Mid-Format Battery Labeling and Collection Working Session

January 27-28, 2025

U.S. Environmental Protection Agency

Welcome

Nena Shaw, U.S. EPA

Introductions and Agenda Review

Pat Tallarico, Facilitator

Participant Introductions

- Please share:
  - Name
  - Title and organization
  - Area within the battery life cycle that you represent

Day 1 Agenda

- **Morning**
  - Welcome
  - Background on EPA's battery work
  - Review of current mid-format battery policies
- **Afternoon**
  - Feedback on barriers, motivators, and outreach for consumers
  - Review of current standards and labeling
  - Mapping current mid-format collection programs

Day 2 Agenda

- **Morning**
  - Welcome
  - Building a more robust collection system for mid-format batteries
  - Recycling industry perspectives on expanding end-of-life opportunities
  - Recap and adjourn

General Considerations

- We are not seeking consensus
  - It's ok to disagree or offer alternatives
- We won't have all the answers
  - More research may be needed
- Creative ideas are welcome
- We may ask you to wear a different hat
- *Do not, in fact or appearance, discuss or exchange present or future price-related information*

Roles

Yours

- Participate honestly
- Be present
- Be curious
- Engage with others in mind
- Be solution oriented
- Be future focused

Ours

- Get you through the agenda efficiently
- Seek clarity
- Ensure people are heard
- Capture your ideas

Background on Mid-Format Batteries: The BIL Mandate and Feedback We've Heard to Date

Ellen Meyer, U.S. EPA and Pat Tallarico, Facilitator

EPA's Ongoing Battery-Related Projects

- Separate but complementary requirements in the Bipartisan Infrastructure Law (BIL):
  - **Battery Collection Best Practices** to identify and increase accessibility to battery collection locations, promote consumer education, and reduce hazards from improper disposal [Sec. 70401(b)]
  - **Voluntary Battery Labeling Guidelines** to improve battery collection and reduce battery waste by promoting consumer education and reducing safety concerns related to improper disposal. [Sec. 70401(c)]
  - **Education Materials** to create consistent messaging to help reduce fires, protect communities, keep workers safe, and recover critical minerals for domestic supply chains. [Sec. 70401(c)]
  - **National Battery Extended Producer Responsibility (EPR) Framework** to address recycling goals, collection models, reporting requirements, and outline pathways for effective recycling [Sec. 40207(f)]

Focus on Mid-Format 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.)

Mid-Format Batteries Are Showing up in Landfills

Photo 1: A Maryland transfer station collected various types of batteries over a one-week period

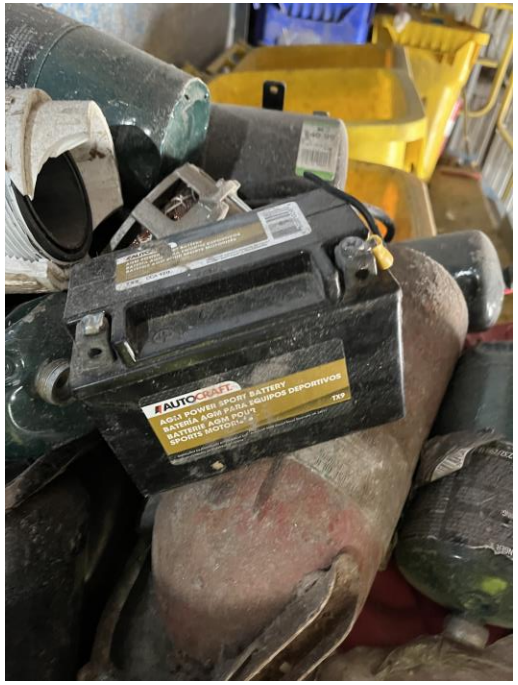
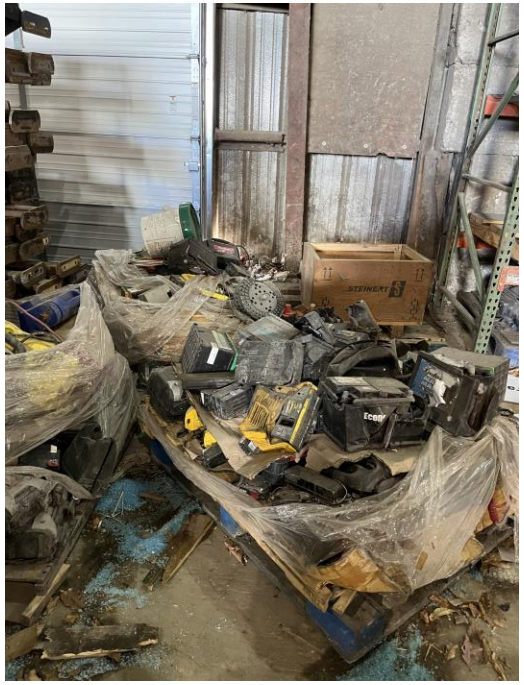
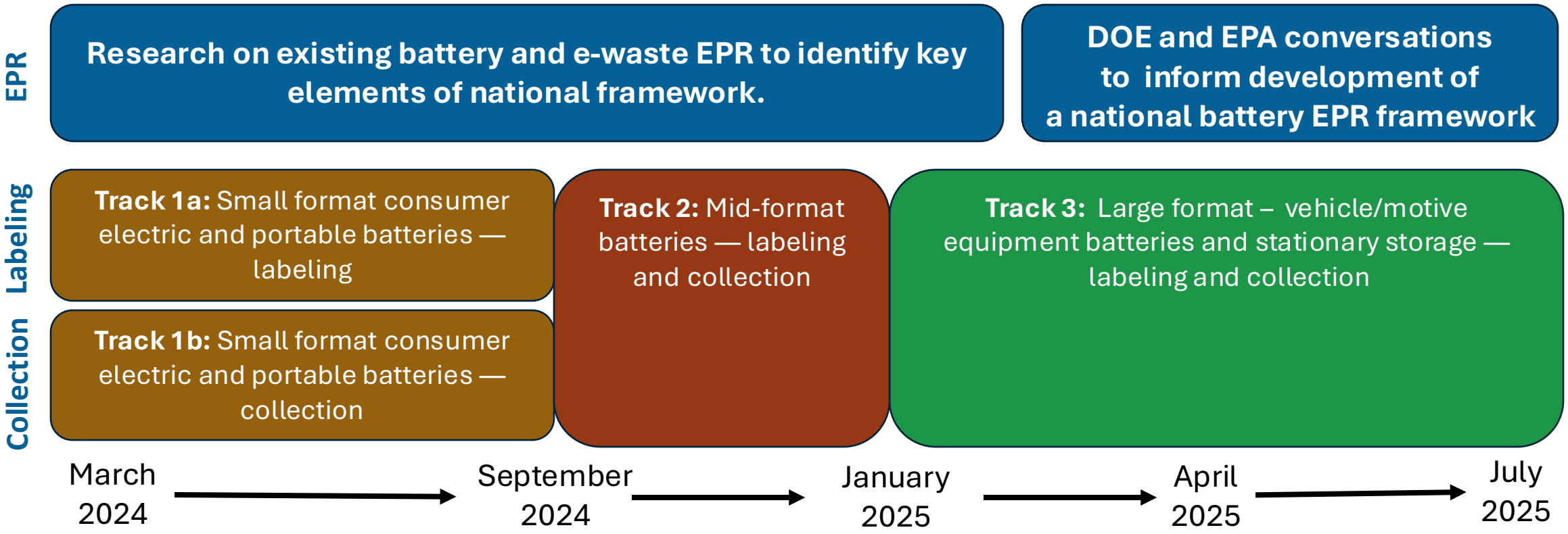


Photo 2: A mid-format battery was collected and sorted out of a recycling facility

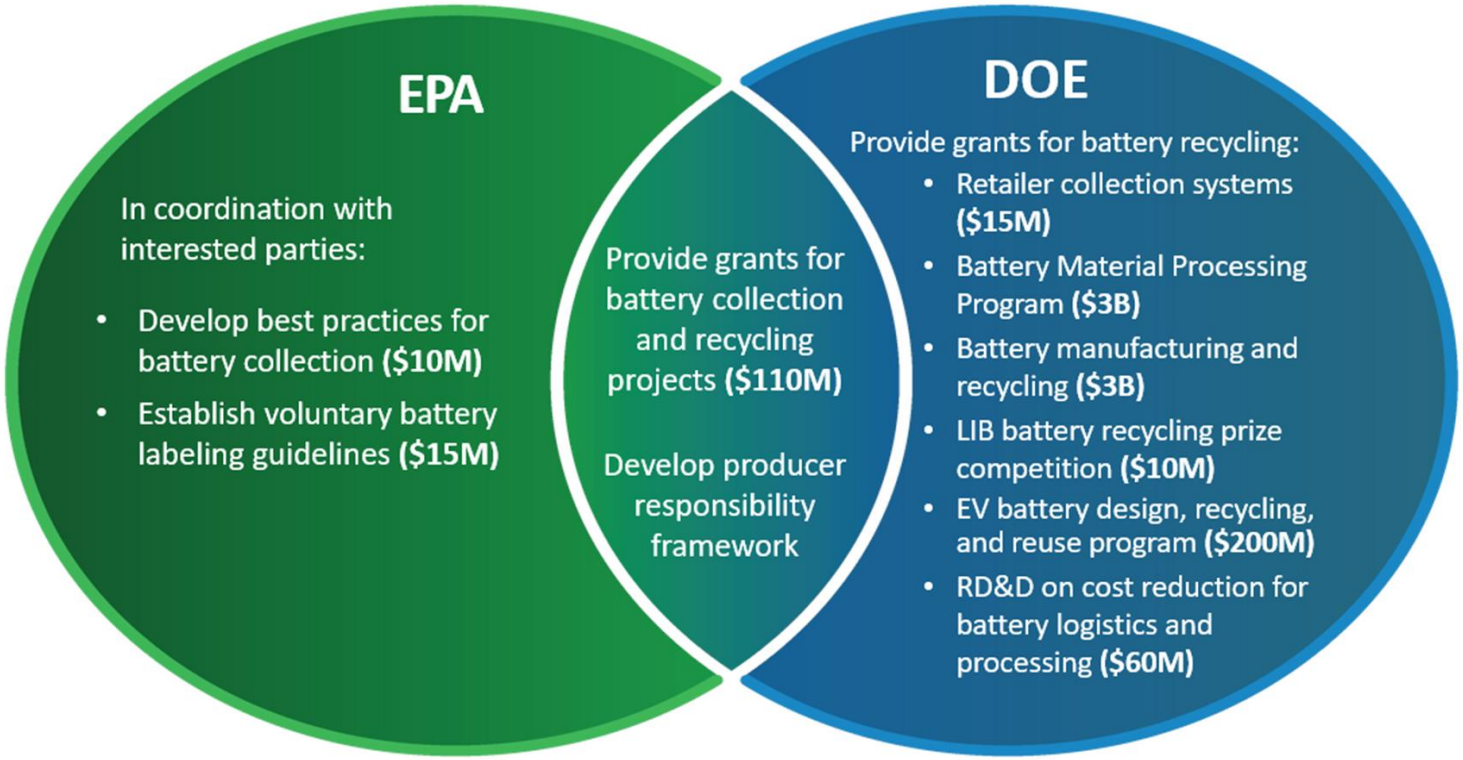


Photos 3: Various battery types await transport to a battery recycler, posing a fire risk

Timeline of Battery-Related Conversations



National Battery EPR Framework



COMPLETED

- **2024: Finalized research** on existing small format battery and e-waste EPR to inform conversations and framework.

PLANNED

- **2025:** DOE and EPA to **convene conversations** to inform the development of a national battery EPR framework.
- **2025: Finalize draft** EPR Framework.
- **2026:** DOE and EPA to **submit EPR framework** and report to Congress.

Battery Collection and Labeling Working Sessions and Work to Date

BACKGROUND

- **October 2021:** Virtual workshop on preventing fires from lithium-ion batteries and increasing recycling
- **May to July 2022:** Virtual feedback sessions on current practices and challenges for collection and labeling
- **June 2022:** Issued a Request for Information (RFI) on current state of battery recycling and labeling

SMALL FORMAT

- **March 19, 2024:** Virtual kick-off call for the battery collection and labeling guidelines
- **April 11, 2024:** Webinar on collection
- **May 14, 2024:** Webinar on collection
- **June 12-14, 2024:** In-person labeling working session
- **June 20, 2024:** Virtual session on small format education and outreach

MID-FORMAT

- **September 12, 2024**: Virtual session on mid-format battery current standards and practices
- **October 15, 2024**: Virtual session on promoting safer battery use and management
- **October 30, 2024:** Virtual session on the concerns, information, and safety needs of consumers
- **November 21, 2024**: Virtual session on expanding end-of-life management
- **January 27-28:** In-person labeling and collection working session
- **March 20, 2025:** Virtual report-out session on the January 27-28 working session

EPA's Upcoming Battery Conversations and Conferences

LARGE FORMAT

- **February 11, 2025:** Virtual session on current standards and practices for large format batteries
- **April 24, 2025:** Virtual session on expanding the end-of-life management of large format batteries

EPR

- **March 12, 2025:** Virtual national battery EPR framework kick-off call
- **Summer 2025:** Additional battery EPR conversations and webinars

INDUSTRY CONFERENCES

EPA will be participating in several upcoming conferences

- **February 3 – 6, 2025**: Electric Power Research Institute (EPRI) Semi-Annual Meeting
- **February 17 – 20, 2025:** NAATBatt 2025
- **March 24 – 25, 2025:** Battery Recycling and Reuse USA
- **May 12-15, 2025**: ReMA Convention
- **May 19-22, 2025**: CleanPower 2025

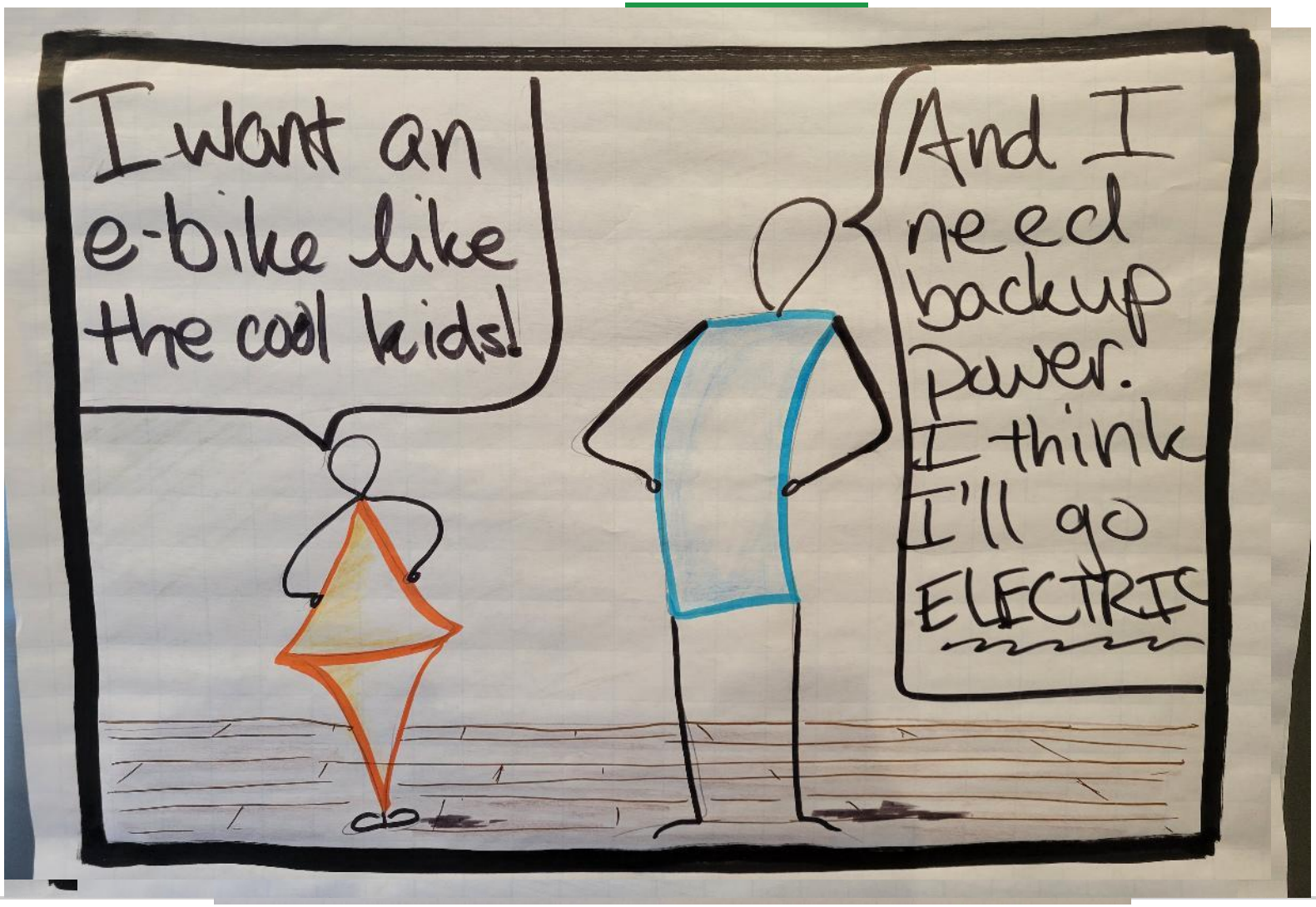
Vision for EPA's Resources and Guidelines

- **Battery Collection Best Practices**
  - EPA will develop best practices for state, Tribal, 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 for publication in 2025 and 2026
    - Best practices guidelines
    - Tailored outreach materials
    - 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.

Mid-Format Battery Customer Journey



Universal Themes for Small and Mid-Format Batteries

- People should know that something is a battery or that a battery is inside a product.
- People should understand what to do and what not to do with the battery.
- People should have access to convenient locations for battery collection.
- There is a lot of information already required to be on or around batteries and it may be difficult to add information in a way that will be effective.

