BATTERY USE IN SCOTLAND NOW AND IN THE FUTURE

BRIEFING ON THE RISE OF BATTERIES AND THE RISKS AND OPPORTUNITIES FOR ENDING THE CLIMATE CRISIS

ZERO WASTE SCOTLAND (WORKING IN PARTNERSHIP WITH TRANSPORT SCOTLAND AND SCOTTISH ENTERPRISE)
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EXECUTIVE SUMMARY

The rise of batteries in the 21st century is powering new ways of living which are enabling people across Scotland to shift to lower carbon lifestyles.

Batteries provide large-scale energy storage which maximises the renewable electricity contribution to the nation's electricity grid, which is the third greenest in the world. They are also integral to the switch to electric vehicles which is accelerating after the UK Government's decision to outlaw the sale of new petrol and diesel cars by 2030.

They are a key part of the huge transformation of our energy systems which Scotland needs to meet its world-leading targets to help end the climate crisis.

However, all batteries have a limited lifespan. The way we manufacture, use and discard them also creates carbon emissions and waste. Rising use of electric vehicles is increasing demand for the batteries to power them. The last decade has also seen an explosion in ownership of smart phones, laptops and other portable consumer electronics, all powered by rechargeable batteries.

To maximise their value and minimise environmental harm, batteries should be kept in use for as long as possible. When they reach their ultimate end of life as batteries, they still contain valuable metals and other materials that should be collected and reprocessed to be reused in other ways. With no such system in place, the growth in demand for batteries will put unsustainable pressure on already vulnerable supply chains, depleting raw materials on a global scale. This risks the perverse and unintended consequence of batteries making the climate emergency worse instead of helping to cut emissions.

The single biggest cause of the climate crisis in Scotland is the carbon impact of everything we produce, consume and too often waste. Keeping products like batteries in a loop of use through the circular economy is key to ending this waste and the damaging emissions it creates. It is already possible to do that by reusing, repurposing, and remanufacturing batteries but this is not currently taking place in Scotland at any significant level. Embedding the circular economy in Scotland's transition to low or no carbon energy through the Green Recovery would retain these resources and their value within our borders as use of batteries grows.

This could give Scotland a way to produce batteries which reduces carbon emissions and creates new job opportunities in the process. Future innovation should also focus on producing new batteries designed with end of life in mind, which are easy to disassemble to increase their value. All of that would reduce Scotland's impact on global climate change and help achieve the Scottish Government's ambition to reach net zero by 2045.

This briefing paper summarises three key reports commissioned by Zero Waste Scotland from Ricardo. It is the result of an important new collaboration between Zero Waste Scotland, Transport Scotland and Scottish Enterprise to assess the issues and opportunities for Scotland which batteries present. It recognises that future policy decisions will affect the growth in battery use and production in Scotland, and their wider environmental and economic impact. Our key objectives were to assess the current battery sector in Scotland and to make projections about the future, in order to identify the potential for Scottish companies to improve sustainability and increase circularity within the supply and disposal chains.

The research includes an assessment of all batteries currently in Scotland, recording the different quantities, types and uses, including crucially how they are treated at end of life. It evaluates the current systems and regulations in Scotland to see whether they enable the nation to recover maximum value from batteries through the circular economy. The reports also explore the future for batteries, including those for electric vehicles, to forecast the likely quantities of end of life materials which will arise - and the opportunities which that may bring for innovative Scottish companies to develop sustainable ways to manufacture and reuse batteries as part of national and global efforts to end the climate crisis.

Background: The lifecycle of batteries

Raw materials are extracted from countries around the world to produce a variety of batteries which are imported to Scotland to be used by consumers and businesses in a range of products from mobile phones, computers and toys (portable batteries) to vehicles (automotive batteries). Batteries are also used by Scottish industries for energy storage and back-up power (industrial batteries). Once batteries are no longer fit for purpose, they are either sent to landfill or scrap – and so their value is lost from the economy – or collected via Extended Producer Responsibility schemes for recycling under the Waste Batteries and Accumulators Regulations. Most of these schemes export batteries to Europe for recycling, with some recycling taking place in the UK for lead-acid automotive batteries.

