NORTH CAROLINA
Department of Environmental Quality

Lithium-ion Battery Recycling

COMMODITY PROFILE

Market Assessment
June 23, 2026

Background

This Lithium-ion (Li-ion) Battery Recycling Market Assessment (Assessment) was conducted by Resource Recycling Systems (RRS) for the North Carolina Department of Environmental Quality (DEQ). The Assessment provides an overview of the current state of North Carolina end-of-life (EoL) Li-ion battery generation and recovery relationships, including estimated total generation rates, recovery rates, future generation rate projections and material demand.

DEQ published a *Report on the Prohibition on Disposal of Lithium Batteries in North Carolina Landfills* in May of 2024, recognizing the increasing prevalence of lithium battery use in a diverse range of consumer products and the elevated fire risk batteries pose to solid waste industry professionals and collection and processing infrastructure in the state. After Dec. 1, 2026, Li-ion batteries will be banned from disposal in North Carolina landfills pursuant to North Carolina General Statutes § 130A-309.10. Lithium is a highly reactive alkali metal that is widely used in the production of certain battery types due to its light weight and electrochemical properties. Lithium has also been designated as a critical mineral and material for energy and national defense purposes per the U.S. Department of Energy, making recovery of lithium from batteries strategically important. This Assessment evaluates the generation and recovery rates of EoL Li-ion batteries to aid North Carolina in understanding future battery management needs.

The Assessment covers two types of businesses: those that collect or aggregate and transport EoL Li-ion batteries and battery-containing products, and those that physically or chemically process materials to create recovered outputs that re-enter the manufacturing supply chain. Throughout the Assessment, the term “battery recyclers” refers to both types of battery recycling businesses.

The Assessment was conducted using industry research as well as data from the fiscal year 2024-25 annual local government solid waste and materials management reports combined with information from North Carolina-based Li-ion battery recyclers listed in DEQ’s North Carolina Recycling Markets Directory. Each North Carolina county and municipality is required to complete an annual report on their solid waste and recycling activities per § 130A-309.09A. NC DEQ provided the extracted fiscal year 2024-25 data for the Assessment. The Recycling Markets Directory is a continuously updated, online database that lists recycling companies that collect, transport, broker, process, or remanufacture recovered materials in North Carolina. In the first quarter of 2026, data surrounding the quantities of Li-ion batteries recovered, costs, capacity, expansion capabilities, investment and support needs were analyzed from twelve of the thirty-eight relevant Li-ion battery recyclers serving North Carolina local governments and businesses.

Generation data was developed from proprietary national Li-ion battery data and adjusted for North Carolina based on population. Primary lithium battery (i.e. single-use batteries) data were not available.

BATTERY TYPES ASSESSED

Within this Assessment RRS categorizes Li-ion batteries into five battery types as defined below in Table 1.

Table 1. Li-ion Battery Type Definitions

BATTERY TYPES	EXAMPLE ITEMS*
Small, Loose Batteries & Electronics	Phones, tablets, laptops, headphones, loose rechargeable batteries, (i.e. AAA, AA, C, D)
Outdoor Equipment & Power Tools	Cordless power tools and lawn maintenance equipment
Battery Embedded Devices (BED)	Speakers, vapes, lights, power banks, toys
E-mobility Devices	E-scooters, E-bikes, golf carts, electric ATVs, skateboards, hoverboards, unicycles
Electric Vehicle (EV) Batteries	Battery Electric Vehicles (BEVs), Plug-In Hybrid Electric Vehicles (PHEVs), hybrid vehicles

**This list is not exhaustive and includes example items for the Li-ion battery types listed. Example items are based on submarket data from Data Bridge data sets.* [1]

Generation of End-of-Life Li-ion Batteries

CURRENT NATIONAL GENERATION

Historically Li-ion batteries were mainly used in personal electronic devices; however, there has been significant growth in the range of consumer products using Li-ion batteries. Li-ion batteries account for as much as 80% of the rechargeable battery market and are the predominant batteries used for cordless power tools and speakers.[2]

Finding quality data on the current generation of EoL Li-ion batteries is challenging given they are used in an increasing array of products, which are made by a variety of companies and distributed via a global supply chain. A 2025 report by U.S.-based battery stewardship group The Battery Network (formerly Call2Recycle) found that, “there is no data currently publicly available on the prevalence of embedded batteries in consumer devices by product category.” Furthermore, the report found “there are no datasets currently available that examine the product types with BED, size of market affected by BED, or growth in BED.” Given the lack of publicly available comprehensive datasets, the RRS research team utilized Li-ion battery type characteristics, lifespan models, historical and forecasted sales data in the U.S. market, and proprietary datasets to inform this Assessment as is further described in the sections below.

[1] Data Bridge Market Research. (2022). North America Lithium-Ion Battery Market – Industry Trends and Forecast to 2031. Data Bridge Market Research. Data based on projected revenue growth.

[2] Giroux, Laurie, Selena Fraser-Arvai, and Maria Kelleher. *U.S. Consumer Rechargeable Battery Sales, Impact of Battery Embedded Devices and Available for Collection under the Call2Recycle Program*. Call2Recycle U.S., 12 June 2025.

PROJECTED MARKET GROWTH

Between 2024 and 2034, market analysts predict U.S. sales for the battery types covered in this Assessment will grow at an average compound annual growth rate (CAGR) of 16%[3] as a response to technological advancements, consumer demands, and regulatory and policy requirements, reaching a projected $62B in sales in the U.S. by 2034. Additionally, a 2022 analysis from McKinsey & Company projected the entire Li-ion battery supply chain, from mining through material recovery and recycling, could grow by over 30% annually through 2030, making battery recycling an increasingly important consideration for North Carolina and its local governments.[4] Table 2 depicts the projected growth for total U.S. sales value by battery type from 2024 to 2034.

Table 2. Total U.S. Sales Value and Growth Projections, by Li-ion Battery Type

BATTERY TYPE	2024 U.S. MARKET VALUE	PROJECTED 2034 U.S. MARKET VALUE	PROJECTED 2024-2034 CAGR
Small, Loose Batteries & Electronics	$5,239,000,000	$22,302,000,000	15.59%
Outdoor Equipment & Power Tools	$600,000,000	$2,524,000,000	15.45%
Battery Embedded Devices	$111,000,000	$408,000,000	13.92%
E-mobility Devices	$1,457,000,000	$6,804,000,000	16.66%
Electric Vehicle (EV) Batteries	$6,628,000,000	$30,343,000,000	16.43%
Total	$14,034,000,000	$62,381,000,000	16.10%

LI-ION BATTERY TYPE CHARACTERISTICS IMPACTING WASTE GENERATION

Lifespan, weight, cost, and U.S. battery sales revenue data and projections were utilized to develop estimates of the number, type, and weight of Li-ion batteries generated.

Lifespan: The average lifespan of a battery varies greatly based on the type of battery, size, and usage. Electric vehicle (EV) batteries are the largest battery type by size and can last up to twenty years while smaller batteries may only have a shelf life of less than five years. With some consumer products, battery life is tied directly to product life, which can be seen in battery embedded devices (BED) that contain Li-ion batteries that are not

[3] Data Bridge Market Research. (2022). North America Lithium-Ion Battery Market – Industry Trends and Forecast to 2031. Data Bridge Market Research. Data based on projected revenue growth. To calculate 2034 projection, 2024-2031 CAGR was extended through 2034.

[4] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular

designed to be easily or efficiently replaced by the average consumer.[5] Products with replaceable batteries, however, typically have a longer product life than battery life. For example, the average lifespan of an e-bike is twice that of its replaceable battery.[6]

Weight: A key factor in Li-ion battery recycling is the weight of the respective battery types. EV batteries are significantly heavier than those in smaller electronic devices. Smaller, loose, and removable batteries often weigh less than one pound, making manual sorting less efficient. Additionally, the smaller or lighter the battery, the greater the risk for improper placement in the wrong waste management stream, and the greater the difficulty in detecting its presence, which increases the risk of fire posed to collection, handling, and processing facilities given the high amount of energy even small Li-ion batteries contain.

Cost: Higher capacity, advanced Li-ion batteries with a longer lifespan are more costly per unit and will impact the market price for recovered EoL Li-ion batteries over time as they become discarded in greater quantities upon reaching the end of their useful life. Significant differences in battery characteristics across battery sizes and chemistries also impacts the marketplace for remanufacture and recycling.

