Current Standards and Practices for Large Format Batteries

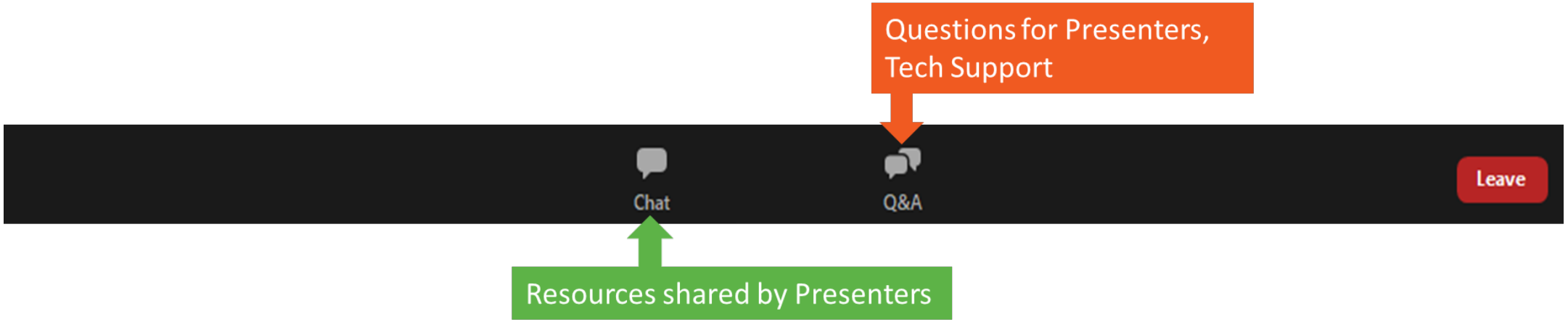
April 24, 2025

U.S. Environmental Protection Agency (EPA)

Logistics and Agenda Review

Pat Tallarico, ERG Team

Webinar Logistics



- **To ask a question:** Type your questions for presenters in the Q&A box. We will answer questions at the end of each presentation.
- **Technical difficulties:** If you are having technical difficulties, please send a message through the Q&A box or email hannah.rosenberg@erg.com

Join at slido.com
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Agenda Overview

1. Opening Remarks, Logistics, and Agenda Review
2. Electric Vehicle (EV) Battery Management: Current Practices and Policy Trends
   - **Kellen Mahoney**, Suppliers Partnership for the Environment
   - **Jeff Haltrecht**, Call2Recycle Canada
3. Decommissioning and End-of-Life Considerations for Stationary Battery Energy Storage
   - **Stephanie Shaw**, EPRI
   - **Taylor Kelly**, EPRI
4. SAE Global EV Battery Traceability Standard
   - **Brian Engle**, Society of Automotive Engineers (SAE) and Amphenol Advanced Sensors
   - **Frank Menchaca**, Li-Bridge
5. Questions and Comments
6. Wrap-up and Next Steps

Background

Ellen Meyer, EPA

Powering the Great American Comeback

- Activities are consistent with current administration priorities, including:
  - January 20, 2025, Executive Order "Unleashing American Energy"
  - Administrator Zeldin's Five Pillars to guide EPA's work:

Pillar 1:
Clean Air, Land, and Water for Every American

Pillar 2:
Restoring American Energy Dominance

Pillar 3:
Permitting Reform, Cooperative Federalism, and Cross-Agency Partnership

Pillar 4:
Make the United States the Artificial Intelligence Capital of the World

Pillar 5:
Protecting and Bringing Back American Auto Jobs

EPA's Ongoing Battery-Related Projects

Separate but complementary requirements in the Infrastructure Investment and Jobs Act (IIJA):

Extended Battery Producer Responsibility Framework

Battery Collection Best Practices

Education Materials

Voluntary Battery Labeling Guidelines

Vision for EPA's Resources and Guidelines

- **Battery Collection Best Practices**
  - EPA will develop best practices for Tribal, state, and local governments to recycle batteries in a manner that is:
    - Technically and economically feasible
    - Environmentally sound and safe
    - Optimizing value and use of materials, including critical minerals
  - Anticipated resources published in 2025 and 2026
    - Best practices document
    - Case studies

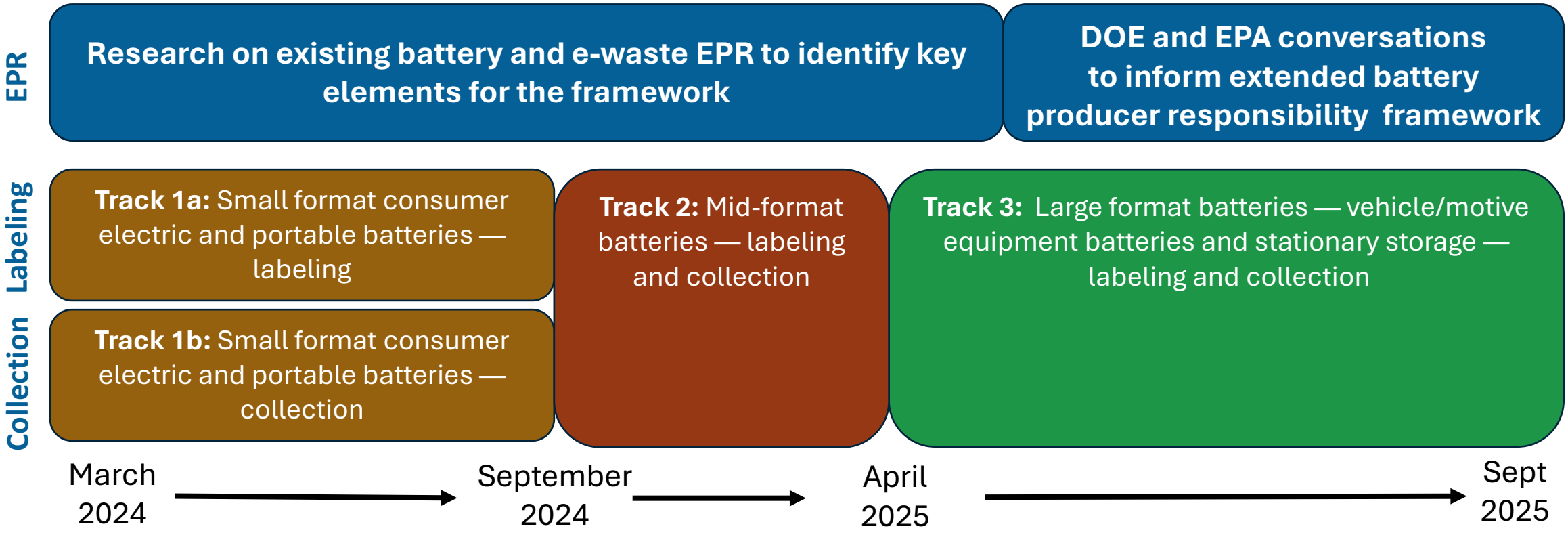
Vision for EPA's Resources and Guidelines

- **Voluntary Battery Labeling Guidelines**
  - EPA aims to develop guidelines for labels that will:
    - Identify battery collection locations
    - Educate consumers about recycling opportunities
    - Reduce safety concerns from improper disposal
  - Anticipated resources for publication in 2025 and 2026
    - Sets of written guidelines for various battery categories
    - Guidance will build on existing standards, emphasize good ideas, and address inconsistencies

Scope of Batteries

Category	Small format consumer electric and portable batteries		Mid-format batteries	Large format batteries
Type	Single use (Primary)	Rechargeable (Secondary)	Rechargeable	Rechargeable
Use	Removable or embedded in electronics and electric devices, such as watches, hearing aids, cameras, key fobs, toys, portable radios, flashlights.	Removable or embedded in electronics and electric devices, such as phones, computers, appliances, small uninterruptable power supplies (UPS), power tools, power banks.	E-mobility including e-bikes, e-scooters. Outdoor power equipment. Portable power stations.	All scales of automotive starting and motive vehicle batteries. Materials handling equipment (forklift, crane, etc.) Recreational (golf carts, marine equipment, recreational vehicles, etc.) Stationary storage (residential, grid, commercial, etc.)

Timeline of Battery-Related Conversations



Themes from Work to Date and Implications for Large Format Batteries

Pat Tallarico, ERG Team

Common Themes: Consumer Focus

People need to know that something is/has a battery

People should know how to identify and use labeled and certified batteries/devices

People should know what to do or not do with the battery/device

People should have access to convenient collection locations

There is already a lot of information on a battery, and adding more information may be difficult or ineffective

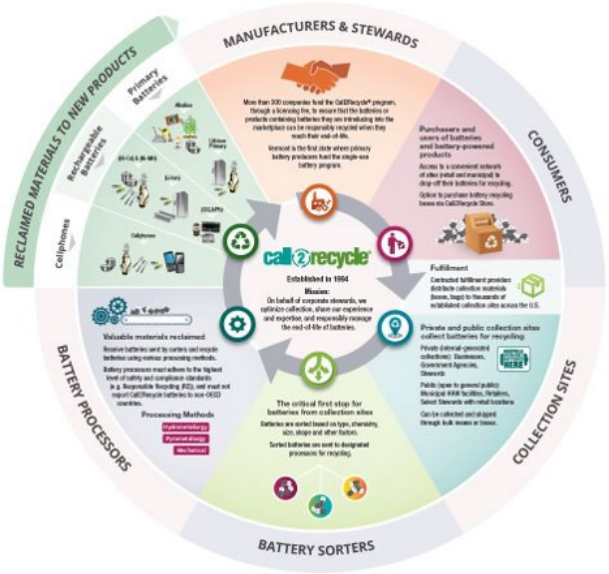
Common Themes: Collection Best Practices for Consumer Batteries

Enhance point of sale information and messaging

Convenient and well-marked collection locations; consistent and wide-spread outreach

Train employees at collection sites; ensure materials are properly packaged and labeled

Partner for program implementation; employ a hub and spoke model of collection for rural areas



Common Themes: Labeling Guidelines

It's a battery!

Do recycle it if you can! Don't put it in your bins!

State/condition

Chemistry

Link to more information

Color?

Common Themes: Challenges for Mid-Format Batteries

- Use/storage hazards
- Retailer concerns about serving as a collection point
- More complex shipping requirements and reluctance of shippers to take mid-format batteries
  - Remote and island locations are particularly challenging
- Difficult to assess charge and discharge safely
- Most current collection systems are voluntary, and some manufacturers / original equipment manufacturers (OEMs) do not participate
- Product design can limit the ability to extract and recycle batteries

Transitioning to Large Format

"Translating" Themes for Large Format

- **The role of the consumer**
  - Is there one? If so, what is it? What information do they need, or what messages do they need to hear?
- **“Collection” best practices**
  - What does collection look like (e.g., auto dealers, scrap dealers/recyclers, auction houses, etc.), and where are the weakest links in the large format battery collection system? How can this system be made more cost effective?
  - How can batteries be stored, discharged, and transported safely and efficiently?
  - How can batteries be designed for more efficient capture at end of life/next life?
  - How can we prevent automobiles and equipment from going abroad?

“Translating” Themes for Large Format

- **Labeling and information needs**
  - How do we address use of un-labeled/un-certified products?
  - Are there any labeling information gaps in current labeling standards or guidelines (e.g., state of health)?
  - How do we improve the information available about batteries (e.g., What is the role of Track and Trace requirements and technologies?)?
- **Training**
  - What are the training needs throughout the collection and recycling system? What do people need to know and what are the key gaps in training availability and content? What is already happening?
- **Economics of recycled materials**
  - What, if anything, can we do to promote the consistent supply of recyclable batteries?

