Report to the North Carolina General Assembly
Environmental Review Commission

Report on the Prohibition on the Disposal of Lithium Batteries in North Carolina Landfills

May 1, 2024

Division of Waste Management, Division of Environmental Assistance and Customer Service

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY

Pursuant to SL 2023-137, Section 19.(b)

Contents

A. Executive Summary

In accordance with Session Law 2023-137 (House Bill 600), *s.* 19(b), the Department of Environmental Quality shall study the proper handling of end-of-life lithium-ion batteries, and specifically, whether any exceptions to a ban on disposal in landfills based on the size of a battery are appropriate. The Department shall report its findings, including any recommendations for legislative action, to the Environmental Review Commission no later than May 1, 2024. These requirements are fulfilled in the following report.

Fire associated with lithium batteries is the greatest concern and challenge as the batteries move through the waste and recycling collection stream according to a 2022 joint letter to US EPA Administrator Regan on the best practices for safe recycling and labeling of lithium batteries.[1] While property damage is harmful to the Nation's waste and recycling infrastructure, it should also be noted the risk that such fires pose to the lives of workers, firefighters, and the general public, the letter further explains.

It is recommended that there are no exceptions on lithium battery size to the ban on landfill disposal as the risk of fires posed by mismanaged batteries is present in all sizes of lithium batteries, as outlined in this report. It is also recommended that the terminology be changed to "lithium batteries" rather than "lithium-ion batteries" to fully capture all batteries that contain lithium. It is also suggested that the legislature provide additional financial support to local governments to conduct household hazardous waste (HHW) collection events in addition to researching additional methods, such as a user fee, to provide future long-term funding for the safe and proper disposal of lithium batteries.

This report includes:

- A background on lithium batteries.
- A regulatory summary summarizing current regulations related to lithium batteries.
- Proper handling and recycling of end-of-life lithium batteries.
- Recommendations to the General Assembly.

B. Background

Batteries that contain lithium include both non-rechargeable batteries, typically referred to as lithium batteries, and rechargeable batteries, typically referred to as lithium-ion batteries. While the batteries differ in their designs, uses, and chemistries, end-of-life batteries of each category pose similar fire risks and contain similarly valuable materials. Both categories of batteries will be referred to as lithium batteries throughout this report.

Lithium batteries power an increasing number of electric vehicles, consumer electronics, and many other devices. Lithium batteries are often preferred due to their higher energy density as compared to other batteries. The Resource Conservation and Recovery Act (RCRA), Subtitle C federal regulations are adopted by reference in state rules at 15A North Carolina Administrative Code (NCAC) 13A and regulate the proper management of wastes generated by specific entities (e.g.,

businesses, government agencies, non-profit organizations, etc.). However, household hazardous waste (HHW) is excluded from regulation under RCRA Subtitle C.

In a 2023 memorandum, the United States Environmental Protection Agency (EPA) stated that most lithium batteries are likely to be hazardous waste at their end of life.[2] While HHW is excluded from RCRA Subtitle C, the EPA recommends that HHW be segregated from the municipal solid waste stream to avoid introducing hazards to workers and communities. The EPA encourages the recycling of lithium batteries wherever possible in a manner that protects communities and the environment.

The high energy density of lithium batteries and the materials used in their construction make lithium batteries prone to thermal runaway when they are damaged.[3] Thermal runaway is a reaction in which the battery discharges its energy and begins self-heating in an uncontrolled reaction. While other types of batteries can experience thermal runaway, lithium batteries are particularly prone due to the larger amounts of energy they store. In addition to thermal runaway, many lithium batteries contain a flammable liquid electrolyte. Damage or mismanagement of lithium batteries creates a risk of fires in garbage cans, during transportation, at intermediate facilities, or end-of-life facilities such as landfills or recycling facilities.[4] Spontaneous fires caused by battery defects have resulted in certain cellular phones being banned from being taken aboard any airline flight by the Federal Aviation Administration in 2016,[5] highlighting the potential risks even relatively small lithium batteries can pose.

Lithium batteries are also a threat to Material Recovery Facilities (MRFs) that inadvertently receive the batteries in the recycling stream.[6] These batteries are believed to be the main cause of increasing fires at MRFs according to a summary opinion written by Resource Recycling Systems to the National Waste and Recycling Association in September 2023.[7] According to data collected from permitted North Carolina solid waste facilities, four fires are believed to have occurred as a result of rechargeable batteries out of 31 facility fires since June 2023. Of those four fires, one is believed to have been directly caused by a lithium battery.

