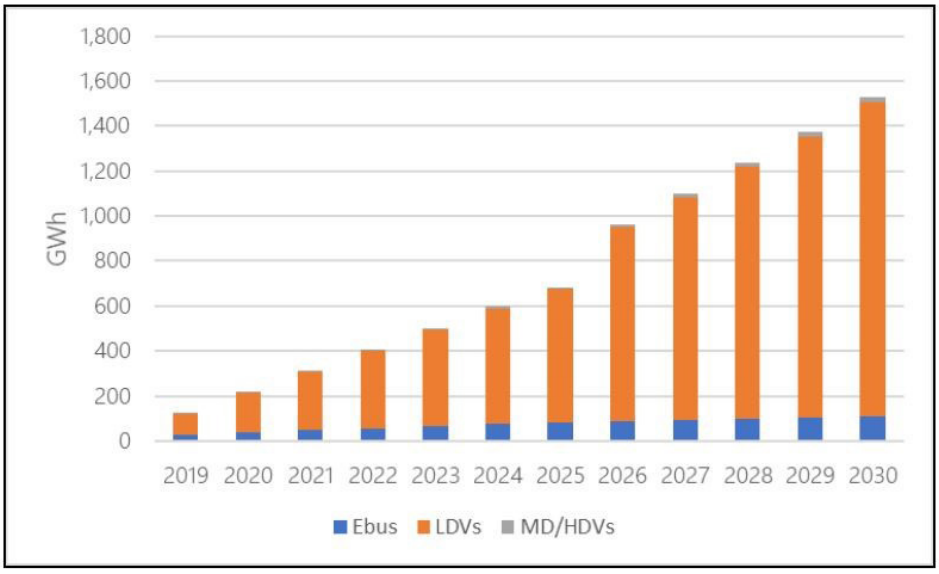
Renewable Energy Equipment Recover-Reuse Program: Energy Storage and Electric-Drive Vehicle Battery Management

PROGRAM BACKGROUND AND HIGHLIGHTS

The Illinois Sustainable Technology Center (ISTC), a unit of the Prairie Research Institute at the University of Illinois Urbana Champaign, was founded in 1984 to bring together pollution prevention research, outreach, and technical assistance to solve environmental problems and conserve natural resources. Building on this tradition, ISTC began to mobilize a team of diverse experts in 2018 to address renewable energy technologies end-of-life recovery challenges and opportunities.

ENERGY STORAGE AND ELECTRIC-DRIVE VEHICLE BATTERY END-OF-LIFE MATERIAL MANAGEMENT

A rise in the deployment of energy storage and electric-drive vehicle (EDV) lithium-ion batteries (LiBs) has created the need for national, regional, and localized LiB reuse and recycling programs. Current energy storage and EDV LiB technologies contain rare earth metals and toxic compounds such as cadmium, cobalt, lead, lithium, manganese, and nickel.[1] The demand for raw materials that are used in energy storage and EDV batteries is expanding. This demand raises concerns about the social and environmental impacts related to the extraction of these raw materials.



Projected global Li-ion deployment in xEV by vehicle class for IEA STEPS scenario (Ebus: electric bus; LDVs light-duty vehicles; MD/HDVs: medium- and heavy-duty vehicles). Source: International Energy Agency, "Global EV Outlook 2020: Entering the decade of electric drive?" IEA, Paris, June 2020.

ENERGY STORAGE AND ELECTRIC-DRIVE VEHICLES BATTERY TECHNOLOGY GOALS:

- Create stakeholder partnerships and conduct yearly stakeholder meetings to evaluate issues and solutions for the next 5-10 years
- Conduct outreach to scrapyards, the energy utility sector, and others using large battery storage systems
- Create a repository of recycling and reuse processes and technologies
- Coordinate with counties and local governments on decommissioning plans to evaluate recovery efficacy for specific regions across the state
- Create guidance documents for generators and other stakeholders on safe and efficient retrieval of batteries for end-of-life recycling and reuse
- Identify optimal collection and transportation options for reuse, recycling, and secondary material markets in Illinois and other Midwest states

CIRCULAR ECONOMY AND END-OF-LIFE SOLUTIONS

EDV LiBs can either be repurposed for a second life as energy storage or recycled to obtain the raw materials. At the end of useful life, EDV batteries can still retain up to 70% of their initial capacity.[2] There is great potential benefit to reusing EDV LiBs in energy storage systems. Efforts are underway to establish state and national LiB recycling standards.

The federal government is funding projects to develop new recycling technologies for end-of-life EDV LiBs. For example, the U.S. Department of Energy's Argonne National Laboratory's ReCell Center is working with other national labs, academic institutions, and collaborators from across the battery supply chain to research, develop, and upscale methods for separation of LiB cathode materials. These efforts will help to create a more robust recycling infrastructure. Argonne is also working with the National Electrical Manufacturers Association (NEMA) to develop standards that will facilitate determination of amount of material and revenue generated by recycling efforts.

As recent advances make recycling more profitable, private companies have become involved in efforts to bolster end-of-life options for EDV LiBs. Manufacturers are increasingly moving forward with collaborative plans to improve the technological and logistical aspects of the national recycling infrastructure.

ISTC ENERGY STORAGE AND ELECTRIC-DRIVE VEHICLE BATTERY END-OF-LIFE STAKEHOLDERS

In response to the growing demand for energy storage and EDV LiBs, ISTC has convened a group of battery and waste management experts and is coordinating the evaluation of key issues associated with the expansion of EDVs across Illinois. Stakeholders include:

- U.S. Environmental Protection Agency
- Illinois Environmental Protection Agency
- Ilinois Department of Commerce and Economic Opportunity
- U.S. Department of Energy's National Renewable Energy Laboratory
- U.S. Department of Energy's Argonne National Laboratory's ReCell Center
- American Clean Power Association
- Clean Grid Alliance
- Manufacturers
- Equipment distributors
- Recyclers
- Electrical grid experts
- Landfill waste industry
- Representatives from Illinois counties
- Environmental justice organizations

Continuous technology evaluation is crucial for decision makers to better understand the impacts of batteries at the local, state, and regional levels. The goal of the stakeholder group is to provide guidance on safe and efficient retrieval of batteries for reuse and recycling in Illinois and beyond.

[1]Fujita, T., et al., *Reduction, reuse and recycle of spent Li-ion batteries for automobiles: A review, 2021*

[2]Neubauer et al., *Identifying and Overcoming Critical Barriers to Widespread Second Use of PEV Batteries, 2015*

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