Small and Mid-Format Batteries: Collection Best Practices

- Many of the collection and labeling best practices identified for small format batteries apply to mid-format batteries. However, due to the battery chemistry, energy density, and larger size of mid-format batteries, some of the specific practices differ
- Convenient and well-marked collection locations
  - **Mid-format:** Consumers need to know if mid-format batteries are accepted at collection sites
- Consistent and diverse outreach
  - **Small and mid-format:** Resources should help prevent fires, keep batteries out of landfills, and have a clear call to action
  - **Mid-format:** Consumers should learn to avoid uncertified or compromised mid-format batteries and understand proper lithium-ion battery purchasing, storage, and handling practices

Small and Mid-Format Batteries: Collection Best Practices

- Train employees at collection sites and be prepared to respond
  - **Small and mid-format batteries:** Employees should know how to identify damaged, defective, or recalled (DDR) batteries
  - **Mid-format:** Emergency response protocols can differ for mid-format batteries, as they pose greater fire and safety risks
- Ensure that materials are properly labeled and packaged for shipment
  - **Mid-format:** Hazardous Material Regulations mandate unique packaging, communication, and shipping guidelines
- Partnerships for program implementation
  - **Mid-format:** International and multi-sector partnerships to standardize transportation and safety standards
- Hub and spoke models for rural/remote communities

Small and Mid-Format Batteries: Labeling Best Practices

- Label and collateral information should
  - **Small and mid-format:**
    - Help consumers recognize a battery and products with batteries and know what to do with a battery at end of life
    - Help make collection sites aware of the type and state/condition of batteries
  - **Mid-format:**
    - Help consumers recognize and know how to manage mid-format DDR batteries
    - Help collection sites recognize lithium-ion batteries and relevant safety and handling protocols
- Space is limited and lots of information is already required
  - **Small and mid-format:** Labels should direct consumers to a website for more information
  - **Mid-format:** Mid-format batteries are prone to misclassification and need durable and clear labels throughout the value chain

Small and Mid-Format Batteries: Labeling Best Practices

- **Small and mid-format:**
  - Color has had/may have limited utility
  - Labels may help keep batteries out of the recycling stream, but other technologies may be more helpful for identifying batteries/battery-containing products if they get through

Mid-Format-Specific Feedback and Workshop Goals

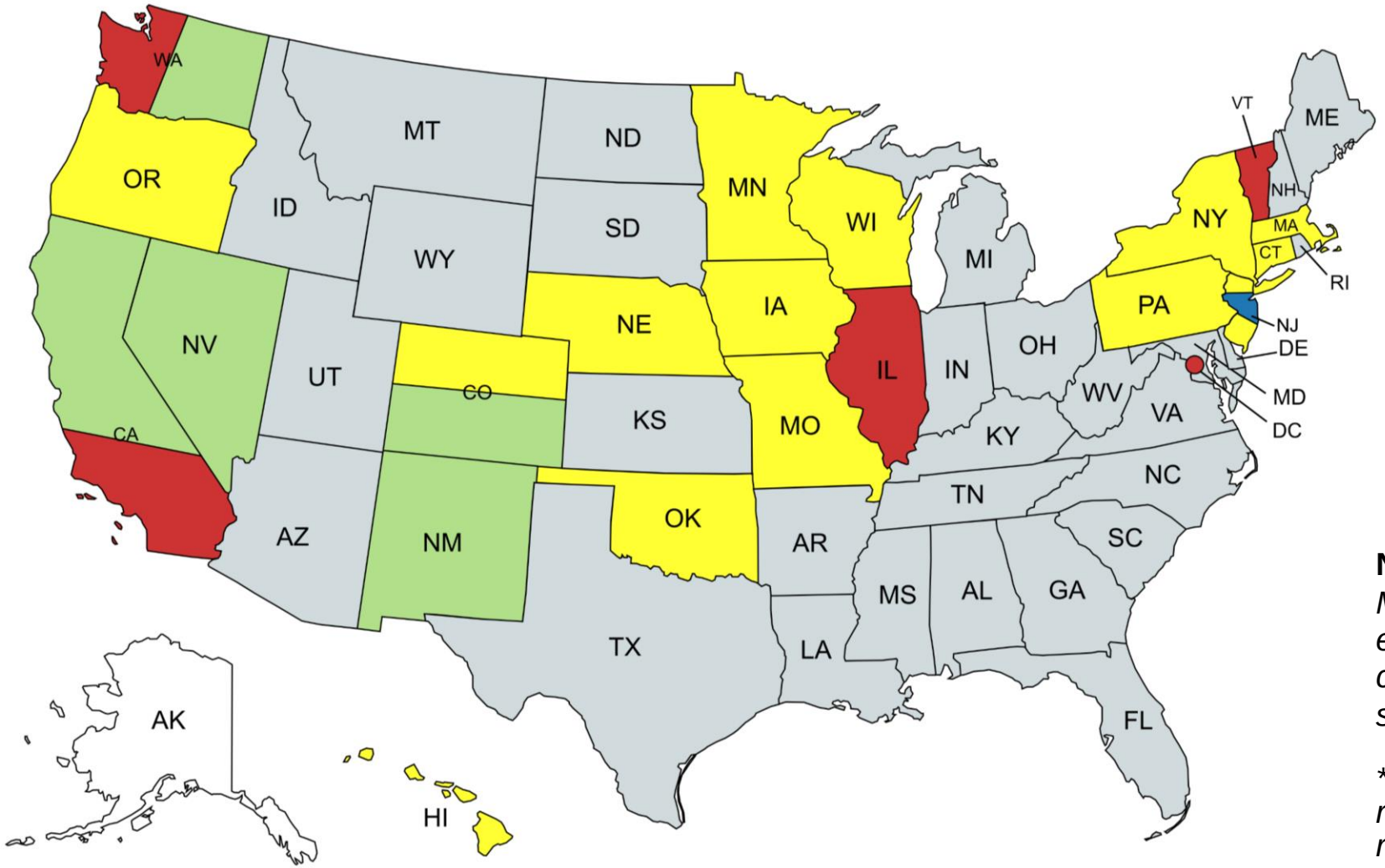
Feedback	Workshop Goals
States see little difference from policy perspective on mid-format and smaller format batteries especially in EPR laws.	Assess how policies could improve mid-format collection, whether/how to include labeling/certification requirements, harmonizing with other policies
Growing level of interest in regulating at the state level due to safety concerns. There is a special concern about use of uncertified batteries.	Assess role of labeling and certification in promoting safe use/recycling
Trend is to more electrification of equipment in the mid-format range (e.g., power tools, outdoor equipment, e-mobility) and putting more power in smaller packages – longer battery life. Can be challenging to define.	Explore how to future-proof policies.
Safety is a key concern – misuse, "do-it-yourselfers", uncertified products. Mid-format may be more thoughtful about end-of-life management because of size of products.	Explore barriers, motivators and messaging
Management costs and transportation challenges were two key barriers to collection of mid-format. Mid-format transportation is different than small format.	Explore ways to address collection challenges

Mid-Format Battery Policies – Unique Policy Considerations for Mid-format Collection

Marc Boolish, PRBA

State Portable and EV Battery EPR Initiatives

Updated January 17, 2025



Existing laws or recently enacted portable battery legislation*

Recently enacted EV battery legislation

Considering or has introduced EV battery legislation for 2025

Considering or has introduced portable battery legislation for 2025*

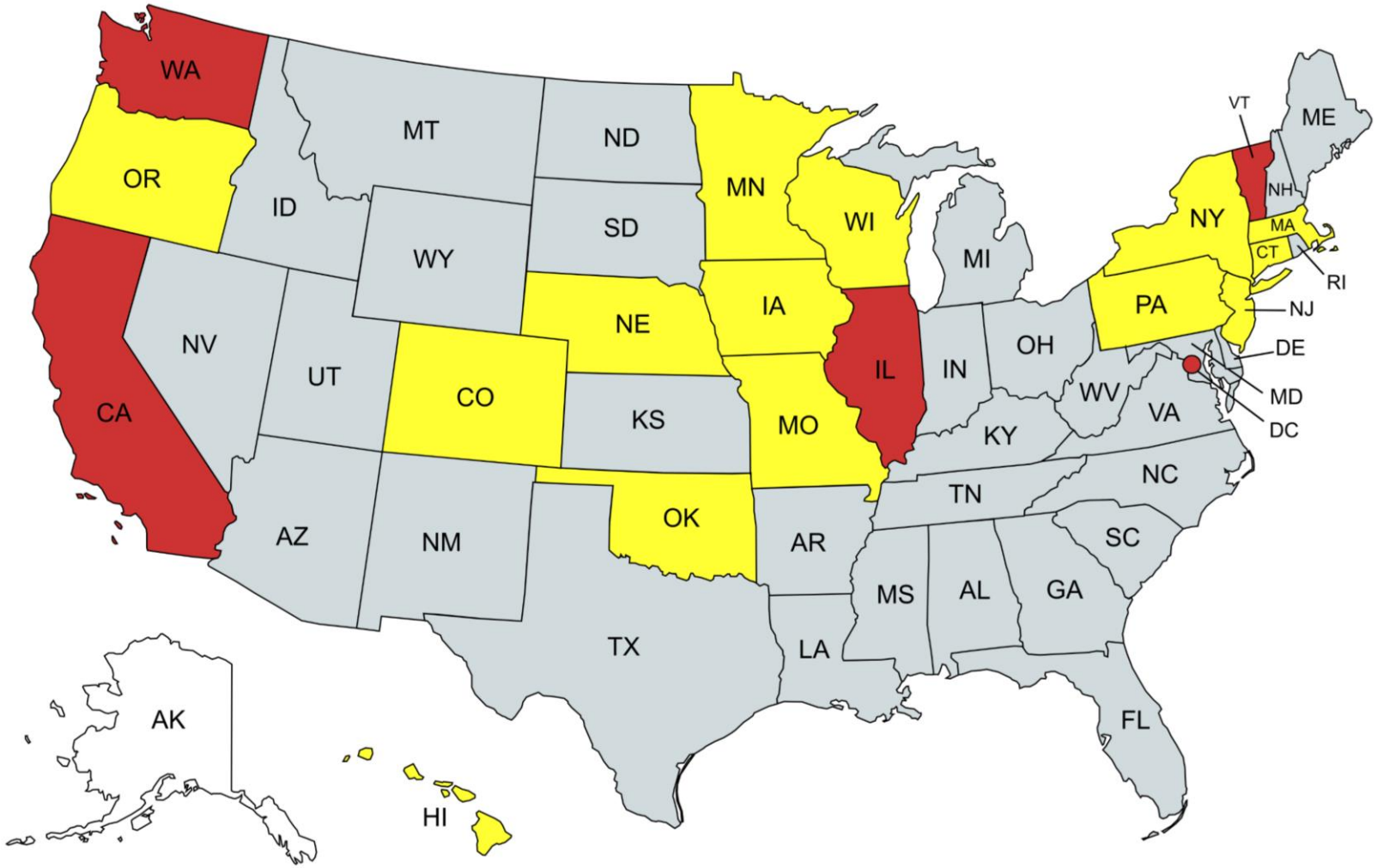
Voluntary rechargeable battery collections

Note: *Iowa, Florida, Maryland, New Jersey, Maine, New Hampshire, and Connecticut enacted laws in the 1990s mandating collection of portable nickel cadmium and small sealed lead acid batteries.*

** Minnesota and New York currently require the collection of portable rechargeable batteries.*

State Portable Battery EPR Initiatives

Updated January 17, 2025



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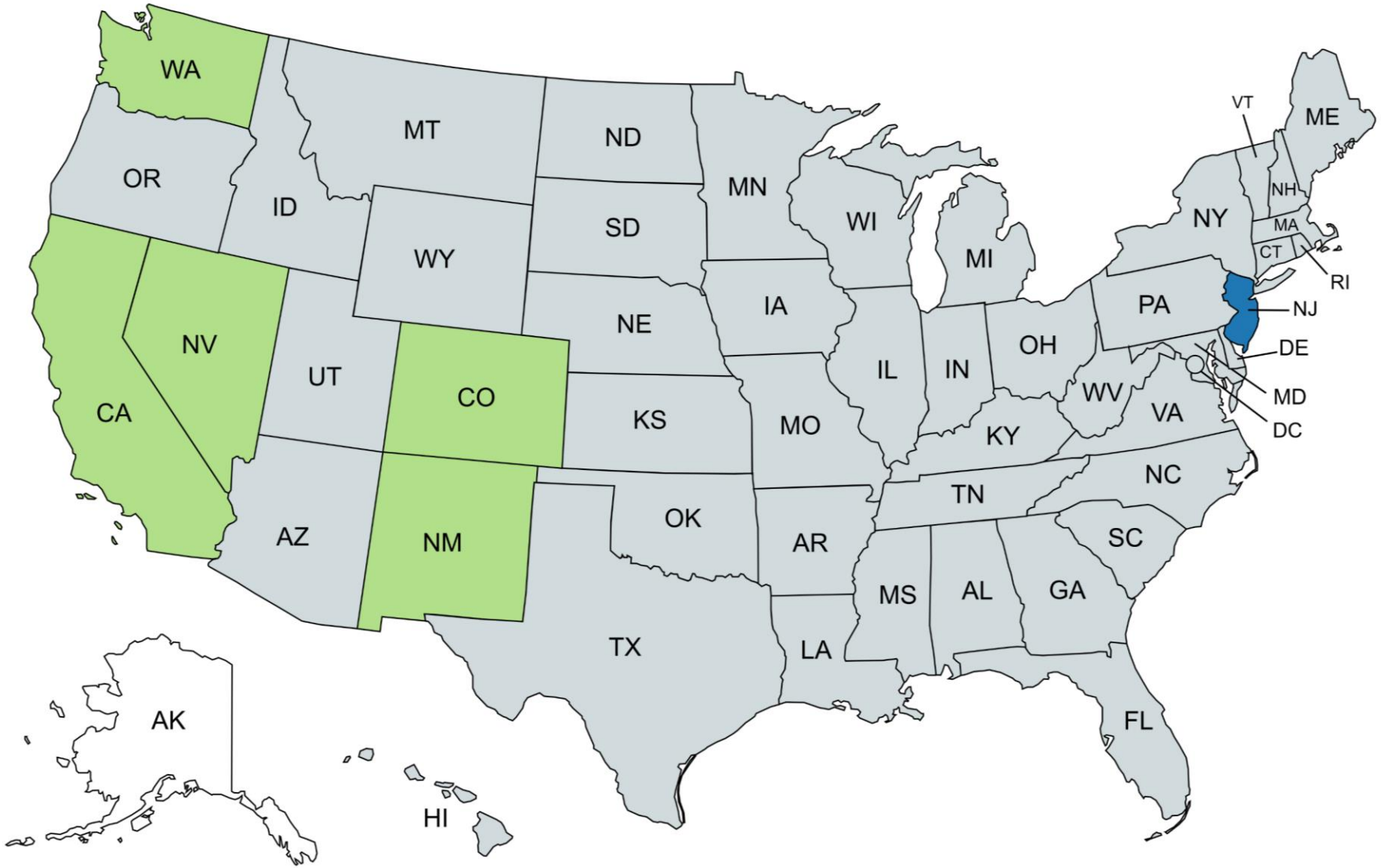
State EV Battery EPR Initiatives

