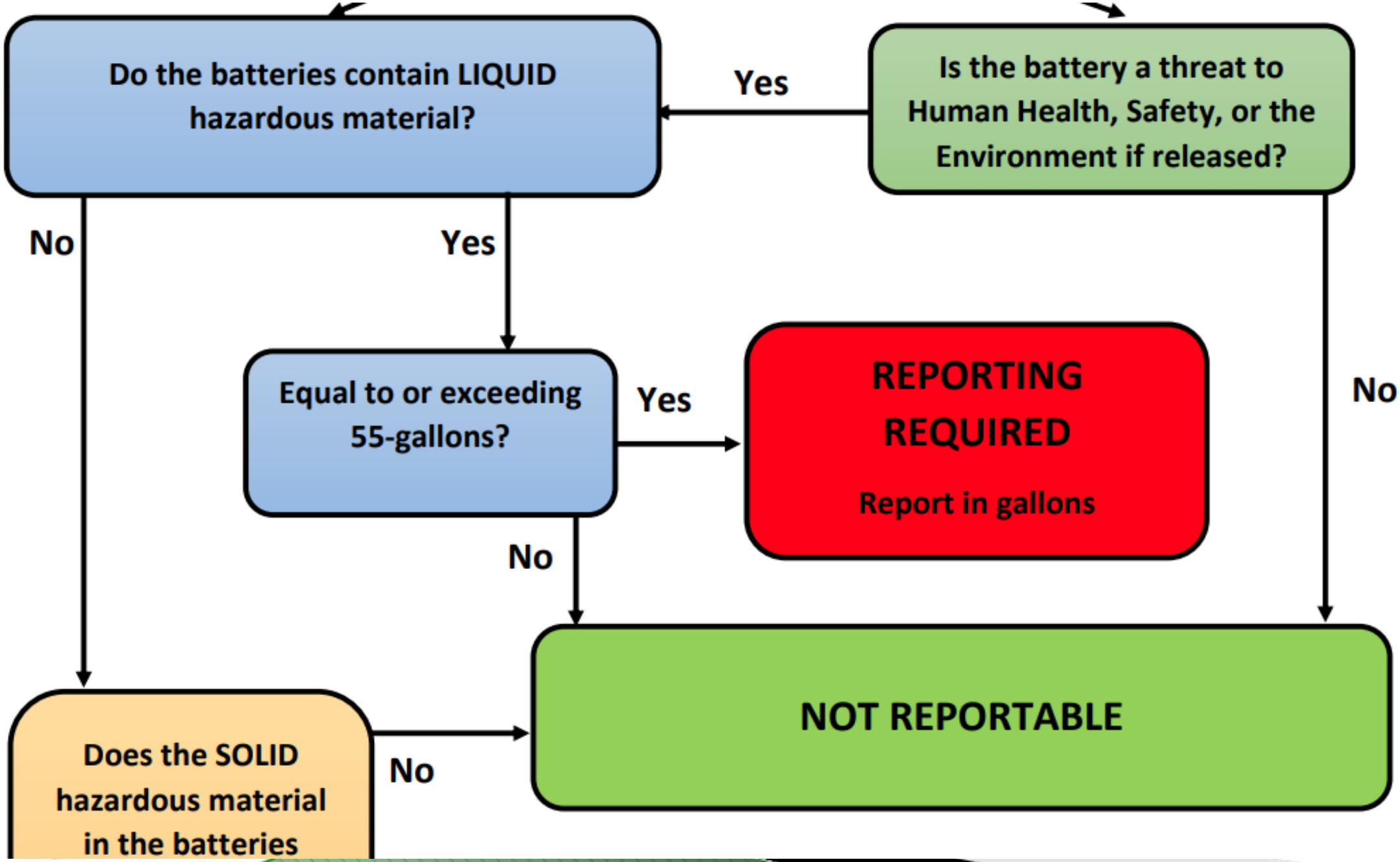
Entering Data - Scenario

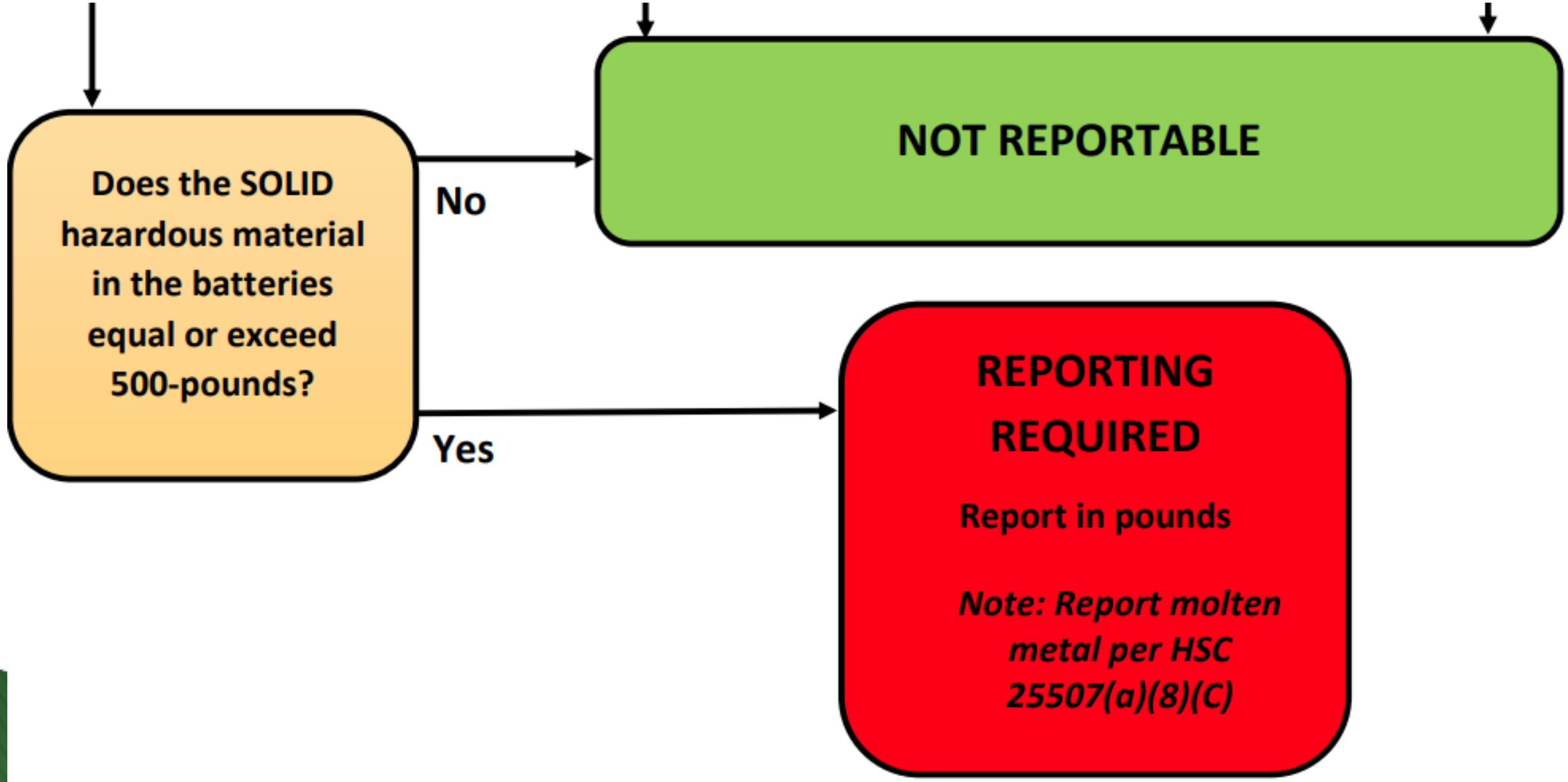
- Electrochemical batteries?
- Exemptions?
- Contains liquid?
- Exceeds threshold?
- Report it?

- Yes, use flow chart.
- No
- No
- Yes, 500 lbs
- Yes

Battery Reporting Flow Chart for HMBP




Is the battery a threat to Human Health, Safety, or the Environment if released?
Yes
Do the batteries contain LIQUID hazardous material?
No
Yes
Equal to or exceeding 55-gallons?
Yes
REPORTING REQUIRED
Report in gallons
No
No
NOT REPORTABLE
Does the SOLID hazardous material in the batteries
No


Does the SOLID hazardous material in the batteries equal or exceed 500-pounds?
No
NOT REPORTABLE
Yes
REPORTING REQUIRED
Report in pounds
Note: Report molten metal per HSC 25507(a)(8)(C)

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What About Device Batteries?

- Can be collected in significant quantities
- May have a storage of new batteries and storage of waste batteries.

Reporting – Mixture components vary

Mixture Components

Hazardous Component Name	CAS Number	% by Weight	EHS
Lithium Cobalt Oxide	12190-79-3	35	Yes / No
Carbon, various forms	7440-44-0	30	Yes / No
Polyer Binders		1	Yes / No
Copper	7440-50-8	15	Yes / No
Aluminum	7429-90-5	10	Yes / No

Additional Mixture Components

Organic Carbonates - 10%
Lithium Salts - 6%
Biphenyl - 92-52-4 - .3%

Example SDS

- "Lithium Iron Phosphate batteries for use in electric storage and solar energy installations. (Electric storage Battery)"

Section 2 - Hazards Identification

Statement of Hazardous Nature

Based on OSHA 29 CFR 1910.1200, these products meet the definition of an "article" and they are not subject to the hazards normally associated with the individual components when used as intended.