Battery use and waste in Scotland today

In 2019 registered retailers recorded 21,114 tonnes of batteries being placed on the market in Scotland and 16,862 tonnes of batteries were declared to have reached end of life. These two ends of the supply chain do not balance because batteries are often kept in use for longer than a year, may be kept in storage or have been disposed of via landfill or scrap and so do not appear in the data. In addition, an unknown proportion of undeclared batteries enter the market by 'free-riding', for example through unregistered international online sales direct to consumers.

There are four approved treatment operators and exporters in Scotland, but no processing or treatment facilities. End of life batteries are collected in Scotland and most are transported to England for sorting by chemistry type.

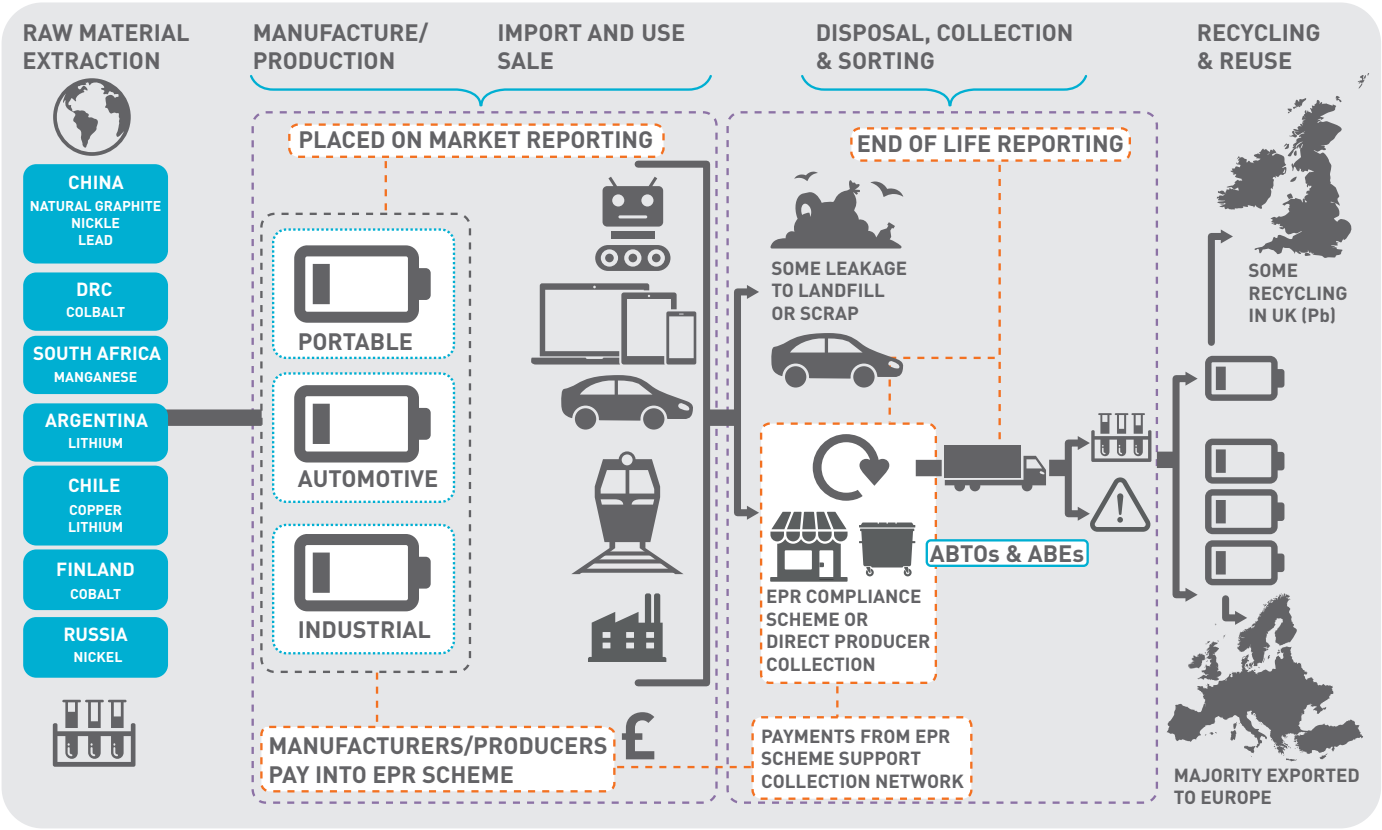
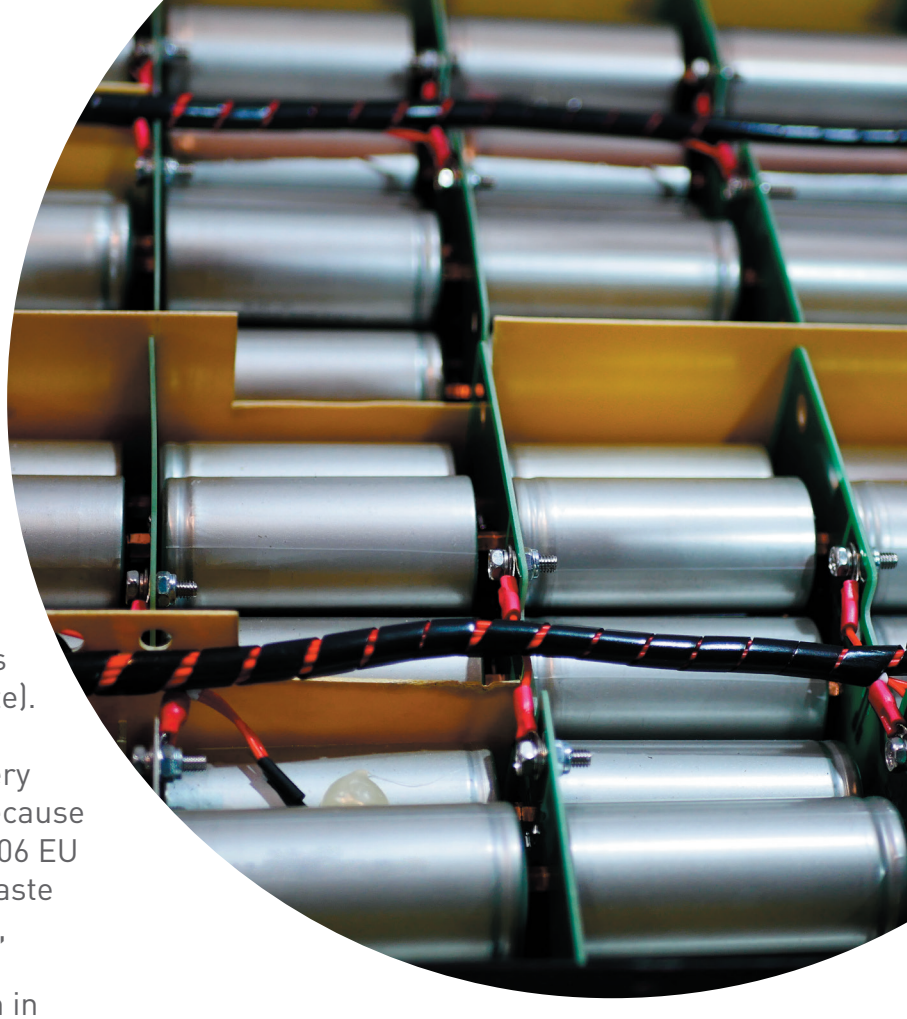