Table 3 summarizes these assumptions for lifespan, weight, and average cost by battery type. Lifespan estimates are based on the number of battery charge cycles and/or shelf life for a range of products for each battery type. Average weight data was determined through reviewing product specifications for replacement batteries for specific products. Average battery cost was determined by researching battery costs for each product type through a sampling of retail establishments such as Amazon.com, Walmart.com, Homedepot.com, and Recurrentauto.com. Weight and cost data were collected in 2024. Five to thirty-four data points were collected for weight and cost data for each battery type. This data along with market sales projections was utilized to project the number and weight of batteries available for recycling.

Table 3. Assumptions about Li-ion Battery Type Characteristics Used to Estimate End-of-Life Generation

BATTERY TYPE	LIFESPAN RANGE[7] (YEARS)	AVERAGE LIFESPAN (YEARS)	AVERAGE BATTERY WEIGHT (LBS.)	AVERAGE BATTERY COST (USD)
Small, Loose Batteries & Electronics	2-5	3.5	0.2	$22
Outdoor Equipment & Power Tools	2-3	2.5	2.3	$181
Battery Embedded Devices	2-5	3.5	0.008	$4
E-mobility Devices	2-5	3.5	22.9	$305
Electric Vehicle (EV) Batteries	10-20	15	904.8	$14,918

[5] Fowler, G. (2022, August 2). Electronics are built with death dates. Let's not keep them a secret. The Washington Post.

[6] Himiway (2023, October 11). Understanding Electric Bike Component Durability. Himiway.

[7] Data Bridge Market Research. (2022). North America Lithium-Ion Battery Market – Industry Trends and Forecast to 2029. Data Bridge Market Research.

BATTERY WASTE GENERATION PROJECTIONS

To estimate the number of EoL Li-ion battery units available for recycling in 2025, U.S. market sales projections were divided by the average battery cost to determine the number of batteries sold by battery type. Lifespan factors were then applied to project the number of batteries available for recycling as shown in Table 4 for 2025 and 2034.

Table 4. Projected EoL Li-ion Battery Units Available for Recycling in the U.S. by Battery Type

BATTERY TYPE	2025 (NUMBER OF UNITS)	2034 (NUMBER OF UNITS)
Small, Loose Batteries & Electronics	232,180,000	845,380,000
Outdoor Equipment & Power Tools	3,450,000	12,510,000
Battery Embedded Devices	26,560,000	84,860,000
E-mobility Devices	4,680,000	18,520,000
Electric Vehicle (EV) Batteries	240,000	870,000
Total	267,110,000	962,140,000

When projecting the number of EoL lithium batteries available for recycling, the small, loose batteries and electronics battery type dominate, accounting for nearly 88% of all units in 2034, as shown in Figure 1.[8] In 2034, the five battery types analyzed are projected to contribute over 962 million units available for recycling, with 845 million of those being from the small, loose batteries and electronics battery type. Battery embedded devices are the second largest category with 84 million units. Figure 2 depicts the total projected number of EoL Li-ion battery units available for recycling in the U.S. through the year 2034.

[8] Number of units estimated by dividing the U.S. sales data for each battery type by the average cost to determine number of batteries of each type sold each year. Lifespan factors by battery type were then applied to determine batteries available each year for recycling.

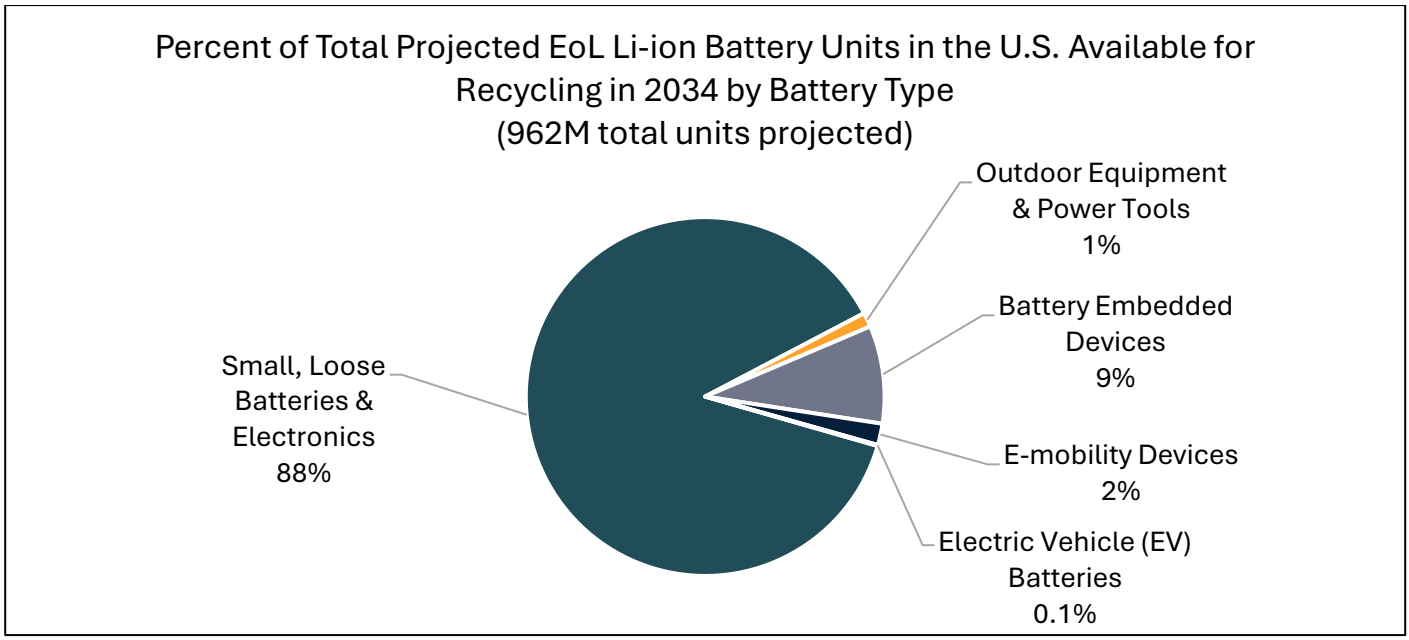

Figure 1. Percent of Total Projected EoL Li-ion Battery Units in the U.S. Available for Recycling in 2034, by Battery Type