DG Classification: Class 9: Miscellaneous Dangerous Goods.

UN Number: 3480 Lithium ion Batteries

GHS Signal word: DANGER

CAS No: 1333-86-4

CLASSIFICATION ACCORDING TO GHS

Self-heating substances and mixtures (1)

Carcinogenicity (2)

Specific target organ toxicity, repeated exposure (1) (lung)

RESPONSE:

P308 + P313: If exposed seek medical attention.

P314: Seek medical attention if you feel unwell.

STORAGE:

P407: Maintain air gap between stacks or pallets.

Weight Provided on SDS

Appearance/ State: Cylindrical - Solid

Section 16 - Other Information

Type	Volts	C/10	Height (mm)	Length (mm)	Width (mm)	Weight (kg)
1	48	80	222	460	240	36
2	48	100	317	558	170	45
3	48	100	133	552	483	47

eye contact, skin contact and ingestion. The following hazard classifications only apply to the electrolyte.

- H226 - Flammable Liquid (Category 3)
- H302 - Oral Toxicity (Category 4)
- H314 - Skin Corrosion/Irritation (Category 1)
- H318 – Eye Irritation (Category 1)
- H335 - Specific organ toxicity; single exposure; respiratory tract irritation (Category 3)
- H372 – Specific organ toxicity; repeated exposure (bones , teeth) (Category 1)

2.2. GHS Label Elements

2.2.1. Pictogram (Electrolyte)

2.2.2. Signal Word: DANGER

Solid vs. Liquid

Section 9: Physical and Chemical Properties

Physical and Chemical Property		Electrolyte
Physical State	Solid	No data available
Color	No data available	No data available
Odor	Odorless	No data available
Melting point/freezing point	No data available	No data available
Boiling point	No data available	No data available
Flammability	No data available	No data available
Lower/upper explosion limit	Not applicable (solid)	No data available
Flash point	Not applicable (solid)	No data available
Evaporation Rate	Not applicable (solid)	No data available

Solid vs. Liquid

- "Lithium ion batteries contain flammable liquid electrolyte that may vent, ignite and produce sparks when subjected to high temperatures (> 150 °C), when damaged or abused (e.g., mechanical damage or electrical overcharge). Burning cells can ignite other batteries in close proximity."

Page 7

If the physical state of materials contained within the battery is unclear (e.g. some electrolytes are in gel form), definitions to help distinguish between a solid and liquid can be found in the California Fire Code Ch. 2 and they are provided here for reference.

Solid – a material that has a melting point and decomposes or sublimes at a temperature greater than 68°F (20°C).

Liquid – a material having a melting point that is equal to or less than 68°F (20°C) and a boiling point which is greater than 68°F (20°C) at 14.7 pounds per square inch absolute (psia)(10kPa). Where not otherwise identified, the term "liquid" includes both flammable and combustible liquid.

Technical Data Sheet (TDS)

BATTERY CHEMISTRY	
Capacity	1.2 kWh / 48.5 Ah
Nominal voltage	25.6 VDC
Depth of discharge (usable capacity)	100%
Ambient operating temperature range	-20° C to 45° C (-4° F to 113° F)
Chemistry	Lithium Iron Phosphate (LFP)
Cell safety certifications	TÜV Rheinland, UL
Roundtrip cell efficiency[1]	96%
MECHANICAL DATA	
Dimensions	390 mm (W) x 325 mm (H) x 220
Weight	25 kg (55 lbs)
Installation	Wall mounted in an indoor space
Enclosure	Indoor – IP20 / NEMA 2
Cooling	Natural convection – No fans

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Chemical Name	CAS #	EINECS EC#	Concentration Range in Electrolyte (w/w %)	Mass Range in Cell (g/g %)
Electrolyte				
Lithium Hexfluorophosphate	21324-40-3	244-334-7	10-20	1-5
Lithium bis-trifluoromethanesulfonoimide	90076-65-6	415-300-0	1-5	0.1-1
Electrolyte Solvents				
Ethylene Carbonate	96-49-1	202-510-0	80-90	10-20
Propylene Carbonate	108-32-7	203-572-1		
Diethyl Carbonate	105-58-8	203-311-1		
Dimethyl Carbonate	616-38-6	210-478-4		
Ethyl methyl carbonate	623-53-0	No listing		
1,3 - Propanesultone	1120-71-4	214-317-9		

Calculation

- If HM is 26% of mass
- Calculation solid: (26/100)*55 lbs = 14.3 lbs, *35 batteries = reportable at 500 lbs