Figure 1 The battery lifecycle

Lead-acid batteries can be smelted in England but other battery types are exported for reprocessing, mainly to Europe.

The most significant tonnage of battery waste in 2019 was lead-acid automotive batteries at 10,410 tonnes, though volumes have decreased over the last decade. Meanwhile, portable battery waste has increased significantly over the last 10 years from approximately 300 tonnes in 2010 to 1100 tonnes in 2019, with the increase in ownership of electronic devices and a move to wireless equipment. (see Figure 2 on battery waste).



There are some gaps in the data on battery consumption and disposal in Scotland because the information is gathered under the 2006 EU Batteries Directive and the associated Waste Batteries and Accumulators Regulations, which pre-dates the increasing use of batteries and their changing composition in more recent years. The directive is currently under review to address this which will hopefully make it more relevant to the current and future market. The UK Government, in partnership with the governments of the devolved administrations, has also committed to reviewing the UK-wide producer responsibility scheme for batteries and accumulators. Under this review the scheme should be updated accordingly to consider reuse, and issues such as free-riding and categories of battery chemistry that are no longer appropriate.

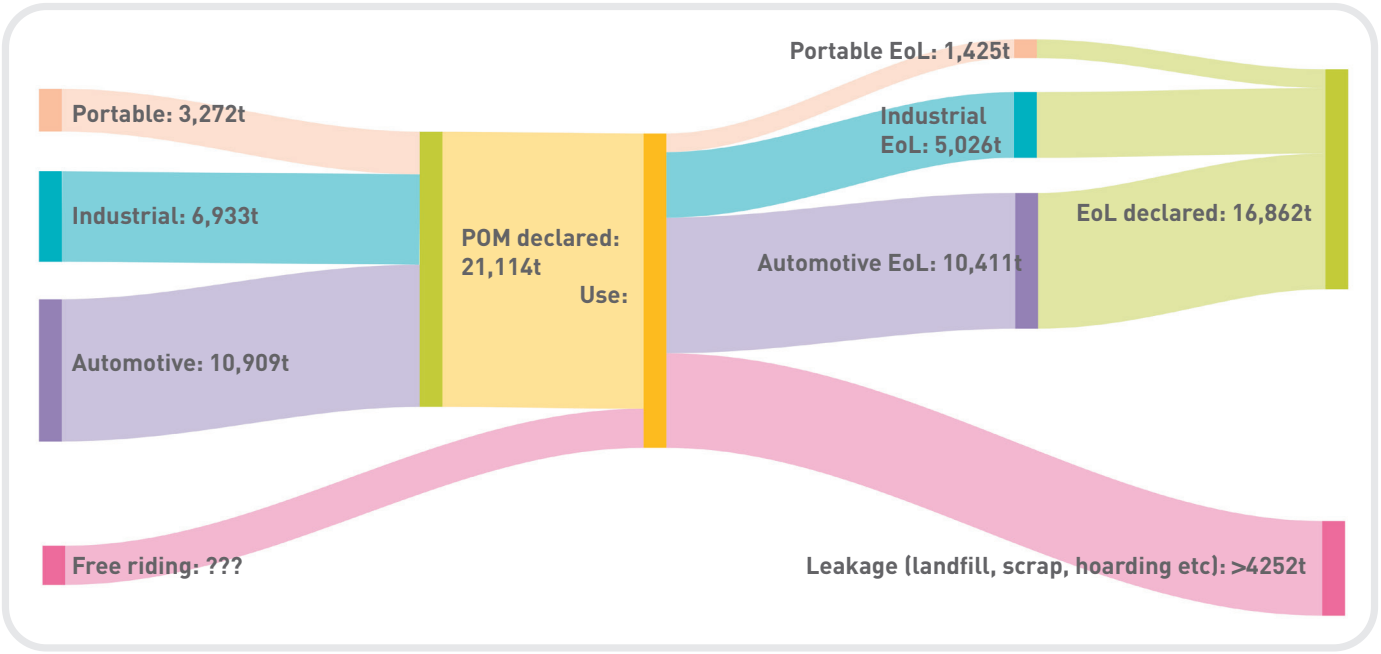


Figure 2 Indicative battery material flows for Scotland, 2019, in tonnes

Future battery use and waste

Our reports predict that the most significant growth in battery use in the future will be in electric vehicles (EV), with a smaller, concurrent, increase in portable batteries for products like mobile phones.

New types of batteries based on emerging technologies and chemical composition are in development but our forecasting suggests that lead-acid will remain predominant in (non-EV) automotive and industrial batteries up to 2050, while portable batteries are likely to remain a mix of chemical compositions and technologies. EV battery chemical compositions are continually progressing and evolving to maximise energy density and longevity and minimise size and weight whilst maintaining strict health and safety requirements. Lithium-based batteries (Li-ion) are likely to remain dominant in EVs and solid-state batteries are forecast to grow in this market from 2035 onwards. Levels of cobalt in batteries are likely to fall as manufacturers seek to lessen their reliance on a scarce and expensive material, and more abundant elements like sodium will become more commonly used.