What are you most interested in learning from the large format battery series?

EV Battery Management: Current Practices and Policy Trends

Kellen Mahoney, Suppliers Partnership for the Environment
Jeff Haltrecht, Call2Recycle Canada

SUPPLIERS PARTNERSHIP FOR THE ENVIRONMENT

call2recycle®
Leading the charge for recycling.™

EV Battery Management

Current Practices & Policy Trends

Kellen Mahoney, Executive Director, SP
Jeff Haltrecht, Executive, Call2Recycle

April 24, 2025

SUPPLIERS PARTNERSHIP FOR THE ENVIRONMENT

SP's Vision: an automotive industry with positive environmental impact.

CARBON NEUTRALITY

NATURE BASED SOLUTIONS

SUSTAINABLE MATERIALS

SUSTAINABLE PACKAGING

RESPONSIBLE BATTERIES

TECHNOLOGY & INNOVATION

TRANSPORTATION & LOGISTICS DECARBONIZATION

WATER STEWARDSHIP

SUPPLIERS PARTNERSHIP FOR THE ENVIRONMENT

EPR Readiness For EV Battery Recovery Project

1. Regulatory summary for all states
2. Types of take-back programs available
3. How each program type operates
4. Potential roles for different industry groups
5. How each OEM can prepare for EPR
6. Key dates
7. How to proceed forward and recommendations

Q1 2024 – US, Canada, EU regulatory comparison

Q3 2024 – Individual OEM needs assessment for EPR readiness.

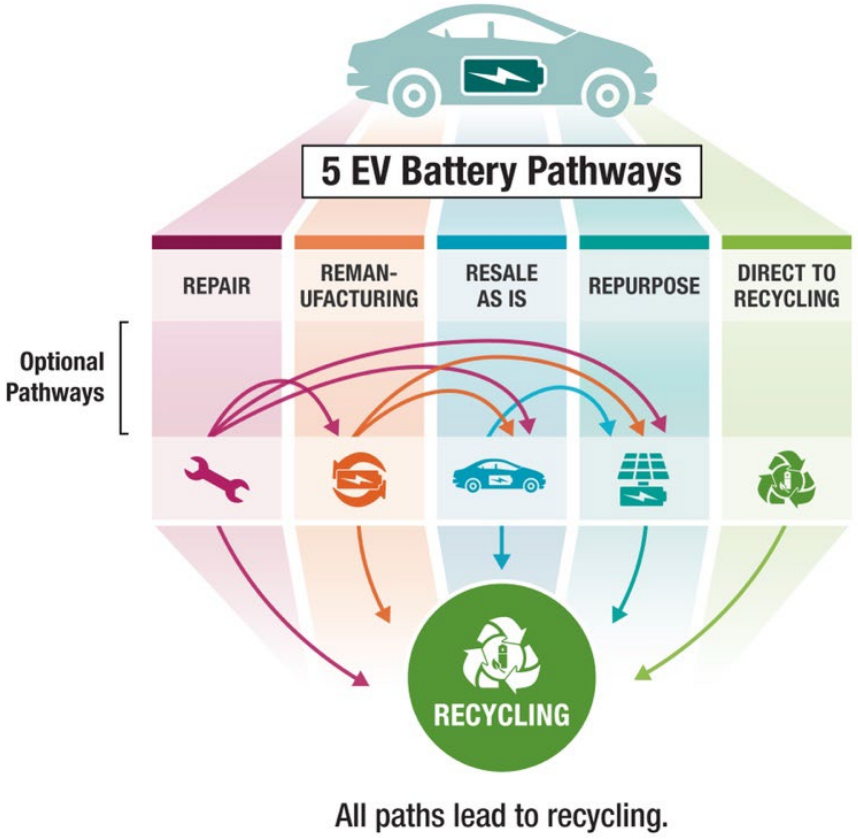
Q1 2025 – EPR Readiness Planning Guide

Research and report by:

call2recycle®
Leading the charge for recycling.™

5 EV Battery Pathways

All equal and interchangeable



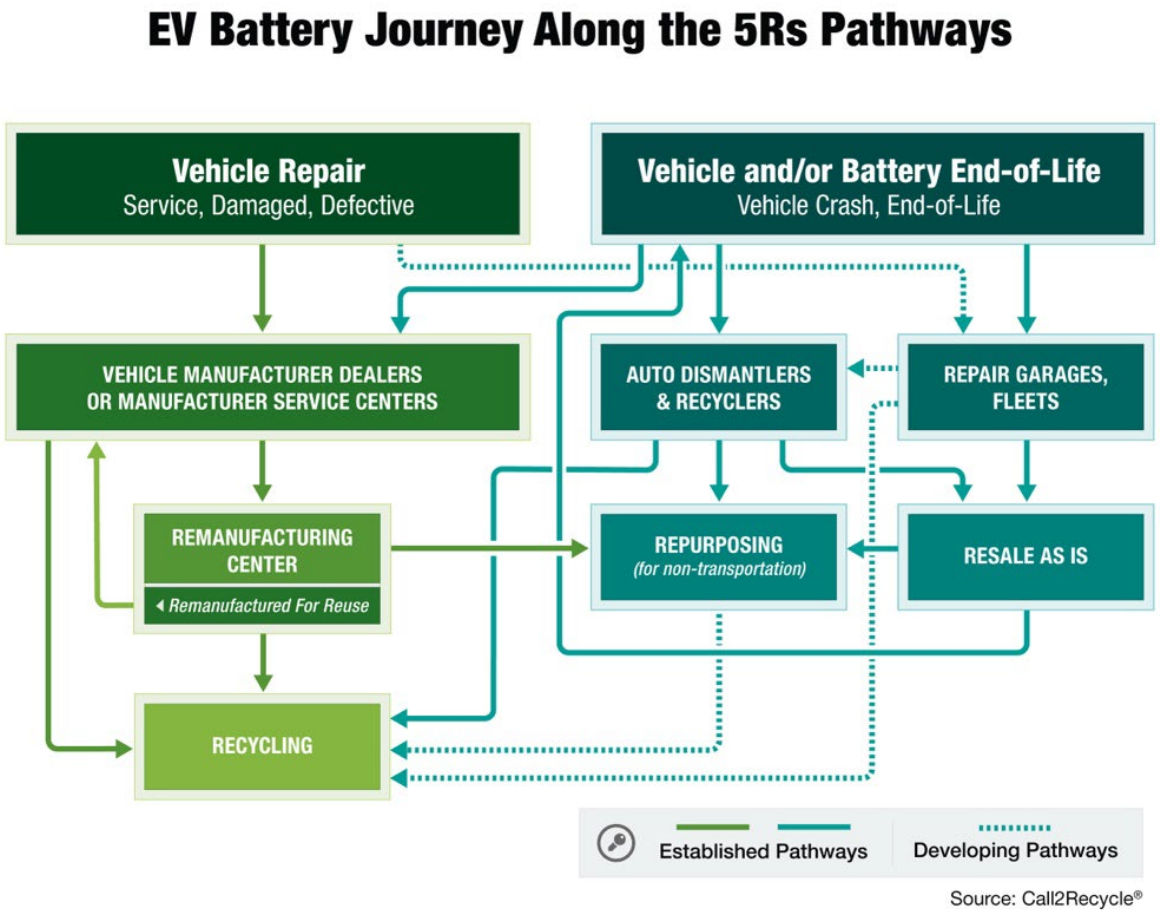
Source: Call2Recycle®

The typical environmental management hierarchy of ‘reduce, reuse, recycle’ is reconfigured with EV batteries. An EV battery may be directed to any of 5 possible pathways depending on the EV battery owner’s business model, processes, location of battery, health of battery, contracts on the battery, and value of battery.

The overarching goal is typically to prioritize extending the life of the EV battery through either repair, remanufacturing, reselling as is, or repurposing; and then recycling the battery when its entire working life is complete.

At the outset, all pathways are available options, and the battery will always move to the right, however it’s not hierarchical.

The EV Battery Journey Along the 5Rs

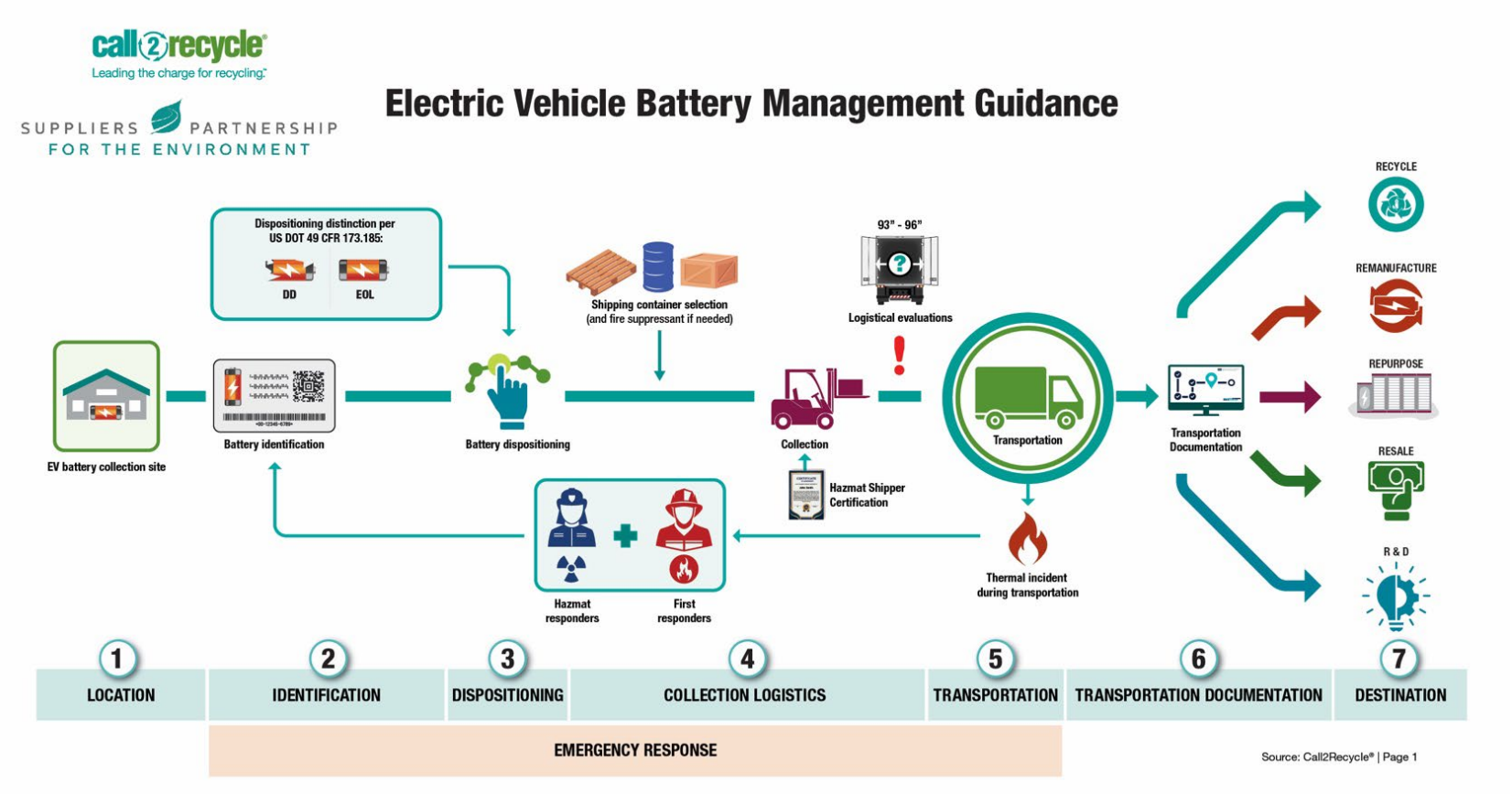


Batteries under warranty generally travel the left side of the industry workflow while out of warranty batteries most often are on the right side.