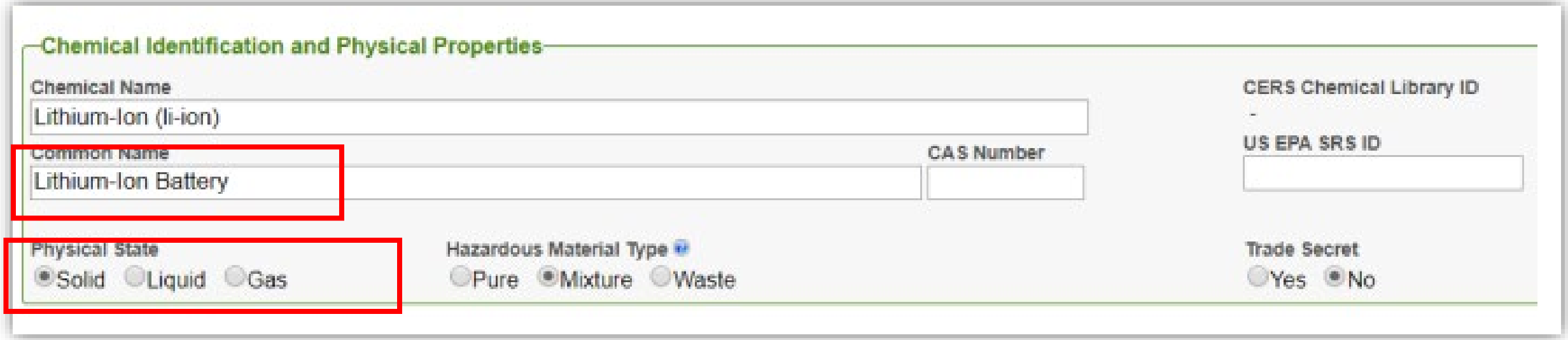
- Calculation liquid electrolyte: $\frac{(26/100)*55 \text{ lbs}}{\text{Specific gravity} * 8.34 \text{ lbs/gal}}$