In general, the projections for end of life battery waste mirror that of the data for products placed on the market, with a time lag dependent on the battery type. As shown in Figure 3, battery waste is predicted to triple over the next 25 years as demand grows across all sectors, potentially reaching over 60,000 tonnes per year in Scotland by 2045. It is expected that 40% of the battery waste in 2050 could be spent electric vehicle batteries. Unfortunately it is not known at what scale these end of life batteries will be available to the second-life market as some vehicle manufacturers are likely to retain ownership.

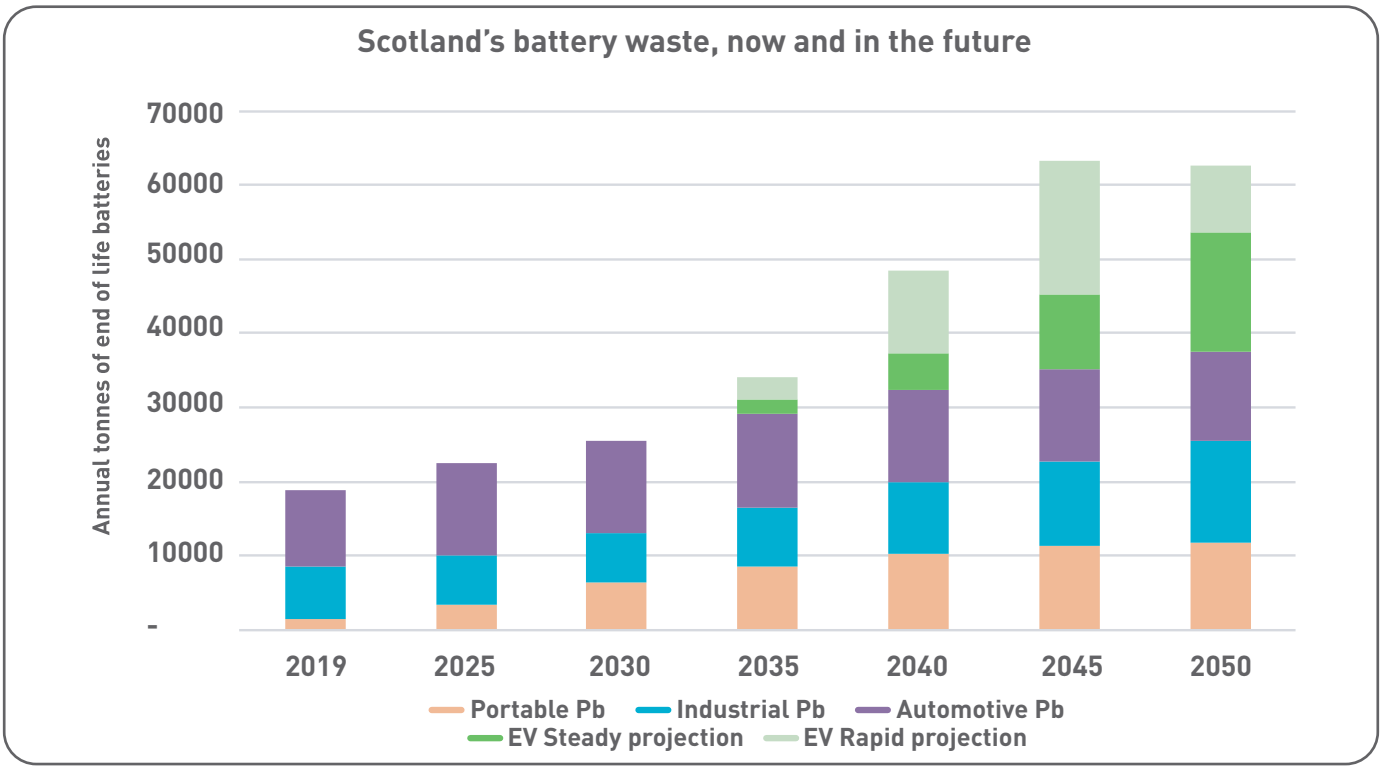


Figure 3 Projected annual tonnage of battery waste in Scotland. Ni-Cd categories omitted from chart as tonnages are negligible.