Updated January 9, 2025

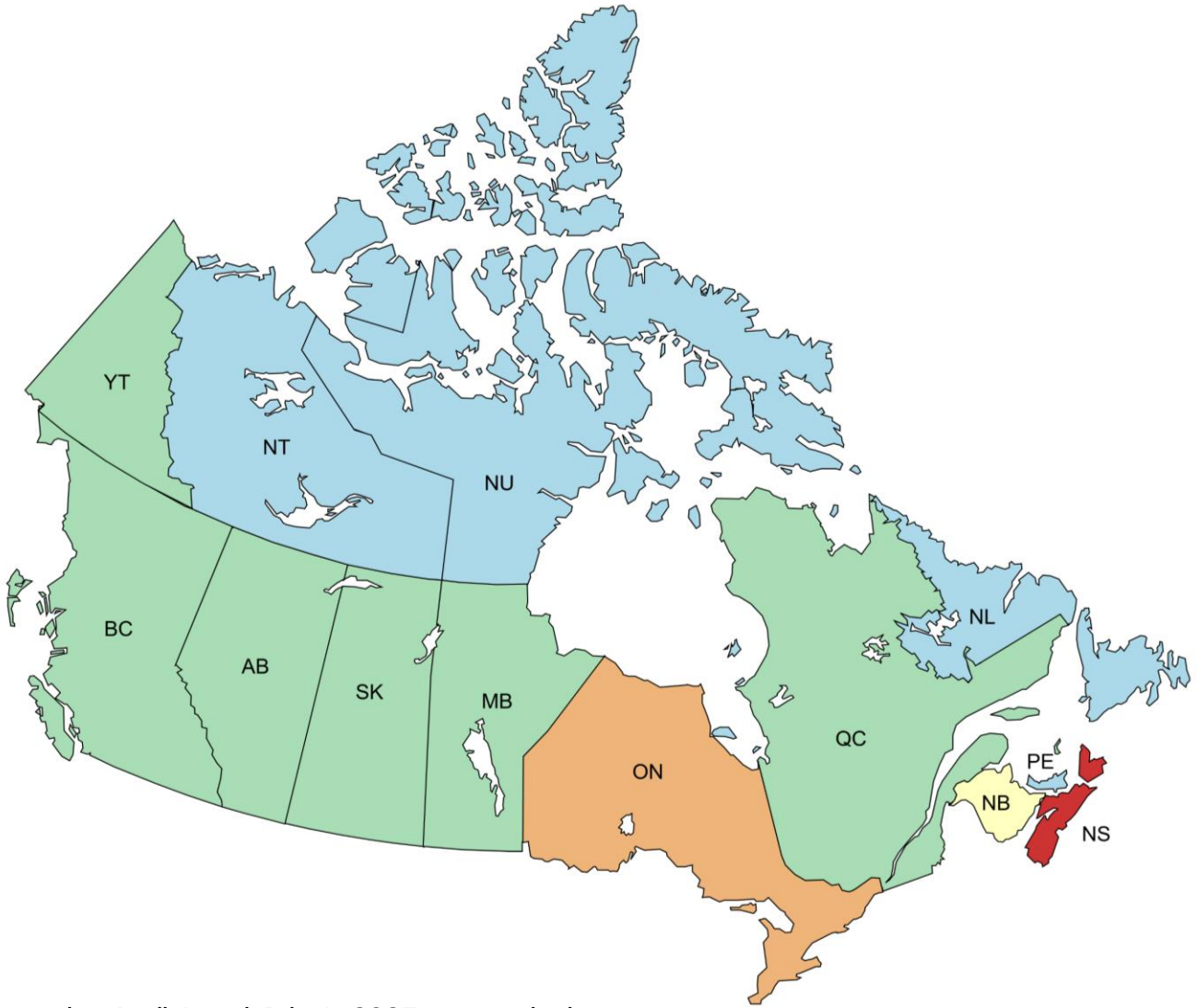


Recently enacted EV battery legislation

Considering or has introduced EV battery legislation for 2025

Provincial All Battery EPR Initiatives

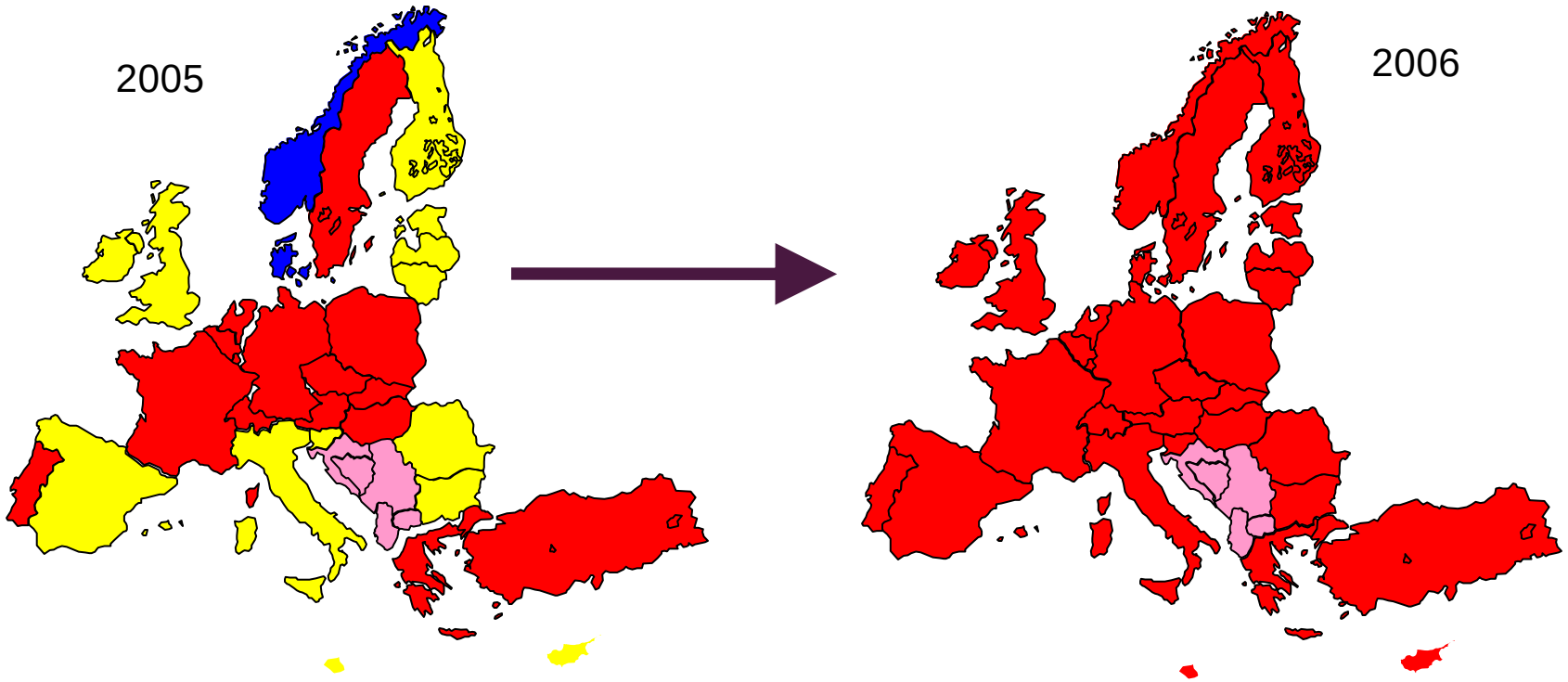
Updated January 21, 2025

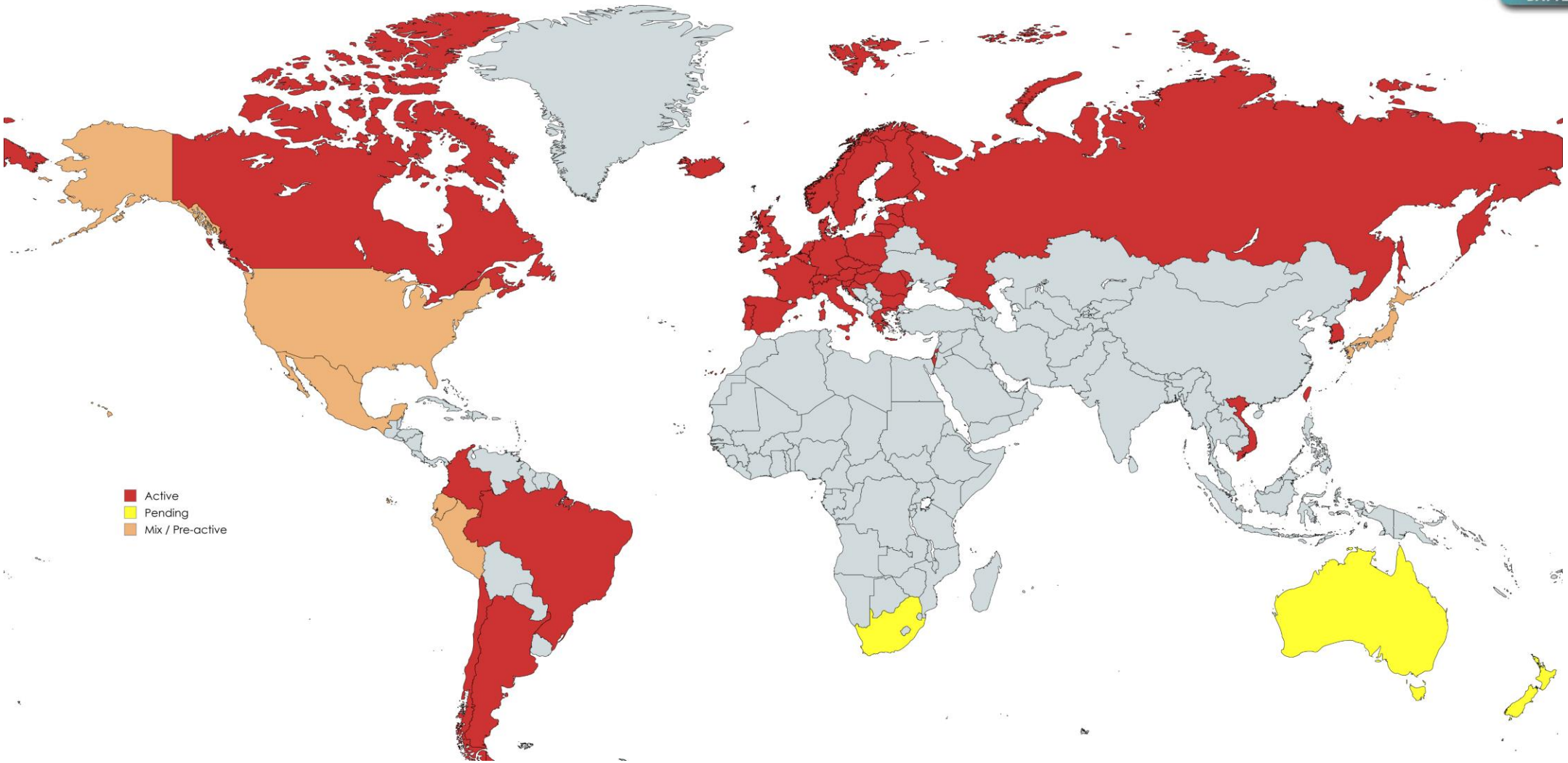


- Recently passed
- Legislative activity
- Existing
- Existing with new activity
- Voluntary program

*Alberta and Yukon Territory active April 1 and July 1, 2025, respectively

European Union
Battery Directive (and WEEE, RoHS)




Active
Pending
Mix / Pre-active

15-Minute Break

Mid-Format Policy Discussion

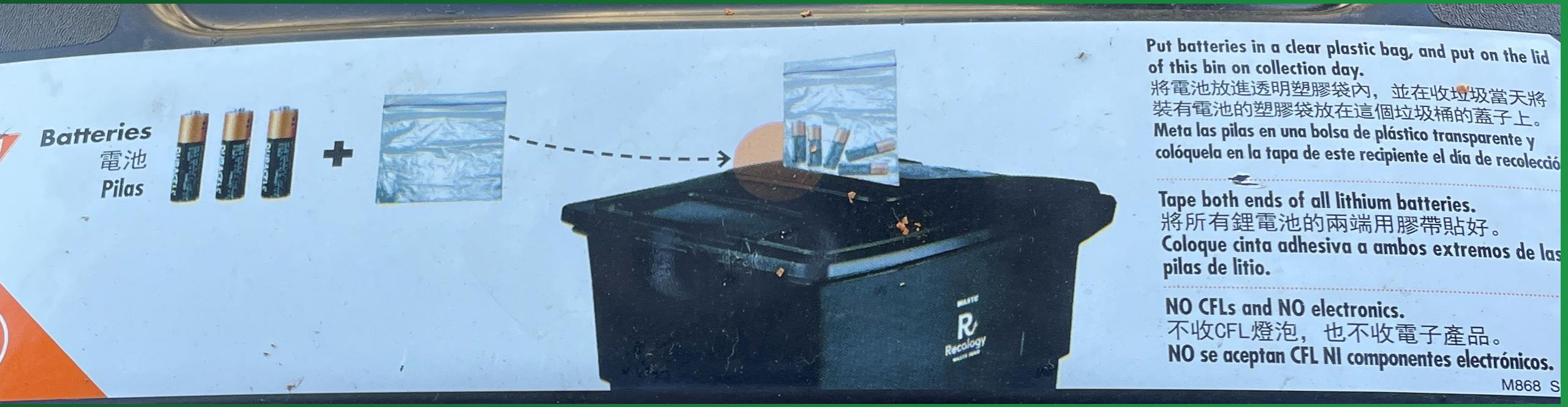
Tabletop Discussion

EPA

Mid-Format Policy Discussion

- Topic 1: What state or local policies and programs would be most beneficial for mid-format batteries? How might these policies and programs vary by battery type?
- Topic 2: What labeling or certification requirements are helpful to include in policies? Advantages/disadvantages? Mid-format vs. small format?
- Topic 3: What are the most important elements of policy to harmonize across state and local programs for mid-format batteries? Why is consistency in these areas important?
- Topic 4: How might we future-proof policies to address changing battery capacities/sizes/chemistries?
- Topic 5: What are the best ways to communicate the progress or success of battery collection programs? What measures should be used to determine the program's success? What kinds of messages should be communicated?

Lunch



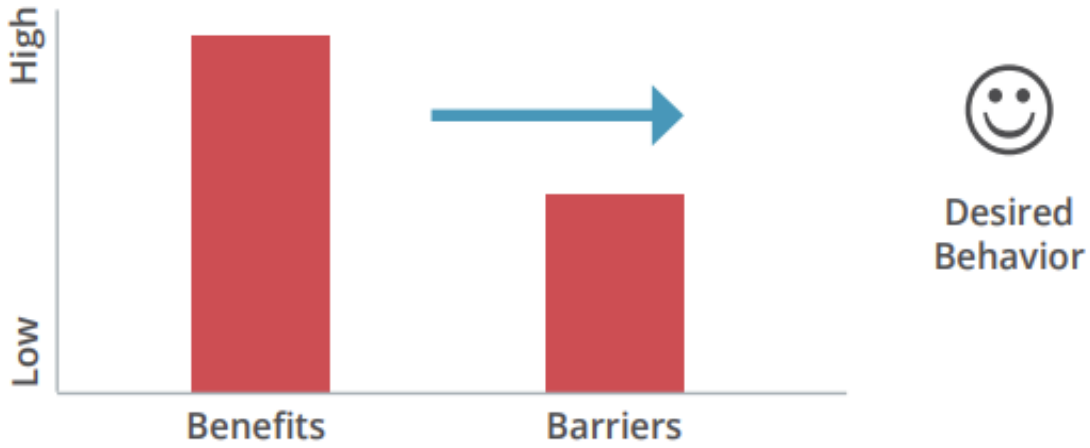
Feedback Session – Barriers/Motivators, Messages and Tactics

Amanda Godwin and Julie Colehour, C+C

EPA

National Consumer Education & Outreach

- Education & outreach are key to driving consumers to properly recycle batteries
  - Consistent and motivational messaging
  - One reliable place to find out how and where to recycle batteries
- Awareness alone does not lead to behavior change, and people don’t change their behaviors because it’s “the right thing to do”
- People do change their behaviors when the benefit and/or motivator to them outweighs the barriers to changing behavior



Purpose, Goals, and Objectives

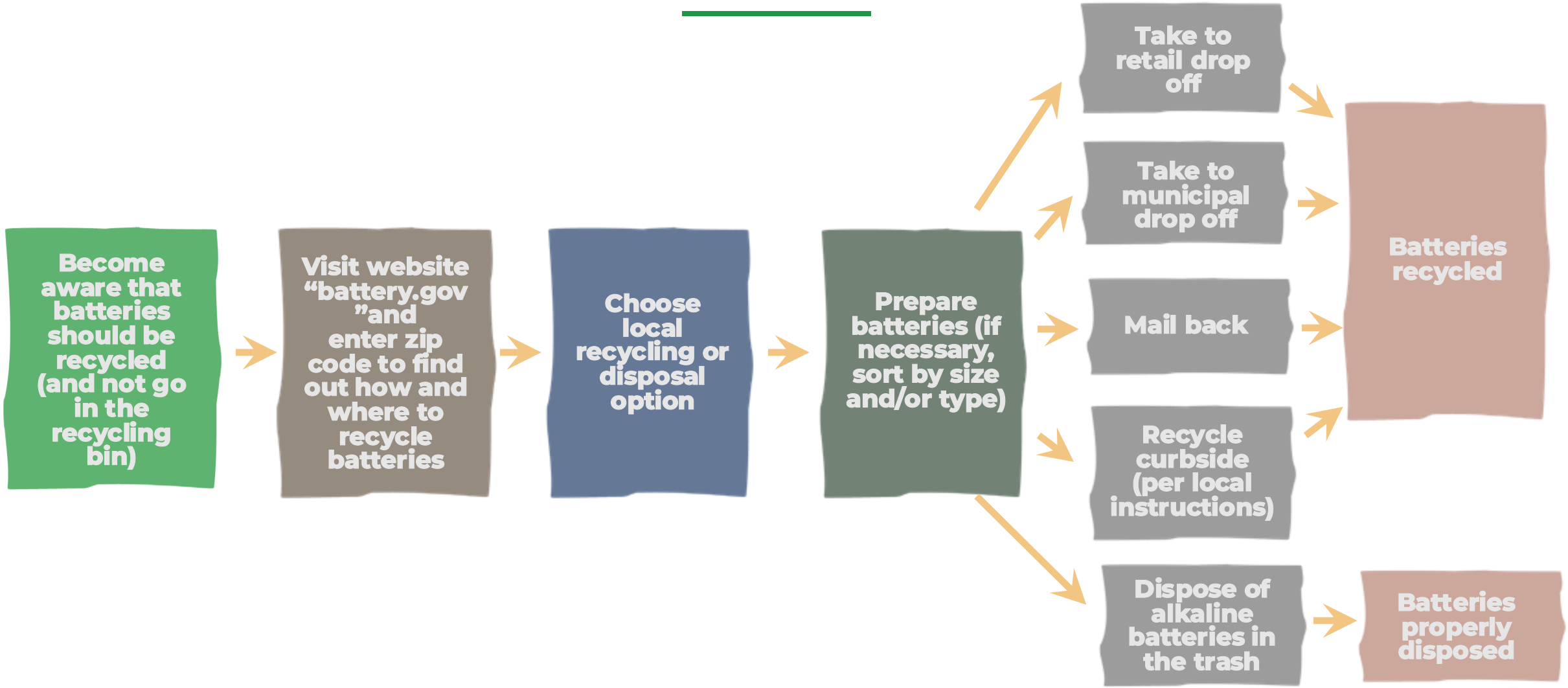
Purpose	Alleviate lifecycle impacts from batteries including reducing fires, protecting communities and our environment, keeping workers safe, and recovering critical minerals for domestic supply chains.
Goal	Help state, Tribal, territorial, and local governments collect and recycle batteries in a manner that is technically and economically feasible, environmentally sound, and safe.

Objectives	How Measured?
• Increase awareness about the need to recycle batteries • Educate about how and where to properly recycle batteries • Improve participation in battery recycling programs • Increase battery recycling accessibility	• Website metrics • Data from MRFs and landfills and community waste sorts on number of batteries in curbside waste stream • Program offering and participation data from local communities • Awareness/behavior surveys • Communication metrics

Education & Outreach Focus

- **Type of batteries:**
  - **Launch:** Portable, removable, batteries, that people have in their homes (small- and mid-format)
  - **Phase 2:** Include products with embedded batteries
- **Focus on "recycling" first and "proper disposal" second** since almost half the states are telling people to put Alkaline batteries in the trash
- Because guidance varies by community, communication best practice will be to have a **one-stop online location** for people to easily find out how to recycle and properly dispose of batteries in their community

Battery Recycling Behavior Chain



Barriers and Motivators:

What is preventing audience from behavior change? What would motivate them to change?

Behavior Objective	Barriers	Benefits/Motivators
Don't put batteries in recycling carts		
Visit online location "battery.gov" to find out what to do with their batteries		
Recycle batteries (mail-back, drop-off, curbside where available)		

Don’t Put Batteries in Trash and Recycling Carts

What is preventing audience from behavior change? What would motivate them to change?

Barriers	Benefits/Motivators
• Too easy to put in cart – extra step to leave house • Not close to the facility • Limited space on battery label • See the word recycle on package or battery • People think if they see the word recycle it can go in their curbside cart • Don’t know what to do with it • Don’t know it has a battery in it (e.g. vapes, toys) • No punishment/enforcement • Public perception of recycling (doubt, mistrust in recycling system) • Prior instructions that are in conflict • Don’t have transportation – access to a car	• Fine or consequence • Large collection footprint – make it very convenient • Standards similar to UK scheme • Make it easy to recycle (e.g. all batteries together, home pick up/curbside) • Feedback on progress/that it works

Visit Online Location "Battery.gov" to Find out What To Do with Batteries

What is preventing audience from behavior change? What would motivate them to change?

Barriers	Benefits/Motivators
• How different demographics consume media – how media is delivered • Not enough collection locations • Access to the internet/not knowing how to find site	• Understanding end use of materials recovered • All info in one spot • Have info also available in a non-online spot (e.g. post office) • Messaging in multiple locations • Visible campaign to raise awareness across multiple channels • NTSC – e.g. seat belt use campaign – advertise the campaign nationally (one campaign) • One place to go that people can remember

Recycle Batteries (Mail-back, Drop-off, Curbside Where Available)

What is preventing audience from behavior change? What would motivate them to change?

Barriers	Benefits/Motivators
• Nuance on what batteries are excepted where – varies (consumer can't tell what to take where) Burden of knowledge on what you can and cannot bring. • Mistrust in recycling • People don't see scooters and e-bikes as batteries (don't understand what products the batteries are in). Scooters lying on street don't help. • Can't mail back mid-format • Carrier (for mail back)	• Kids tell parents (school education) • Consistent guidance for consumers (guided by data) • Incentives for consumers – trade in credits

Messages

Fire risk/safety

Batteries contain flammable materials. When they aren't disposed of or recycled properly, they can spark and catch fire in collection trucks or recycling facilities and cause injuries and damage. It's important to me to keep drivers and other workers safe by figuring out what to do with batteries when I'm done with them.

Environmental

Almost all batteries need to stay out of the trash because they contain toxic materials that could pollute soil and water. I can take the time to put batteries where they belong when I'm done with them to recover and reuse these potential pollutants, keep them out of landfills, and help reduce the need for mining of raw minerals.

Recovery of Critical Minerals

Batteries contain valuable critical minerals like aluminum, cobalt, copper, lithium, manganese, and nickel. When I properly dispose of and recycle them, I can do my part to help the U.S. rely less on importing minerals from overseas and use them in manufacturing new products that are good for our economy and security.

Brainstorm: Consumer Outreach

Based on what you know, or battery recycling campaigns you've been involved with, what are effective strategies for reaching and motivating consumers?