Several commonly used materials in lithium batteries, including aluminum, lithium, cobalt, manganese, and graphite, are identified in the United States Geological Survey's 2022 list of critical minerals,[8] which are mineral commodities that are deemed critical for the U.S. economy and national security. Recycling lithium batteries is an effective way to conserve these critical minerals and reduce the overall energy needed to produce new batteries.

C. Regulatory Summary

1. Hazardous Waste and Universal Waste Regulations

All entities (e.g., businesses, government agencies, non-profit organizations, etc.), except for households, are required by the Resource Conservation and Recovery Act to manage lithium batteries properly at their end-of-life. Most lithium batteries are hazardous waste at the end of life due to the hazardous waste characteristics of ignitability and reactivity. The characteristic of ignitability, assigned EPA waste code D001, applies to wastes that have low flash points, can spontaneously combust, or are oxidizers. The characteristic of reactivity, assigned EPA waste

code D003, applies to wastes that are normally unstable, react violently with water, or are capable of detonation or explosive reaction when subjected to heat. Hazardous waste is banned from disposal in North Carolina landfills (15A NCAC 13B .0103(d)). End-of-life lithium batteries (that are not from households) can be managed under the streamlined federal hazardous waste management standards for universal waste in 40 CFR 273, adopted by reference in state rules at 15A NCAC 13A .0119. until they reach a destination facility for recycling or disposal. The universal waste regulations streamline the hazardous waste management standards for certain categories of hazardous waste that are commonly generated by a wide variety of establishments, such as batteries.

Management standards within the universal waste regulations include basic container management practices including accumulation in a closed container that is structurally sound and can contain leaks, with container markings to identify the contents, basic training for employees handling the waste, response to releases, accumulation on-site of no more than one year, and ensuring proper management by another universal waste handler or destination facility.

Entities that accumulate more than 11,000 pounds of all universal waste (e.g. batteries, fluorescent lamps, mercury-containing devices, aerosol cans, etc.) have additional requirements that include notifying the state of their activity and keeping records of all shipments of universal waste to another handler or destination facility.

Entities (that are not households) that choose not to use the universal waste standards for the management of their used batteries must make a proper waste determination and if determined to be hazardous waste, need to follow the hazardous waste regulations applicable to their hazardous waste generator category—very small quantity generator, small quantity generator, or large quantity generator. This includes, at a minimum, proper recycling, or disposal of hazardous waste.

In 2023, the EPA announced that they are working on a proposal for universal waste standards specifically tailored for lithium batteries, separate from the existing general universal waste category since these batteries can cause fires when improperly discarded or otherwise mismanaged.[9]

Although households are exempt from regulations on managing used batteries, the EPA states that lithium batteries should not go in the household garbage or recycling bins.[10]

2. Household Hazardous Waste Exemption and Handling Requirements

Household Hazardous Waste (HHW) refers to wastes generated by normal household activities by individuals on the premises and is primarily composed of materials found in wastes generated by consumers in their homes. The Department of Environmental Quality's Division of Waste Management – Solid Waste Section (SWS) regulates the collection of HHW.[11]

Lithium batteries brought to a permanent HHW collection facility, or a temporary collection event are collected, packaged in bulk, and transported to a permitted hazardous waste

treatment, storage, and disposal facility. Lithium batteries that are not brought to a HHW collection event are either disposed of in municipal solid waste landfills by normal trash collection services or may be taken to retail facilities, such as Lowe's Home Improvement,[12] Home Depot,[13] and BatteriesPlus,[14] which offer an outlet for consumers to properly dispose of lithium batteries. The disposal of lithium batteries via normal trash collection services results in a risk of worker injury and fires both while in transportation and at transfer stations and landfills.

3. Research on Battery Management at Agencies outside of North Carolina

DEQ's Hazardous Waste Section emailed the North American Hazardous Materials Management Association membership forum on March 8, 2024, requesting feedback on lithium battery acceptance in their solid waste landfills and HHW collection facilities. Fourteen municipalities provided responses that included programs in Arizona, Arkansas, Colorado, Iowa, Texas, Utah, Wisconsin, California, Washington, and Florida.