Future battery use and waste

Circular economy opportunities in batteries

Our research identifies a range of actions which could develop a circular economy in battery use:

- Introduce a revised Extended Producer Responsibility (EPR) scheme for batteries which places greater requirements on producers, data reporting, waste management fees, and labelling.
- Work with renewable developers, grid networks, and telecoms operators to understand their future energy storage needs and inform research and development activities.
- Encourage high-quality research into battery chemical compositions, design, applications, and end-of-life waste management within Scottish academia, providing a supportive framework for innovation.
- Support development of EV battery design, manufacturing and materials refinery capability.
- Improve collection and sorting infrastructure to maximise second-life opportunities.
- Develop grading capability and matching services for domestic second-life markets.
- Engage further with stakeholders in potential stationary energy storage second-life markets for EV batteries.
- Introduce battery recycling targets and carbon footprint declarations to encourage the greatest use of valuable materials. This is likely to be achieved through regulatory alignment with the revised EU Battery Directive.

CONCLUSIONS

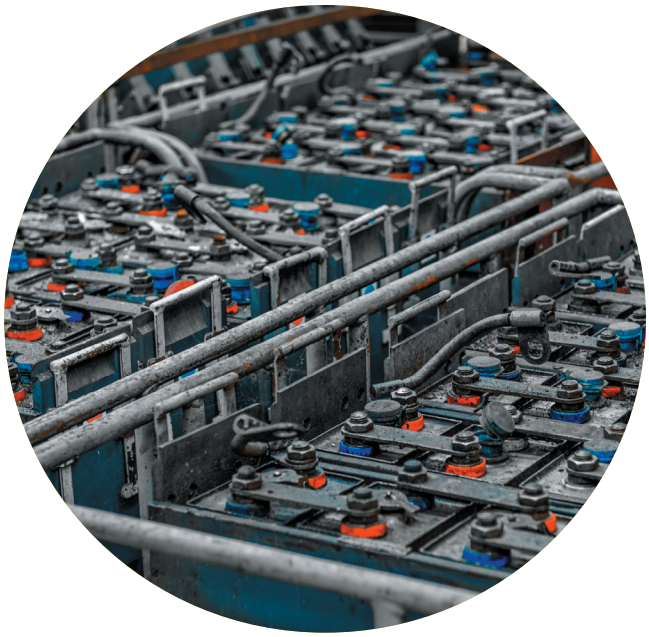
Predicting the future of batteries is complicated. The supply chain is global, and constant design innovation makes investment in reprocessing infrastructure a risky business, as well as making it difficult to achieve the necessary economies of scale. Our projections show there may be sufficient future demand for Li-ion batteries in Scotland to consider investment in an appropriately sized recycling facility; however, the viability of such a plant would be dependent upon the availability of feedstock. We don't currently have data on the quantities of EV batteries and that data is unlikely to become available on the open market as some car manufacturers seek to retain ownership.

Therefore the key immediate opportunities for Scotland involve improving infrastructure to ensure maximum capture of waste batteries, with a grading, sorting and matching function to maximise reuse. If current discussions around the commissioning of a gigafactory in Scotland to produce new EV batteries come to fruition, then it will be important to integrate circularity via local supply chains.

The best way to reduce our carbon and resource footprint from batteries, like all products, is to stop wasting them in the first place by reducing our over-consumption. If switching from petrol and diesel cars to electric vehicles drives up private car ownership and unsustainable demand for batteries it will not do enough to cut the waste and emissions behind the climate crisis. To succeed, the transition from fossil fuels to green energy needs to be supported by a parallel transition in the wider travel network, including further improvements to public transport, active travel and support for haulage and couriers.

Consumers and businesses need greater support and education to make use of circular economy sustainable ways to access technology too. Zero Waste Scotland works with a range of firms and other organisations on green schemes for leasing the latest technology or buying refurbished devices to create a sustainable market. Alternative methods of renewable energy storage should also be considered, along with improving energy efficiency to reduce the demand of the storage.

More widely, future policy decisions about renewables, clean transport and energy storage should be made in tandem with appropriate planning for resourcing to achieve the best net carbon outcome. Decisions taken in isolation can result in unintended consequences such as depletion of critical finite resources, offshoring of carbon emissions, and embedding a reliance on countries with lower labour and regulatory costs. All of those risk making the climate crisis worse. Sustainable, innovative and collaborative use of batteries in the circular economy is key to ensuring they power Scotland towards net zero by 2045.



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