

Lithium Battery Recycling: Keeping Up With The Electric Vehicle Boom

Introduction

The United States is currently seeing the environmental hazards and possible negative long term effects created by the manufacture and disposal of lithium-ion batteries, including the release of toxins into soil and groundwater, and the batteries as fuel for large landfill fires. When compared to lead car batteries, which are recycled at a rate of 99%, electric vehicle lithium-ion batteries are recycled at only a 5% rate.¹ China, and some European countries, have begun to require the recycling of lithium-ion batteries, and this blog proposes the United States adopt similar national regulations to minimize the longer term environmental harm of the booming electric vehicle movement.

Growth of Lithium-Ion Batteries

The lithium-ion battery has had a relatively short life but has quickly established itself as an important and impactful technological advancement. In the mid 1970s, a group of scientists across the globe began to find success in developing a product that would morph into our modern day lithium-ion battery.² Due to oil shortages, they were attempting to create a rechargeable battery that would lessen, or eliminate, the

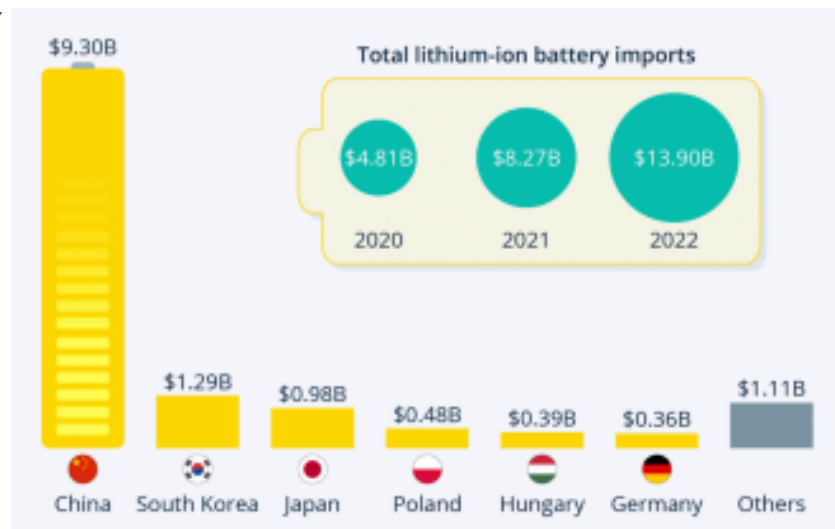


Figure 1

need for fossil fuel energy in the future.³ The lithium-ion batteries found market success in the 1990s after customer acceptance of the new product began to rise.⁴ By the 2020s, we see lithium batteries everywhere—from phones, laptops, electric toothbrushes, e-bikes, and possibly most importantly, electric vehicles. The recent electric car boom has led to a ginormous market for lithium-ion batteries in the United States and supports their continued mass production and importation.⁵

1. Ier, "Environmental Impacts of Lithium-Ion Batteries," IER, May 11, 2023.

2. Zhao Liu, "The History of the Lithium-Ion Battery," Thermo Fisher Scientific, June 13, 2023.

3. Zhao Liu

4. Zhao Liu

5. "Global EV Outlook 2024 – Analysis ." IEA, 2024.

Electric car sales reached 14 million in 2023, over ninety percent being in China, Europe and the United States.⁶ Figure 1 shows the total imports of lithium-ion batteries from foreign countries into the United States in 2022.⁷ In addition, the United States was responsible for manufacturing 114 gigawatt hours worth of lithium-ion batteries in 2023, worth \$13.7 billion.⁸ The manufacturing power of the United States is projected to rise to \$71.6 billion by 2032.⁹

Environmental Concerns of Lithium-Ion Batteries

Although originally designed with sustainability at the forefront, with the goal of lessening our reliance on fossil fuels, lithium-ion batteries have come with their own set of environmental questions and concerns. The mass use of the batteries is currently creating significant disposal issues as the batteries complete their current life cycle.¹⁰ Some of the environmental hazards and negative long term effects from the disposal of the batteries into landfills include the release of toxic metals from the batteries into soil and groundwater systems.¹¹ The batteries are also accidental fuel for large and unpredictable landfill fires. The combustion of the batteries during fires also releases toxic metals into the atmosphere, groundwater, and soil.¹²