Lower economic value batteries are more likely to be found at auto dismantlers & recyclers or independent repair garages.

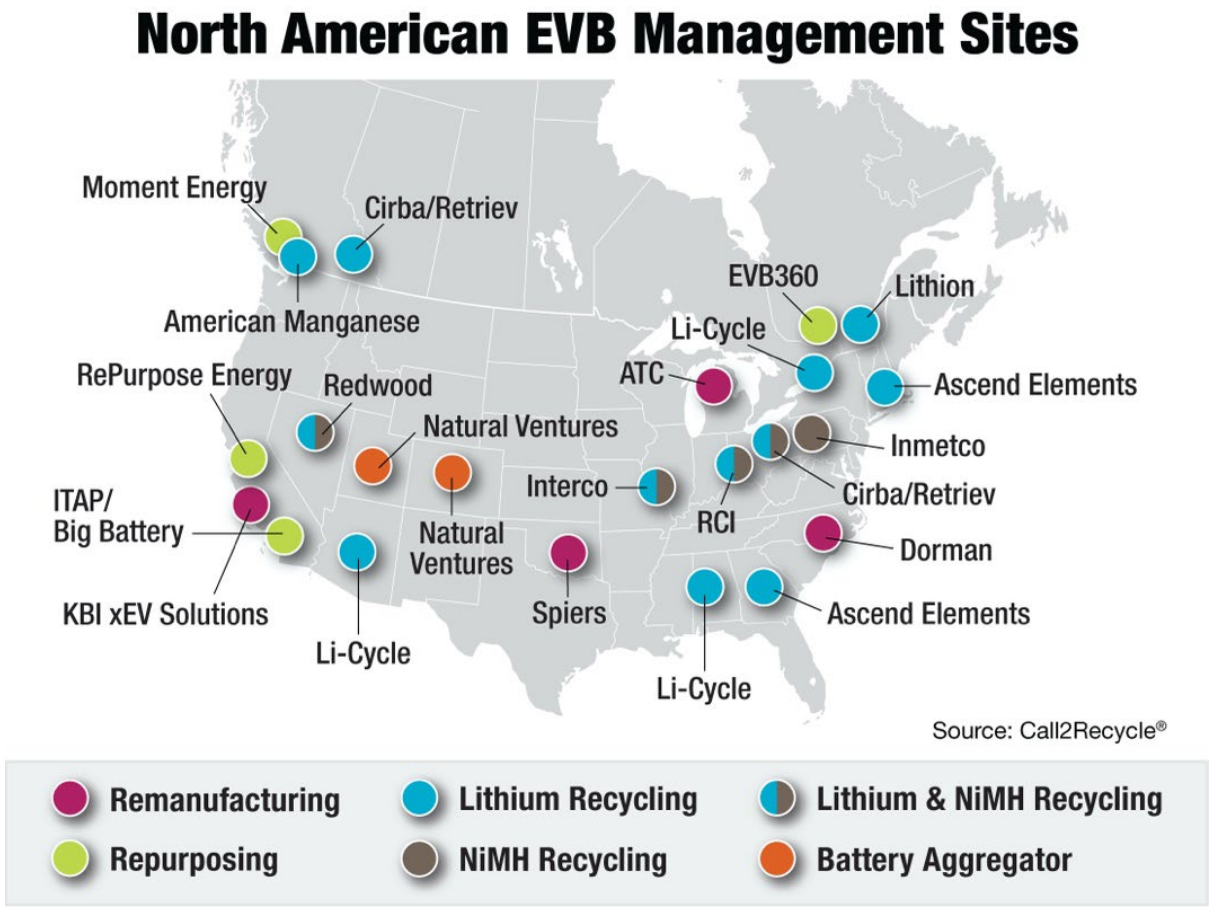
We can see where the 5Rs reside in this graphic: Repair, Remanufacturing, Resale as is, Repurposing, and Recycling.

The 7 Steps of EV Battery Logistics



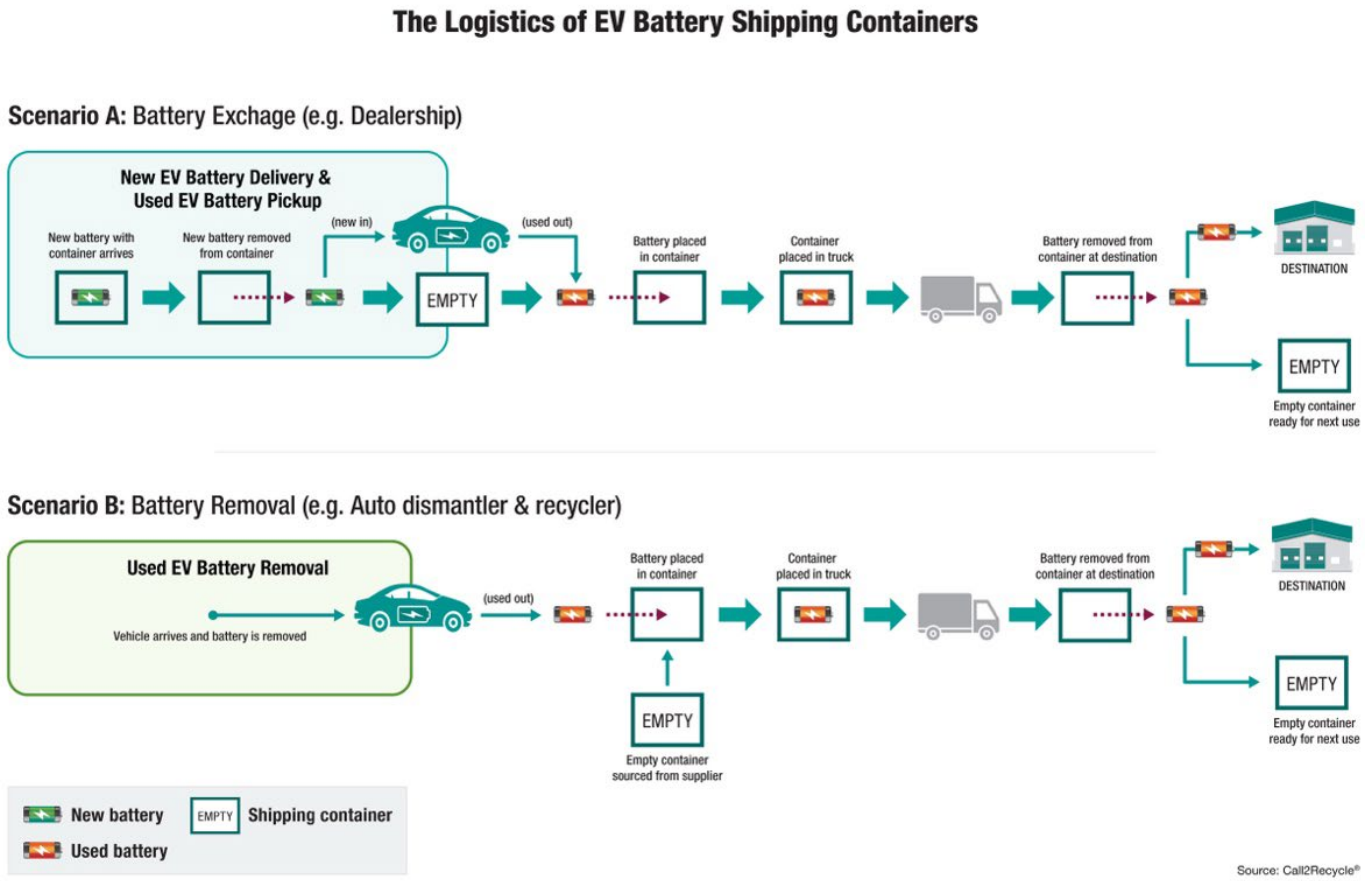
The workflow for collecting, transporting, and recycling an EV battery is generally the same and is governed by the 49 CFR 173.185 regulation in the United States.

North American EV Battery Management Sites



There are more than enough end-of-life battery management facilities in North America for the volume of batteries in the market today.

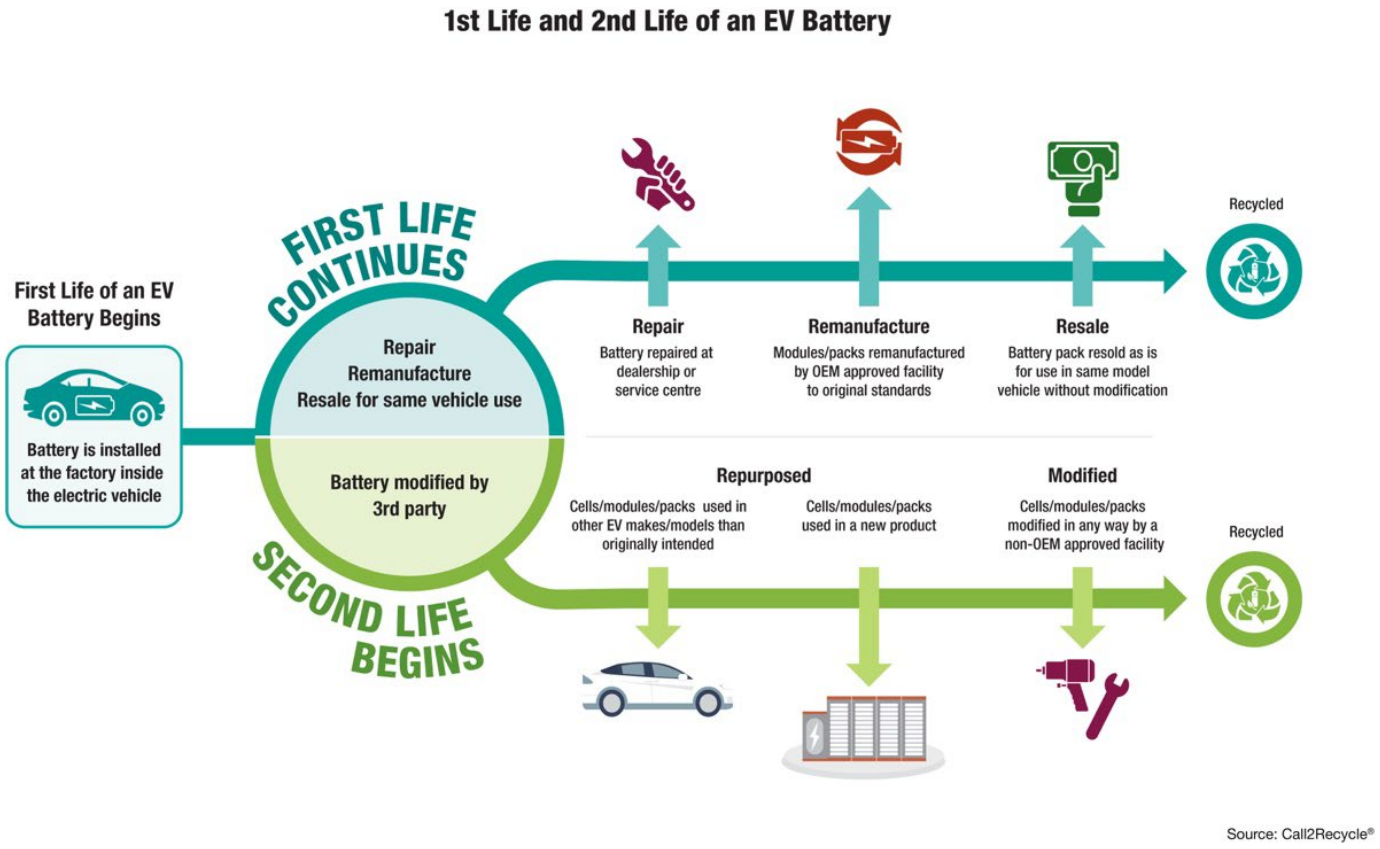
The Logistics of EV Battery Shipping Containers



Availability of containers to ship damaged-defective batteries must be considered, and that workflow differs between dealerships and auto dismantlers & recycler.