15-Minute Break

Labeling and Standards and Real-World Applications

Brian Engle, SAE and Dr. Judy Jeevarajan, UL

UL/IEC Standards for Mid-Format Batteries

Judy Jeevarajan, Ph.D.
Electrochemical Safety Research Institute (ESRI)
UL Research Institutes

Presented at EPA Meeting on Mid-Format Batteries
January 27, 2025

Electrochemical Safety Research Institute (ESRI)

Advancing safer design and deployment of energy storage and energy generation through science

UL Standards – Motive Applications

Courtesy: Alex Liang, UL Solutions

Standard	Title	Product Covered	Example
ANSI/CAN/UL 2272:2024	Electrical Systems for Personal E-Mobility Devices	**Electrical system including battery** for **personal e-mobility devices** such as hoverboard and electrical kick scooters	 
ANSI/CAN/UL 2849:2022A	Electrical Systems for eBikes	**Electrical system including battery** for **e-bikes**	

UL Standards – UL 2272 (End-Product) Test Requirements

Courtesy: Alex Liang, UL Solutions

Test	Section	Number of samples[a]
Electrical Tests		
Overcharge	24	1 personal e-mobility device
Short Circuit	25	1 personal e-mobility device
Overdischarge	26	1 personal e-mobility device
Temperature	27	1 personal e-mobility device
Imbalanced Charging	29	1 personal e-mobility device
Dielectric Voltage Withstand	30	1 personal e-mobility device
Isolation Resistance	31	1 personal e-mobility device
Leakage Current	32	1 personal e-mobility device
Grounding Continuity	33	1 personal e-mobility device
Mechanical Tests		
Vibration	34	1 personal e-mobility device
Shock	35	1 personal e-mobility device
Crush	37	1 personal e-mobility device
Drop	38	1 personal e-mobility device
Mold Stress	39	1 personal e-mobility device
Handle Loading	40	1 personal e-mobility device
Strain Relief Tests (Cord Anchorages)	43	2 test specimens of the part under test or complete personal e-mobility device

UL Standards – UL 2272 (End-Product) Test Requirements (Cont'd)

Courtesy: Alex Liang, UL Solutions

Environmental Tests		
Water Exposure Tests a. IPX4 b. Partial Immersion	44	2 personal e-mobility devices
Thermal cycling	45	1 personal e-mobility device
Motor Tests		
Motor Overload	41	1 motor/personal e-mobility device
Motor Locked Rotor	42	1 motor/personal e-mobility device
Material Tests		
20-mm End Product Flame Test (Note: Not conducted if minimum V-1)	7.2	3 test specimens of the part under test (polymeric enclosure sample)
Label Permanence	46	1 test specimen of the part under test (label adhered to end use surface)
[a] Samples from different tests may be re-used for multiple tests if still intact so that its re-use does not affect the test results and the manufacturer is in agreement. Minor modifications can be made to samples such as replacement of fuses, etc. in order to reuse samples for multiple tests.		

UL Standards – UL 2849 (End-Product) Test Requirements (e-bikes, e-scooters and e-motorcycles)

Test	Test
27 Input Test	32.10 Thermal cycling
28 Temperature Test (eBike)	33 Impact Test
28 Temperature Test (Battery)	34 Mold Stress
29 Isolation Resistance Test	35 Flexing Test
30 Dielectric Strength Test	36 Ingress Protection Tests
31 Humidity Conditioning Test	37 Permanence of Marking
32.2 Overcharging test	38.1 Vibration Test (eBike)
32.3 Component fault tests	38.2 Vibration Test (Battery)
32.4 Forced ventilation/blocked ventilation	39.2 Strain relief
32.5 Locked rotor motor test	40 Startup Assistance Mode Test
32.6 Running overload test	41.2 Reverse Pedaling Test
32.7 Short circuit test	41.3 Pedal Cessation Test for EPACs
32.8 Imbalanced charging test	41.4 Cutoff When Braking Test
32.9 Shock test	41.5 Cutoff at Maximum Speed Test

ANSI/CAN/UL/ULC 2271:2023
Batteries for Use In Light Electric Vehicle (LEV) Applications

6.25 LIGHT ELECTRIC VEHICLE (LEV) – A light duty on-road or off-road vehicle that uses electricity as its source of energy for motive power, which is not considered suitable for use on highway systems. The following are examples of LEVs:

a) Electric bicycles;

b) Electric scooters as defined in 6.14;

c) Electric wheel chairs;

d) Golf carts;

e) All-terrain vehicles;

f) Non-ride-on industrial material handling equipment;

g) Unmanned aerial vehicles (UAVs);

h) Ride-on floor care machines; and

j) Personal e-mobility devices

NOTE: A LEV is not limited to the examples given above. Any EESA used in an LEV that meets the above definition can be covered by this Standard unless there is a dedicated LEV standard specifying the requirements for its EESA

UL 2271 - Batteries for Use In Light Electric Vehicle (LEV) Applications Tests and Sample Requirements

Courtesy: Alex Liang, UL Solutions

Test	Section	Number of samples [a, b]
Electrical Tests		
Overcharge	23	1 EESA
High Rate Charge	24	1 EESA
Short Circuit	25	1 EESA
Overload Under Discharge	26	1 EESA
Overdischarge	27	1 EESA
Temperature	28	1 EESA
Imbalanced Charging	29	1 EESA
Dielectric Voltage Withstand	30	1 EESA
Isolation Resistance	31	1 EESA
Mechanical Tests		
Vibration Endurance	33	1 EESA
Shock	34	1 EESA
Crush (on road)	35	1 EESA
Drop	36	1 EESA
Mold Stress	37	1 EESA
Handle Loading	38	1 EESA
Roll Over	39	1 EESA
Strain Relief Tests (Cord Anchorages)	40	2 test specimens of the part under test or complete EESA

UL 2271 - Batteries for Use In Light Electric Vehicle (LEV) Applications Tests and Sample Requirements

Courtesy: Alex Liang, UL Solutions

Environmental Tests		
Immersion Test	41	1 EESA
Water Exposure Test (IP code rating)	42	1 EESA
Thermal Cycling	43	1 EESA
Material Tests		
20-mm End Product Flame Test (Note: Not conducted if minimum V-1)	7.2	3 test specimens of the part under test (polymeric enclosure sample)
Label Permanence	44	1 test specimen of the part under test (label adhered to end use surface)
Single Cell Failure Design Tolerance Test		
Single Cell Failure Design Tolerance Test	45	1 EESA
a Samples from different tests may be re-used for multiple tests if still intact so that its re-use does not affect the test results and the manufacturer is in agreement. Minor modifications can be made to samples such as replacement of fuses, etc. in order to reuse samples for multiple tests.		
b Testing can be conducted on a subassembly of the EESA if determined to be representative.		

UL Standards

- UL 1642, UL 2054, IEEE 1625, IEEE 1725 include the operating region concepts with requirements that **cells be maintained** within this region.
- Others that include these critical concepts:
  - 2013: UL 2595, General Requirements for Battery-Powered Appliances (Horizontal standard that can cover ride on lawnmowers and floor cleaning machines. Used in conjunction with another end product standard)

- UL **end product safety standards** that take this approach include but not limited to (current editions below):
  - 2015: UL OOI 2056, Power Banks
  - 2016: UL 2272, Electrical Systems for Personal E-Mobility Devices
  - 2016: UL 2743, Portable Power Packs
  - 2018: UL 583, Electric-Battery-Powered Industrial Trucks
  - 2018: UL 3030, Unmanned Aircraft Systems
  - 2018: UL 3100, Automated Guided Vehicles (AGVs)

International Battery Standard (Lithium-ion)

Standard No.	Standard Title	Summary
IEC 62133-2	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems	Cells and batteries for portable applications
IEC 63057	Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium batteries for use in road vehicles not for the propulsion	Batteries for vehicle auxiliary power (not for motive)
IEC 60335-2-114	Household and similar electrical appliances – Safety – Part 2-114: Particular requirements for self-balancing personal transport devices for use with batteries containing alkaline or other non-acid electrolytes	Electrical requirements for hoverboards

IEC 62133-2 SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SAFETY REQUIREMENTS FOR PORTABLE SEALED SECONDARY CELLS, AND FOR BATTERIES MADE FROM THEM, FOR USE IN PORTABLE APPLICATIONS – Part 2: Lithium systems

Test	Cell a, c	Battery
7.2.1 Continuous charge	5	–
7.2.2 Case stress	–	3
7.2.3 ESD immunity test (battery)	-	1
7.2.4 Normal Charging Extreme Parameters	5 per temperature	-
7.2.5 Vibration	3	3
7.2.6 Mechanical Shock	3	3
7.3.1 External short-circuit (cell)	5 per temperature	–
7.3.2 External short-circuit (battery)	–	5
7.3.3 Free fall	3	3
7.3.4 Thermal abuse	5 per temperature	–
7.3.5 Crush	5 per temperature	–
7.3.6 Abnormal charge: – 7.3.6.1 Overvoltage charging – 7.3.6.2 High rate charging	5 total 3 for overvoltage charging 2 for high rate charging	5 total 3 for overvoltage charging 2 for high rate charging

IEC 62133-2 (contd.)

7.3.7 Forced discharge	5	-
7.3.8 Overdischarge Test	-	5
7.3.9 Internal short-circuit[b] (Select one test from the three options) – 7.3.9.2 Forced internal short-circuit[d] – 7.3.9.3 Alternative internal short-circuit test method – 7.3.9.4 Cell tear down analysis with production line criteria	 5 per temperature 5 per temperature 5	-
Annex E Measurement of the internal AC resistance for coin cells	3	-

[a] Excludes coin cells with an internal resistance greater than 3 Ω, and small cells other than coin types with an internal resistance greater than 3 Ω and capacity of < 300 mAh

[b] Not applicable to coin cells

[c] For tests requiring charge procedure of 7.1.2 (procedure 2): 5 cells per temperature are tested

[d] The 7.3.9.2 test is not applicable for lithium ion polymer cells as defined in 3.16

History and Need for Standards

Courtesy: Alex Liang, UL Solutions

- Alkaline batteries first sold in 1968-1970. It was a variation of the Leclanche cells.
  These did not pose catastrophic safety risks, hence no standards were developed at that time for batteries.
- 1970s to 1980s: The first commercial lithium batteries were primary (non-rechargeable) lithium metal batteries
  - UL 1642, Lithium Batteries, 1st edition was published in October 1985 to address safety of primary lithium batteries.
- 1980s to 1990s: The first commercial secondary (rechargeable) lithium batteries were secondary lithium metal batteries.
  - UL 1642, 2nd edition was published in November 1992 and included requirements to include secondary lithium batteries.
- 1990s: Rechargeable NiCd was the main chemistry used for rechargeable batteries for portable followed closely by NiMH battery chemistry.
- May 1997: UL 2054, Household and Commercial Batteries was first published
  - UL 2054 is non-chemistry specific, but was originally developed to address safety of nickel cells and batteries
  - Evolved to also cover the safety of portable lithium-ion battery packs.

History and Need for Standards

Courtesy: Alex Liang, UL Solutions

In the late 1990s and beyond, lithium-ion batteries became the battery chemistry of choice
With long cycle life, high energy density (gravimetric and volumetric), good rate capability and no memory effect, it started replacing the nickel systems.

UL 1642 and UL 2054 were the safety standards used to certify Li-ion batteries.

- The end-product standards contained few/no battery criteria
- Would rely on the battery standards for safety.

Proliferation of the use of Li-ion batteries to power a myriad of portable applications started in the 2000s.
@ 2003 – 2005: Well publicized field incidents involving lithium-ion battery products began

- 2006 – Dell laptop battery recall, largest in history at the time (Sony lithium-ion cells)
- Other laptop manufacturers and other cell manufacturers also recalled their devices
- There were cell phone incidents as well

Need for Recycling

UL Listed Products and Marks

- A **Listed Product** is a complete product which can be used on its own such as a computer, monitor, mouse, keyboard.
- UL's Listing Service is the most familiar and desired form of UL's product safety certification programs.
- A UL Listing Mark on a product means that the product comply with all the construction and performance requirements of this category, and it is suitable for either field or factory installation.

Marks:

Enhanced Mark:

JL Listing Mark for USA

UL Listing Mark for Canada

UL Listing Mark for Canada and the USA

UL Recognized Products and Marks

- A **Recognized Component** is a component (or part) of a product bearing the Recognized Component Mark that may be used in UL Certified Products.

- Recognition is intended for components that may be incomplete in construction or restricted in performance capabilities and not for use as field-installed components. They may be entirely suitable for factory installation on other equipment when the limitations of use are known to a manufacturer and when their use within those limitations is investigated by UL.

UL Recognized Component Mark for USA

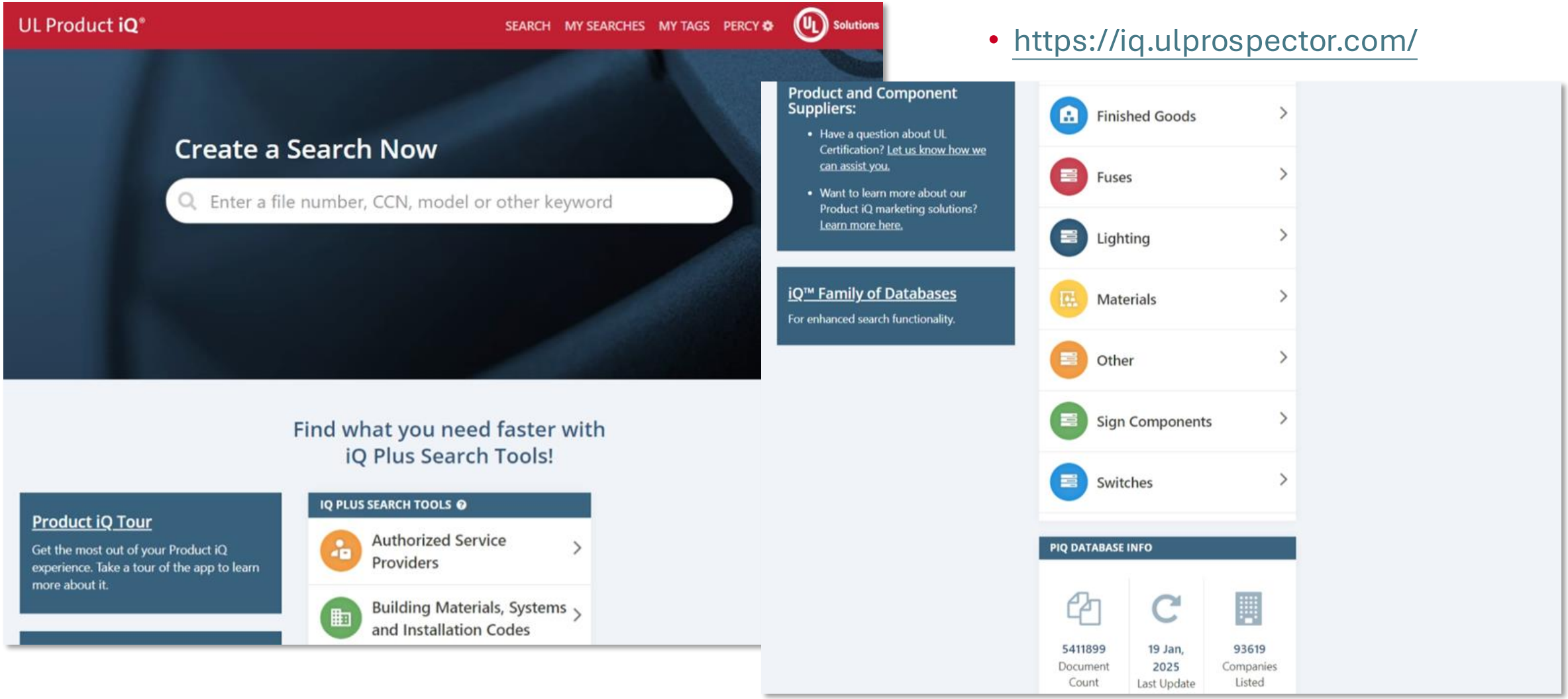
UL Recognized Component Mark for Canada and the United States

UL Recognized Component Mark for Canada

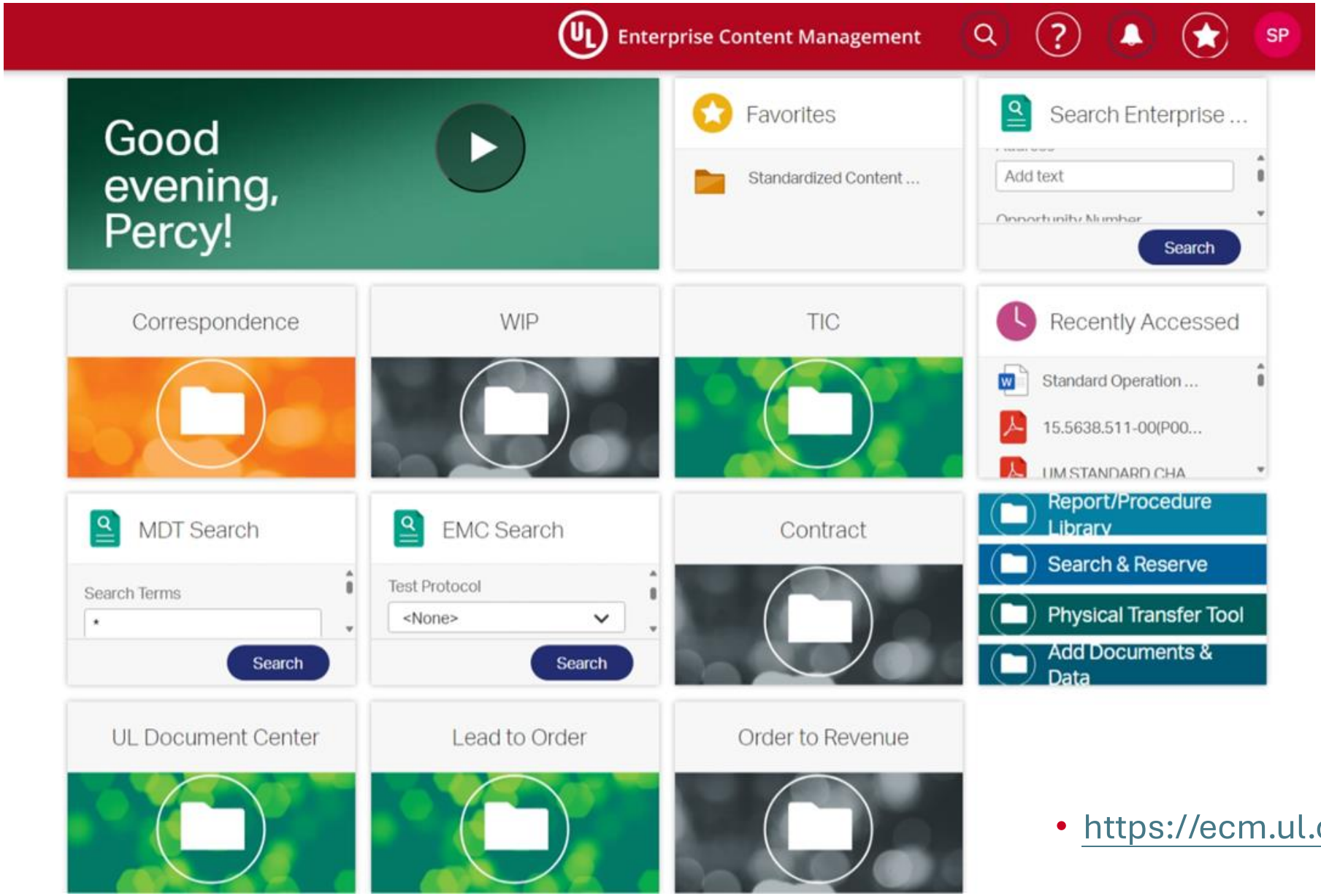
A UL Recognized Battery (for Factory Installation)

The UL Certification Directory (UL Product iQ)

- https://iq.ulprospector.com/



The Internal-Use UL Enterprise Content Management (ECM)



- https://ecm.ul.com/otcs/llisapi.dll/app

How Does UL Assure Continuous Compliance of a Certified Product?