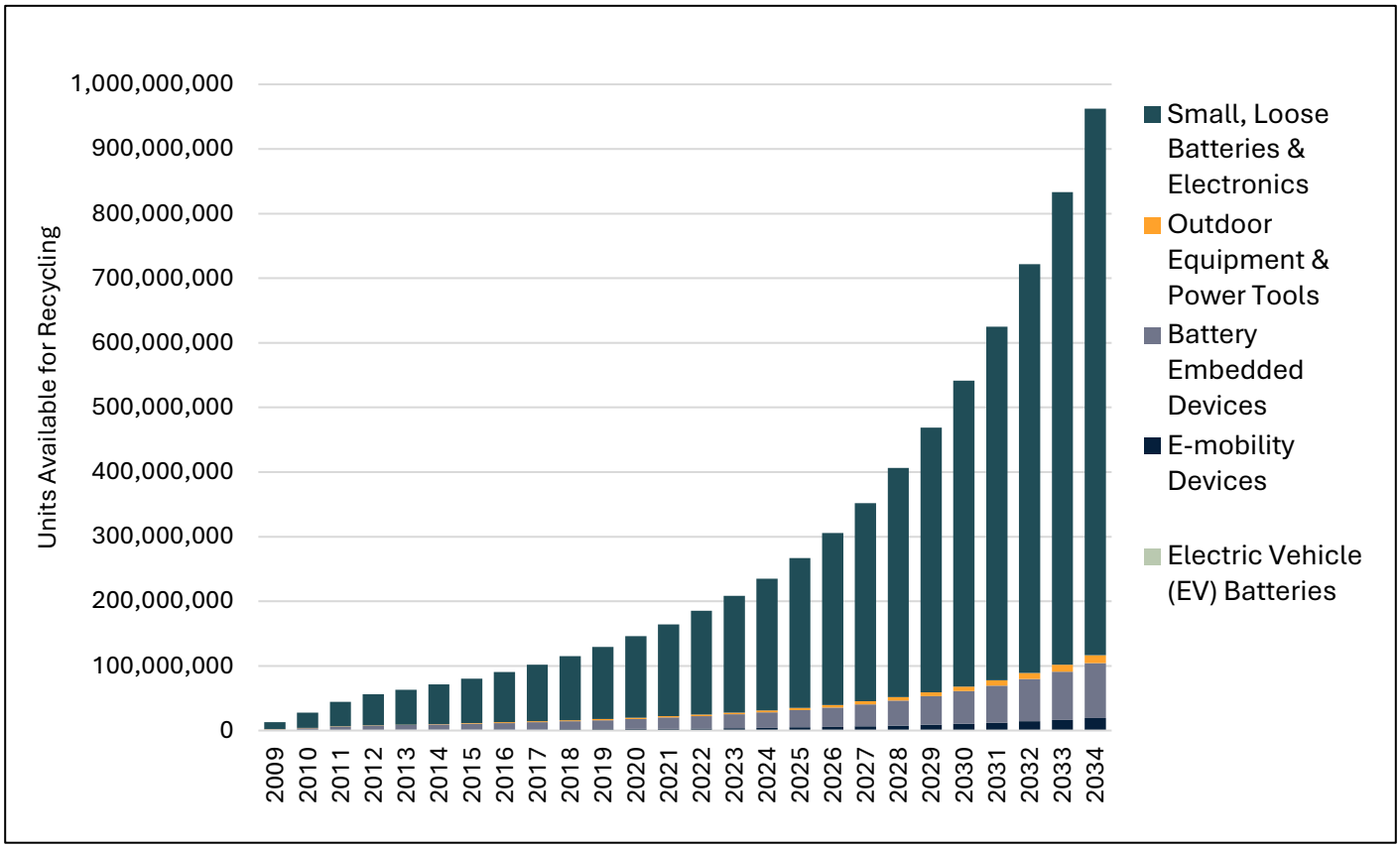

Figure 2. Total Projected EoL Li-ion Battery Units Available for Recycling in the U.S. through 2034

The weight of EoL Li-ion batteries available for recycling was estimated by multiplying the number of batteries available for recycling by the average battery weight for each battery type. Figure 3 shows that in the U.S., the largest recyclable quantity by weight, at almost 400,000 tons per year, will come from EV batteries in 2034. The e-mobility battery type will add another 200,000 tons per year in 2034.

Weight offers a vastly different perspective than total units, as small electronics have a smaller overall impact on waste generation due to their lower weight. For example, in 2034, it's projected that the small, loose batteries, and electronics battery type will contribute to nearly 88% of all Li-ion battery units available for recycling while only contributing 13% of the total estimated tons of EoL Li-ion batteries available for recycling as shown in Figure 3.

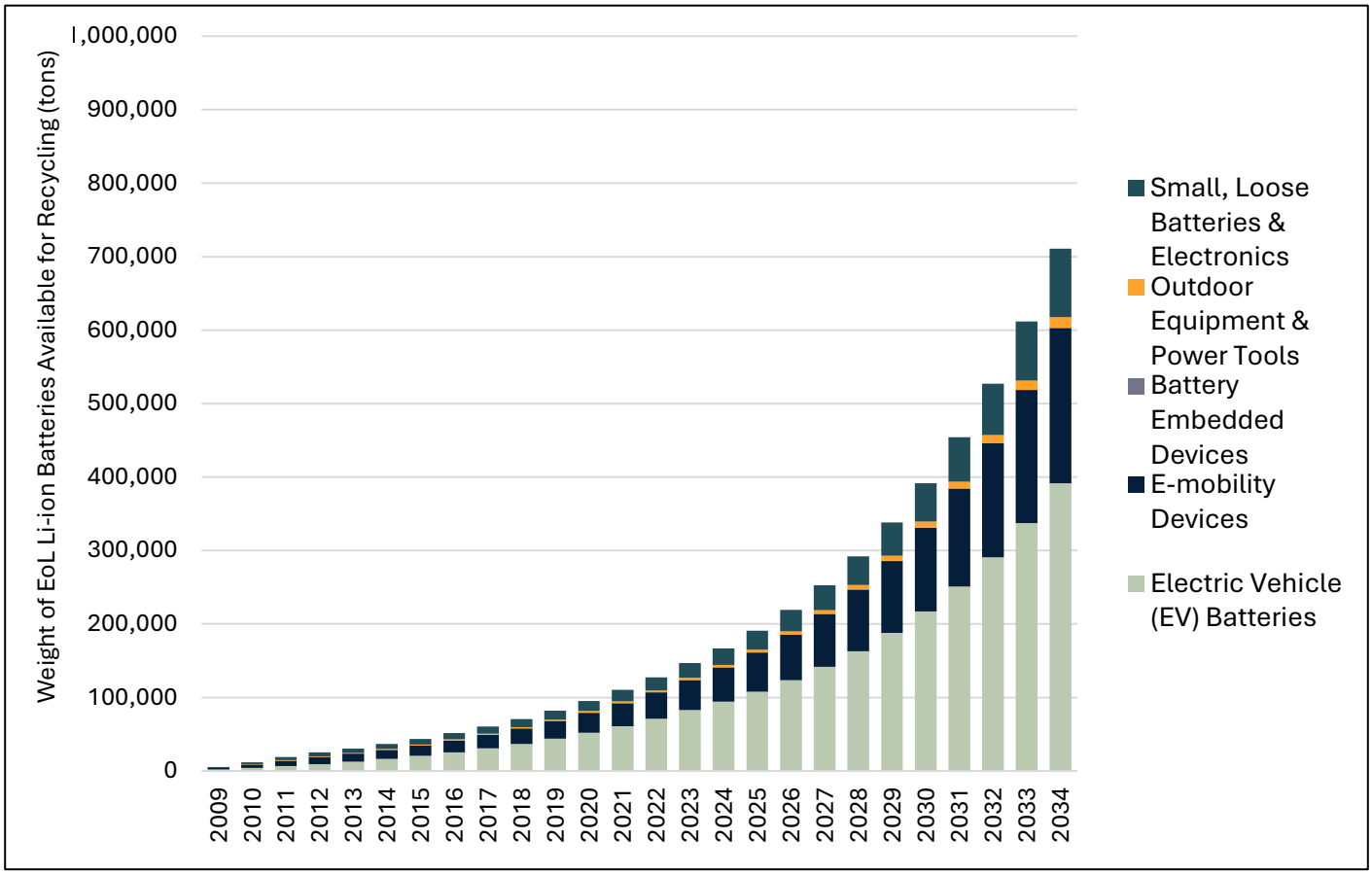

Figure 3. Total Projected Weight of EoL Li-ion Batteries Available for Recycling in the U.S. through 2034

Note on Lifespan Variability: Projections assume each battery will reach its average expected lifespan; however, actual battery performance will vary. Some batteries may last longer than anticipated, while others may fall short of expectations. To provide a more comprehensive view, additional projections are included to illustrate outcomes under different lifespan scenarios. These projections show the impact if the batteries perform at the lower end of their lifespan range versus the higher end. This range of scenarios allows for better planning and risk management, accommodating the variability inherent in battery performance.

Low Lifespan Scenario: If batteries reach their end-of-life sooner than expected, they could have a more significant impact on the U.S. battery recycling system. For instance, if projections are based on the lower range of anticipated lifespan (see Table 3 for values), a larger volume of materials will become available earlier.

By 2034, EVs may introduce an additional 100,000 tons of batteries into the market compared to projections based on average lifespans as shown in Figure 4.