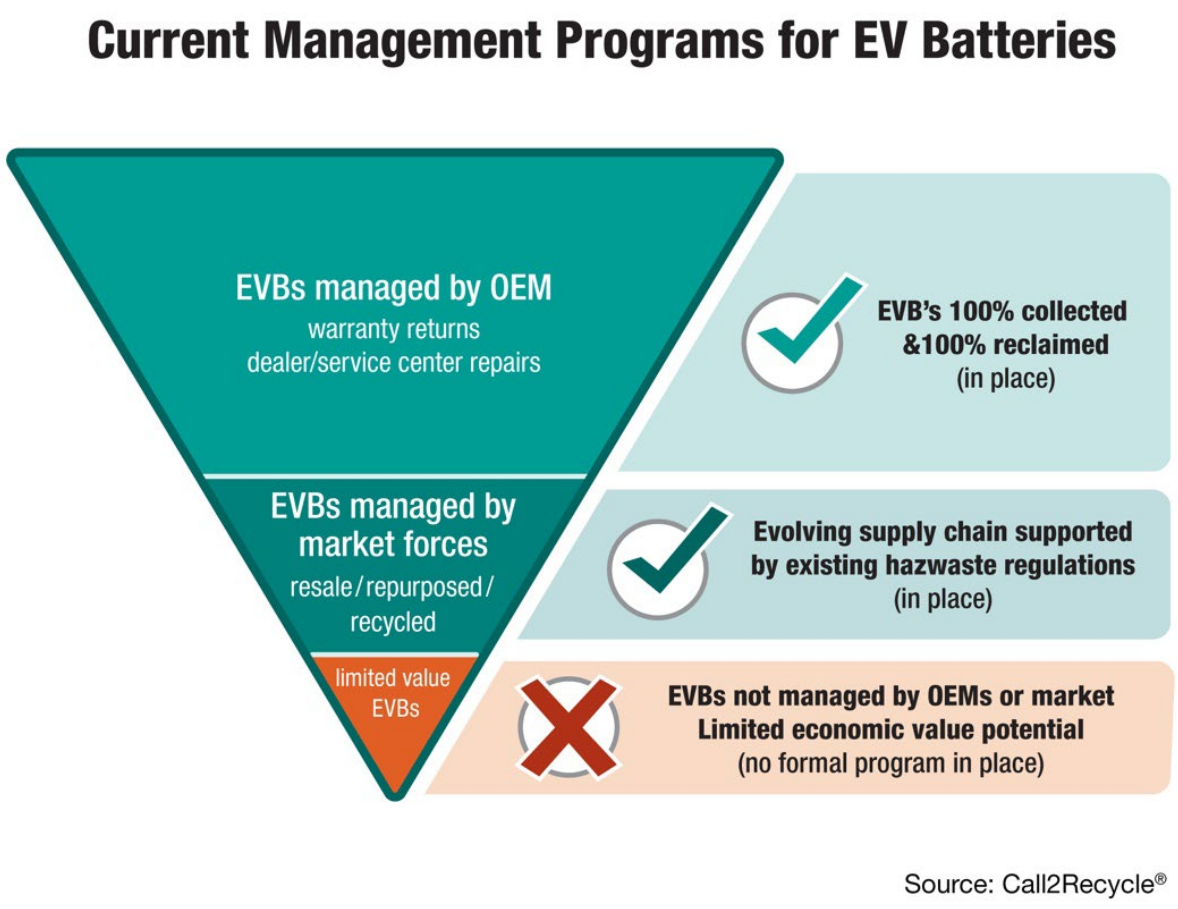
1st Life and 2nd Life of an EV Battery

In 2nd life, the EV battery is an input material for a new producer.



A successful industry delineates between batteries in their first life (OEM is the producer) vs. second life where the battery is an input raw material for a new product being placed on the market by a new producer.

EV Battery Management Programs



Source: Call2Recycle®

Most EV batteries on the market in the United States today have established management programs and processes in place.

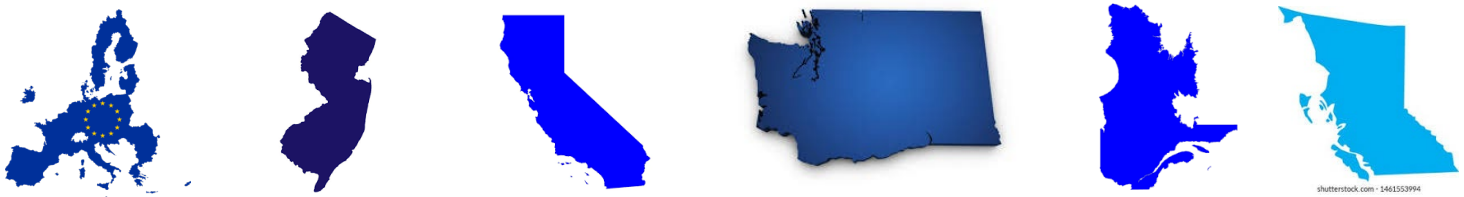
It is those with low economic value that may at times become unwanted (orange triangle in graphic).

An industry led pilot currently operating in Quebec, EV Battery Recovery ™, is designed to capture those low economic value batteries when needed.

Commonality in Policy Discussions and Enacted Regulations

EU, New Jersey, California, Washington, Quebec, and British Columbia policy discussions and enacted regulations have the following commonality:

1. **Policy solutions for low economic value / stranded batteries.**
2. **Battery labelling guidelines.**
3. **Discussions/clarity to entity responsible for 1st life vs 2nd life.**
4. **Disposal bans / recycling requirements.**



Common EV Battery Management Principles

1. **Clearly articulated delineation between 1st life and 2nd life responsibility**. The definition should be guided by the fact that EV battery packs/modules/cells are input materials to a new product assembled by a new producer who then puts it in the market, giving it a second life.

2. **Be mindful of narrow definitions for what type of entity can or can't be a battery recycler** based upon their technology. Ruling out existing operators may force batteries to travel further distances that result in a higher carbon footprint across the lifecycle.

3. **Forced recycling in a given jurisdiction may prematurely shorten the life of a battery** or cause its recycling to be at a higher cost if that is not the highest value pathway for the battery.

4. **Be mindful of funding mechanisms that don't account for the battery's full value** in the supply chain. Most EV batteries on the market today have economic value and there are established market systems in place for removing and reselling EV batteries or providing them to other processors.

5. **There must be clarity between the requirements of end-of-life battery collection policies and Universal Waste regulations when a battery enters the recycling pathway.**

6. **Avoid thinking of battery handling as a hierarchy** (eg: reuse, repurpose, recycle) given EV batteries travel any one of 5 pathways (repair, remanufacture, resale as is, repurpose, recycle) that are all equally viable and interchangeable depending on the health, location, value, ownership, and warranty status of the battery.

Do consumers play a role in the recycling of EV batteries? If so, what information or messages do they need to receive, and when, to ensure they are able to facilitate the recycling process?

What do you think is the weakest link in the automotive life cycle that could prevent the safe recycling of large format batteries?

Decommissioning and End-of-Life Considerations for Stationary Battery Energy Storage

Stephanie Shaw, EPRI

Taylor Kelly, EPRI

Decommissioning and End-of-Life Considerations for Stationary Battery Energy Storage

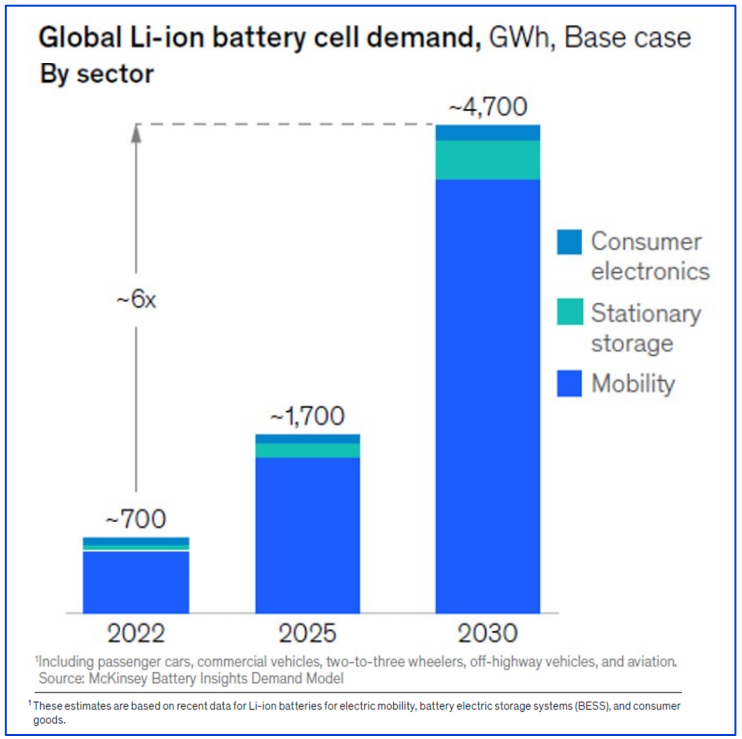
For EPA Webinar: Current Standards and Practices for Large Format Batteries

Taylor Kelly, Ph.D., EPRI
Stephanie Shaw, Ph.D., EPRI

April 24, 2025

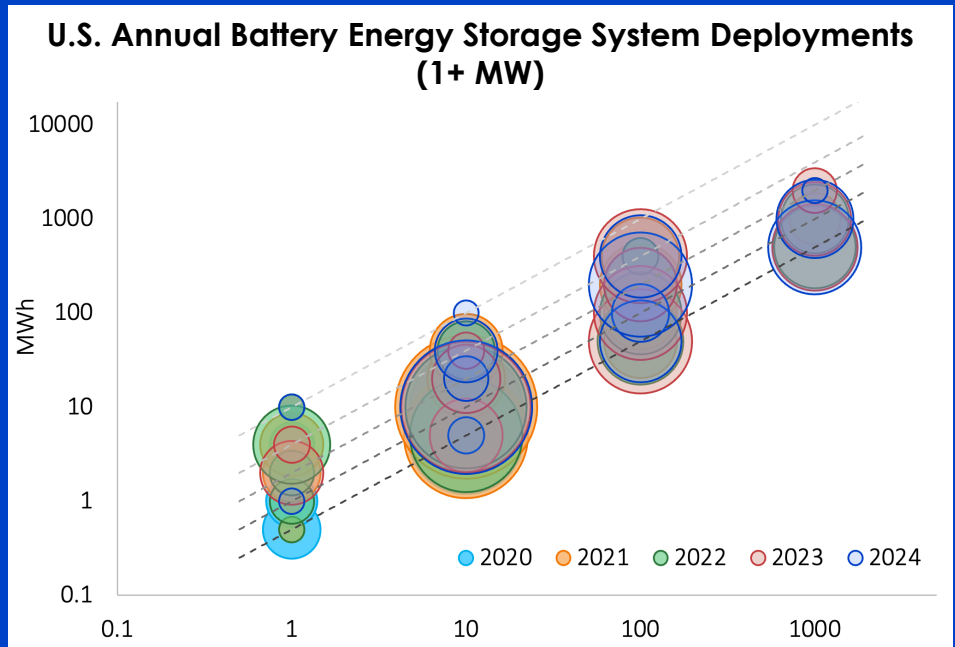
Lithium Ion Battery End-of-Life (EOL) Materials Streams

Expected growth in lithium ion battery (LIB) demand is driven by the mobility sector, with stationary storage growing rapidly.