- **Follow-Up Service (FUS):**
  - Factory inspection of construction:

  UL field engineer visits factory to verify the product in production line matches the one submitted for UL certification, in terms of safety-critical construction/component.

  - FUS sample **test**:
    - ✓ UL field engineer samples product from production line. UL lab repeats selected UL tests to determine if it continuously complies with UL standard.
    - ✓ For UL 62133-2, the test is external-short-circuit test.

How Does UL Assure Continuous Compliance of a Certified Product?

- **Market Surveillance:**
  - Market Survey Program:

  UL samples product from marketplace, and undergo construction review and testing to determine if it continuously complies with UL standard.

- **Why do we need FUS and Market Surveillance:**
  - The requirement from the international standard for certification agencies, ISO 17065: Products bearing certification mark shall be subjected to a “periodic surveillance” to ensure ongoing compliance with the standard.

SAE Government/Industry Meeting 2025

Battery Committee and Hybrid-EV Committee Overview

Dante Rahdar

Ground Vehicle Committee Manager

Dante.Rahdar@SAE.org

SAE International

o +1.248.273.4084

m +1.248.275.9469

Brian Engle

SAE Fellow

Chair, SAE Battery Standards Steering Committee

Chair, SAE First Responders Task Force

Brian.engle@amphenol-sensors.com

m +1.248.978.5736

100 SAE EV, Hybrid, and Fuel Cell Vehicle Published Documents

Mobility, Advanced™

Fuel Cell Fueling: J2600, J2601, J2601/1. J2601/2, J2601/3,J2601/4, J2601/5, J2719, J2719/1, J2799, J1766, J2578, J2579

Fuel Cell Testing: J2615, J2616, J2617, J3219

Fuel Cell Systems: J2579, J2594, J3089

EV Battery Recycling/Secondary Use: J2984, J2974, J3071, J2997

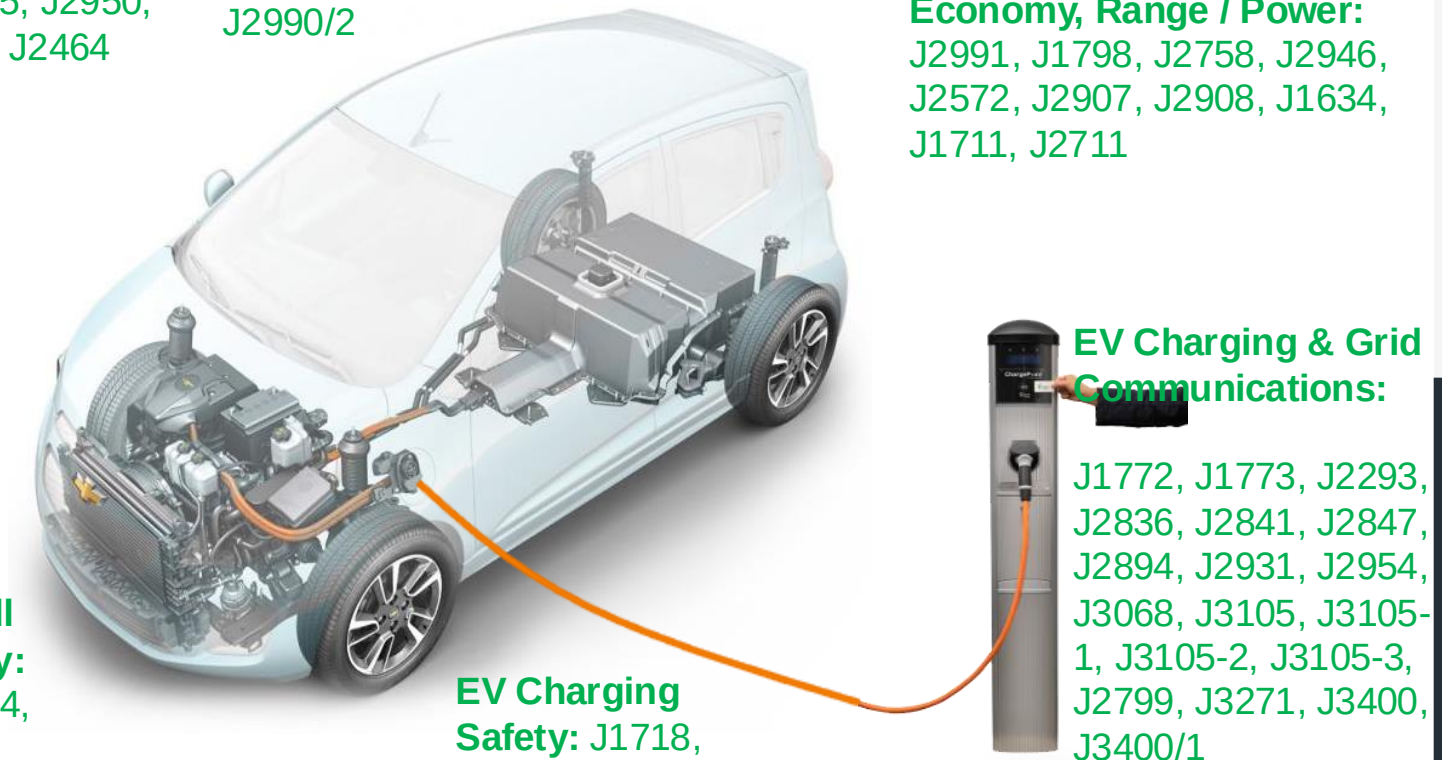
Energy Transfer Systems: J2293, J2293/1, J3072

EV, Hybrid, Fuel Cell Vehicle Safety: J1766, J2344, J2910, J2578, 3108, J3108/1, J3235, J2950, J3325, J2929, J2464

Battery Testing: J1798, J1798/1, 1798/2, J2288, J2289, J2380, J2758, J3220, J3277, J3277/1

EV, Hybrid, Fuel Cell Vehicle Terminology: J1715, J1715/2 J2574, J2760

EV, Hybrid, Fuel Cell Vehicle Crash Safety: J3040, J1766, J2990, J2990/2



EV Charging Safety: J1718, J2953/1, J2953/3

EV, Hybrid, Fuel Cell Vehicle Economy, Range / Power: J2991, J1798, J2758, J2946, J2572, J2907, J2908, J1634, J1711, J2711

EV Charging & Grid Communications: J1772, J1773, J2293, J2836, J2841, J2847, J2894, J2931, J2954, J3068, J3105, J3105-1, J3105-2, J3105-3, J2799, J3271, J3400, J3400/1

https://standardsworks.sae.org/standards-committees/hybrid-ev-committee
https://standardsworks.sae.org/standards-committees/fuel-cell-standards-committee
ttps://standardsworks.sae.org/standards-committees/vehicle-battery-standards-steering-committee

Vehicle Battery Standards Steering Committee

Mobility, Advanced™

750+ Committee Membership Individual Participants

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

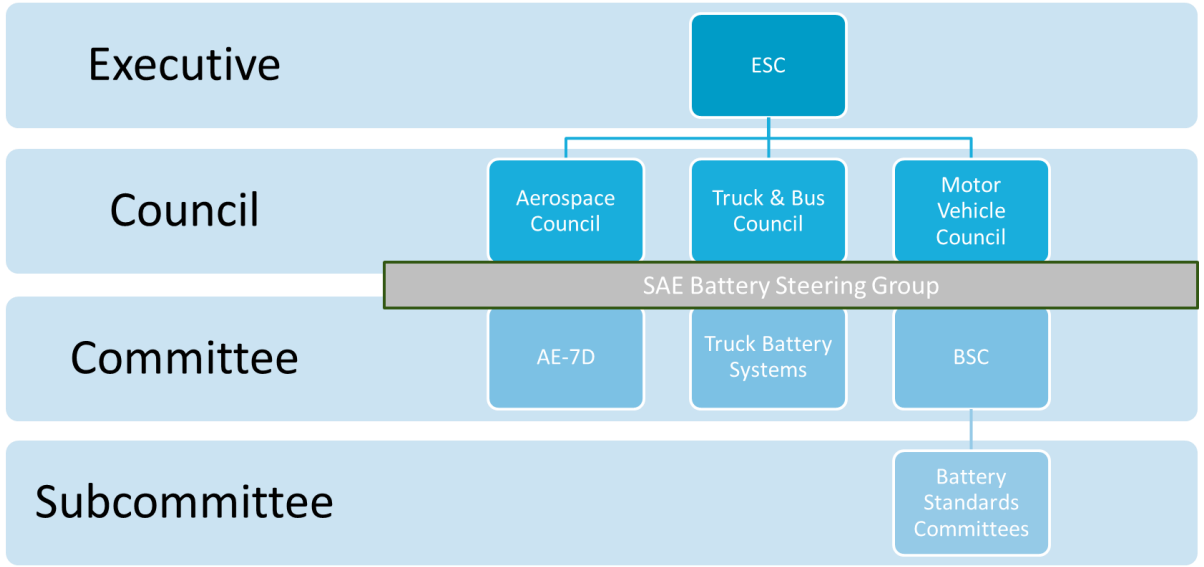
32 Subcommittees

40 Published Documents

Vehicle Battery Standards Steering Committee

Mobility, Advanced™

The Battery Standards Steering Committee is responsible for developing and maintaining documents related to the field of vehicle battery technology, including both starter and traction batteries. Emphasis is currently being placed on Electric Vehicle traction batteries (including passenger car, truck and bus), stationary storage, marine batteries, agriculture and construction.
https://standardsworks.sae.org/standards-committees/vehicle-battery-standards-steering-committee



Vehicle Battery Standards Steering Committee

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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

Battery Pack Venting Committee

Mobility, Advanced™

This committee is tasked with developing it's first document, J3325 Battery Pack Venting Units

Scope
Battery packs used in mobility applications require pressure equalization of airspace within the pack to ambient barometric pressure conditions in a dynamic environment as well as provide emergency venting of cell vent gases that are released during cell failure to prevent explosion events. This technical information report will provide guidance on component design for pack pressure equalization and emergency venting across vehicle battery packs including micromobility, passenger vehicles, and heavy-duty pack applications.
Rationale
This information report has been requested by industry to guide battery pack engineers towards improving battery pack safety as mandated in new regulations like GB 38031 and UN ECE R100 Rev. 03. As battery pack venting units play an important role in holisitc battery pack safety concepts, this document provides guidance on functional requirements, state-of-the-art vent designs, and system integration.

This is a brand-new document under development and meetings are ongoing. J3325 is currently in committee ballot for the first time.

https://standardsworks.sae.org/standards-committees/battery-pack-venting-committee

Recycling-related work

TEVVBC10 Battery Standards Recycling Committee

The Battery Recycling Committee will cover all recycling concern within the recycling stream for Lithion-ion, and new chemistries

J2974_201902	Technical Information Report on Automotive Battery Recycling	Feb 11, 2019	Revised
J2984_202109	Chemical Identification of Transportation Batteries for Recycling	Sep 10, 2021	Revised
J3071_201604	Automotive Battery Recycling Identification and Cross Contamination Prevention	Apr 05, 2016	Issued

TEVVBC11 Global Battery Traceability Standards Committee

https://standardsworks.sae.org/standards-committees/battery-global-traceability-standards-committee

The SAE Battery Global Traceability Committee will develop standards for common battery data and security to be shared with various global stakeholder groups enabling sustainability and compliance for the global battery supply and value chain. This includes standards for traceability data on the origin/provenance of critical battery minerals; battery and performance data to optimize battery lifecycles, improve safety, ensure responsible use, remanufacturing/repurposing, recycling; and accounting for the sustainability and interoperability throughout. This committee will work on an interoperable (international) standard for battery tracing, building upon the works of prior global projects issued with minimal requirements and securing the option to enrich following standards, based on necessity.

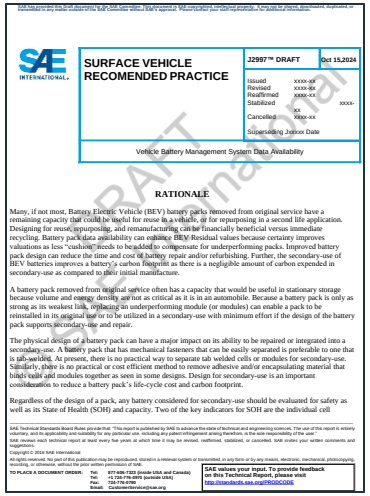
Recycling-related work

TEVVBC15 Secondary Battery Use Committee

https://standardsworks.sae.org/standards-committees/secondary-battery-use-committee

The Secondary Use Battery Committee will write SAE document that explore secondary uses for new chemistry batteries

Draft – J2997 - Vehicle Battery Management System Data Availability



SURFACE VEHICLE RECOMMENDED PRACTICE

J2997™ DRAFT Oct 15,2024

Issued xxxx-xx
Revised xxxx-xx
Reaffirmed xxxx-xx
Stabilized xx xxxx-xx
Cancelled xxxx-xx
Superseding Jxxxx Date

Vehicle Battery Management System Data Availability

RATIONALE

Many, if not most, Battery Electric Vehicle (BEV) battery packs removed from original service have a remaining capacity that could be useful for reuse in a vehicle, or for repurposing in a second life application. Designing for reuse, repurposing, and remanufacturing can be financially beneficial versus immediate recycling. Battery pack data availability can enhance BEV Residual values because certainty improves valuations as less "cushion" needs to be added to compensate for underperforming packs. Improved battery pack design can reduce the time and cost of battery repair and/or refurbishing. Further, the secondary-use of BEV batteries improves a battery's carbon footprint as there is a negligible amount of carbon expended in secondary-use as compared to their initial manufacture.

A battery pack removed from original service often has a capacity that would be useful in stationary storage because volume and energy density are not as critical as it is in an automobile. Because a battery pack is only as strong as its weakest link, replacing an underperforming module (or modules) can enable a pack to be reinstalled in its original use or to be utilized in a secondary-use with minimum effort if the design of the battery pack supports secondary-use and repair.

The physical design of a battery pack can have a major impact on its ability to be repaired or integrated into a secondary-use. A battery pack that has mechanical fasteners that can be easily separated is preferable to one that is spot-welded. At present, there is no practical way to separate tab welded cells or modules for secondary-use. Similarly, there is no practical or cost efficient method to remove adhesive and/or encapsulating material that binds cells and modules together as seen in some designs. Design for secondary-use is an important consideration to reduce a battery pack's life-cycle cost and carbon footprint.

Regardless of the design of a pack, any battery considered for secondary-use should be evaluated for safety as well as its State of Health (SOH) and capacity. Two of the key indicators for SOH are the individual cell

SAE values your input. To provide feedback on this Technical Report, please visit http://standards.sae.org/JXXXXCOOK

TEVVBC18 Battery Field Discharge Committee

https://standardsworks.sae.org/standards-committees/battery-field-discharge-committee

The scope of this committee's work will include establishment of recommended practices to enable safe field procedures

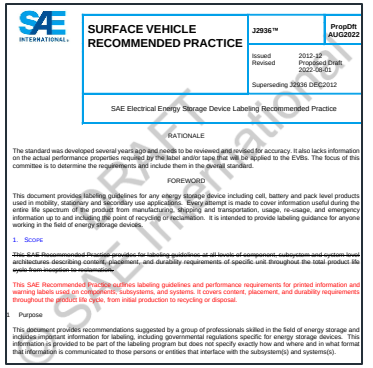
TEVVBC3 Battery Tape and Label Committee

https://standardsworks.sae.org/standards-committees/battery-tape-label-committee

Establish universal labeling criteria of all battery systems

1 WIP – draft update of J2936 in process

1 Docs



SURFACE VEHICLE RECOMMENDED PRACTICE

J2936™ PropDft AUG2022

Issued 2012-12
Revised Proposed Draft 2022-08-01

Superseding J2936 DEC2012

SAE Electrical Energy Storage Device Labeling Recommended Practice

RATIONALE

The standard was developed several years ago and needs to be reviewed and revised for accuracy. It also lacks information on the actual performance properties required by the label and/or tape that will be applied to the EVBs. The focus of this committee is to determine the requirements and include them in the revised standard.

FOREWORD

This document provides labeling guidelines for any energy storage device including cell, battery and pack level products used in mobility, stationary and secondary use applications. Every attempt is made to cover information useful during the entire life spectrum of the product from manufacturing, shipping and transportation, usage, re-usage, and emergency information up to and including the point of recycling or reclamation. It is intended to provide labeling guidance for anyone working in the field of energy storage devices.

1. SCOPE

This SAE Recommended Practice provides for labeling guidelines at all levels of component, subsystem and system level architectures describing content, placement, and durability requirements of specific unit throughout the total product life cycle from inception to recycle.

This SAE Recommended Practice outlines labeling guidelines and performance requirements for printed information and warning labels used on components, subsystems, and systems. It covers content, placement, and durability requirements throughout the product life cycle, from initial production to recycling or disposal.

1. Purpose

This document provides recommendations suggested by a group of professionals skilled in the field of energy storage and includes important information for labeling, including governmental regulations specific for energy storage devices. This information is provided to be part of the labeling program but does not specify exactly how and where and in what format that information is communicated to those persons or entities that interface with the subsystem(s) and systems(s).

J2936_201212	SAE Electrical Energy Storage Device Labeling Recommended Practice	Dec 07, 2012	Issued

Recycling-related work

Mobility, Advanced™

TEVVBC4 Battery Transportation and Storage Committee

https://standardsworks.sae.org/standards-committees/battery-transportation-committee

Establish best practices for environmental and safety transportation of batteries. Work in conjunction with all government regulations.