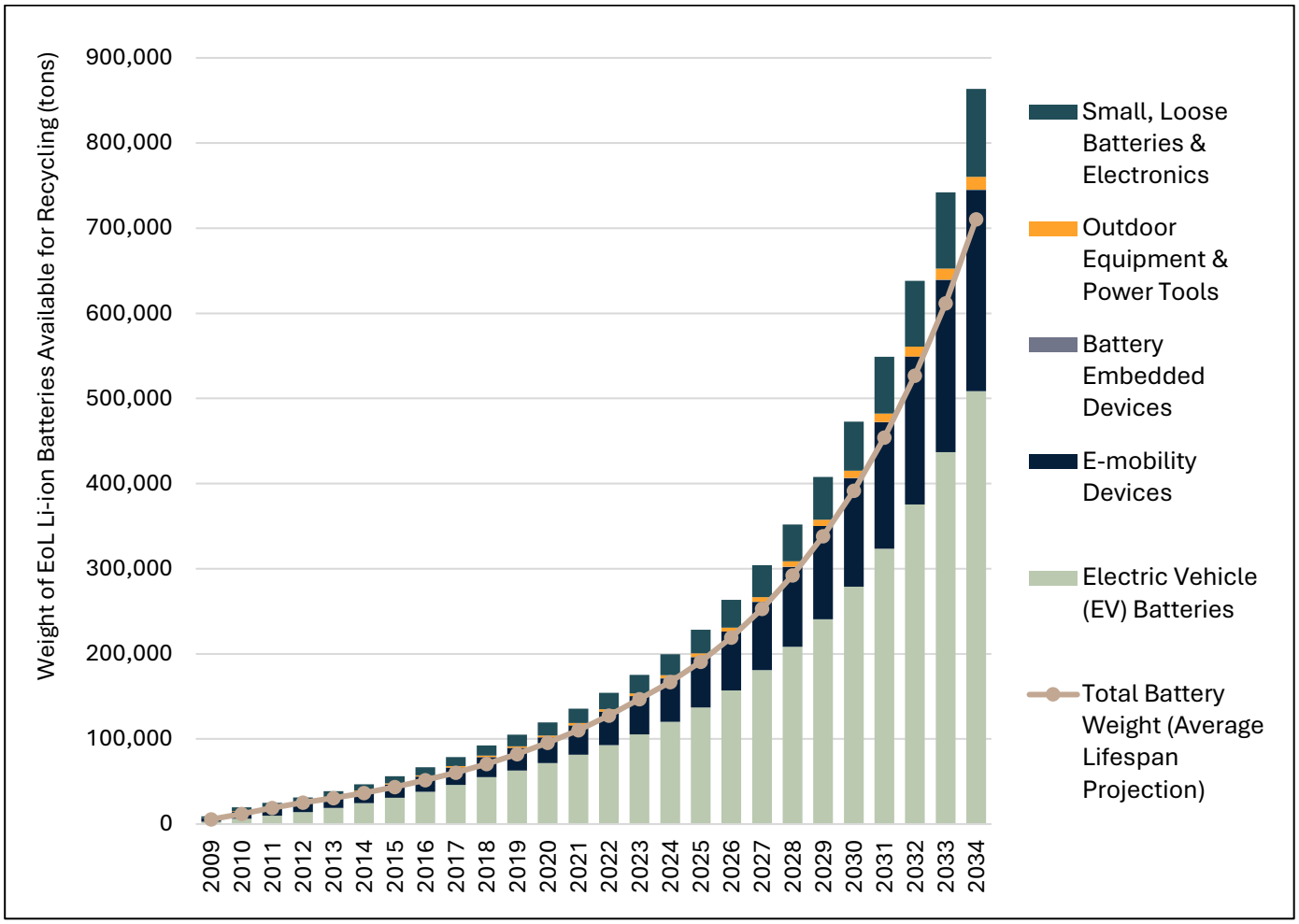

Figure 4. Total Projected Weight of EoL Li-ion Batteries Available for Recycling in U.S. (Low Lifespan Projection)

High Lifespan Scenario: Conversely, if batteries last longer, then tonnages of EoL Li-ion batteries entering the recycling system will be delayed. In the high lifespan scenario, while electric vehicle batteries would still contribute significantly by 2034, they would introduce almost 80,000 tons less in batteries compared to average lifespan projections as shown in Figure 5. This extension in battery life could reduce the immediate weight of EoL Li-ion batteries available for recycling; however, ongoing monitoring of battery life and performance is essential to respond effectively to changes in battery and product lifespans.

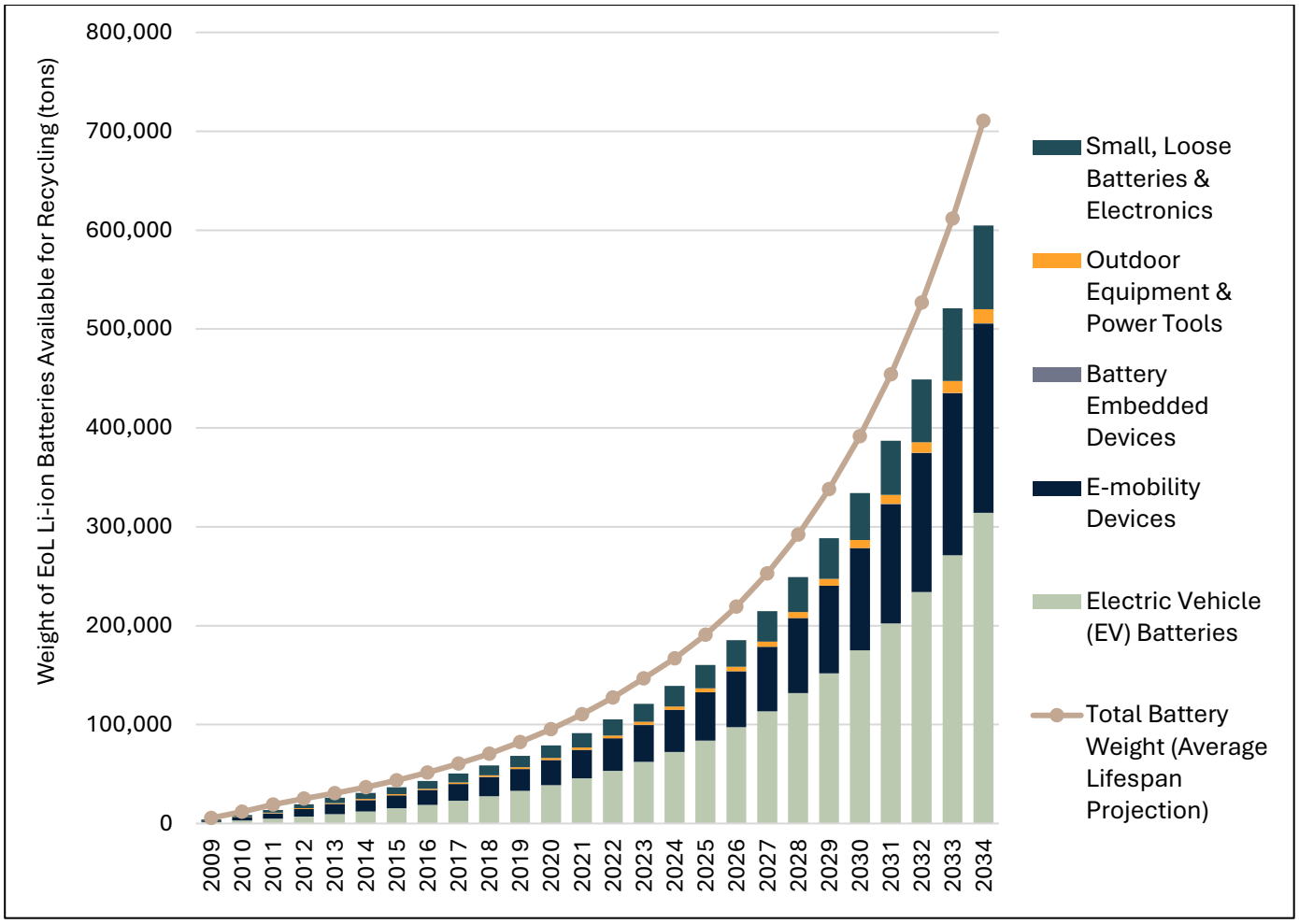

Figure 5. Total Projected Weight of EoL Li-ion Batteries Available for Recycling in U.S. (High Lifespan Projection)

CURRENT GENERATION IN NORTH CAROLINA

Given North Carolina has a disposal ban on Li-ion batteries taking effect on December 1, 2026, it is important to use the available national data and projections for the U.S. market to extrapolate the current Li-ion battery generation within the state. Furthermore, the 2025 North Carolina Waste Characterization Study, which entailed a multi-season waste sort conducted at three disposal facilities located across different regions of the state, found that 21 of the 175 waste loads sampled (i.e. 12% of all samples) contained lithium batteries destined for disposal.