Source: Battery 2030: Resilient, sustainable, and circular", January 2023, McKinsey & Company, www.mckinsey.com. Copyright ©2023 McKinsey & Company. All rights reserved. Reprinted with permission.

EOL management provides critical material recovery options, and reduction in environmental, health, and safety risks of battery waste.



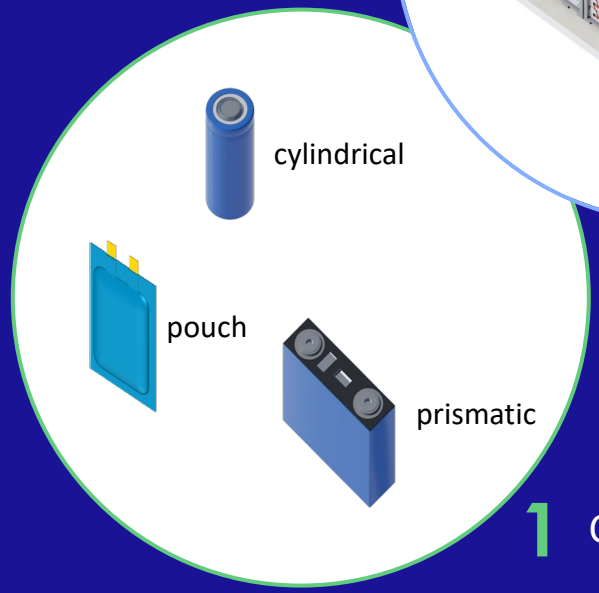
Bubble diameter indicates the number of projects that fall within the power and duration bins in the table below. Larger bubbles indicate more projects within a specified system capacity and duration range.

Source: Energy Storage – 2024: A Year in Review. EPRI, Palo Alto, CA: 2024. 3002029645.

Preferred LIB chemistries for EVs and BESS are similar, but the sheer difference in battery capacity requires a unique approach to decommissioning and transporting stationary energy storage batteries.

2024 Average Capacity per vehicle/facility (kWh)	
EV	71.4
US facility	188, 500

Cell Journey in the Energy Storage System Life Cycle



1 Cell manufactured

2 Cells packaged into modules, racks, units

3 Units integrated into BESS

Units decommissioned and disassembled to modules and cells **4**

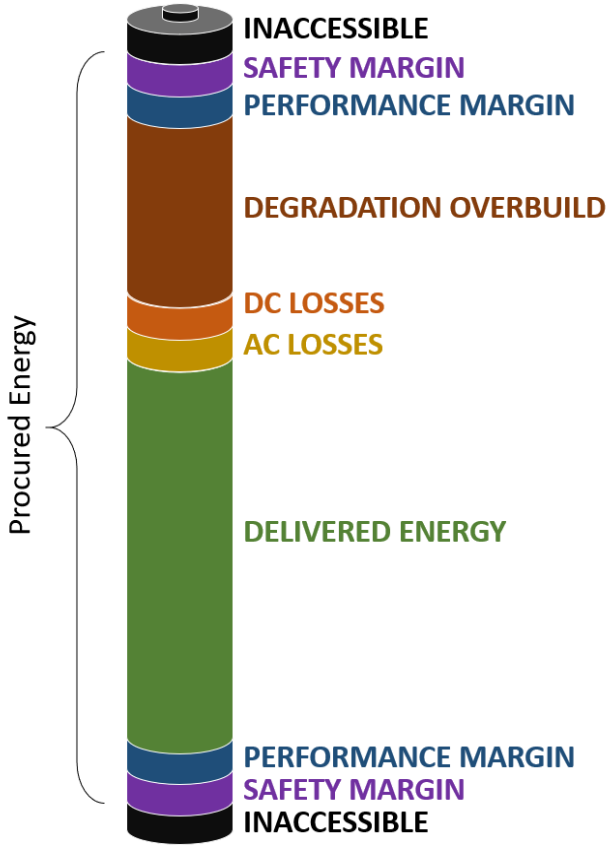
Cells recycled, repurposed or reused **5**

Responsibility for battery cells could transfer several times from production through recycling

When is End-of-Life for Stationary Energy Storage?

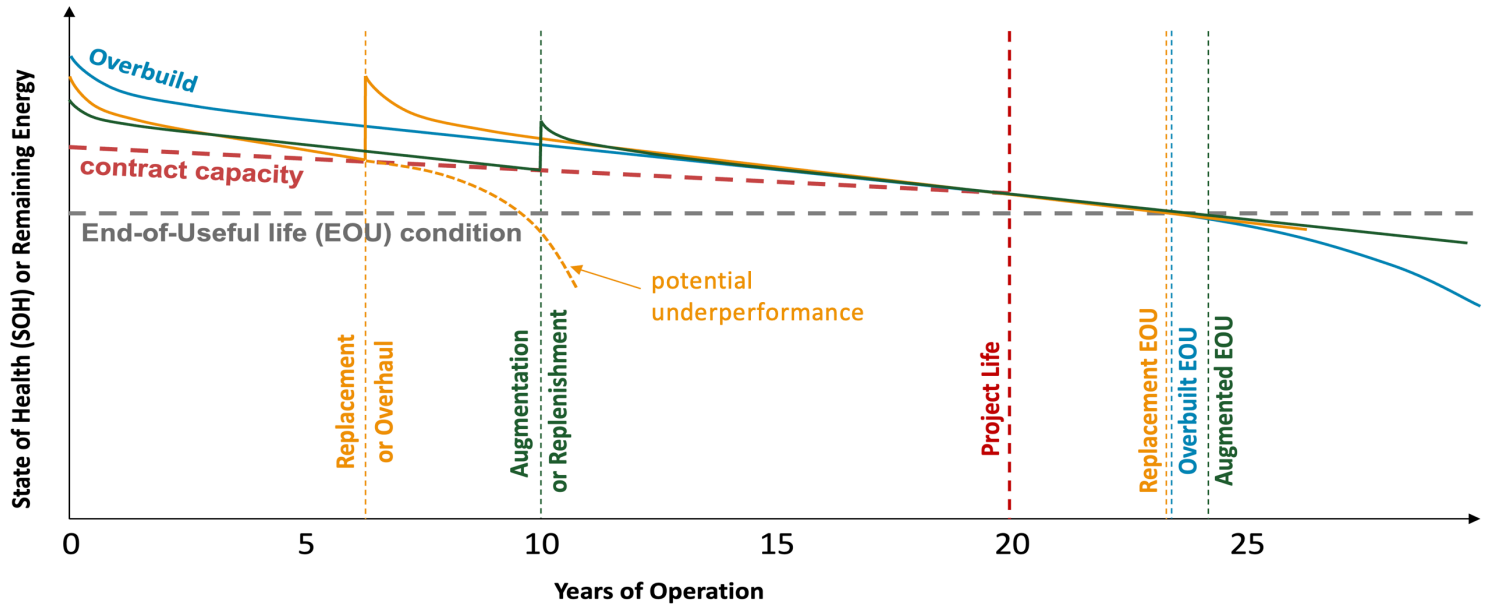
Does the 80% capacity retention rule of thumb apply to battery energy storage systems (BESS)?

- Procured and delivered energy are not the same. Owners and operators may not know the procured energy capacity.
- Contractually allowable degradation may be based on delivered energy and terms could differ from project to project.



Note: *Figure is intended to be illustrative, not to scale.*

- Different strategies are used to maintain an allowable energy capacity over the project life, defined in years.



BESS modules may retain significant capacity at end-of-life. Recycling frequently still preferred option of utilities vs. reuse or repurpose.

NFPA 855 (2023): Equipment and signage

4.6 Equipment.

4.6.1* Listings. ESS shall be listed in accordance with UL 9540, unless specifically exempted in other sections of this standard.

4.7.4* Signage.

Where it goes

4.7.4.1 Approved signage shall be provided in the following locations:

(1) On the front of doors to rooms or areas containing ESS or in approved locations near entrances to ESS rooms
(2) On the front of doors to outdoor occupiable ESS containers
(3) In approved locations on outdoor ESS that are not enclosed in occupiable containers or otherwise enclosed

What is contains

4.7.4.2* The signage required in 4.7.4.1 shall be in compliance with ANSI Z535 and include the following information as shown in Figure 4.7.4.2:

(1) "Energy Storage Systems" with symbol of lightning bolt in a triangle
(2) Type of technology associated with the ESS
(3) Special hazards associated as identified in Chapters 9 through 15
(4) Type of suppression system installed in the area of the ESS
(5) Emergency contact information

4.7.4.3 A permanent plaque or directory denoting the location of the disconnecting means for all ESS on or in the premises shall be installed at each service equipment location and at the location(s) of the system disconnect(s) for all ESS capable of being interconnected.

4.7.4.3.1 Energy storage located on property that is under the exclusive control of utilities, secured from public access, and in accordance with 90.2(D)(5) of *NFPA 70* shall not be required to comply with 4.7.4.3.

4.7.4.3.2 Lead-acid and nickel-cadmium battery systems less than 50 V ac or 60 V dc in telecommunications facilities that are covered by and in compliance with NFPA 76 and secured from public access shall not be required to comply with 4.7.4.3.

Retroactive labeling requirements

4.7.4.4 Existing ESS shall be permitted to retain the signage required at installation except as modified by 4.7.4.5.

4.7.4.5 Existing ESS signage shall be updated to comply with the requirements for new ESS installations when the system is retrofitted or existing signs need to be replaced.

4.7.4.6 Battery and ESS cabinets in occupied work centers covered by 9.5.1.2.1 shall be provided with exterior signs that identify the manufacturer and model number of the system and electrical rating (voltage and current) of the contained system, and any relevant electrical, chemical, and fire hazard.

Installation standards define *site-level* labeling requirements

NFPA 855 (2020 & 2023) Requires Decommissioning Plans

8.1.3* The decommissioning plan shall be provided to the AHJ and include the following information:

(1) An overview of the decommissioning process developed specifically for the ESS that is to be decommissioned
(2) Roles and responsibilities for all those involved in the decommissioning of the ESS and their removal from the site
(3) Means and methods in the decommissioning plan submitted during the permitting process to be made available at a point in time corresponding to the decision to decommission the ESS
(4) Plans and specifications necessary to understand the ESS and all associated operational controls and safety systems, as built, operated, and maintained
(5) A detailed description of each activity to be conducted during the decommissioning process and who will perform that activity and at what point in time
(6) Procedures to be used in documenting the ESS and all associated operational controls and safety systems that have been decommissioned
(7) Guidelines and format for a decommissioning checklist and relevant operational testing forms and necessary decommissioning logs and progress reports
(8) A description of how any changes to the surrounding areas and other systems adjacent to the ESS, including, but not limited to, structural elements, building penetrations, means of egress, and required fire detection and suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed

8.2 Decommissioning Process.

8.2.1 The AHJ shall be notified prior to decommissioning an ESS.

8.2.2 The ESS shall be decommissioned by the owner of the ESS or their designated agent(s) in accordance with the decommissioning plan.

8.3 Decommissioning Report. A decommissioning report shall be prepared by the ESS owner or their designated agent and summarize the decommissioning process of the system and associated operational controls and safety systems.