2 Docs

Document	Title	Date	Status
J2950_202006	Recommended Practices for Shipping Transport and Handling of Automotive-Type Battery System - Lithium Ion	Jun 09, 2020	Revised
J3235_202303	Best Practices for Storage of Lithium-Ion Batteries	Mar 20, 2023	Issued

TEVVBC9 Battery Standards Advanced Battery Concepts Committee

https://standardsworks.sae.org/standards-committees/battery-standards-advanced-battery-concepts-committee

Generate ongoing information reports for monitoring of new energy storage technologies which will require standards in the future to serve the transportation industry. These ongoing information reports will serve to direct future committee work within the Battery Standards Steering Committee to assure the SAE International Organization stays in front of the new technologies

Draft Document: **J3296 The Guideline for Advanced Battery Technology**

Hybrid - EV Committee

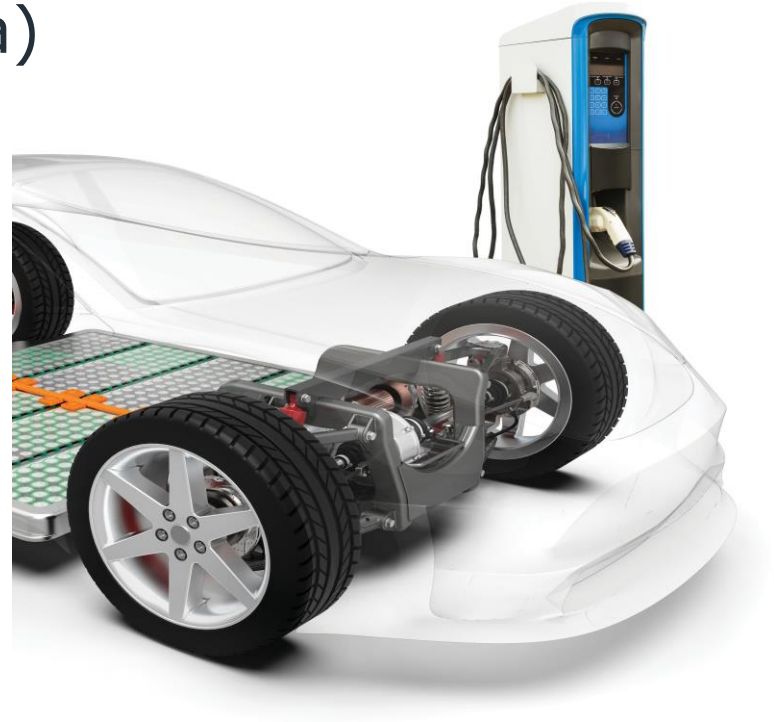
Mobility, Advanced™

1,348 Committee Membership Individual Participants

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

10 Reporting Task Forces

42 Published Documents



Hybrid - EV Committee

Mobility, Advanced™

The Committee is responsible for developing and maintaining SAE Standards, Recommended Practices, and Information Reports related to the field of hybrid vehicle technology. The following topics are within the scope of this committee's work: safety aspects of hybrid systems in vehicles, test procedures to establish the performance of hybrid systems and components, nomenclature, vehicle interface and serviceability requirements.
https://standardsworks.sae.org/standards-committees/hybrid-ev-committee

Sub-Task Forces of interest include:

- Hybrid-EV J3400 NACS Electric Vehicle Coupler Task Force
- J3105 Medium and Heavy-Duty Vehicle Conductive Charging Task Force
- J2954 Wireless Power Transfer and Alignment Task Force
- J3271 Megawatt Charging System for Electric Vehicles TF
- Hybrid and EV First and Second Responder Task Force
- Hybrid J1772 Connector Task Force
- Hybrid Communication and Interoperability Task Force

Hybrid-EV J3400 NACS Electric Vehicle Coupler Task Force

Mobility, Advanced™

This team is working on a revision of SAE J3400 North American Charging System (NACS) for Electric Vehicles that was published as a recommended practice in 2024.

The development of J3400/1 Electric Vehicle Charging Adapter Safety and OEM Qualified Device Designation as a brand-new technical information report.

They're also developing J3400/2 Connectors and Inlets for the North American Charging System (NACS) for Electric Vehicles as a brand-new recommended practice.

All three documents are currently open as a work in progress and weekly meetings are ongoing.

https://standardsworks.sae.org/standards-committees/hybrid-ev-j3400-nacs-electric-vehicle-coupler-task-force

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

Dante Rahdar

Ground Vehicle Committee Manager

Dante.Rahdar@SAE.org

SAE International

o +1.248.273.4084

m +1.248.275.9469

Discussion

1. What is working or not working about current labeling standards?
2. What's missing from current or planned labeling requirements or standards to promote more effective recycling activities? What are the most effective messages, resources, and outlets for this information?

5-Minute Break

Mapping Current Voluntary Mid-format Collection Programs

Rob Latham, Call2Recycle; Mike Fritz, Human Powered Solutions and NBDA; Brandon Martin, OPEI; and Micah Day, STIHL USA

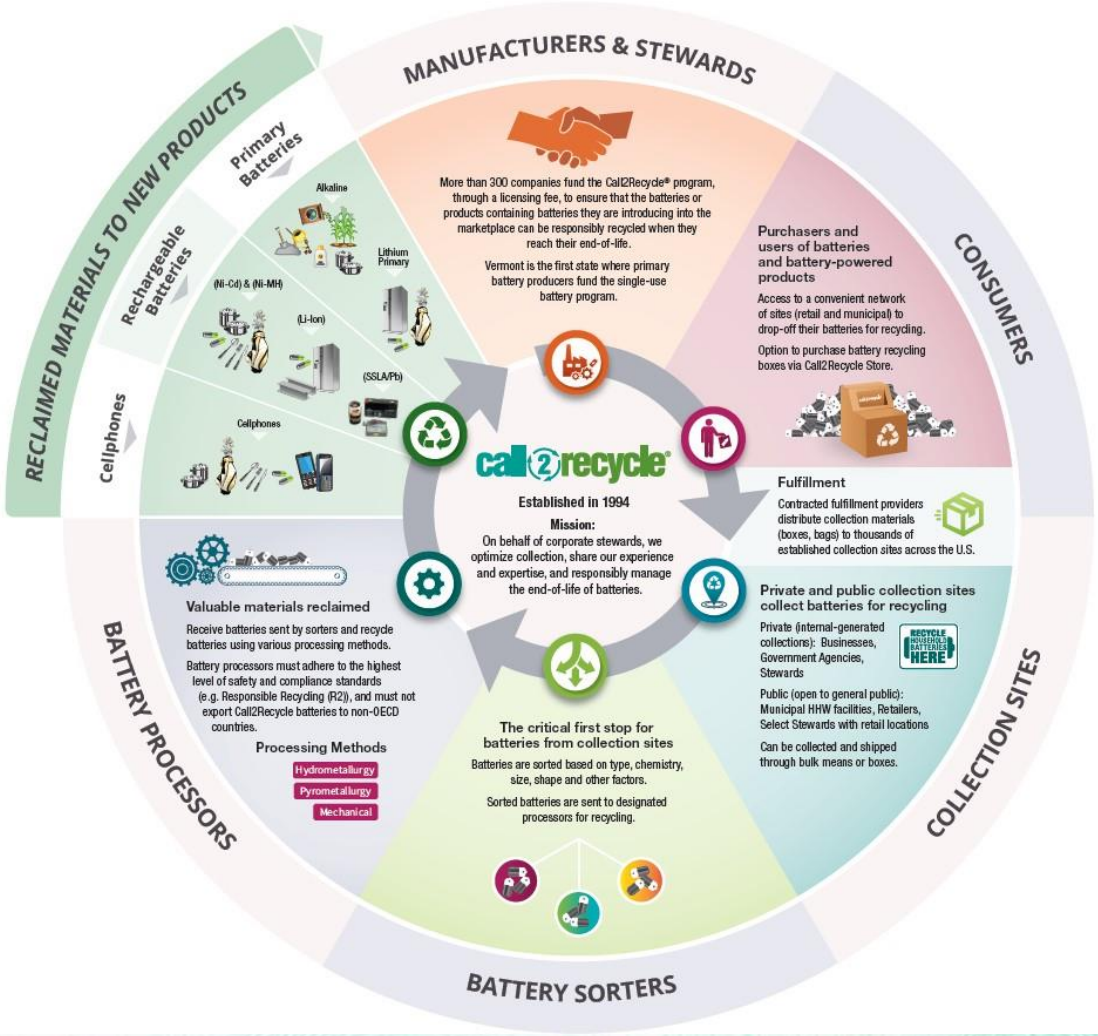
Mid-Format Batteries: Role of Manufacturers and Retailers in Promoting Safer Use and Management

Rob Latham
Call2Recycle, Inc.

call2recycle®
Leading the charge for recycling.™

About Call2Recycle

How the Program Works



Millions of products powered by mid-format batteries have been sold and will need to be collected, transported and recycled in a safe and environmentally sound manner.

Call2Recycle has partnered with dozens of OEMs from two industries - bicycle & outdoor power equipment – to provide a turnkey solution to safely transport and compliantly recycle used mid-format batteries.

Industry Funded Programs

Industry Funded Mid-Format Battery Recycling Programs

e-bike battery recycling
powered by Call2Recycle | endorsed by PeopleForBikes

- Started in March of 2022.
- Call2Recycle administers the first, voluntary industrywide e-bike battery recycling program in the U.S. - the first transportation sector united under one battery recycling solution.
- Supported by more than 50+ e-bike brands with more than 2,000+ collection sites trained and actively accepting e-bike batteries for recycling.

high energy battery recycling
powered by Call2Recycle

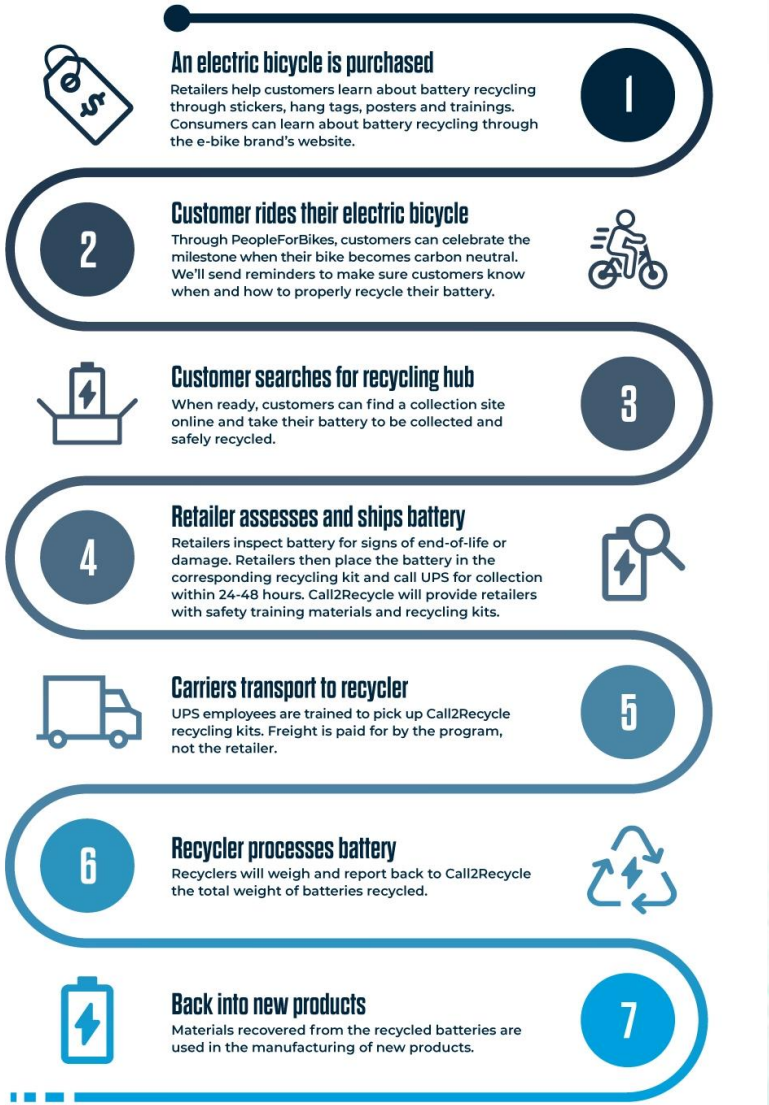
- Started April 2024
- Call2Recycle administers the first, voluntary high-energy battery (over 300-watt hours) recycling program in the U.S.
- Supported by seven manufacturers (16 brands) of outdoor power equipment to responsibly recycle batteries at select regional and national retailers- ~1,800 collection sites.

Participating Brands

Participating E-Bike Brands

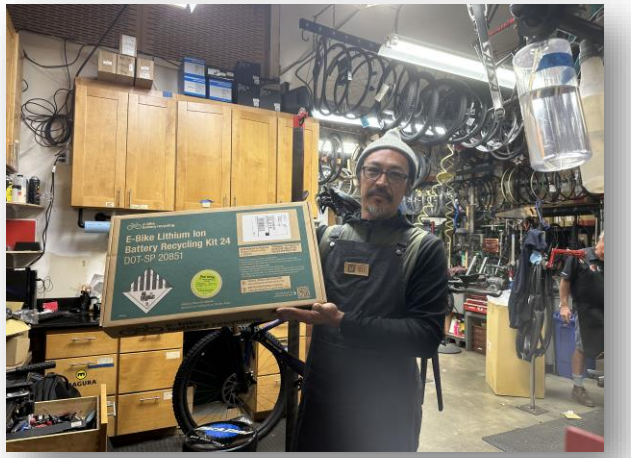
Participating High Energy Brands

How the Programs Work



Collection Sites

How Does a Location Become a Collection Site?



How Are Batteries Collected & Transported?

End-of-Life Batteries

- All-In-One recycling kit with US DOT Special Permit.
- Cumulative watt-hours cannot exceed 3,600. Any battery 1,200 watt-hours or greater must be at 30% or less SOC.
- *This kit will exempt retail employees from having to be specially trained to ship hazardous material*.

Damaged / Defective Batteries

- All-In-One recycling kit for damaged / defective batteries.
- Available on an as needed basis.

E-Bike Shops – Lithium Ion Battery Incident Kit

Educating Consumers

How does Industry Educate Consumers?

[Hungry For Batteries Campaign]

How do Collection Sites Educate Consumers?

Hang Tags

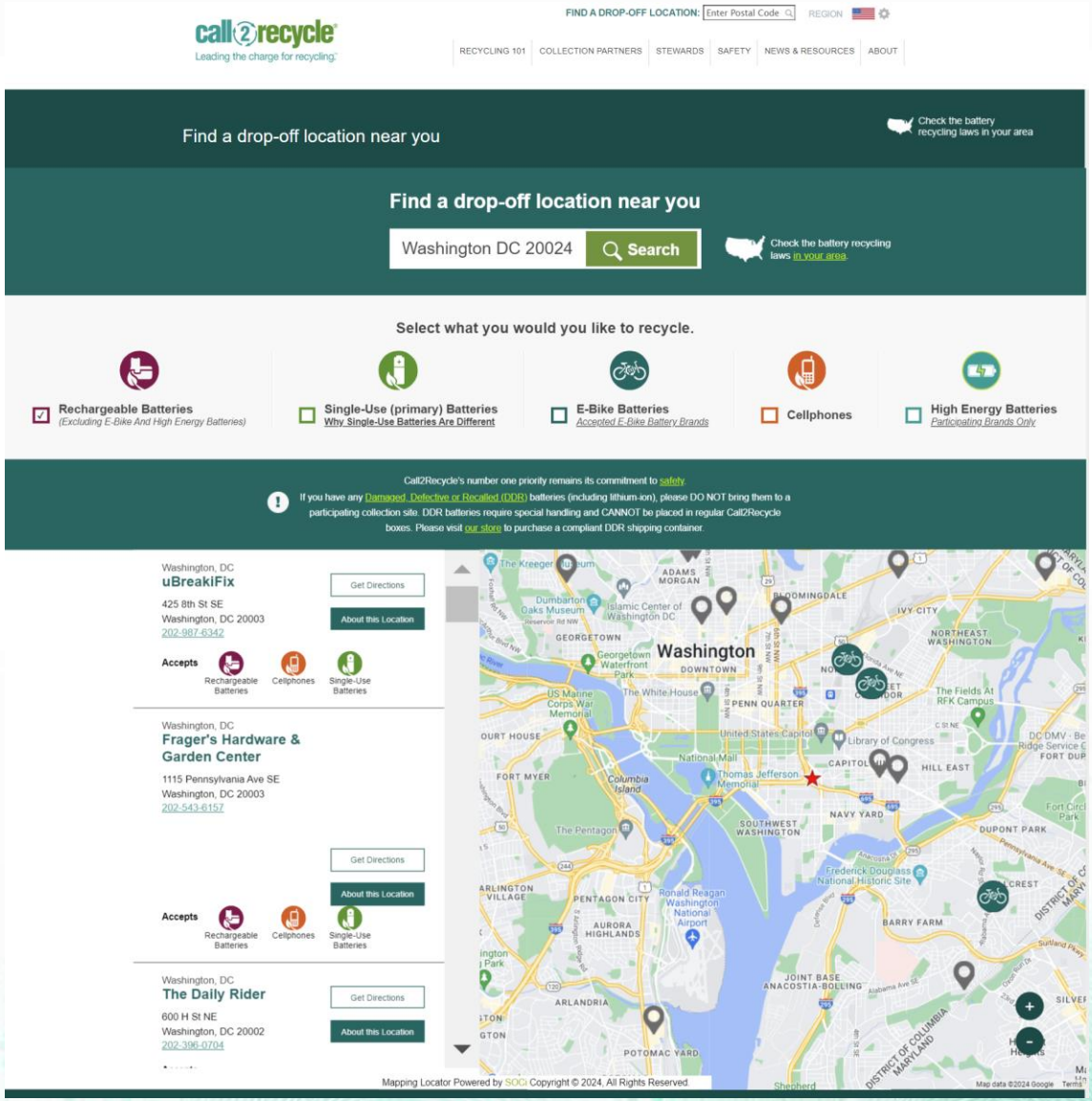
Posters

11”x17”

Stickers + Window cling

- Point of sale materials available to foster customer interactions around recycling
- Digital campaign assets available for website, emails, and newsletters.

How Do Consumers Find a Collection Site?



Frequently Asked Questions

Rob Latham
Call2Recycle, Inc.
RLatham@Call2recycle.org

Mid-Format Batteries: Issues Faced By Ebike Retailers

Prepared by the
National Bicycle Dealers Association
For the EPA

Issues facing the Independent eBike Retailer:

- Limited options for recycling services:
  - Call2Recycle
- Suppliers must subscribe; other brands not eligible
- Retailers pay fee
- Lack of safe handling and storage infrastructure
- Must establish handling and storage protocols
- Staff training requirements (end-of-life vs compromised)
- Customer education guidelines
- High battery replacement cost, refurbishment, Right-To-Repair, DIY
- Insurance issues
- If returning without Call2Recycle support:
  - Must become a certified shipper
  - Training
  - Packaging
  - Labeling
  - HazMat shipper

Mike Fritz
Chief Technology Officer
Human Powered Solutions, LLC
mike@humanpoweredsolutions.com

Prepared for the
National Bicycle Dealers Association

Outdoor Power Equipment Institute

Powering good.

Brandon Martin & Micah Day

Mid-Format Consumer Battery Labeling and Collection Meeting

How the Program Works

high energy battery recycling
powered by Call2Recycle

1

User purchases and enjoys high energy battery

Retailers can help customers learn about high energy battery recycling at time of sale.

2

User returns battery at its end-of-life

When their high energy battery is at its end of life, customers can find a collection site online to drop off their battery for safe disposal.

3

Retailer assesses and ships battery

All drop off locations have been trained on how to safely intake, package, and ship high energy batteries for recycling.

4

Carriers transport to recycler

UPS employees are trained to pick up Call2Recycle recycling kits. Shipping is paid for by the program, not the retailer.

5

Recycler processes battery

Recyclers will weigh and report back to Call2Recycle the total weight of batteries recycled. Materials recovered from the batteries are used in the manufacturing of new products.