To estimate the quantity of EoL Li-ion batteries currently generated, the national estimate for 2025 shown in Figure 3 was scaled to North Carolina on a population basis with the state comprising approximately 3.27% of the U.S. population.[9] Table 5 below uses North Carolina's 2025 population to estimate the amount of Li-ion batteries currently available for recovery within the state.

[9] United States Census Bureau. (n.d.). U.S. and World Population Clock. United States Census Bureau. https://www.census.gov/popclock/

Table 5. U.S. and North Carolina Estimated Total EoL Li-ion Battery Weight in 2025, By Battery Type

BATTERY TYPE	AVERAGE WEIGHT (LBS.)	ESTIMATED TOTAL U.S. WEIGHT IN 2025 (TONS)	ESTIMATED TOTAL NC WEIGHT IN 2025 (TONS)	ESTIMATED TOTAL NC WEIGHT IN 2025 (LBS)
Small, Loose Batteries & Electronics	0.2	29,259	957	1,914,000
Outdoor Equipment & Power Tools	2.3	4,577	150	300,000
Battery Embedded Devices	0.008	119	4	8,000
E-mobility Devices	22.9	61,750	2,019	4,038,000
Electric Vehicle (EV) Batteries	904.8	123,435	4,036	8,072,000
TOTAL		**219,139**	**7,166**	**14,332,000**

Recovery of End-of-Life Li-ion Batteries

NORTH CAROLINA DATA LIMITATIONS

Mandatory private sector reporting requirements tracking the annual quantities of EoL Li-ion batteries recovered for recycling are nonexistent at the statewide and national level. While North Carolina requires units of local government to submit an annual materials management and recycling report, Li-ion battery recovery data reporting only began in the fiscal year 2024-25 reporting cycle. Local government reporting includes the collection of residential material only; therefore, any business-generated recovery is not captured through the local government reporting process. Because local governments contract with private-sector companies that handle EoL Li-ion battery recycling, some data reported by local governments likely overlap with data from battery recyclers, potentially resulting in double counting of some data.

NORTH CAROLINA LOCAL GOVERNMENT RECOVERY

As discussed, North Carolina requires units of local government to submit an annual materials management and recycling report. The report is a comprehensive accounting of the variety of types of materials recovered from traditional household-generated recycling commodities, such as: plastic bottles and jars, glass bottles, and aluminum and steel cans, mixed paper and cardboard, to specialty waste, including tires, construction and demolition materials, electronics, food waste, cooking oil, motor oil, textiles, household hazardous waste, car and dry-cell batteries and latex paint.

The most recent fiscal year 2024-25 annual report included a new waste category to capture the quantity of Li-ion batteries recovered by local government programs. Table 6 shows that 25,900 pounds of Li-ion batteries were reported recovered in fiscal year 2024-25 out of a total of 1.37 million pounds of all battery types recovered. For perspective, the 25,900 pounds of Li-ion batteries reported as recovered by local governments is equivalent to approximately 0.18% of the total EoL Li-Ion battery weight estimated to have been generated in the state in 2025. It is important to note that local governments serve just one piece of the collection infrastructure, with a focus on batteries generated at households. Furthermore, local governments may have limitations on the types of EoL Li-ion batteries accepted and may not handle types like EV batteries or all battery embedded devices. Still, local government collection is expected to grow in the coming years as more EoL Li-ion batteries are generated and consumer knowledge about responsible disposal improves.

Table 6. NC Local Government Residential Drop Off Battery Recovery Data in Fiscal Year 2024-25

BATTERY TYPE	RECOVERED (LBS.)	RECOVERED (TONS)	PERCENT BY WEIGHT OF ALL TYPES OF BATTERIES RECOVERED
Lead acid	1,098,600	549	80%
Li-ion	25,900	13	2%
Dry cell-Household (including alkaline)	219,800	110	16%
NiCad	5,940	3	0.4%
All types (unspecified)	23,740	12	2%
TOTAL	**1,374,000**	**687**	**100%**

RECOVERY REPORTED FROM BATTERY RECYCLERS SERVING NORTH CAROLINA

DEQ identified 38 battery recyclers that collect, aggregate, or process Li-ion batteries from North Carolina. Of the 38 battery recyclers, 12 were willing to confidentially share information surrounding the quantities of Li-ion batteries recovered, the associated costs, processing capacity, expansion capabilities, and their investment and support needs. The data in the following section reflects a snapshot of battery recycler feedback from those willing to share information as part of this Assessment.

Most North Carolina battery recyclers serve as collectors or aggregators with only a few reporting physically or chemically processing Li-ion batteries. Except for one processor using a reductive calcination or high temperature heat method, other processors guarded their information as proprietary and provided no further information. End products resulting from processing include battery grade salts used to make new batteries, metals, black mass, plastics, and repurposed batteries for stationary storage systems. Figure 6 illustrates the location of 38 Li-ion battery recyclers in North Carolina and the region. It is noted that Figure 6 shows fewer than 38 location markers because some Li-ion battery recyclers share the same city or region. Cities with multiple co-located Li-ion battery recyclers include Charlotte (5), Greensboro (3), Johnson City (2), Raleigh/Garner (4), and Winston-Salem (2). For confidentiality reasons, individual companies are not identified in the following analysis and discussion.