Beyond the environmental and safety risks of the batteries after disposal, manufacturing the batteries also poses similar environmental, health, and long term sustainability concerns. Lithium mining itself causes toxic metals to enter the ecosystem and the atmosphere around the mine, causing both biological damage and health problems for human inhabitants of the area.¹³ The current process of brine mining, the method most used for lithium extraction, is energy intensive and uses large quantities of water.¹⁴ Lithium is also a nonrenewable resource, meaning we continue to be reliant on a finite material to power much of our world.¹⁵

6. "Global EV Outlook 2024 – Analysis ." IEA, 2024.

7. Felix Richter, "Where Does the US' Get Most of Its Lithium-Ion Batteries?," World Economic Forum, 2023

8. "Global EV Outlook 2024 – Analysis ." IEA, 2024.

9. Katelin Kharrati, "US Lithium-Ion Battery Market Size Reach \$71.6 Billion 2032," Custom Market Insights, January 13, 2024,

10. IER "Environmental Impacts of Lithium-Ion Batteries," IER, May 11, 2023.

11. IER "Environmental Impacts of Lithium-Ion Batteries," IER, May 11, 2023.

12. IER "Environmental Impacts of Lithium-Ion Batteries," IER, May 11, 2023.

13. March Zheng, "The Environmental Impacts of Lithium and Cobalt Mining," Earth.org, January 20, 2025

14. March Zheng.

15. March Zheng.

Making the Case for Battery Recycling

Lithium-ion batteries are a wonderful technological advancement, but the environmental and safety risks they have created is a real concern. According to Josh Kelly, the program manager for Vermont's Department of Environmental Conservation Waste Management & Prevention Division, "waste management officials in 39 states around the country consider them [lithium-ion batteries] to be the most difficult kind of waste management material to manage."¹⁶ We must find ways to lessen the negative impact of these batteries on the environment, allowing electric vehicles and other lithium battery-powered devices to fulfill their sustainability promise. From a safety standpoint, minimizing the number of batteries in landfills through recycling programs will decrease their potential to cause catastrophic fires.¹⁷

Jen Holliday, the Director of Public Policy for the Chittenden Solid Waste District in Burlington, Vermont highlights the added possibility for environmental improvement created through reuse.¹⁸ "There are some really important components in batteries that are scarce, and we want to get them recycled so the material can get used again," she says.¹⁹ Proper recycling provides the opportunity to increase the long term sustainability of the product by decreasing "unnecessary waste and allows a variety of elemental, valuable metals like nickel, cobalt and manganese to be recovered and used again in new products."²⁰

Improving our ability to recycle lithium-ion batteries and requiring them to be recycled could be the difference maker for their long term positive impact. The United States currently lacks adequate national regulation for the batteries at the end of their lifecycle, leading to the large quantity of them ending up in landfills. Most regulation in the United States appears to be happening at the state level, and while helpful, a larger national effort is needed to match the sheer size of the global lithium-ion industry. Other leading lithium-ion producing countries, such as China and a few countries across Europe, are ahead of the United States when it comes to regulation of the batteries' disposal and recycling. China's lead provides the United States with a possible roadmap for our own advancement in the lithium-ion battery world, if we are smart enough to take it.