8.3.1 The report shall include the final decommissioning plan and the results of the decommissioning process.

8.3.2 The report shall include any issues identified during decommissioning and the measures taken to resolve them.

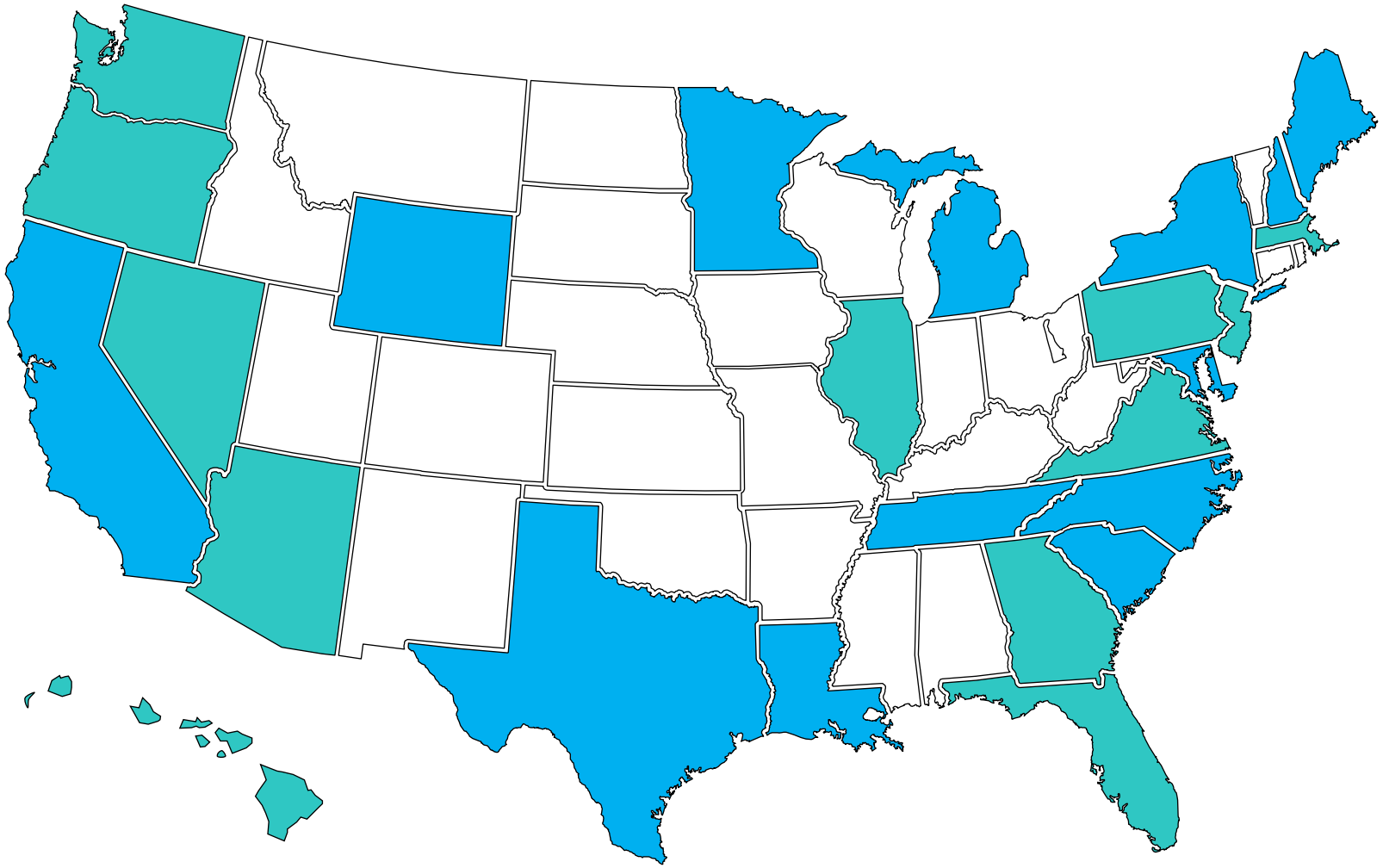
EPRI helps utilities break down tasks

Utility Stakeholder Group	Summary of Decommissioning/Disposal Involvement
Project Management	Integrate input from all other functions/stakeholders into overall decommissioning plan and execution. Ensure cross-coordination among all functions and parties.
Engineering	Undertake electrical disconnection and site disassembly or supervise external contractors undertaking this work. The site and/or land owner(s) must determine if removal of all site structures and any environmental remediation of the site is desired and necessary.
Safety	Engage closely on electrical disconnection, termination of conduits, and disassembly site works.
Operations	De-register BESS from asset pool and update operational plans accordingly.
Legal	Ensure clarity of responsibility/liability for asset and hazards at each stage of decommissioning and site disassembly. Review needs for compliance with relevant environmental and transportation regulations.
IT/OT/Cybersecurity	Ensure proper termination of external communication access as needed.
Corporate Sustainability	Partner with Project Management to ensure that disposal plan in accordance with ESG policy to the fullest extent possible.
Asset Recovery / Asset Management	Track the final disposition and associated costs or profit of key equipment.
Environmental Compliance	Advise on jurisdictional regulations relating hazardous materials retention and disposal that are applicable to the BESS. Prepare any required regulatory documentation of compliance.
Site Manager	Review plans, coordinate onsite activities, and interface with third parties during decommissioning. May own & update decommissioning plan.

Decommissioning plans can be a place to compile key product and site-level labeling, which supports EOL management

U.S. State Adoption of BESS Decommissioning Requirements

Preliminary



State adopted NFPA 855 in building code

State requires decommissioning plan. Includes states that require solar facility, inclusive of energy storage, decommissioning plans

Planning at the point of procurement is a necessity!

Packaging and Transport Considerations

Source: Modified from Li-Cycle

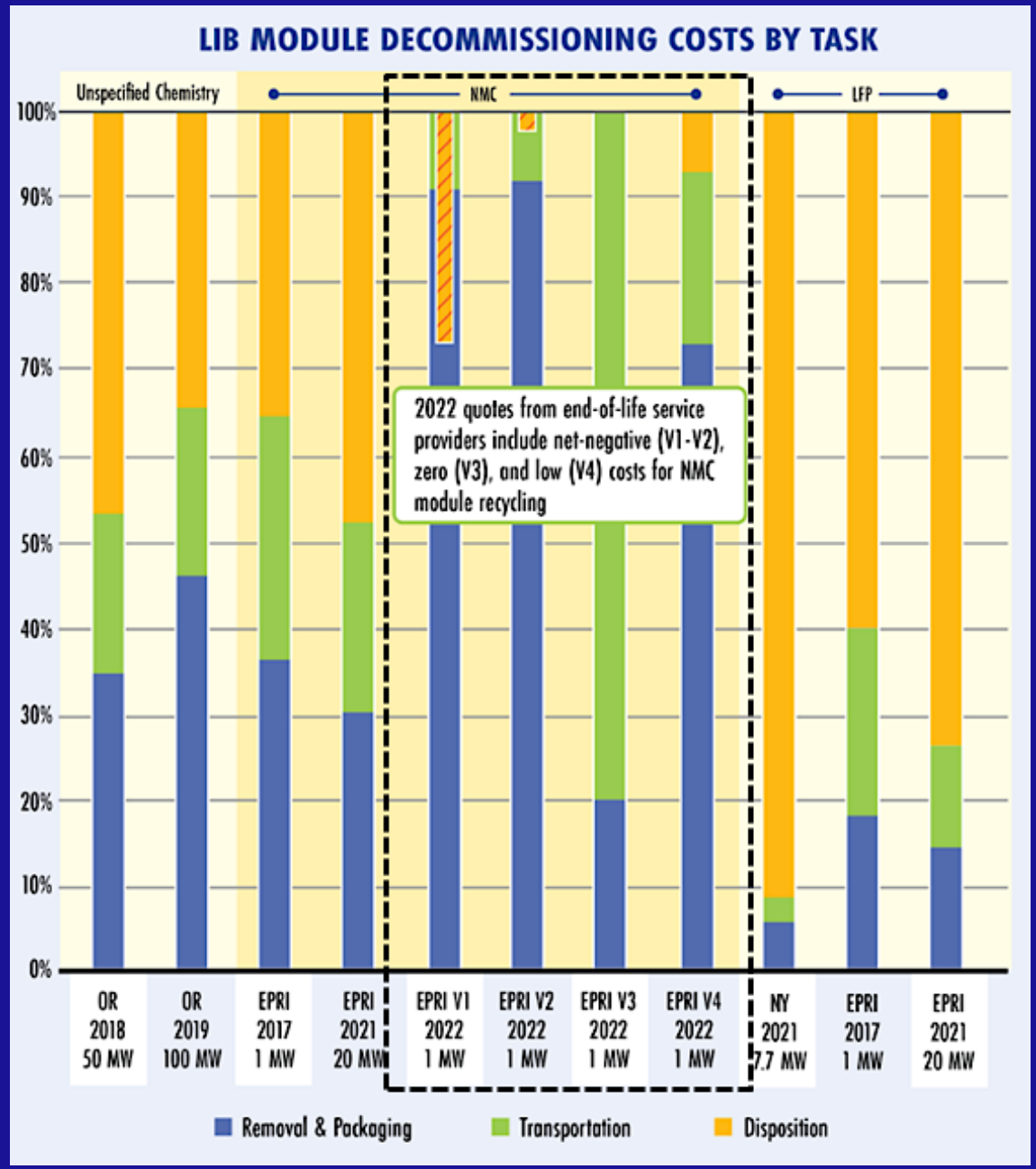
	Undamaged–Universal Waste *Shipment does not contain breached, leaking, damaged, defective, or recalled cells.*	Damaged/Defective/Recalled - Universal Waste *Shipment does not contain breached or leaking cells.*	Breached/Leaking – Hazardous Waste
US DOT Hazardous Materials Regulation Requirements	✓ Packaging conforms to regulations specified in **49 CFR §173.185**, *Non-bulk Packaging for Hazardous Materials – Lithium cells and batteries.*		
	✓ Packaging prevents short circuits and equipment activation.	✓ Batteries are individually placed in an Authorized Outer Container ✓ Packaging is non-combustible, electrically non-conductive, absorbent, and cushioning.	✓ Packaging contains inert absorbent material
	✓ Batteries weighing ≧ 12kg (26.5lb) have a strong outer casing OR batteries < 12kg are in a strong outer packaging.	**Special Permits** ✓ Display the SP # on the container. ✓ Confirm acquisition of a valid Party Status if required by the Special Permit. ✓ Verify compliance with all requirements of the Special Permit.	
Other Considerations and Information	✓ Coolant ports and leaks are plugged and sealed. ✓ Review past shipment photos for inner and outer packing procedures and to verify container conformity to regulations. ✓ Has a Safety Data Sheet been provided for each type of battery being shipped? Have dismantling instructions been provided?	✓ Have diagnostic reports been provided for context on the criticality of the battery?	
	✓ Verify total gross weight that is within its rated capacity. ✓ No stacked plastic pallets		✓ No stacked pallets ✓ Drums have a pressure relief valve

Aligning unit and module labeling with transportation regulations could help to streamline decommissioning and reduce EOL costs.

