



Proper Management of ESS Batteries at End of Life:

WHOSE OBLIGATION IS IT ANYWAY?

WHITE PAPER

INTRODUCTION

The adoption of Battery Energy Storage (BES) in grid applications has generated considerable excitement due to the positive impact on the environment by displacing the use of fossil fuels. Huge growth has been forecasted for Battery Energy Storage Systems (BESS), with deployments projected to grow to 35 GW by 2025.

But what happens when the batteries reach the end of their life? Over time, batteries will no longer be useful for their intended applications and will need to be recycled. Improper handling of batteries can be detrimental to the environment, diminishing the positive impact this technology is expected to deliver.

This paper outlines the regulatory obligations with proper end-of-life management, and who owns the obligation and associated cost.

End of Life Management Starts at the Beginning of Life

Battery Energy Storage Systems (BESS) demand specialized labor and strategic oversight to manage regulatory compliance and maintain performance throughout their entire lifecycle, from beginning to their inevitable end-of-life. Developing a comprehensive strategy for battery management, whether that entails recycling or repurposing, is a complex undertaking that requires advanced planning.

Think of it as writing a will for your battery system. While end-of-life considerations may not seem urgent during installation or operation, proactive planning for these final stages is a wise and necessary investment. Proper care at the end of a system's life is just as critical as its installation. Additionally, many regulations assign a specific party the legal responsibility for managing these end-of-life obligations; a detail that is often overlooked but carries significant implications.

End-of-Life Management: Whose Obligation Is It?

Three primary parties are involved in the deployment of energy storage systems.

01. Battery OEMs
02. System Integrators
03. Battery System Owner/Operators

Who owns the obligation and the associated cost to properly manage the batteries at the end-of-life is sometimes discussed at project inception, but often deferred until later because the issue is perceived to be a concern years in the future. The reality is that this is not a "future" issue—battery failures occur throughout their lifecycle.

Further, the mishandling of batteries during installation can result in damage that renders the battery unusable, resulting in early life failures. This mishap can occur on new technologies or irresponsible operation of the battery outside of the manufacturer's guidelines, leading to failure during use. In some cases, latent defects may lead to premature failure or potentially a recall by the OEM.

The management of industrial batteries is governed by a complex framework of regulations spanning the entire lifecycle—from cradle to grave. A thorough understanding of these obligations is essential, as the consequences of non-compliance can be significant. Developing a comprehensive decommissioning and end-of-life strategy is not only a best practice; it's a regulatory imperative.



Regulatory Obligations in the US

Battery end-of-life management carries significant regulatory compliance risks due to the federal, state, and local regulations governing hazardous waste. There are a number of regulatory requirements that affect the transportation, handling, storage, and disposal of batteries throughout their lifecycle.



Hazardous Waste Regulations: At the beginning of life, and throughout the lifecycle, most batteries used in energy storage applications are considered hazardous material and regulated by the US Department of Transportation (DOT) Hazardous Materials Regulations (HMR) under Title 49 of the Code of Federal Regulations, Subchapter C. When a battery reaches the end of its useful life and is destined for disposal, it is considered waste, and additional regulations apply. While many are aware that the HMR regulates the packaging, marking, labeling, and transporting of hazardous materials, it also contains requirements for training, safety, security, and recordkeeping that apply to anyone who handles hazardous materials.

Management of Hazardous Waste: The US Resource Conservation and Recovery Act (RCRA) regulates the generation, transportation, treatment, storage, and disposal of hazardous solid wastes under Title 40 of the Code of Federal Regulations, parts 262 through 273.

Because of the regulatory burden associated with managing hazardous wastes, the US EPA created Universal Waste regulations to ease the burden and promote the collection and recycling of commonly generated wastes, including batteries. Intact batteries that classify as hazardous waste may be managed as Universal Waste, while batteries that are not intact, such as a battery that has been damaged to the point of leaking electrolytes, must be managed as a fully regulated hazardous waste.