OPEI

Participant Observations

Marks and Labeling

- Standardized Labeling (Regulatory Perspective):
  - Mandated by regulatory bodies to ensure consistency, safety, and transparency across products to the consumer
  - Visible specific details, such as chemistry, safety warnings, or usage instructions
  - The change process and third-party label certification

- Certified Mark by a Stewardship Organization (SO):
  - Created and licensed by SOs to indicate compliance with specific standards, utilizing labeling guidelines
  - Additional layer of certification, ensuring that the battery meets the organization's criteria
  - Provide a visible means identification of SO participation to collection points

- Free-Riders
  - Simply put, in business, it's crucial to justify cost expenditures in comparison to the competition

Reporting & Enforcement: Centralized and streamlined

- How to ensure equal and fair participation
  - Auditing the program

Participant Observations

User returns battery at its end-of-life

Accessibility:

- Where do retailers, manufacturers, and online retailers fit in: points-of-sale vs. collection point
  - The Manufacturer
    - Different models – Individual program, Stewardship participation, Internal Hubs, Networks
    - Reverse logistics
  - Points-of-sale
    - Concerns about adding non-monetary employee responsibilities for the retailer
    - Loss of valuable store front space
    - Gap in understanding of EPR Laws or name recognition of Stewardship Organizations
    - Lack of understanding on how being a collection location can increase customer traffic
  - Online Retailers
    - Logistics
    - Tracking

SCAN ME

Industry Engagement Continues

Carriers transport to recycler

- Logistics Efficiency:
  - DOT – Special Permits
  - Carriers
  - Collection points
  - EPA collaboration (i.e., PHMSA, Coast Guard)

- Remote Area Collections:
  - High Shipping Costs
  - Small Volumes
  - Logistical Challenges
  - Regulatory Compliance (i.e., Travel through Canada)

Further Engagement

- Program Awareness
- Education & Outreach
  - Collaborative partnerships and coalitions
  - Targeted campaigns
  - Compliancy list
  - Reporting Hotline

Powering good.

Mid-format Battery Labeling and Collection Working Session

January 27-28, 2025

U.S. Environmental Protection Agency

Day 1 Recap and Plan for Day 2

Pat Tallarico, Facilitator

EPA

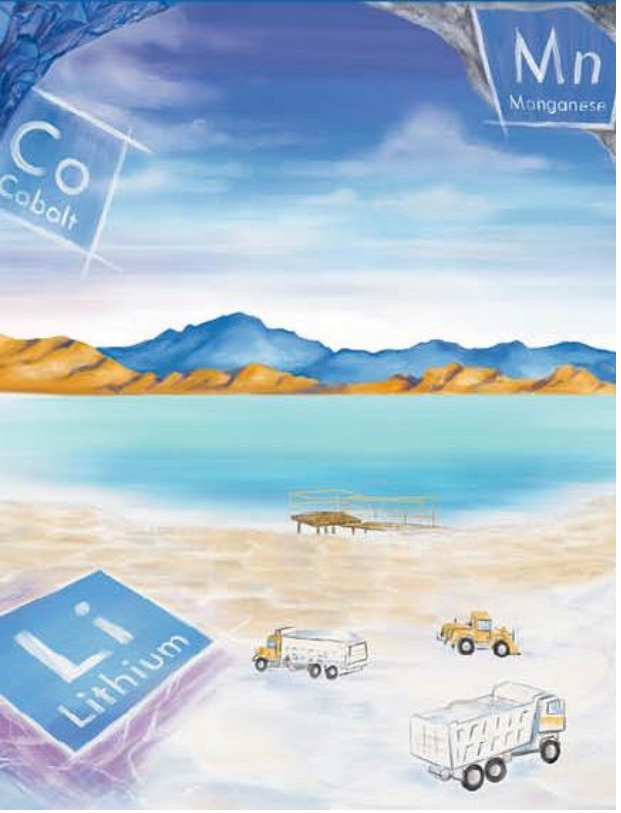
Welcome

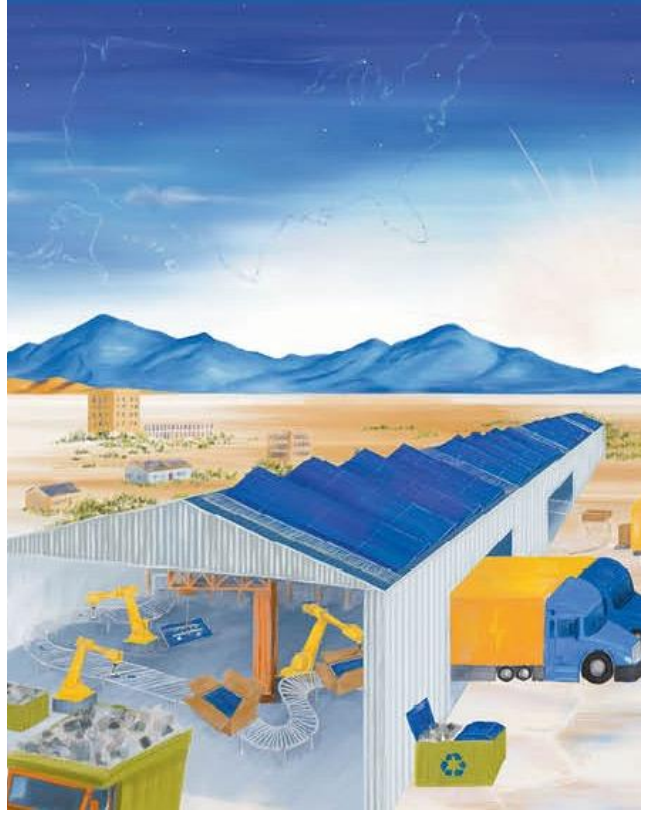
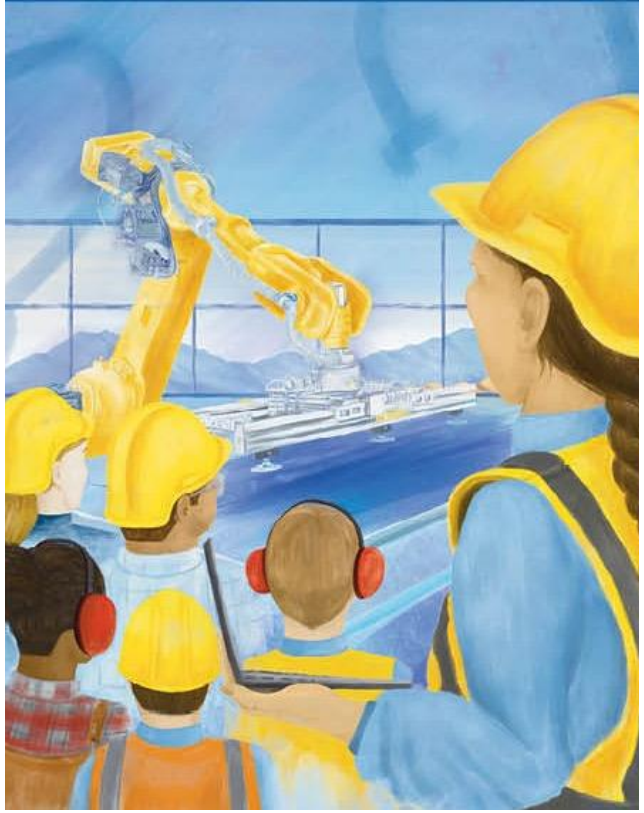
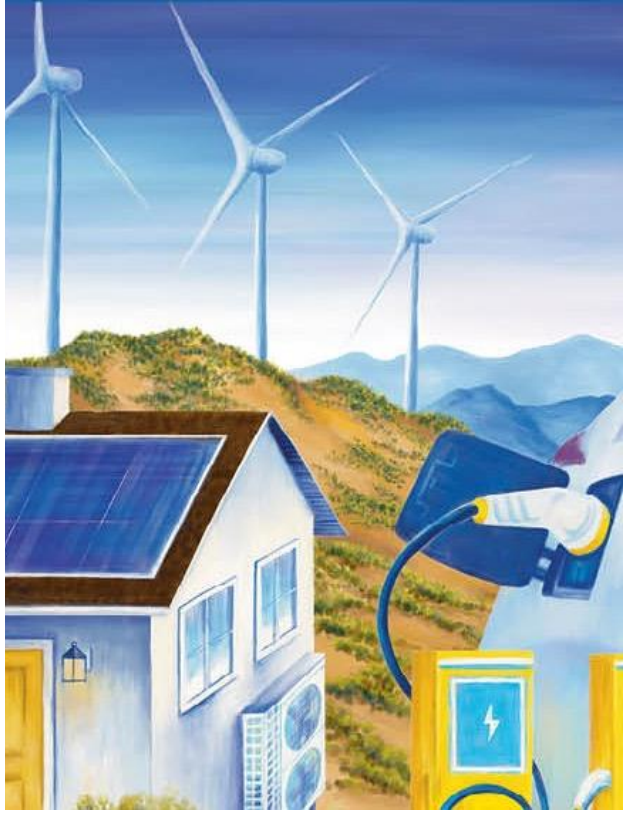
Ellen Meyer, U.S. EPA

Office of Manufacturing and Energy Supply Chains

Batteries and Critical Materials

January 2025



INVESTING IN AMERICA'S ENERGY FUTURE.

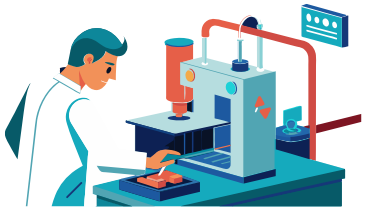
U.S. Department of ENERGY

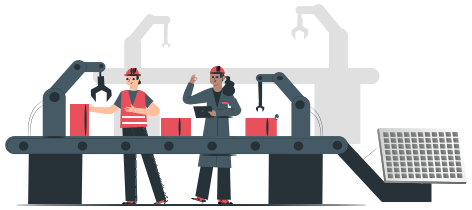
DE-RISKING ENERGY SUPPLY CHAINS SINCE 2022

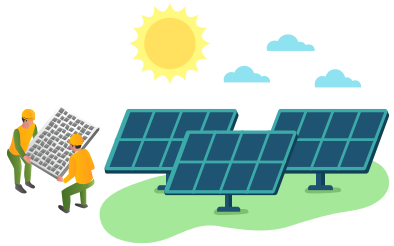
The Office of Manufacturing & Energy Supply Chains' (MESC) mission is to **eliminate vulnerabilities in the United States' energy supply chains**, securing energy independence and bolstering economic growth.

DOE-ENABLED, PRIVATE SECTOR-LED CLEAN ENERGY DEVELOPMENT

Basic Research → **Development** → **Demonstration** → **Deployment**







Product Innovation

- Office of Science (SC)
- Office of Electricity (OE)
- Office of Fossil Energy & Carbon Management (FECM)
- Office of Energy Efficiency & Renewable Energy (EERE)
- Advanced Materials & Manufacturing Technologies Office
- Office of Nuclear Energy (NE)
- Advanced Research Projects Agency - Energy (ARPA-E)

Product Installation

- Office of Clean Energy Demonstrations (OCED)
- Grid Deployment Office (GDO)
- Loan Program Office (LPO)

Product Manufacturing

- Office of Manufacturing & Energy Supply Chains (MESC)

BIPARTISAN INFRASTRUCTURE LAW (BIL)

$7.6B in DOE BIL funds allocated to MESC

- 320 TOTAL REBATES
- 46 STATES IMPACTED
- 26K+ JOBS CREATED OR RETAINED

$24M ITAC Implementation Grant Program (Section 40521 b1)

- 142 TOTAL PROJECTS
- 34 STATES IMPACTED

$5B Batteries Materials Processing, Manufacturing, Recycling (Section 40207)

- 47 TOTAL PROJECTS
- 27 STATES IMPACTED
- 22K+ JOBS CREATED OR RETAINED

$351K Transformer & EPS Rebates (Section 40555.1 and 40555.2)

- 53 TOTAL REBATES
- 17 STATES IMPACTED

$81M ITAC Centers of Excellence & Expansion (Sections 40521 b2 and b3)

- 46 TOTAL PROJECTS
- 31 STATES IMPACTED
- 2,400+ AVG. STUDENTS IN TRAINING ANNUALLY

$22M State Manufacturing Leadership (Section 40534)

- 12 TOTAL PROJECTS
- 12 STATES IMPACTED

$683M Advanced Energy Manufacturing & Recycling Grants (Section 40209)

- 20 TOTAL PROJECTS
- 15 STATES IMPACTED
- 4,400+ JOBS CREATED OR RETAINED

FUNDS DEPLOYED TO-DATE

MANUFACTURING INVESTMENTS

MESC'S ROUND 1 BATTERY PORTFOLIO

Mineral Processing

TALON METALS CORP

Construct an advanced domestic battery minerals processing facility.

Beulah, ND | Initial Operation: 2027

Precursor Component Manufacturing

Mexichem

First U.S. manufacturing plant for lithium hexafluorophosphate (LiPF6) electrolyte salt.

St. Gabriel, LA | Initial Operation: 2026

SOLVAY

A new battery-grade polyvinylidene fluoride (PVDF) facility.

Augusta, GA | Initial Operation: 2026

Anode Component Manufacturing

ANOVION TECHNOLOGIES

First U.S.-owned and operated large-scale production of synthetic graphite anode material.

Bainbridge, GA | Initial Operation: 2026

Sila

Construct a commercial-scale silicon anode production facility.

Moses Lake, WA | Initial Operation: 2026

GROUP14

Commercial manufacturing of next-generation silicon-carbon composite anode material.

Moses Lake, WA | Initial Operation: 2024

NOVONIX

Mass production of lower carbon intensity synthetic graphite anode materials.

Chattanooga, TN | Initial Operation: 2024

Cathode Component Manufacturing

ALBEMARLE

New lithium processing plant that uses domestic sustainably extracted spodumene.

Kings Mountain, NC | Initial Operation: 2028

6K

Demonstration to produce multiple battery chemistries more cost effectively and sustainably.

Jackson, TN | Initial Operation: 2025

ICL

Commercial production of Lithium Iron Phosphate cathode powder.

St. Louis, MO | Initial Operation: 2026

ASCEND ELEMENTS

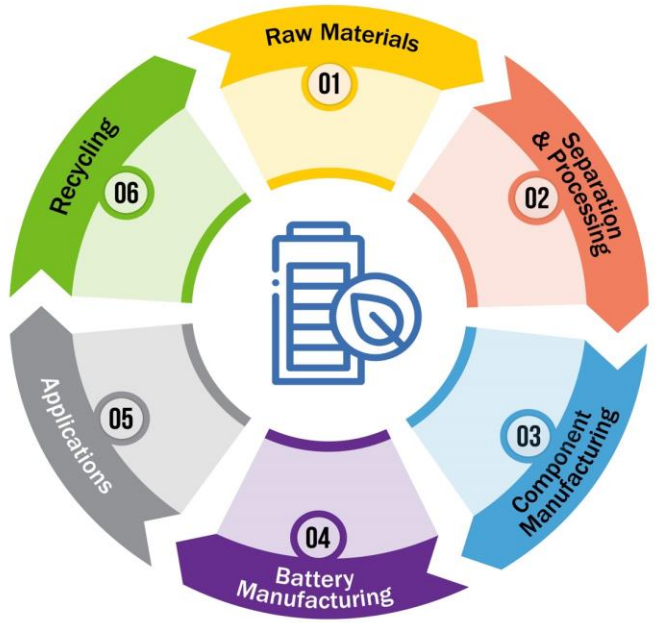
Two awards: First commercial-scale, integrated metal extraction and pCAM facility in the USA.

Hopkinsville, KY | Initial Operation: 2025

ABTC AMERICAN BATTERY TECHNOLOGY COMPANY

Demonstration of battery-grade lithium hydroxide from unconventional sedimentary resources.

Tonopah, NV | Initial Operation: 2026



Recycling

Cirba Solutions

Expansion and upgrade of Li-ion recycling facility.

Lancaster, OH | Initial Operation: 2024

U.S. Department of ENERGY

MESC'S ROUND 2 BATTERY PORTFOLIO

Raw Materials and Precursors

Standard Lithium / equinor

Commercial domestic production of lithium carbonate using direct lithium extraction.
Lewisville, AR | Initial Operation: 2029

TerraVolta

Commercial-scale facility for direct lithium extraction from domestic brine resources.
Texarkana Region | Initial Operation: 2029

revex TECHNOLOGIES

Integrate nickel mining with next-generation critical mineral processing to turn waste streams into valuable critical materials.
Champion, MI & Gwinn, MI | Initial Operation: 2028

GROUP14

Commission and operation of a domestic silane manufacturing plant to directly feed silicon-based anode production
Moses Lake, WA | Initial Operation: 2027

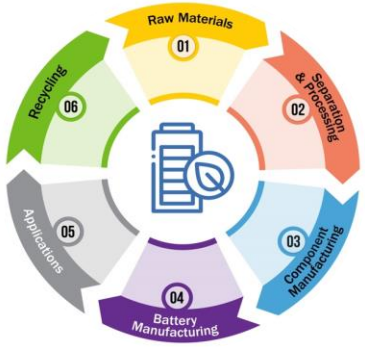
Separation & Processing

Element 25

Building and operating an environmentally sustainable refining facility to produce high purity manganese sulphate monohydrate.
Baton Rouge, LA | Initial Operation: 2028

SOUTH32

Building and operating an environmentally sustainable refining facility to produce high purity manganese sulphate monohydrate.
Patagonia, AZ | Initial Operation: 2029



Anode & Cathode Component Manufacturing

Albemarle

Retrofitting of a domestic manufacturing facility to produce commercial quantities of Li metal anode material for next-generation lithium-ion batteries.
Charlotte, NC | Initial Operation: 2027

BIRLA CARBON

Low carbon-footprint next-generation synthetic graphite.
Orangeburg, SC | Initial Operation: 2028

Mitra Chem

Building and operation of domestic commercial production plant for LFP cathode materials and next generation battery materials such as LMFP.
Muskegon, MI | Initial Operation: 2026

CABOT

Building and operating facilities that produce carbon nanotubes and conductive additives at commercial scale.
Wayne County, MI | Initial Operation: 2026

NANOGRAF CORPORATION

Establish an advanced silicon anode manufacturing facility.
Flint, MI | Initial Operation: 2027

URBIX

Commercial-scale facility for cost-effective, sustainable, and efficient production of coated spherical purified graphite.
Muscle Shoals, AL | Initial Operation: 2028

Electrolyte & Separator Component Manufacturing

DOW

Domestic manufacturing using waste CO_2 to produce high-value battery grade carbonate solvents.
U.S. Gulf Coast | Initial Operation: 2030

Solid Power

Continuous production of sulfide-based solid electrolyte materials.
Thornton, CO | Initial Operation: 2028

Honeywell

Commercial-scale facility for domestic production of LiFSI, a next-gen electrolyte salt.
Geismar, LA | Initial Operation: 2029

Braskem

Retrofitting and expanding existing ultra-high molecular weight polyethylene production unit to enhance domestically produced separator quality.
LaPorte, TX | Initial Operation: 2028

Battery Manufacturing

EnerSys

Battery cell manufacturing facility producing high performance, cost competitive prismatic and cylindrical cells.
Piedmont, SC | Initial Operation: 2028

FORGE BATTERY

New facility to produce high energy cylindrical Li-ion cells, with embedded commercial capabilities for ALD.
Morrisville, NC | Initial Operation: 2026

Form energy

Installing and running a commercial-scale iron-air battery manufacturing line.
Weirton, WV | Initial Operation: 2027

Recycling

ABTC AMERICAN BATTERY TECHNOLOGY COMPANY

Construction of a new commercial-scale Li-ion battery recycling facility using materials from battery manufacturers and automotive OEM partners.
South Carolina | Initial Operation: 2027

ASCEND ELEMENTS

Construction of recycling facilities that convert graphite waste into high purity battery grade graphite with a low carbon footprint.
Hopkinsville, KY | Initial Operation: 2029

BLUE WHALE MATERIALS

Building and operating advanced Li-ion battery recycling facilities that produce a dry mixed metal precursor at high purity.
Bartlesville, OK | Initial Operation: 2026