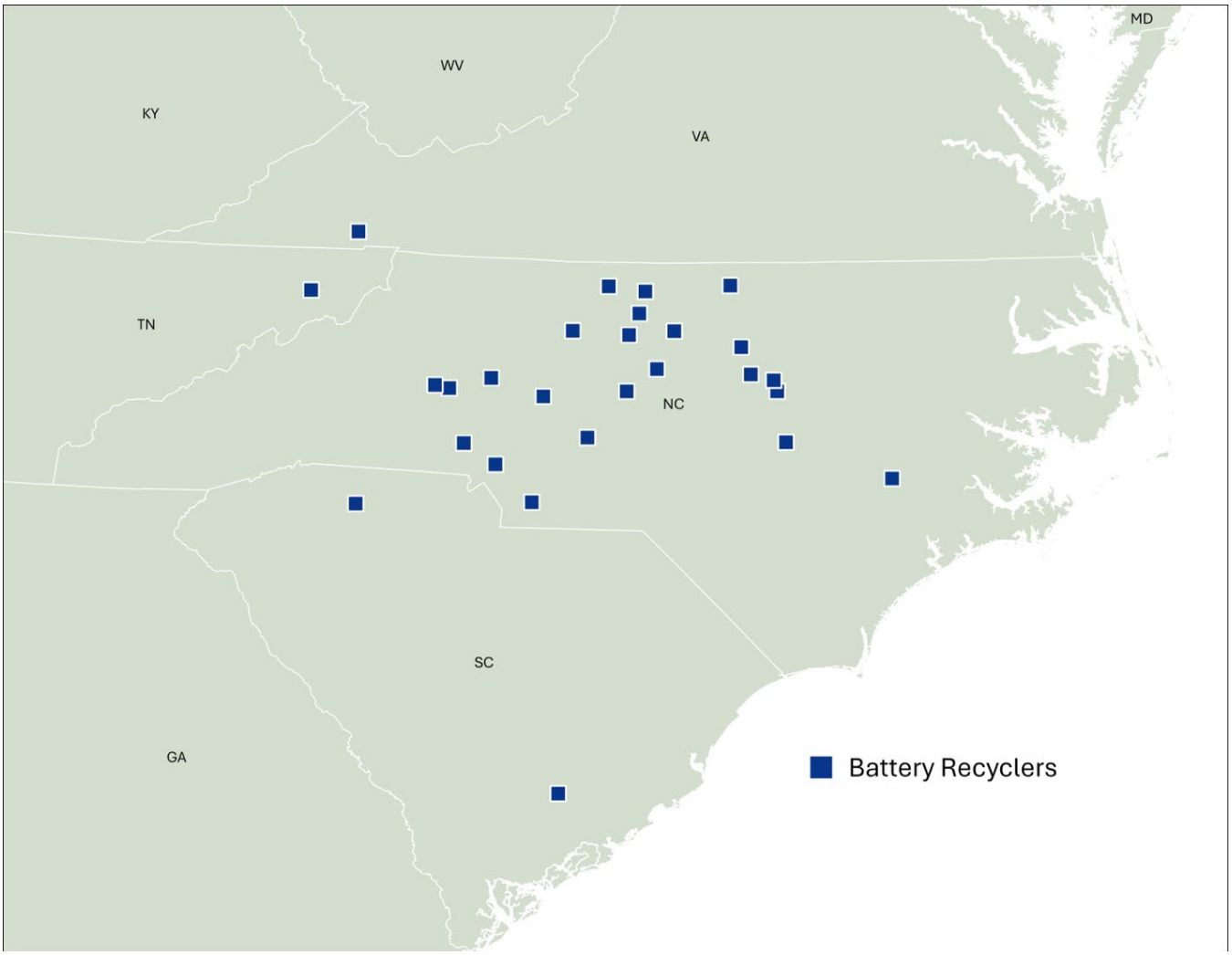

Figure 6. Map of North Carolina and Regional Li-ion Battery Recyclers in 2025

In 2025, a total of twelve Li-ion battery recyclers serving North Carolina reported handling, processing or recycling 132.8 million pounds of EoL Li-ion batteries in total collected from across the U.S. as shown in Table 7. The batteries originated from a wide range of sources including residential and commercial collections, retail take-back programs, electronic waste companies, battery manufacturers, and household hazardous waste management programs. Given the data represents the total collected quantity of Li-ion batteries managed by these recycling companies from across the U.S., it is not possible to identify what percentage of this total was generated from North Carolina. Additionally, because Li-ion battery aggregators and collectors transport materials to downstream recyclers, some double counting of data is likely.

For these reasons, the tonnage managed in Table 7 should not be interpreted as the total amount of Li-ion battery material processed from North Carolina, but rather the scale and total amount of Li-ion battery material managed by the twelve recycling companies that participated in this Assessment. However, it is difficult to draw conclusions on what percentage of managed batteries are comprised of each respective Li-ion battery type given nearly 100% of managed pounds were reported only as a combined total without specifying battery type composition in more detail.

Table 7. U.S. Li-ion Batteries Managed in 2025 as Reported by Twelve Participating Recyclers

LI-ION BATTERY TYPE	MANAGED POUNDS IN 2025
Removable consumer	28,600
Battery embedded devices (BED)	12,025
E-bike, e-scooter, portable power station	500
Damaged, defective, recalled (DDR)	650
Other (all battery types combined)	132,758,000
TOTAL	**132,800,000**

SOURCES AND TYPES OF BATTERIES CURRENTLY RECYCLED

Battery recycling businesses serving the North Carolina marketplace handle all types of EoL Li-ion batteries. Figure 7 indicates that removable consumer batteries and battery embedded devices are the most common battery type handled by more than 90% of battery aggregators and recyclers. Damaged, defective, recalled (DDR) batteries are the second most common battery handled by 75% battery recyclers. More than half of the battery recyclers also handle E-bikes/scooters, portable power stations, and EV/energy storage batteries. Other less common materials handled include manufacturing rolled battery scrap. One battery recycler noted facilitating a software program for original equipment manufacturers (OEMs) and EV car battery management, but do not directly manage them. Another stated that they handle all battery types except for vapes/e-cigarettes. Given that vapes and e-cigarettes contain a hazardous nicotine component and a Li-ion battery, it is possible other battery recyclers may also not accept these devices and this may warrant further study.

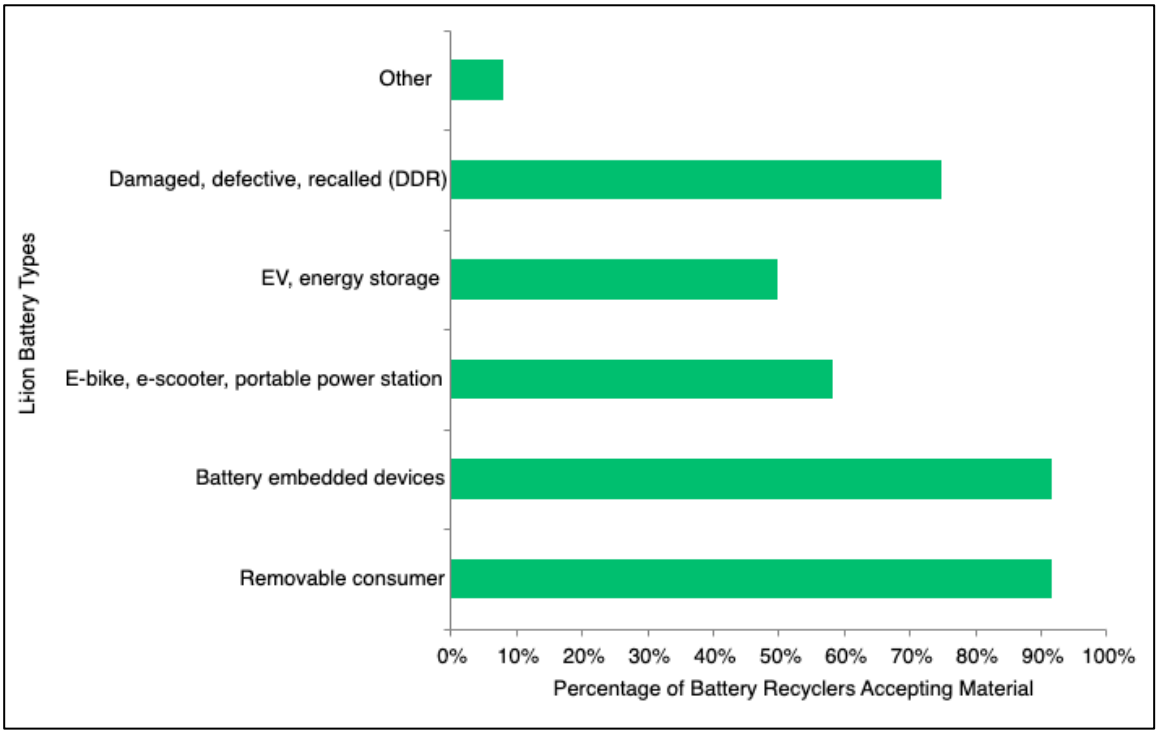

Figure 7. Percent of Battery Recycling Companies Managing Li-ion Batteries by Battery Type in 2025

Battery recyclers provided data on the types of generators from which they receive Li-ion batteries. Figure 8 illustrates the percentage of battery recyclers that reported receiving Li-ion batteries from each of the eight generator source categories. As shown, businesses represent the leading source of batteries, with approximately 83% of battery recyclers reporting acceptance of material from this category. Retail take-back and local government collection programs are the next most prevalent sources, each supplying material to 67% of recyclers. Hazardous waste companies account for a moderate share, with approximately 58% of recyclers reporting acceptance from this category. Battery manufacturers, mail-back programs, and electronics recyclers each supply approximately 42% of recyclers. The "Other" battery type shows the lowest prevalence, reported by fewer than 10% of battery recyclers and includes material from original equipment manufacturers, battery cell manufacturers, and a national battery collection nonprofit organization.