The Party Responsible: Under RCRA, the waste generator is obligated to determine whether its waste is hazardous and regulated under RCRA. The waste generator is defined by RCRA as "...any person, by site, whose act or process produces hazardous waste identified...". This would typically be the owner/operator of the BESS, as the operation and use of the battery led to the need for disposal. A hazardous waste may be specifically listed by the EPA or exhibit characteristics of ignitability, corrosivity, reactivity, or toxicity under prescribed testing conditions.

State-Specific Regulations: Each state has its own regulatory requirements that must be followed for compliance. For example, states like Texas are enforcing increasingly stringent regulations, such as House Bill 3809, which requires companies to submit detailed end-of-life management plans and financial assurances as part of the project permitting process. This example reinforces the concept of implementing an end-of-life plan at the beginning of life.

Outsource Battery Management
to **Renewance**, a Qualified Leader
in Battery Stewardship

US Resource Conservation and Recovery Act (RCRA) Considerations

Lithium-ion batteries, one of the most common technologies used in BES applications, are not listed as a hazardous waste, but may possess characteristics that trigger RCRA regulations.

Beyond waste classification, RCRA imposes several additional requirements with respect to handling, storage, transportation, and disposal. The requirements vary depending on the volume of waste that is being generated, so it is important for waste generators to understand their classification and the associated obligations. These obligations may include:

- Understanding the on-site accumulation limits, which define the amount of hazardous waste/ Universal Waste. A generator is allowed to “accumulate” on-site without a permit.
- Obtaining an EPA Identification Number, which is a unique number that identifies the generator by site. The EPAID number must be obtained prior to exceeding the on-site accumulation limits.
- Monitoring and complying with accumulation time limits, which define the amount of time hazardous/ Universal Waste is allowed to accumulate on site.
- Ensuring appropriate personnel complete classroom or on-the-job training to become familiar with proper hazardous/Universal Waste management and emergency procedures for the wastes handled at the facility.
- Maintaining records demonstrating compliance with the regulations, including tracking off-site waste shipments. Records must be retained for a defined period of time (typically 3-years).

...it is important for **waste generators** to understand their classification and the associated obligations.

Warranty Implications

Many BESS systems come with a warranty from the OEM on the individual components as well as a long-term performance guarantee. The OEM warranty generally covers replacement of the failed components, provided they were operated under the terms of the contract. Warranty terms may include return of the failed component to the OEM, but that is not always the case. Performance guarantees typically address capacity degradation and system availability, neither of which will likely involve the take-back of degraded or failed components. Of course, not all battery failures are warrantable events and therefore remain the burden of the system owner/operator to manage.

When a battery fails and is replaced, the classification of the failed battery as waste depends on whether it is intended to be repaired or sent for disposal.



Many **owners/operators** believe that management of that failed battery falls to the OEM, but that may not necessarily be the case.

Unless warranty terms specifically transfer title of the failed battery to the OEM, the battery is still owned by the owner/operator, and thus they hold the obligation for proper management of that battery. If the battery is intended to be recycled, then the owner/operator is still considered the waste generator and is obligated to comply with the associated regulations. Any party involved in the downstream handling of that battery must also comply with RCRA requirements.

If the removed battery is returned to the OEM for evaluation and potential repair, then the battery is not yet considered to be waste. Should the OEM subsequently determine that the battery is to be recycled, then the OEM is considered the waste generator and is therefore bound to the RCRA requirements.