Foreign national regulation has gone in a few directions. China is regulating the amount of lithium and metals such as nickel and cobalt that must be recovered through the smelting process, 90% for lithium and 98% for nickel, cobalt, and other metals.²¹ Chinese regulation also requires proper recycling and disposal protocol for material waste created during the manufacturing process.²² A change from the 2019 to the 2024 version of the Chinese national regulation included a requirement that recycling enterprises must be able to recycle batteries from electric bikes, increasing their capabilities to reuse materials.²³ The regulation also requires

16. Greta Solsaa, "Vermont Promotes Proper Battery Recycling as New Battery Technology Poses Increasing Fire Risks," VT Digger, March 17, 2025

17. Greta Solsaa.

18. Greta Solsaa.

19. Greta Solsaa.

20. Greta Solsaa.

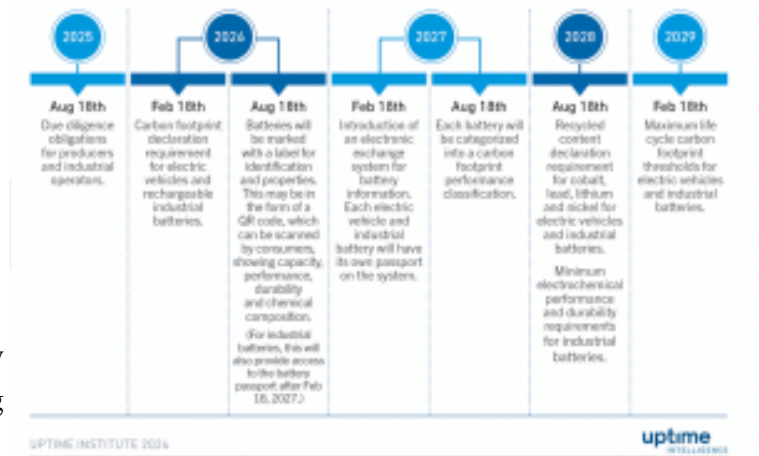
21. "China Used EV Batteries Recycling Standards 2019 vs. 2024," Mysteel, August 22, 2024.

22. "China Used EV Batteries Recycling Standards 2019 vs. 2024," Mysteel, August 22, 2024.

23. "China Used EV Batteries Recycling Standards 2019 vs. 2024," Mysteel, August 22, 2024.

that by 2023, 45% of all discarded lithium-ion batteries in the country be processed through a recycling process and boosts that requirement to 70% by 2030.²⁴

The European Union's regulations focus on the reuse of materials, expecting that the lithium-ion batteries will find secondary and tertiary uses, rather than just being smelted for their raw materials.²⁵ The EU is also requiring that lithium-ion batteries have a



“minimum recycled content of 12% for cobalt, 4% for lithium, 4% for nickel and 85% for lead.²⁶ By 2035, these thresholds will increase to 20% cobalt, 10% lithium, 12% nickel and 85% lead.”²⁷ The EU’s plan also includes aggressive goals to track the carbon footprint of lithium-ion batteries in use by 2029 in their newest regulations that went into effect in the summer of 2024.²⁸ Figure 2 outlines the EU’s plan for carbon tracking the lithium-ion batteries.²⁹ In contrast, the United States has no requirements for recycling and the EPA simply recommends managing the batteries as hazardous material when individuals are disposing of them. Although not sufficient on their own, state initiatives in the United States show great promise for stronger regulation of lithium-ion batteries from manufacturing to disposal. A statewide producer responsibility program in Vermont, that requires companies selling lithium-ion batteries to pay a percentage of their sales back towards improved resources for battery waste management and advancement of recycling efforts, is set to take effect at the beginning of 2026.³⁰

Expanding on the precedent set by other countries, and state-led regulation, will prepare the United States for the massive increase of lithium battery production and consumption projected to continue here at home, and across the globe. Keeping up with this massive increase through innovation is the only way to fulfill the environmental promise of lithium-ion power and the electric vehicle industry.

24. “China Used EV Batteries Recycling Standards 2019 vs. 2024,” Mysteel, August 22, 2024.

25. Rosa Lawrence, “EU Battery Regulations: What Do the New Rules Mean?,” Uptime Institute Blog, June 20, 2024.

26. Rosa Lawrence.

27. Rosa Lawrence.

28. Rosa Lawrence.

29. Rosa Lawrence.

30. Greta Solsaa, “Vermont Promotes Proper Battery Recycling as New Battery Technology Poses Increasing Fire Risks,” VTDigger, March 17, 2025.

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