BESS Decommissioning Cost Summary

- EPRI receiving quite variable quotes for decommissioning projects
  - ***Salvage value is a driver:*** NMC battery value ranged from $1 to >$1.50 / kg over previous year
  - ***But recycling capacity and operations are now bigger drivers***

- Cost contributors
  - Removal & Packaging: materials, decommissioning equipment, labor
  - Transportation: weight, distance
  - Disposition: net recycling value



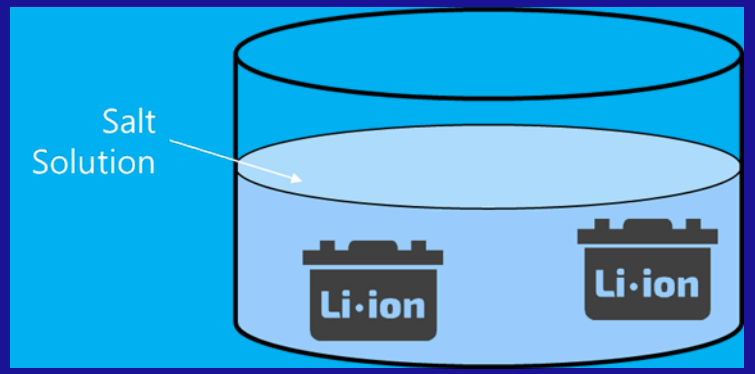
Case Study: Cedartown Decommissioning Overall Cost*

Spend Category	Cost
Logistics	**$58,300**
Extra-long flatbed lowboy w/pilot car	$42,400
Tractor-trailer truck (53’ trailer) (2)	$11,000
Box truck (25’ trailer)	$ 4,900
Equipment Rented	**$22,313**
Crane, 2.5 days	$20,283
Forklift	$1,530
Generator	$500
Travel, Lodging, Food, etc.	**$12,838**
Labor	**$12,240**
Tools & Materials Purchased	**$2,457**
Grand Total	**$108,147**

- Metal content is the biggest variable in determining total recycling value
- Documentation (NMC) vs reality (LMO + NMC)
- Resale of modules to bring greater financial return

Public report available at www.epri.com; 3002027944

R&D Need for Damaged Battery Decommissioning



- **If de-energizing with a salt solution:**
  - *What salt? What concentration?*
  - *How much per module?*
  - *How long? Cost?*
  - *What post-processing is required for the solution?*
  - *Does chemistry matter?*
  - *… and so forth.*

Risk Assessment & Preparation for Transport	Transport	Final Processing
Determination of DDR → Dismantling → De-energization	Packing → Shipping	Further Stabilization → Recycling
Key Research Questions	**Key Research Questions**	**Key Research Questions**
• How does one accurately identify the condition of the LIB? • When might I consider de-energizing the LIB for transport? • What are current methods for de-energizing DDR LIB?	• What are leading practices for packaging? • What are current regulations for transport and shipping?	• Once arrived, how should the LIB be handled? • What implications does DDR have for recycling and final disposition?

Second Life Needs for Large-Format Lithium Ion Batteries

01

Performance Assessment

BMS software that can effectively manage operations, even with batteries of varying characteristics or mixes of different manufacturers or models.

Commercialization of quick, accurate, cost-efficient SOH monitoring with standard calculations

02

Market Uncertainty

Economic value for various platforms, applications, capacity sizes, and designs

Include costs of testing, refurbishing and certification procedures

No government incentives

Battery-As-A-Service?

03

Associated Risk

Extensive safety testing (e.g., aging effects and other drivers)

Insufficient data yet to characterizes risk for vendor guarantees and warranties

Feasible contractual and legal terms that clearly address liability

04

Cooperation

Strong cooperation is needed among the original battery supplier, EV manufacturer, and second-life vendor to ensure the transfer of appropriate information needed to develop safe and efficient second-life BESS

TOGETHER…SHAPING THE FUTURE OF ENERGY®

www.epri.com

What, if anything, can energy storage companies do to help ensure that the batteries they use are repurposed or recycled?

Global EV Battery Traceability Standard

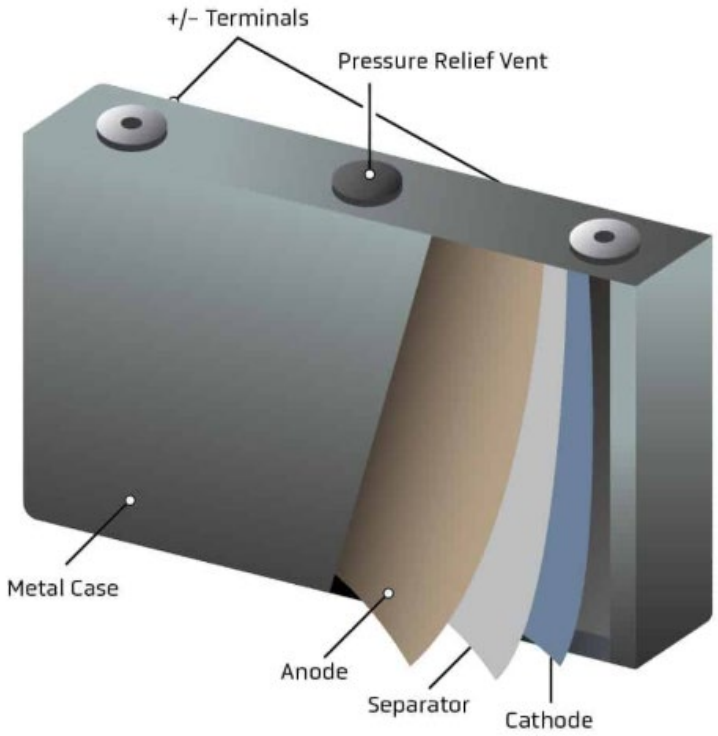
Brian Engle, SAE and Amphenol Advanced Sensors

Frank Menchaca, Li-Bridge

EV Battery Material Traceability

Advancing U.S. EV battery manufacturing through standardization of traceability

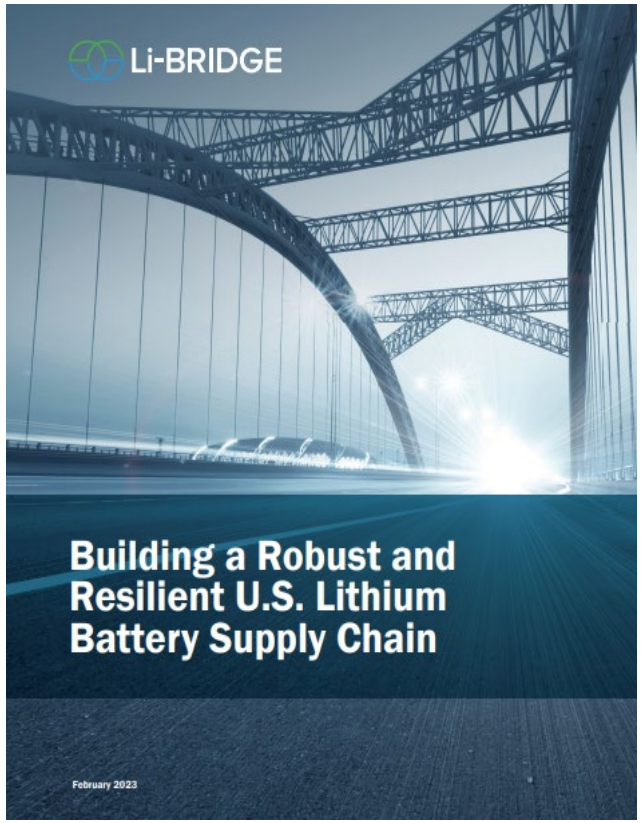
Objectives



Objectives

Report on a battery materials traceability standard that:

- Serves industry's needs for efficiency and consistency and integrity
- Supports growth of U.S. battery manufacturing and recycling
- Enables companies to take advantage of available incentives in the U.S.
- Allows US to take a leadership position with EU in traceability (2/1/27)
- Lowers the cost of US providers to comply with EU battery regulations
- Can be completed in <12 months



LiBridge and Industry

LiBridge

A public-private alliance committed to accelerating the development of a robust and secure domestic supply chain for lithium-based batteries

Argonne National Laboratory

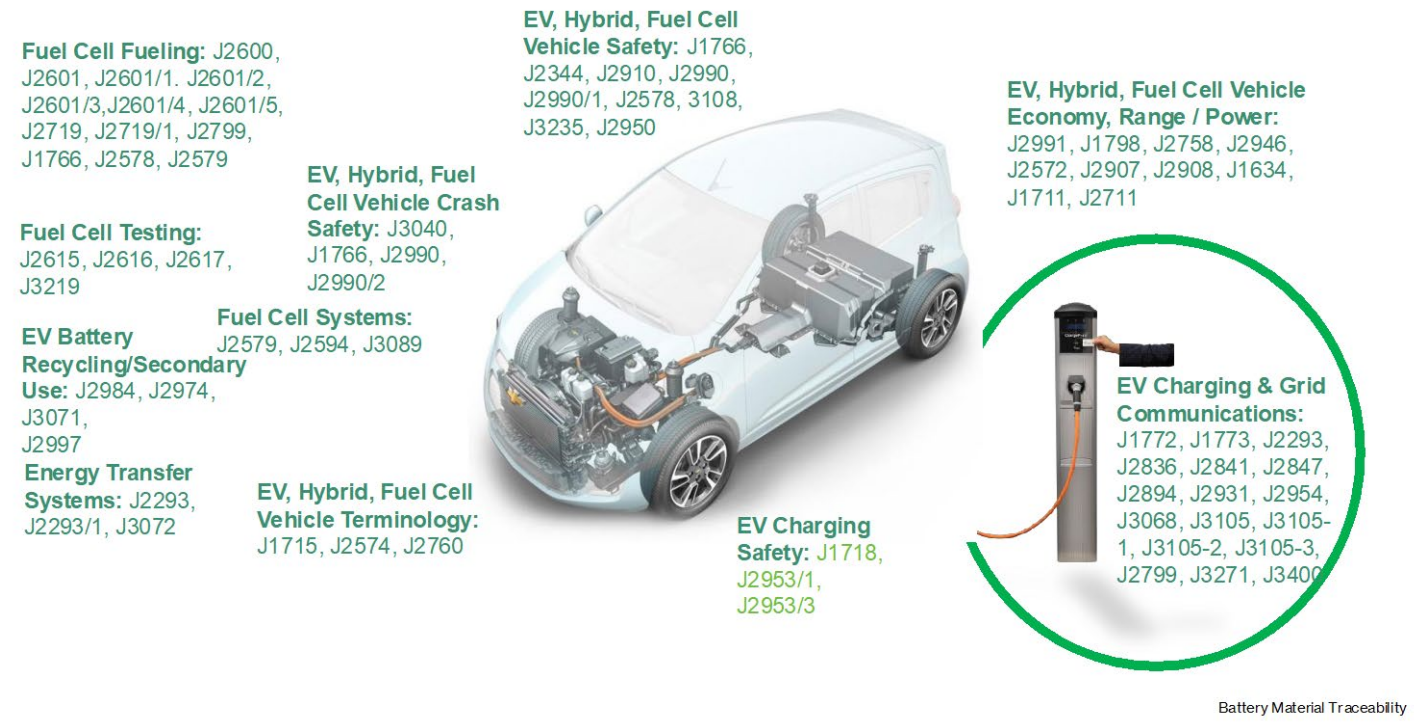
Leads coordination of Li-Bridge by serving as the facilitator between private industry and the **Federal Consortium for Advanced Batteries**

Met in August 2024 with 50+ representatives

Purpose was to understand the landscape of traceability comprising OEMs, suppliers, traceability third parties

Key Takeaways

Landscape is fragmented. Some companies planning for compliance with the EU Digital Product Passport (DPP). Some not engaged in traceability. No consistent practice or reporting. Supply chain is disorganized and inefficient. Adds friction and difficulty for new market entrants.



Battery Material Traceability

Solving with standardization

SAE International is the oldest and largest standards organization for engineers in aerospace, automotive and commercial vehicle industries.