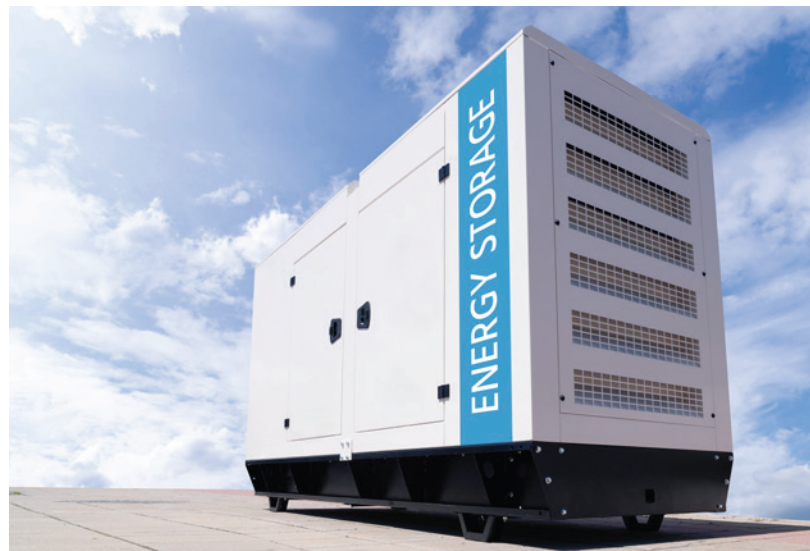
Penalties: What You Need to Know

Hazardous material and hazardous waste regulations govern the management of batteries through their lifecycle. Understanding those obligations is important since failure to comply has consequences, and some of those consequences include reputational damage, financial penalties, and even imprisonment for the most severe violations.

Violations of the HMR can carry both civil and criminal penalties. A civil penalty involves fines of up to \$79,976 for each violation, or up to \$186,610 if the violation results in death, serious illness, or severe injury to any person or substantial destruction of property. A person who knowingly, willfully, or recklessly violates

a requirement of the HMR can be imprisoned for up to 5 years. If the violation involves the release of a hazardous material that results in death or bodily injury to any person, the maximum penalty increases to up to 10 years in prison.

Failure to comply with RCRA regulations can also result in civil or criminal penalties. Civil penalties for those who violate the regulations carry a fine of up to \$74,553 per day, per violation. A person who knowingly violates RCRA hazardous waste regulations is subject to a penalty of up to 5 years in prison. Penalties double for subsequent violations. If a person committed such a violation while knowing that such an act put another person in imminent danger of death or serious bodily injury, the penalty increases to 15 years and/or up to \$250,000 for an individual or \$1,000,000 for an organization.



While not all violations will carry the maximum penalties, enforcement actions are openly communicated by the responsible US agencies, and the resulting damage to a company's reputation resulting from a violation is difficult to quantify.

Conclusion

A common misconception among those involved with deploying Battery Energy Storage Systems (BESS) is that the liabilities associated with managing their batteries are something they do not need to worry about for several years. The reality is that there are a number of regulatory requirements that apply throughout the entire lifecycle.

If you have deployed a BESS and are not aware of the associated obligations, you are at risk of non-compliance. Some system owners/operators believe an agreement exists with the OEMs to take the batteries back at the end of life at no cost.

While the potential recycling costs with some battery chemistries make such an agreement, it is unlikely unless it is written into the contract. More importantly, it does not change the fact that the systemowner/operator must still comply with waste generator obligations.



How Renewance Can Help

Renewance is at the forefront of the transition to a sustainable, decarbonized economy by providing comprehensive lifecycle management service solutions for industrial batteries. Managing an end-of-life plan for battery systems is a complex and time-intensive process; one that many companies may not be equipped to navigate alone. The task requires in-depth knowledge of evolving local, state, and federal regulations, along with the capacity to ensure full compliance at every stage. Without the right expertise, the risk of oversight or non-compliance can be significant.

Outsourcing to a turnkey solution provider like **Renewance** can reduce the risk of non-compliance and offer peace of mind during a stressful and complicated process. When you work with **Renewance**, you get comprehensive battery lifecycle services from beginning to end-of-life, designed to optimize performance and ensure responsible management from start to finish. Our services include installation and commissioning, maintenance services, and end-of-life solutions.

Renewance also brings deep industry expertise in proper commercial battery recycling and is a winner of Phase III of the U.S. Department of Energy's Lithium-Ion Battery Recycling Prize, which focused on fast-tracking efforts to identify, develop, and test disruptive solutions to improve the battery reverse supply chain.

Ready to manage industrial batteries with confidence?

For more information about our services, visit www.batterystewardship.com or contact a representative of **Renewance** in the U.S. at 1-800-233-5038 or sales@renewance.net.