The following includes some of the feedback provided by the respondents:

- The Mesa County, Colorado, and King County, WA programs are the only respondents that have banned lithium batteries in their solid waste facility. They banned all sizes of lithium batteries regardless of energy level.
- None of the other seven EPA Region 4 states (Georgia, Kentucky, Tennessee, South Carolina, Alabama, Mississippi, and Florida) have current or proposed bans on lithium-batteries in the landfill.
- Thirteen out of fourteen respondents have HHW Programs, or other programs that accept battery-embedded devices.
- Two programs received grants to assist with collecting batteries at the HHW Programs.
- Wisconsin 2023 Senate Bill 906 provides grants for collecting and recycling rechargeable batteries.[15]
- Five of the respondents reported fires at their facilities from lithium batteries.

D. Proper Handling and Recycling of End-of-Life Lithium Batteries

1. Current Management of Household Lithium Batteries

Originating primarily in households, the municipal solid waste stream usually travels through numerous waste management facilities, including transfer stations, landfills, and recycling facilities. Unfortunately, lithium batteries can be incompatible with this complex system of waste management, as they can be damaged at many different steps, potentially leading to fires. Despite this incompatibility, the number of lithium batteries entering the municipal waste stream is growing rapidly. Some varieties of lithium batteries may pose additional risks when improperly disposed of in recycling bins or garbage cans. For example, devices such as vape pens with embedded lithium batteries can be unintentionally discarded in trash cans and start fires by igniting trash, or lithium batteries may contact metallic objects or liquids and short-circuit, potentially starting a fire.[16]

Currently, lithium battery recycling opportunities for consumers include collection programs offered by local governments and retail store drop-off locations offered by stores such as Lowe's Home Improvement, Home Depot, and BatteriesPlus. Many retail drop-off locations are coordinated through Call2Recycle's national battery recycling program which receives funding from manufacturers of battery-containing products to cover the costs of recycling at end-of-life.

Local governments receive and accept lithium batteries through a variety of programs, all of which have a cost to operate.

- Lithium batteries are often accepted at HHW collection facilities and events although collection days vary from temporary events held once or twice a year to permanent programs open multiple days per week.
    - Currently, 29 permitted permanent collection facilities accept HHW operating in 23 counties that are primarily accessible to individual county residents. These collection facilities might not accept all forms of HHW, such as lithium batteries.
    - The SWS also permits one-day temporary HHW collection events, which all 100 counties, municipalities, and businesses are eligible for. During fiscal year (FY) 2022-23, 33 counties, municipalities, and businesses held 53 temporary HHW collection events, some of which were in counties that also have permanent HHW collection facilities. These temporary collection events might not accept all forms of HHW, such as lithium batteries, and might only be accessible to county residences.
- In FY 2022-23, 20 counties and 11 municipalities offered designated household battery collections outside of HHW events. These programs are generally open to the public year-round offering a more convenient recycling opportunity. However, there may be limitations on the types of batteries accepted.
- Lithium batteries are also managed through electronics recycling programs when they are embedded or left inside consumer electronic devices such as cell phones, laptops, portable charging units, toys, and power tools. Generally, electronics recyclers are prepared to manage lithium batteries and have procedures in place to safely remove and recycle the batteries entering their facilities with accepted consumer electronic devices.

While electronics recycling programs are widely available throughout the state (offered in 97 counties), they only address lithium batteries contained in consumer electronic devices. The lithium battery landfill ban may warrant counties and municipalities to expand battery collection programs through HHW facilities or designated battery collections. Local governments incur costs from running battery recycling programs, including paying for recycling services, providing labor to operate programs and properly handle and prepare batteries for storage and shipment, and educating the public. Therefore, it is suggested that the State offer resources to local governments to provide for battery recycling collection, education and outreach, and additional business drop-off locations.

2. Proper Handling

The landfill and incineration ban for lithium batteries can alleviate the problems caused when lithium batteries enter the municipal solid waste and traditional recycling streams. Additionally, recycling lithium batteries can help meet the increasing demand for the critical minerals present in lithium batteries. However, specific education is needed to ensure that batteries are not placed in curbside recycling containers but rather brought to designated battery recycling locations.

Before ultimately disposing of or recycling lithium batteries, several best practices can be utilized to ensure that lithium batteries are handled safely. These best management practices include taping the terminals of lithium batteries and/or individually bagging lithium batteries. Trained staff at HHW recycling facilities, HHW recycling events, or retail stores that accept lithium batteries can ensure that these best management practices are utilized when lithium batteries are collected.