Creating a standard based on industry priorities voiced at LiBridge meeting. Standardize traceability data for:

1. Battery information: capacity, date of service
2. Identification and proportions of critical minerals
3. Producer information
4. Battery components (e.g. modules and cells)

Vehicle Battery Standards Steering Committee

Mobility, Advanced™

750+ Committee Membership Individual Participants

171 Represented Employers (OEM's, Suppliers, Government, and Academia)

32 Subcommittees

40 Published Documents

Vehicle Battery Standards Steering Committee

Mobility, Advanced™

BSSC COMMITTEES: Q1 2025

BC1 Battery Safety Standards Committee
BC2 Battery Standards Testing Committee
BC3 Battery Standards Label & Tape Committee
BC4 Battery Transportation Committee
BC5 Battery Size Standardization Committee
BC6 Starter Battery Committee
BC7 Truck Battery Systems Committee
BC8 Battery Standards Fuel Economy & Range Committee
BC9 Battery Standards Advanced Battery Concepts Committee
BC10 Battery Standards Recycling Committee-
BC11 Battery Global Traceability Committee
BC12 Battery Test Equipment Committee
BC13 Battery Terminology Committee
BC14 Battery Materials Testing Committee
BC15 Secondary Battery Use Committee
BC16 Start-Stop Battery Committee
BC17 Battery Diagnostics
BC18 Battery Field Discharge and Disconnect Committee
BC19 Battery Systems Connection Committee
BC20 Battery Management Systems
BC 21 Battery Thermal Management Committee
BC22 Bus Battery System Committee
BC23 Battery Systems Adhesives-Sealants-Heat Transfer Materials
BC24 Battery Sensors Committee
BC25 Construction Agricultural and Off Road Rechargeable ESS Committee
BC26 Micro mobility Battery Standards Committee
BC27 Truck Battery Systems
BC29 Battery Swapping Committee
BC30 Battery Pack Venting Committee
BC31 Insurance
BC32 Vehicle Platform Power Management Committee

First Responders Task Force

SAE J3327 SURFACE VEHICLE
EV BATTERY TRACEABILITY RECORD

Objectives:

1. **Establish a consistent, shared format and vocabulary for identifying and recording key elements of traceability:**
    a. **Battery information**
    b. **Critical minerals contained within the battery**
    c. **Battery components contained within the battery**
    d. **Economic Operator and reliable chain of custody information, i.e. ownership of materials, components and products along the value chain**
2. **Leverage existing standardization and specifications, supporting one common global practice.**
3. **Create efficiency throughout the global battery supply chain and enable the foundation for recycling and re-use.**
4. **Allow a methodology for the qualified manufacturer/economic operator to compute the following:**
    a. **The value of the applicable critical minerals (as defined in section 45X(c)(6)) contained in a battery that were extracted or processed in the United States and free trade agreement countries**
    b. **The value of the components contained in a battery that were manufactured or assembled in North America**
    c. **Provide models for battery data management.**

Number	Data	Unit	Static (S)/ Dynamic (D)	Mandatory (M)/ Recommended (R)	US/ EU/ Both (B)
6.1 Entity Identification					
6.1.1	Economic Operator (EU); Qualified manufacturer	ID	D (EU) S (US)	M	B
6.2 Battery Information					
6.2.1	Digital Identifier	ID	S	M	B
6.2.2	Date of Service	ID	S	M	B
6.2.3	Vehicle Identifier	ID	S	M	US
6.2.4	Battery Mass	ID	S	M	B
6.3. Battery Chemistry					
6.3.1	Itemized List of Applicable Critical Minerals (ACM)	String	S	M	B[1]
6.3.2	For each ACM, its associated constituent material	String	S	M	US
6.3.3	For each ACM, mass measured in kilograms (kg)	String	S	M	US
6.3.4	For each ACM, mass measured in kilograms (kg) in each **Battery Cell**	String	S	M	US
6.3.5	The number of **battery cells** incorporated into each **battery.** Note: the battery cell number should match the number provided in the **battery**	ID	S	M	US

[1] Note: The EU Digital Product Passport requires a smaller subset of critical minerals be reported: cobalt, lead, lithium and nickel.

Standard is organized to harmonize **with EU Digital Product Passport for Batteries**:

- Entity information
- Battery information
- Battery chemistry
- Extraction information
- Manufacturing and processing information
- Component information

Standard also harmonizes with **CARB ACCI II standard for recycling**

Sets up for separate, future standards on:

- **Chain of custody model**
- **Traceability auditing standard**

Note: neither chain of custody modeling nor auditing is part of EU DPP.

Thank you for your time and attention. Please contact us if you'd like to get involved regarding SAE's standards development process.

Dante Rahdar

Ground Vehicle Committee Manager

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What, if any, gaps are there in the current labeling standards or requirements for large format batteries that need to be filled to ensure everyone has the information they need about a battery during its life?

Questions and Comments

Pat Tallarico, Facilitator

Wrap-up and Next Steps

Ellen Meyer, EPA

Upcoming Large Format Battery Labeling and Collection Working Session

Meeting Topic	Meeting Date	Meeting Time	Format	Registration
Expanding End of Life Management for Large Format Vehicle Batteries	June 17, 2025	2:00–4:00 PM EDT	Virtual	Registration page

Contact Us:

Email batteries@epa.gov if you have an interesting story to tell about battery collection

Questions and Answers from the Webinar

Taylor Kelly, EPRI

Do you have any suggested solutions for addressing barriers to repurposing that are related to things like insurance and UL certification needs?

UL certification could help to standardize product requirements that could factor into insurer decisions, but compliance testing could introduce another barrier for the second life product manufacturer as compliance and safety testing may be expensive. Ultimately, more data is needed to perform risk assessments. More demonstration data is needed and consistent results across several deployments used to build second-life performance datasets.

Is there a compliance issue associated with using second life batteries in energy storage systems? Will the United States mandate compliance in the future?

The energy storage system used in second life would need to comply with the same regulations as first-life battery energy storage systems.

Questions and Answers from the Webinar

Pat Tallarico, ERG Team

Can you explain the requirements for moving batteries by vessel?

The laws are the best place to look for the requirements. The guidance document posted here includes references to transportation regulations relevant to EV batteries: https://www.supplierspartnership.org/evbtransportation/

Will battery labeling include specific chemistries? It is essential to effective recycling.

Any voluntary labeling guidelines will address all chemistries.

Can you give an example of repurposed batteries?

Any time you are using it for a different use than was intended. This happens sometimes when people use an EV battery as a power wall or stationary power storage.

Can you explain a little more about the difference between modified and repair?

Repair is typically done through certified technicians and includes lighter work done under OEM guidance. Remanufacturing happens when a battery is taken out of a vehicle and repaired elsewhere and potentially replaced with another battery. Modification may happen when a battery is repurposed or put into other types of vehicles where some modifications may be needed.

Questions and Answers from the Webinar

Pat Tallarico, ERG Team

Which secondary markets (type of battery energy storage system applications) are second-life EV batteries most suitable for?

These types of batteries are usually used at smaller facilities or in residential systems.

Where can you see the battery swapping station cluster reports that were referred to in your presentation?

A lot of documents are available at SAE.org. If you want to be part of the process, scan the bar code or reach out to SAE to be part of a committee.

Li-Bridge mentioned that the traceability standard will provide models for battery data management through a battery registry — do you envision that there would be one centralized registry that producers and operators would submit data to, or that each entity would manage their own data? If the former, who do you anticipate managing a centralized data platform? Would this be EPA, DOE, or non-government?

The data would be managed in a decentralized system; producers would not submit data to a central location.

Questions and Answers from the Webinar

Pat Tallarico, ERG Team

ANSI and SAE are competing standards, which one will prevail, and which one is key here?

ANSI people participate in SAE process as do other standards bodies, so the products should be harmonized.

Will every business that handles a high voltage battery be obligated to report

It is a voluntary standard so no one will be obligated to participate.

How can emergency responders access proprietary chemical information for an emergency response?

There is a process and standard that govern emergency rescue guidance for vehicles. It is a different process to assess information quickly, including what hazards and risks they may face.

How would a standard (either ANSI or SAE) be enforced to remove the OEM information during the remanufacturing or repurposing for resales purpose in the market?

Unlike EU Battery Passport, SAE standard is linked to the VIN number so people would be able to see if it was in the original vehicle or has it been changed. It is meant to identify instances where the battery is being reused as well.

Questions and Answers from the Webinar

Pat Tallarico, ERG Team

Will fire investigators have access to information that will be gathered under the traceability standard?

The standard will be available to anyone, but the manufacturer will control access to the data.

Will this document include when the EV battery is safe to remove from an EV and any special equipment?

The traceability standard does not address this. There is a separate document set for safe transportation and storage: SAEJ2990 and 3108.

Questions and Answers from the Webinar

Kellen Mahoney, Suppliers Partnership for the Environment

Is any type of special packaging used for used large format batteries during transportation to prevent thermal incidents?

The two guidance documents linked here include information on transportation and packaging safe handling practices, including references to specific regulations and requirements: https://www.supplierspartnership.org/evbtransportation/ and https://www.supplierspartnership.org/evb-safehandling/.

Questions and Answers from the Webinar

Jeff Haltrecht, Call2Recycle

Your slides referred to batteries being 100 percent "recyclable." What do you mean when you use that term?

Live answered: The “100 percent recyclable” phrasing reflects a goal rather than a current state. While some materials in large format batteries can technically be recycled, achieving true 100 percent recovery depends on technology, economics, and logistics. The term also highlights that recycling is the final step in a series of pathways: repair, remanufacturing, resale as is, repurposing, and then recycling. Graphics emphasize “recycling” because it’s the end-of-life step after value recovery options are exhausted. The goal is to ensure that when batteries do reach the end of their usable life, they are captured and processed through systems that maximize material recovery with minimal emissions. This reflects the evolving understanding of recycling within a circular economy framework, particularly for complex systems like EV batteries.

How will EOL recyclers be held accountable for cradle-to-grave management of batteries? What if EV battery parts show up on eBay?

Live answered: I think there's a couple parts to this question. The eBay piece and parts of a battery showing up on eBay: if they're in first life, it should be the OEM's responsibility. If it's in second life, then it's that new producer's responsibility to manage those parts responsibly. And that's the kind of clarity that we need. It doesn’t mean banning sales, but we need to define who owns it and who’s responsible when it's reused or resold.

Questions and Answers from the Webinar

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Questions and Answers from the Webinar

Kathy Lett, U.S. EPA

How should leaking lead acid batteries be handled?

EPA has some guidance about debris waste that addresses leaking batteries. The main message is that cracked or leaking batteries should be stored in acid-resistant, leak proof containers and shipped separate from intact batteries. https://iwaste.epa.gov/guidance/natural-disaster/fact-sheets/types-of-waste?id=auto-batteries

Is EPA (or U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration) tracking incidents at recyclers (black mass plants)?

EPA published a report in 2021 that covered battery fires in the waste stream that were covered in the media. We are aware that this was a significant undercount, because smaller incidents that were not covered in the media would not be in the report. We are also aware that thermal events throughout the waste stream have continued to trend upwards since the report was published: https://www.epa.gov/recycle/importance-sending-consumers-used-lithium-ion-batteries-electronic-recyclers-or-hazardous.

Questions and Answers from the Webinar

Brian Engle, SAE

First responders are getting questioned after an incident on environmental items that may not be covered by an emergency response guidebook. Would the traceability standard be useable for our environmental folks to follow up with for chemistry, etc.?

SAE will be addressing environmental hazards recommendations in SAE J2990. Updates are coming soon.