Example Contents

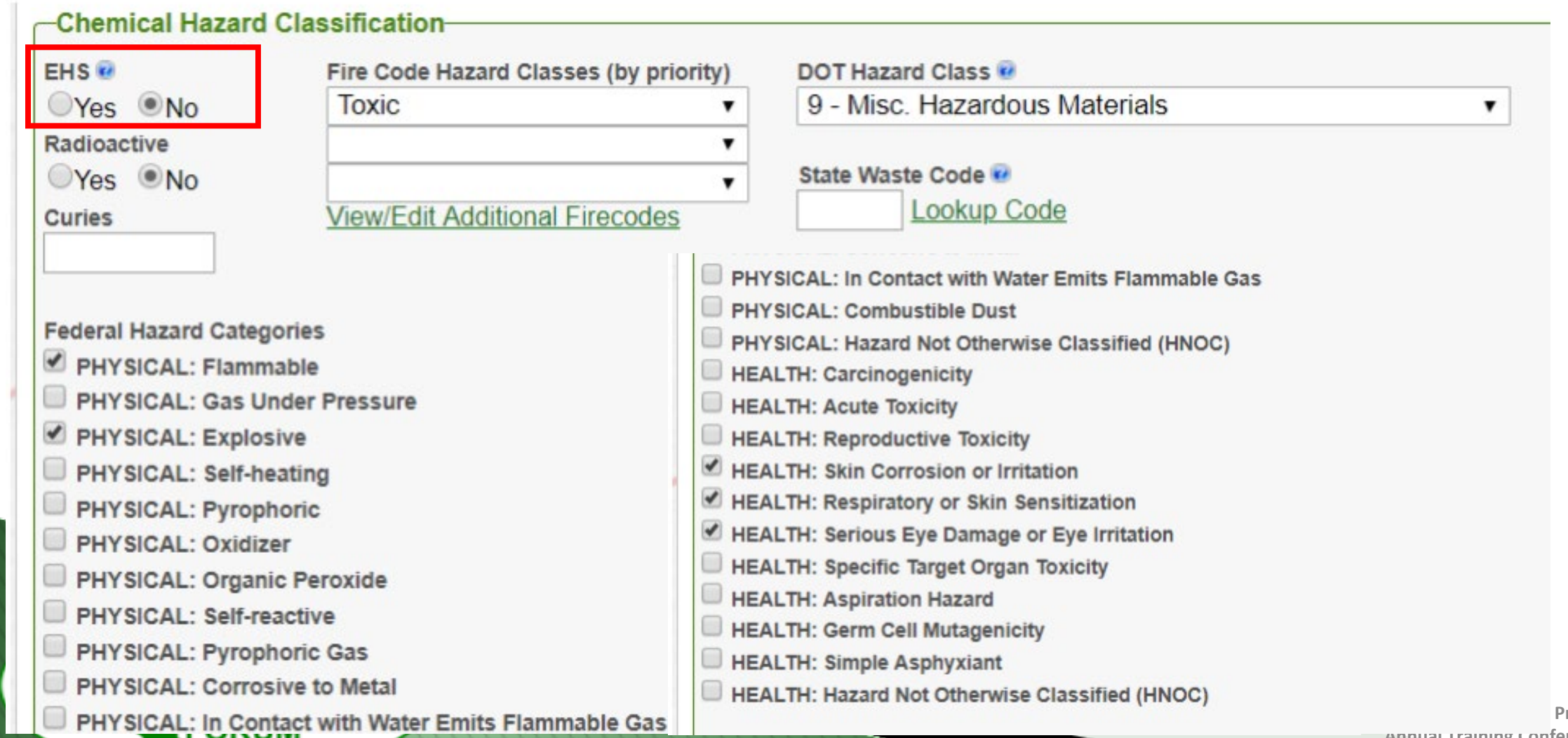
Ingredients

Cathode.	Lithium Iron Phosphate	(active material)
	Polyvinylidene Fluoride	(binder)
	Graphite	(conductive material)
Anode:	Graphite	(active material)
	Polyvinylidene Fluoride	(binder)
Electrolyte:	Organic Solvent	(non-aqueous liquid)
	Lithium Salt	
Others:	Heavy metals such as Mercury, Cadmium, Lead, and Chromium are not used in the batteries.	

Reporting


Chemical Identification and Physical Properties
Chemical Name
Lithium-Ion (li-ion)
CERS Chemical Library ID
-
US EPA SRS ID
Common Name
Lithium-Ion Battery
CAS Number
Physical State
Solid
Liquid
Gas
Hazardous Material Type
Pure
Mixture
Waste
Trade Secret
Yes
No

Reporting – Hazard Classification

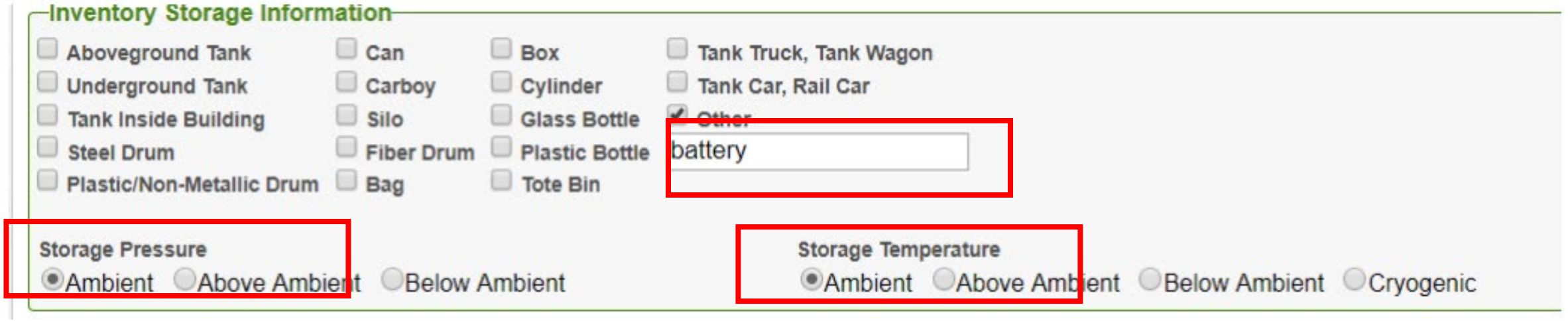


Reporting – Location and Quanitity

Inventory Location and Quantity

Chemical Location	**Average Daily Amount**	**Maximum Daily Amount**	**Units**
Battery rack	500	550	○ gallons
Chemical Location Confidential EPCRA	**Largest Container**	**Annual Waste Amount**	○ cubic feet
○ Yes ◉ No	5		◉ pounds
Map # (Optional) / **Grid # (Optional)**	**Days on Site**		○ tons

Reporting – Storage information



Reporting – Mixture components vary

Mixture Components

Hazardous Component Name	CAS Number	% by Weight	EHS
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Polyer Binders		1	Yes / No
Copper	7440-50-8	15	Yes / No
Aluminum	7429-90-5	10	Yes / No

Additional Mixture Components

Organic Carbonates - 10%
Lithium Salts - 6%
Biphenyl - 92-52-4 - .3%

Lead-Acid Batteries

- 14 batteries, 71 pounds each. 994 lbs total. **Reportable or not?**

- Cal/EPA Policy Memo (2011) & Federal reporting guidance.

- Main hazard – Releasable electrolyte. Calculate total on site.

Title 27 Lead-Acid Battery Reporting

27 CCR § 15186.1

§ 15186.1. Standard Descriptions for Chemical Inventory Reporting.