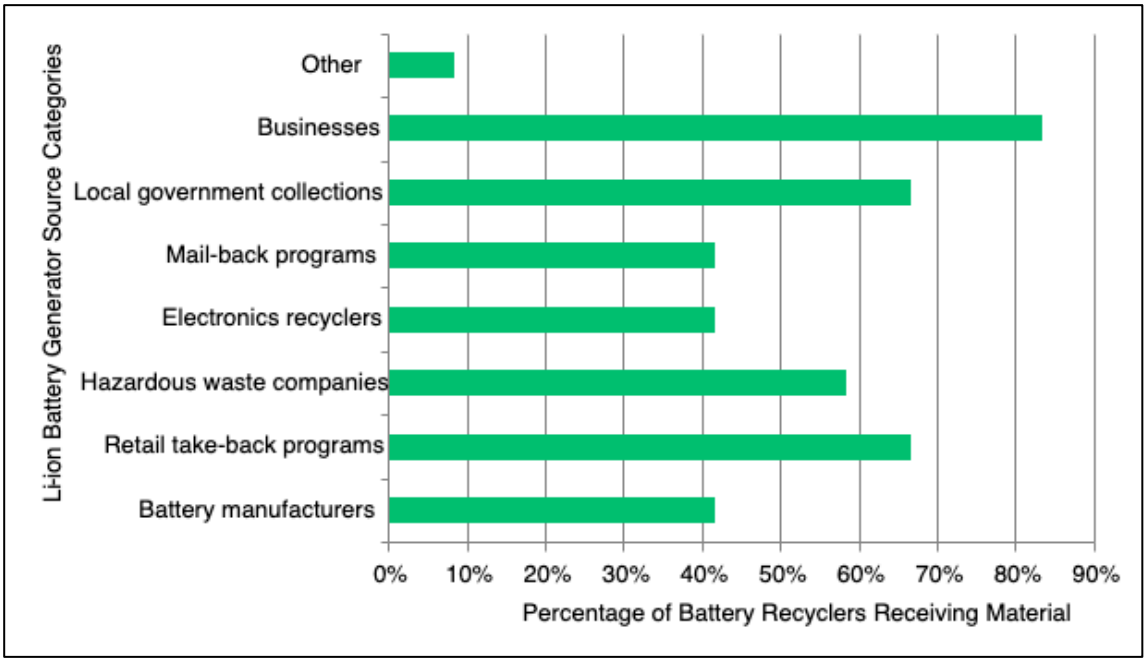

Figure 8. Accepted Sources of Batteries and Percentage of Supply Received in 2025

In addition to accepting Li-ion batteries, 83% of battery recyclers reported accepting other battery chemistries such as lithium primary, alkaline, nickel cadmium, nickel metal hydride. Lead acid batteries or car batteries were reported as accepted by 75% of battery recyclers. Additional battery types, such zinc oxide, mercury and non-automotive wet lead acid batteries were reported as accepted by 17% of battery recyclers.

PROCESSING CAPACITY

Most North Carolina battery recyclers serve as collectors or aggregators with only a few reporting physically or chemically processing Li-ion batteries. Aggregator capacity is dependent on processors, who in turn supply raw materials to the battery manufacturing supply chain. Reported capacities ranged from thousands to millions of pounds, reflecting the spectrum from collectors to processors. Despite the limited data, more than 80% of the battery recyclers reported operating below capacity, suggesting recyclers see room to scale material capture to meet the growing supply of EoL Li-ion batteries and products.

EXPANSION AND INVESTMENT NEEDS

As EoL Li-ion battery volumes continue to grow year over year, the markets for managing these batteries must grow as well. Encouragingly, more than 75% of battery recyclers reported the ability to expand their facility capacity. One facility reported a specific planned expansion of 8.8 million pounds, while the majority indicated nearly limitless expansion, but did not provide specific capacity figures. While optimistic, growth will ultimately depend on market demand for recycled Li-ion feedstocks and associated investment support.

Indicated in Figure 9**,** more than 80% of Li-ion battery recyclers identified access to funding as their foremost investment need. One facility specifically cited the need for additional capital to install specialized processing equipment. However, the remaining recyclers did not provide additional information surrounding specific investment needs.

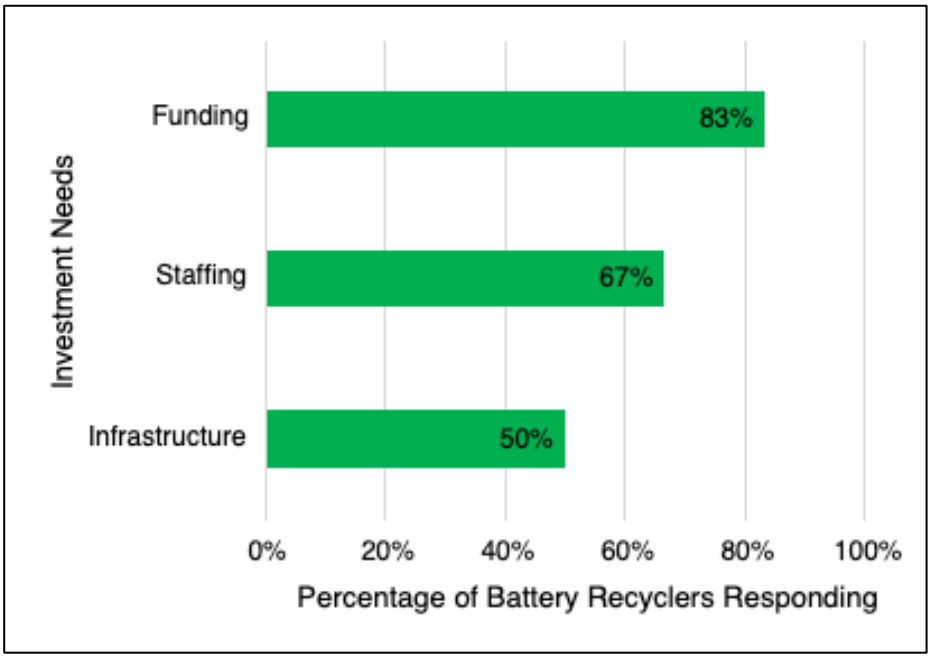

Figure 9. Li-ion Battery Recyclers Capacity Expansion Investment Needs in 2025

PRICE

Unlike some traditional recyclables, like cardboard that can generate revenue for the generator, recycling Li-ion battery materials will typically cost the generator money to manage at the end of life. Exceptions are cell phones and laptops, which contain high-value precious metals such as gold, silver, palladium, copper, cobalt, and rare earth metals. These products may earn the generator a rebate or help offset overall Li-ion battery management costs.

Beyond the type and value of the batteries themselves, total end-of-life management costs are shaped by several factors: safe handling requirements, transportation and labor costs, and the complexity of the recycling processes needed to recover raw materials.

Table 8 gives some insight into the range of potential costs charged to generators by the battery collectors, aggregators, and processors. Ultimately costs will vary based on volume, location, format, service needs, and types of battery chemistry.

Table 8. Estimated Li-ion Battery Recycling Costs Charged by Battery Recyclers in 2025

BATTERY TYPE	COST RANGE ($/LB.)	AVERAGE COST ($/LB.)
Removable consumer	$0.15 - $3.75	$1.36
Battery Embedded Devices (BED)	$0.50 -$3.00	$1.63
E-bike, e-scooter, portable power station	$3.00	$3.00
Electric Vehicle (EV), energy storage	$1.75 - $2.50	$2.13
Damaged, defective, recalled (DDR)	$1.50 -$20.00	$8.83

CHALLENGES FACING BATTERY RECYCLERS

Battery recyclers were candid providing examples of current challenges surrounding the Li-ion battery recycling marketplace in North Carolina. The two primary challenges faced by battery recyclers involve access to EoL Li-ion batteries and improper packaging and shipping of EoL Li-ion batteries creating safety and environmental concerns.

The battery recyclers speculate that public participation is minimal, and more batteries are being disposed of instead of being collected for recycling. For those that are recovered, one processor estimated that 60% of material is lost to overseas processors with lower environmental protection standards. This loss of material represents a missed opportunity to provide domestic sources of recycled battery feedstock for the growing Li-ion battery manufacturing industry in North Carolina and neighboring states. It also diminishes the United States ability to retain lithium in domestic markets, which has been noted as a critical mineral and material for energy and national defense purposes per the U.S. Department of Energy.[10]

According to battery recyclers, there is a clear lack of education on the procedures for packaging a variety of lithium batteries and products. Improper preparation, such as mixing battery chemistry types and failing to label or protect terminals can create dangerous fire risk situations for generators as well as battery collectors, transporters, and processors. Ensuring that lithium batteries are prepared and packaged according to safe handling, best management practices will also reduce economic losses from collection vehicle and processing equipment fires.

Another concern mentioned by a battery recycler is the worry that the market will become flooded with batteries resulting in battery processing fees that exceed generator's ability to pay, such as a local government drop-off program receiving more batteries than anticipated and not having adequate budget to cover the cost of proper recycling. Another remarked that because of the complexity of lithium batteries, they are not all recycled in the same manner. Different types of lithium batteries require different and more expensive processes to recycle, which may create situations where it is not profitable to recycle them.