Cirba Solutions

Building and operating a facility to process end-of-life Li-ion batteries and scrap from manufacturers to recover critical materials.
Columbia, SC | Initial Operation: 2027

CLARIOS

Recycling Li-ion battery production scrap into cathode active materials through a true closed-loop supply chain.
Florence, SC | Initial Operation: 2028

Li Industries

Retooling a former manufacturing facility to establish a large-scale LFP cathode active material direct recycling and production plant.
Kettering, OH | Initial Operation: 2025

U.S. Department of ENERGY

CONSUMER ELECTRONICS BATTERY RECYCLING, REPROCESSING, AND BATTERY COLLECTION - STATE AND LOCAL PROGRAMS – ROUND 1

Will reach more than 27M consumers

Projects begin Fall/Winter 2024/25

Increasing Safe Collection of Batteries at County and Tribal Battery Collection Sites

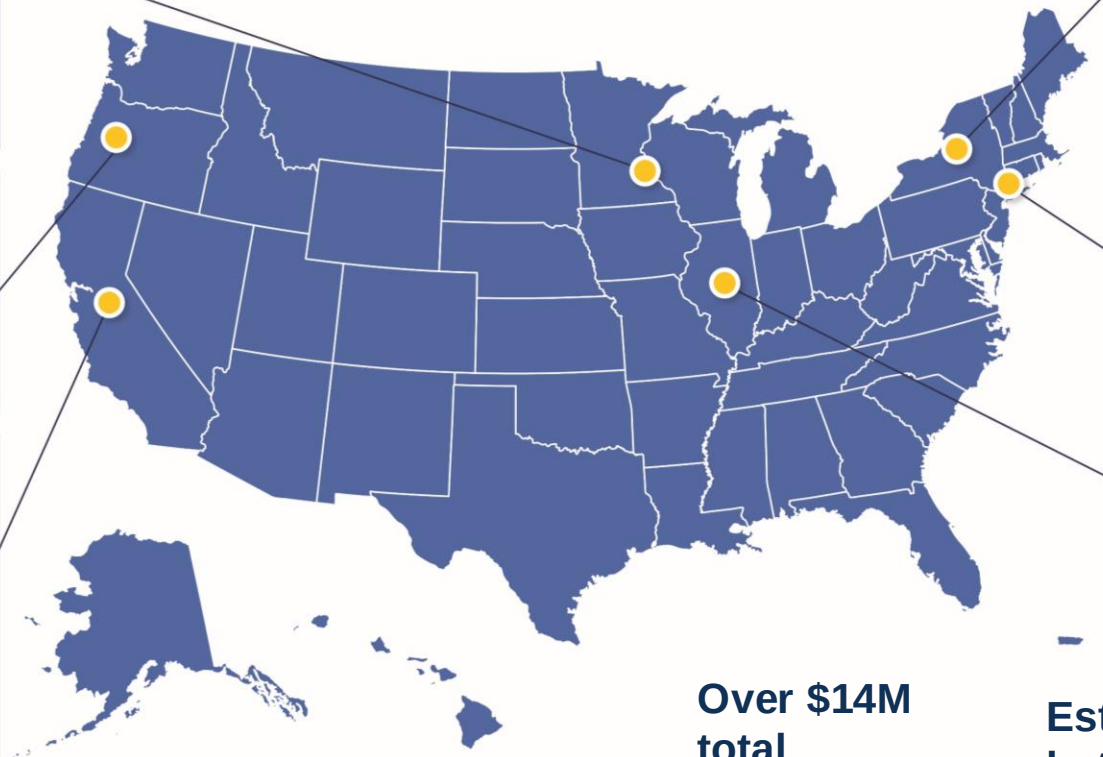
MINNESOTA POLLUTION CONTROL AGENCY
Saint Paul, MN | $1,250,000

Radical Recovery of Batteries for Recycling

LANE COUNTY PUBLIC WORKS WASTE MANAGEMENT DIVISION
Eugene, OR | $1,019,632

Enhancing Merced County Programs for Consumer Electronic Battery Collection, Recycling and Processing

MERCED COUNTY REGIONAL WASTE MANAGEMENT AUTHORITY
Merced, CA | $86,790



Multi-Agency Household Battery Recycling Program Expansion

ONONDAGA COUNTY RESOURCE RECOVERY
Syracuse, NY | $708,971

Mobile Battery Drop-off

NEW YORK CITY DEPARTMENT OF SANITATION
New York, NY | $2,150,000

Recharging Local Batteries Collections

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
Springfield, IL | $2,000,000

Over $14M total investment

Estimated 7-20K pounds of batteries collected per year for each project

U.S. Department of ENERGY

CONSUMER ELECTRONICS BATTERY RECYCLING, REPROCESSING, AND BATTERY COLLECTION FOR STATE AND LOCAL GOVERNMENTS – ROUND 2

State	Lead Organization	Description of Technology
TN	Tennessee Department of Environment and Conservation	Establish consumer battery collection stations at 50 mobile HHW events per year, install permanent battery collection points at select higher education institutions and local government facilities, and develop a comprehensive statewide battery safety and recycling education program.
MI	Department of Environment, Great Lakes & Energy	Establish a state-level collection network centered around batteries, enhance the “Know It Before You Throw It” campaign for a specific focus on batteries; create a consumer battery-focused accelerator track to support battery recycling and address solutions across the logistics supply chain.
NV	Washoe County	Partner with Redwood Materials to support northern Nevada’s Tech Hub efforts to create a circular battery supply chain economy by establishing 20 Smart Bin collection sites in community centers around the region. Create outreach and education campaigns to inform residents of the bins’ locations, explain why battery recycling is important, and how their participation supports an emerging, local economy.
NY	Erie County	Hold drive-thru battery collection events; create a battery safety and recycling presentation for Senior Citizens in consultation with Senior Services; work with four major refugee resettlement agencies in Erie County to create an accessible battery awareness and safety program for their clients; and distribute battery safety and awareness materials.

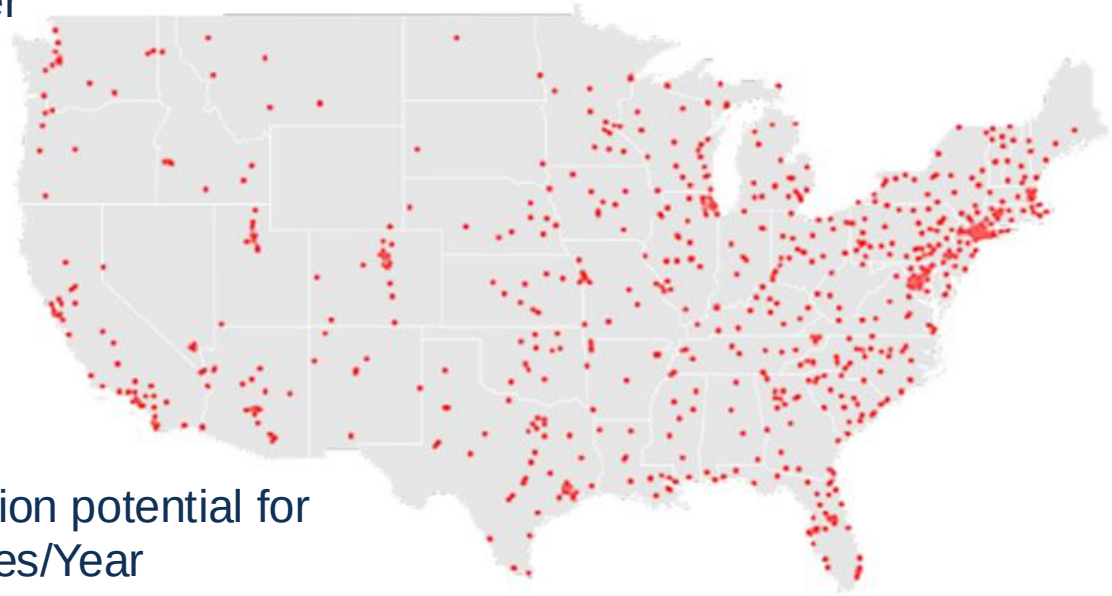
CONSUMER ELECTRONICS BATTERY RECYCLING, REPROCESSING, AND BATTERY COLLECTION FOR STATE AND LOCAL GOVERNMENTS – ROUND 2

State	Lead Organization	Description of Technology
WI	Wisconsin Department of Natural Resources	Establish new battery collection locations to complement the existing network of E-Cycle Wisconsin electronics collection sites (with a focus on Justice40 and DAC access) including at least one site per county; increase the volume of batteries collected through the sites participating in this project; and increase public awareness of how to safely manage end-of-life batteries, reducing fires in the waste stream.
IA	Dubuque Metropolitan Area Solid Waste Agency (DMASWA)	Construct a new battery recycling and collection hub with dedicated space create a centralized drop-off location for collecting and processing spent batteries; and expand an existing educational program, including an intensive outreach and communication campaign, social media posts, handouts, news releases, and promotional materials.
IN	Allen County, Indiana	Double the annual battery collection through new collection points; and develop a well-trained workforce for battery recycling.

CONSUMER ELECTRONICS BATTERY RECYCLING, REPROCESSING, AND BATTERY COLLECTION - RETAILER PROGRAMS

Projects begin
Fall/Winter
2024/25

More than 1,000 collection points
across the US



Battery collection potential for
~ 20 M batteries/Year
~ 6 M + lbs. / Year

Over $30M overall investment

BatteriesPlus

Staples

No cost to consumers, predicted to increase battery recycling by 100% over pilot programs

U.S. Department of ENERGY

Building a More Robust Collection System for Mid-Format Batteries

Pat Tallarico, Facilitator

Discussion

- Group 1: How do we ensure broader participation from manufacturers? What policies could be implemented that would drive manufacturers to participate more fully?
- Group 2: How might we address logistical concerns – e.g., storage, transportation, remote access, etc. - related to collection of used mid-format batteries?
- Group 3: How do we expand the collection footprint – including and enabling retailers and municipalities?
- Group 4: Exploring and expanding on ideas for education, outreach, and messaging.

15-Minute Break

Recycling Industry Perspectives – Improving and Expanding End-of-life Opportunities for Mid-Format Batteries

Danielle Spalding, Cirba Solutions

Cirba® Solutions

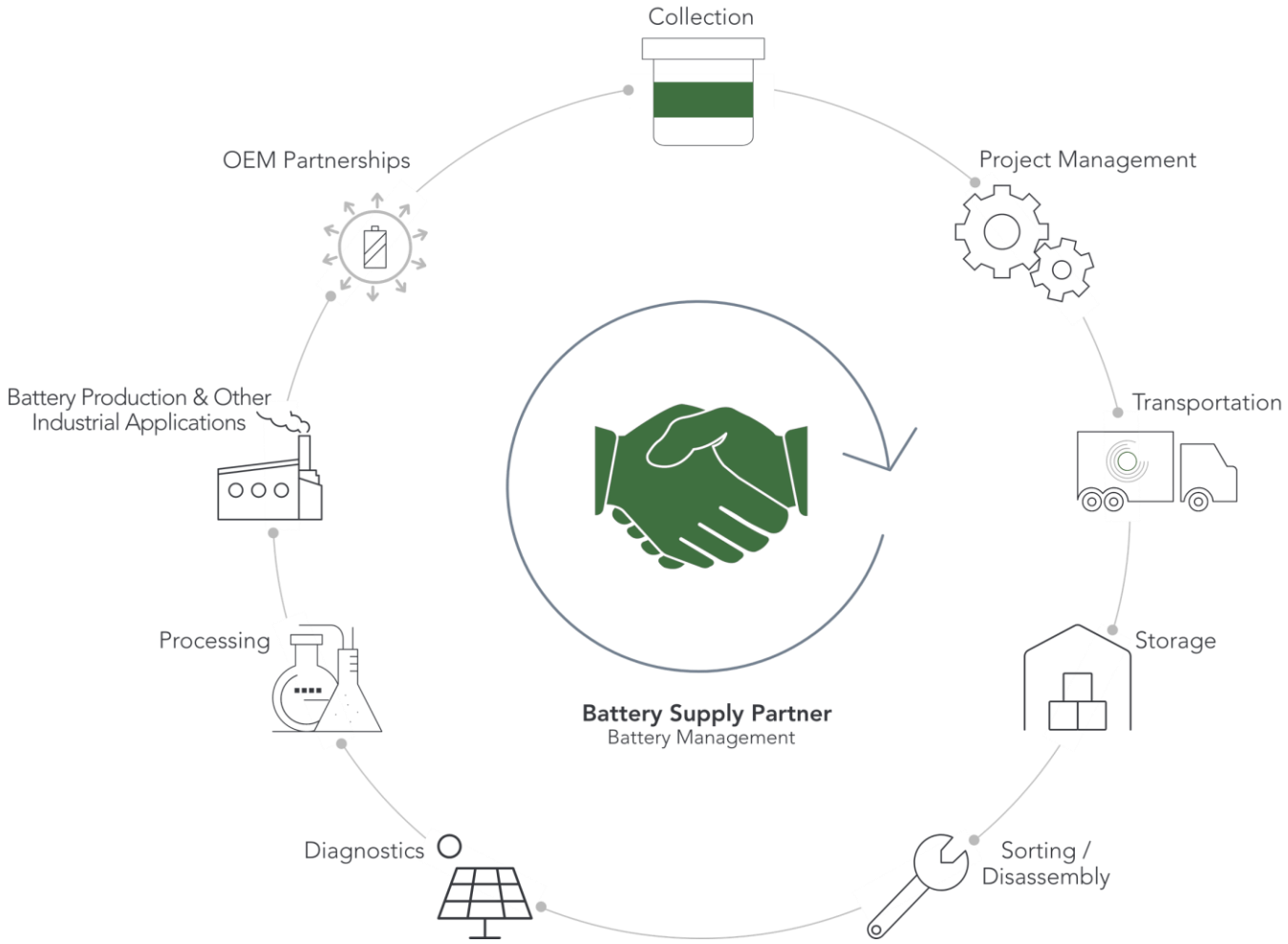
Battery Management & Materials

EPA Mid-Format Consumer Working Battery Labeling and Collection

January 28, 2025

Battery Recycling Leader
Comprehensive Solutions for Partners

- 30+ Years of Experience (founded in 1991)
- Feedstock EOL batteries from EVs, Production Scrap, Portable Electronics, Post-Consumer, Energy Storage Systems, and more
- 6 operational sites in North America: Arizonia, California, Michigan, Ohio, & British Columbia
  - South Carolina (coming soon)



Successes and opportunities around collection or labeling to enhance the sector.

Collecting & Packaging

Prep for Processing

Lessons & Themes

It Starts with Collection

Challenges are often on the responsibility of the collection site or improper disposal stream and are pushed downstream.

- Mid-format batteries are often part of small format collection (commingling) approach
  - Requiring sorting at the collection site

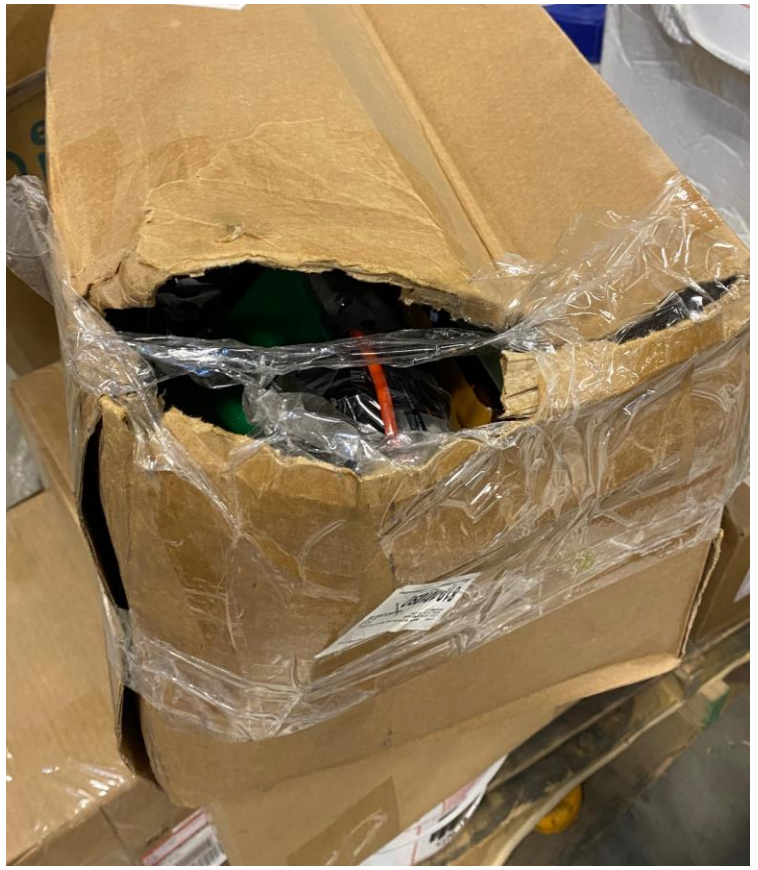
- Un-maned sites

- Managing many waste streams at one-time

When batteries are sent through improper disposal streams, challenges include:

- Situations with “free riders”
- How identifying damaged batteries
- How to ship batteries

Packages Shipped for Recycling



Collection Challenges

- Misunderstanding /misidentifying by customers and collection sites can lead to incorrect labeling and paperwork.
  - Shipping/Transport paperwork incorrect
  - Non-compliant for carrier
- Weight is a default for mid-format for the general public. Need education on energy density.
  - Knowledge of Watt hour vs Amp Hour vs Volts

Taser Battery

Replacement Battery

Power Tool

What Happens to Your Batteries?

B A T T E R Y S O R T I N G

Your trusted ally in battery recycling.

One of the largest and most efficient battery sorting operation in North America.

Receiving

Battery Seperation

Data Collection

Safe Disposal

Confiration of Reclamation Certificate

In-Market

- 15-year relationship
- Employee Training
  - 25 modules of training
- Consumer Education
  - Signage on collection
  - Signage throughout the store
  - Takeaways at the counter

Challenges

- Higher energy density and higher potential for overheating / circulating
- Package state after shipment
- Mixed-loads
- Terminal protection
- And more…

Successes

- Education through training, webinars, etc.
- On-site information
- Packaging solutions entering the market


Cirba® Solutions
Battery Management & Materials
The Future is Electrified.
Our standards set us apart.
Our services & technologies move you forward.
Real experience and proven results.
cirbasolutions.com

Cirba Solutions: *Battery Recycling Leader*

Cirba Solutions Recycling Facilities

Overview

- Headquartered in Charlotte, NC, USA
- 7 Strategically Located facilities
- Handle all battery formats and chemistries
- Feedstock EOL batteries, EV batteries, production scrap, portable electronics, post-consumer, energy storage systems, healthcare and more
- Shredding and Hydrometallurgy processing approach that return Critical Minerals (Li, Ni, Co, Mn) back into the Domestic Battery Supply Chain

Turn-Key Collection for Everyday Batteries

We make battery recycling simple, fast and safe thanks to our turnkey kits.

All kits contains all elements to meet the compliance and transportation regulatory guidelines for handling, packaging and transporting batteries.

Simply collect all your dry cell and handheld electronics batteries in one container using the easy-to-follow packaging instructions.

Order
Order kit online

Collect
Place kit in high traffic area for collection

Ship
Hand kit off to your local shipper

Recycle
Materials are recycling

Day 2 Recap and Adjourn

Ellen Meyer, U.S. EPA