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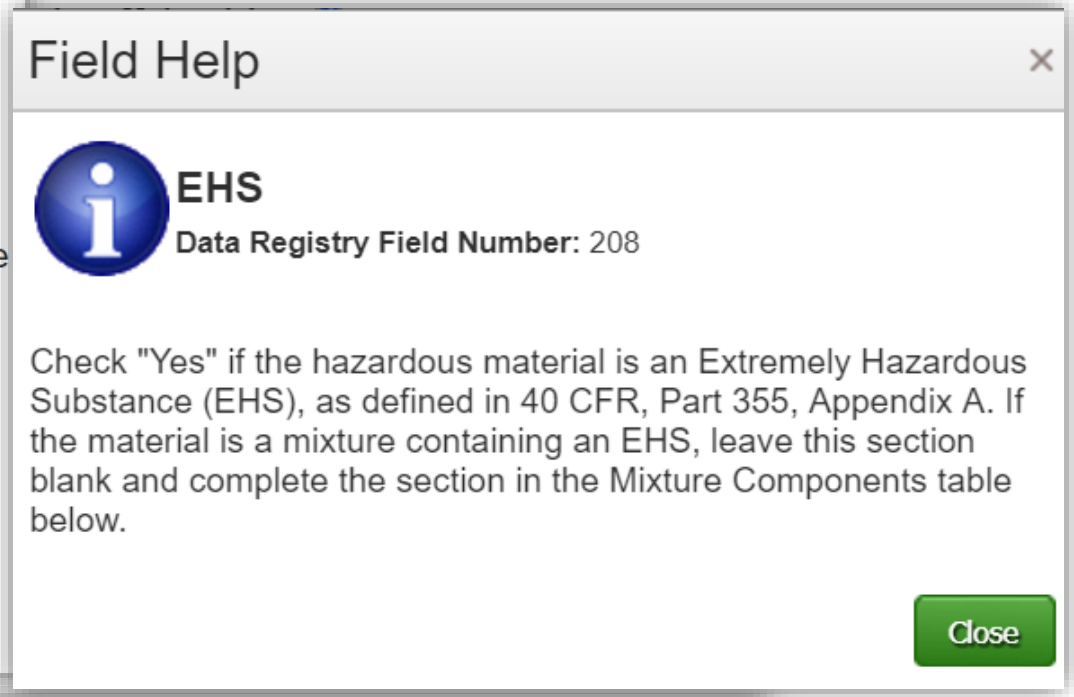

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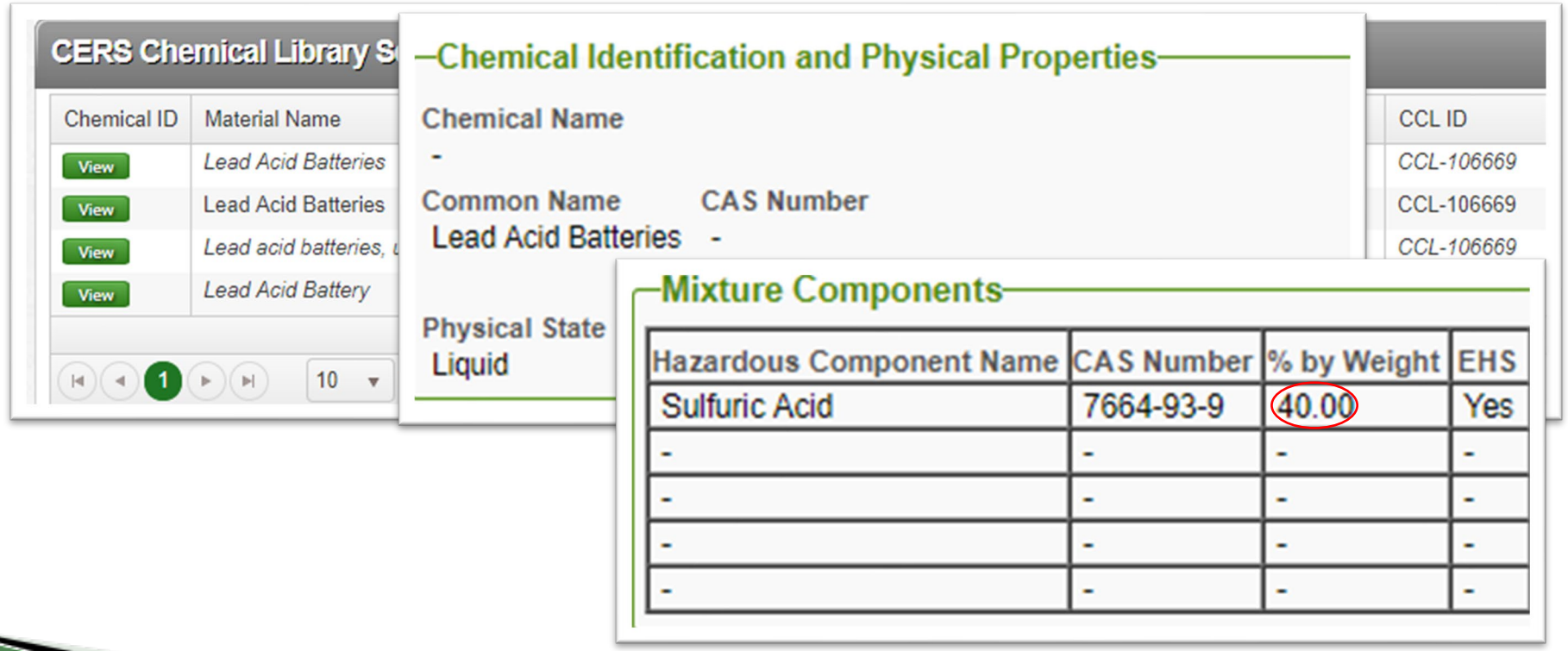
Lead-Acid Batteries Template on CERS