[10] United States Department of Energy. (n.d.). What are critical materials and critical minerals? United States Department of Energy. https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals

BATTERY MANUFACTURING GROWTH POTENTIAL

Along with the robust battery recyclers serving as collectors or aggregators in the state, and Redwood Materials Inc. developing a recycling processing campus in neighboring South Carolina, North Carolina has the unique distinction of having the entire Li-ion battery supply chain either present or growing within its borders and neighboring states. The Kings Mountain district in Gaston and Cleveland counties contain more than 80% of the nation's lithium ore reserves.[11] Located in Gaston County, Livent Corporation (Arcadium Lithium), operates the largest lithium hydroxide refinery in the United States.[12]

Since 2022, the North Carolina Department of Commerce announced many types of Li-ion battery manufacturing-related projects proposed for development. However, over the last few years, there has been reversal of momentum and action. As of 2026, the Toyota Battery Manufacturing plant in Randolph County is operational while other projects have stalled.[13] Due to market uncertainties and the rollback of federal EV policies, it is unclear if the proposed Li-ion battery projects will proceed or regain their previous momentum.

Recommendations

As more Li-ion batteries enter the market and are discarded each year, a growing number will require better end-of-life solutions, as evidenced by the increasing prevalence of EoL Li-ion battery fires being reported. These solutions will need to vary based on the physical characteristics of the different battery types. Battery size and configuration vary widely depending on their respective uses. For instance, some incorporate small, single-cell batteries, while others deploy module packs made up of many cells. These and other physical and chemical composition characteristics substantially impact the range of reuse, remanufacturing, and recycling solutions. Viable solutions and business cases will depend on both the number of retired units and the overall market configuration for battery reuse and recycling.

Additionally, different waste management stakeholders may prioritize recovery of battery types differently than battery reclaimers, processors and manufacturers. For instance, while the small, loose batteries, and electronics battery type has by far the most units, the collection costs and risk the threat of fire poses to staff and facilities handling and storing them make this battery type less desirable to target for recovery on a per unit basis compared to the larger EV battery type that offers higher per unit values due to the larger quantities of precious metals that can be recovered. Likewise, vapes and e-cigarettes pose unique handling requirements due to the nicotine residue they contain. Waste management companies and public sector entities providing collection, handling, processing, and disposal services want to ensure all single use and rechargeable lithium battery types, regardless of weight, are properly managed to avoid damage to personnel and property caused by fires.

[11] Carpenter, P.A., III, Jeffrey C. Reid, and Charles H. Gardner. "NC Mineral Resources – An Overview." North Carolina Department of Environmental Quality, 1995, www.deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/mineral-resources/mineral-resources-faq.

[12] Ellis, K. (2022, November 15). Livent makes Bessemer City largest lithium hydroxide site in U.S. Gaston Gazette. https://www.gastongazette.com/story/news/2022/11/15/livent-makes-bessemer-city-largest-lithium-hydroxide-site-in-u-s/69647211007/

[13] Gordon, B. (2026, January 8). North Carolina promised a 'battery belt.' Where are the factories entering 2026? *The News & Observer*. https://www.newsobserver.com/news/business/article314180867.html

Effective December 1, 2026, Li-ion batteries are banned from landfill disposal pursuant to G.S. 130A-309.10. Prior to the adoption of this legislation, DEQ published a *Report on the Prohibition on Disposal of Lithium Batteries in North Carolina Landfills* that includes three recommendations which align with the findings of this Assessment. Below we denote where the findings from this Assessment align with DEQ's previous recommendations while also providing additional enhanced recommendations for North Carolina to consider improving lithium battery recycling infrastructure, education, and policy. It is important to note much of these recommendations are the result of direct feedback from battery recyclers on how DEQ can assist battery recyclers with the upcoming landfill ban. Some recommendations may conflict with state-wide policy decisions or are beyond the scope of assistance that the state can provide.

1. PURSUE LEGISLATION AND POLICY

Strengthen the regulatory framework for battery recycling. At least nine states have passed extended producer responsibility (EPR) laws regulating batteries. Policy options include but are not limited to:

- Pass an EPR law covering Li-ion batteries to complement the landfill ban and provide funding for responsible management and recovery of Li-ion batteries.
- Pass an EPR law covering all battery types to provide funding for responsible management and recovery since consumers will not differentiate between Li-ion batteries and other battery types.
- Establish an advanced recycling fee charged to consumers when purchasing batteries or BEDs to help subsidize the cost of recycling. For example, in California, state-approved recyclers apply directly to the state for financial compensation per pound of eligible e-waste processed. Collectors also receive a portion of funding. There is no middle broker distributing the funds.

2. REVISE THE LANDFILL BAN TERMINOLOGY WITHIN STATE STATUTES

It is recommended that the language within the state statutes be amended to ban disposal of "lithium batteries" rather than the more limited "lithium-ion batteries" with the current terminology only focusing on a limited subset of batteries. As recommended in DEQ's 2024 lithium battery report, while the terminology of the landfill ban is specific to Li-ion batteries, all lithium battery types and all lithium battery sizes, not just Li-ion batteries, pose the risk of fires when not properly captured within existing HHW and recycling collection systems available within the state. Additionally, there is an understanding that the public will not differentiate between Li-ion batteries as a subset of all lithium battery types and will expect to be able to recycle them all.

3. IMPROVE EDUCATION AND OUTREACH

Many North Carolina residents and businesses may not yet know about the state's landfill disposal ban making the need for more targeted public education paramount. The 2025 North Carolina Waste Characterization Study, found that 21 of 175 sampled waste loads, approximately 12%, contained a lithium battery, further demonstrating the need for more education and outreach on proper end-of-life battery management:

- Create public awareness campaigns about safe battery disposal and the fire risks of putting lithium batteries in trash and recycling bins.

- Support local government drop-off collection programs given the anticipated influx of batteries they will be receiving by providing clear guidance, including example signage, on how to safely store, pack, and transport batteries.
- Focus messaging on how improper battery disposal endangers the lives and well-being of local solid waste staff and can lead to catastrophic loss of essential solid waste and recycling facilities as this has shown to motivate consumer behavior change more than focusing on the environmental benefits of recycling.
- Include messaging targeted at specific battery embedded devices (e.g. vapes, e-cigarettes, and portable speakers) rather than only messaging about Li-ion batteries to reach target audiences who may not be aware these products contain Li-ion batteries and are a fire threat if not properly managed at the product's end-of-life.

4. OPTIMIZE COLLECTIONS

Build stronger connections between local governments, organizations, and battery recyclers to improve the flow of materials and efficiency of collections:

- Connect local government recycling contacts with information about collection options with battery recyclers.
- Consolidate batteries collected from local government collection sites with very small quantities into a few regional pickup hubs rather than scattered individual locations thereby reducing fuel costs, time, and overall cost per pound collected.
- Issue an RFP for a state term contract that incentivizes vendors by minimizing the number of pickup stops.

5. SUPPORT DROP-OFF COLLECTION PROGRAMS

In alignment with DEQ's 2024 lithium battery report, it is recommended to expand access to battery drop-off collection options for residents and businesses. In addition, Battery recycler feedback also offered additional suggestions:

- Establish dedicated battery drop-off spots at local government landfills and other government facilities.
- Continue to add drop-off locations over time to increase convenient access which has been shown to increase participation in collection programs.
- Evaluate hazardous waste regulatory options for small businesses that allow or incentivize free drop-off options for businesses producing small quantities of lithium batteries.

6. DEVELOP MARKETS

Strengthen market development efforts for in-state battery recycling:

- Ensure downstream processors used by collectors and aggregators have adequate capacity to handle the anticipated increase in battery volume as collection efforts scale up.
- Develop more processing capabilities within North Carolina by leveraging grant funding to support in-state investments.
- Support the expansion or recruitment of battery recyclers by making connections to funding sources including state or federal grants and incentives from the North Carolina Economic Development Partnership or Department of Commerce.

7. LEVERAGE GRANT FUNDING

Provide grant funding to grow battery recovery and processing:

- Offer grants to help North Carolina local governments manage batteries responsibly, expand convenient collection points, and communicate clearly and effectively to residents.
- Provide grant funding for collection and/or processing equipment to help North Carolina battery recyclers better serve their customers and increase processing capacity within the state, reducing the need to send materials out of state or overseas.