3. Recycling

Many lithium batteries have higher concentrations of cobalt, nickel, lithium, and manganese exceeding the concentrations found in natural ores, which makes end-of-life lithium batteries a valuable resource.[17] Battery recyclers provide the opportunity to recover these valuable materials. Recyclers can use a variety of methods to recover material recovery, including mechanical or physical separation, pyrometallurgy, and hydrometallurgy. Mechanical or physical separation splits battery components into smaller constituent parts, pyrometallurgy is a process using heat to extract metals, and hydrometallurgy is a chemical leaching process for extracting and separating metals. Recyclers may also be able to target lithium batteries for direct reuse, such as reusing electric vehicle batteries as energy storage batteries attached to the electrical grid.[18] Battery recyclers that receive universal waste lithium batteries must manage those batteries in accordance with the universal waste handler requirements discussed in Section C of this report. While batteries generated by households are exempt from these requirements, many battery recycling facilities receive both universal waste and HHW lithium batteries and manage both in accordance with the universal waste handler requirements.

E. Recommendations

DEQ requests the North Carolina General Assembly's consideration of the following recommendations.

- ***The language of the proposed ban should read "lithium batteries" rather than "lithium-ion batteries" to fully capture all batteries that contain lithium.***
  Batteries that contain lithium include both non-rechargeable batteries, typically referred to as lithium batteries, and rechargeable batteries, typically referred to as lithium-ion batteries. While the batteries differ in their designs, uses, and chemistries, end-of-life batteries of each category pose similar risks. If the intent of the landfill ban is to exclude all batteries that contain lithium from being disposed of in landfills, it is recommended that the language of

the ban be changed from “Lithium-ion Batteries” to “Lithium Batteries.” The term “Lithium Batteries” will also provide consistency with the terminology currently used in the proposed lithium battery universal waste standards.

- ***No exceptions are recommended to the ban on landfill disposal based on battery size.***
  The materials found in lithium batteries include critical minerals, and providing an exception based on battery size will result in fewer of these critical minerals being recycled. Further, the risk of fires posed by mismanaged batteries is present in all sizes of lithium batteries, and fires started by even small lithium batteries can result in other materials in the municipal solid waste stream igniting, potentially causing transportation, transfer station, and landfill fires. This will simplify implementation for landfill operators and local governments as well as make education and outreach easier.

- ***Additional resources for local governments to properly dispose of lithium batteries should be encouraged.***
  Many lithium batteries that are generated by households fall into the category of HHW and the disposal of these HHW lithium batteries is excluded from RCRA Subtitle C regulations. The lithium battery landfill ban may warrant counties and municipalities to expand battery collection programs through HHW collection locations or designated battery collections. The total amount of lithium batteries collected in FY 2022-23 was not tracked. However, a total of 168,226 pounds of batteries were collected at HHW collection locations. While some retail stores, such as Lowe’s Home Improvement, Home Depot, and BatteriesPlus offer an outlet for households to properly dispose of lithium batteries, many counties in North Carolina do not currently have HHW collection programs, increasing the burden on citizens to properly recycle lithium batteries.

  During FY 2022-23, 23 counties operated permanent HHW collection facilities, totaling 29 collection locations, and another 11 counties and 10 municipalities offered a one-day HHW collection event. Also, an additional 32 one-day collection events were held in counties at other locations that have permanent collection facilities. Local governments incur costs from running HHW collection programs. In FY 2022-23, the total cost reported to operate 53 one-day collection events is $805,320 and the total cost to operate the permanent collection facilities is $5,189,968. Commonly, collection operations are contracted to third-party companies. Individual collection location costs differ based on the contractor company used, contract specifics, distance to the HHW processing facility, type of HHW collected, and the duration of collection activities. Therefore, it is suggested that the State offer resources to local governments to provide for general HHW collection operations, including lithium battery collection, and education and outreach, and for additional public drop-off locations. These resources will provide citizens throughout the State the opportunity to properly dispose of lithium batteries in a way that is protective of human health and the environment.

It is recommended that a study on other options for the management of lithium batteries be conducted. Several states, including Iowa and Minnesota, will require manufacturers, distributors, or retailers to have recycling and management programs in place. These recycling and management programs may include retail store drop-off locations or phone numbers established to provide recycling information to consumers.[19] Florida requires products with non-removable batteries to be recycled, and manufacturers and distributors must pay the cost of recycling. Another source of potential funding for battery recycling programs could include a surcharge or tax on products containing lithium batteries. Similar to the programs that govern scrap tires or white goods in North Carolina, a user fee to offset the costs of managing the waste properly should be considered.

F. References

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