Lead-Acid Battery Calculation

Example: AGM-12125T

12 batteries *1.50 gallons Electrolyte per battery

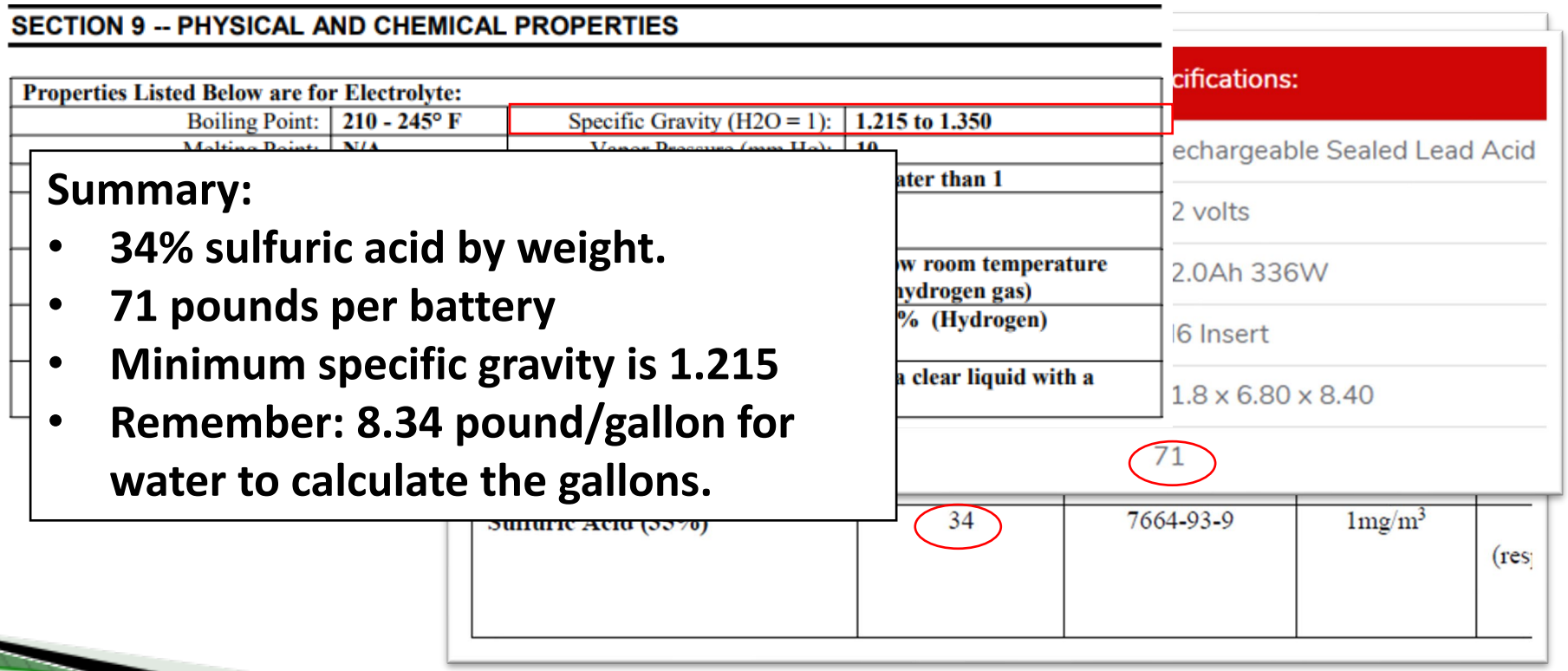
12*1.50= 18 gallons electrolyte

BELOW THRESHOLD

Part Number	Gallons of Electrolyte*
AGM-1234T	0.38
AGM-1240T	0.46
AGM-1248T	0.81
AGM-1255T	0.64
AGM-1265T	0.99
AGM-1280T	0.92
AGM-1285T	1.22
AGM-12100T	1.11
AGM-12125T	1.50
AGM-12148T	1.88
AGM-12210L	2.19
AGM-12255L	2.52
AGM-6100T	0.63
AGM-6220T	1.35
AGM-6300T	1.87
AGM-6400HT	2.54
AGM-2660T	1.35
AGM-2900T	1.87
AGM-21200HT	2.54

*Specific gravity of electrolyte when battery is fully charged ranges from 1.28 to 1.36.

Lead-Acid Battery Calculation



SECTION 9 -- PHYSICAL AND CHEMICAL PROPERTIES

Properties Listed Below are for Electrolyte:			
Boiling Point:	210 - 245° F	Specific Gravity (H2O = 1):	1.215 to 1.350

ater than 1

w room temperature
ydrogen gas)
% (Hydrogen)

a clear liquid with a

cifications:

echargeable Sealed Lead Acid

2 volts

2.0Ah 336W

6 Insert

1.8 x 6.80 x 8.40

71

Sulfuric Acid (33%)	34	7664-93-9	1mg/m³	(res

Summary:

- **34% sulfuric acid by weight.**
- **71 pounds per battery**
- **Minimum specific gravity is 1.215**
- **Remember: 8.34 pound/gallon for water to calculate the gallons.**

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Lead-Acid Battery Calculation

Total Electrolyte Volume = (%Weight/100) x (pounds per battery) / (Specific Gravity electrolyte) x (8.34 pounds/gallon)

$$\frac{(\%34/100) \times (71 \text{ pounds})}{(1.215) \times (8.34 \text{ pounds/gal})}$$

= 0.34*71 / (1.215*8.34) =
2.83 gallons per battery

2.83 gallons per battery * 14 batteries = 39.62 ≃ 40 gallons
40 gallons < 55 gallons, below threshold.

Conditional Exemptions

- **25507.2.**Corrosive liquids, not to exceed 500 pounds of extremely hazardous substances, used as electrolytes, and in closed containers.
- **25507 (a)(4) (A):** Below 5,000 pounds for solids or a total volume of 550 gallons for liquids - hazardous material classified as irritant or sensitizer.
- **Apply for an exemption 25507 (c)-(e):** Handler may apply for exemption from HMBP hazardous material.

HSC 25507, **HSC 25507.2.**

CUPA Exemptions

1. **CUPA may initiate exemption of a hazardous material (25507(c)).**
   - No significant threat in a release.
   - Proper notice: Public input, hearing. 15 day notice to secretary.
2. **Handler may apply for exemption from HMBP (25507(d)) or hazardous material (25507(e)).**
   1. Conditional exemption from portions of HMBP.
   2. Must find no a significant threat if released and no effect on emergency response to a release.
   3. Written basis for and circumstances that justifying the exemption.
   4. CUPA must have a procedure for public input.

Additional discussions

- Provide templates on CERS.
- Address questions about lithium ion battery contents

Are you fully Charged?

Know about batteries

Know where to expect them

Know how to report them

References

- US Energy Information Administration:
- CA Independent Systems Operator
- BatteryUniversity.com
- Energy.gov
- Cal CCA

Articles

- Techonology:
  - New generation of ‘flow batteries' could eventually sustain a grid powered by the sun and wind
- Energy storage facilities:
  - https://investor.pgecorp.com/news-events/press-releases/press-release-details/2022/The-Next-Giant-Leap-for-Electric-System-Reliability-PGE-Proposes-Nearly-1600-MW-of-New-Battery-Energy-Storage-Capacity/default.aspx
  - https://svcleanenergy.org/news/california-community-power-members-approve-second-lithium-ion-long-duration-energy-storage-contract/
  - https://cal-cca.org/california-ccas-exceed-11-gigawatts-in-long-term-contracting-with-new-build-clean-energy-resources/

Articles

- Toxic Gases:
  - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5577247/
  - Toxic fluoride gas emissions from lithium-ion battery fires
  - https://www.osti.gov/servlets/purl/1235360#:~:text=While%20other%20materials%20are%20being,ethyl%20methyl%20carbonate%20(EMC).
  - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5577247/
- Fires:
  - https://www.cnbc.com/2022/09/20/tesla-megapack-battery-caught-fire-at-pge-substation-in-california.html

RECORDED WEBINARS

- UL Test Method 9540A: https://www.ul.com/resources/ul-9540a-test-method-brings-clarity-insurance-and-fire-mitigation-professionals
- NAHMMA Battery Webinar Series: https://nahmma.org/Lithium_Battery_Webinar_Series

Videos

- FM Global test