

Circular Economy in Electric Buses



What is circular economy?

It is a holistic concept that seeks to **maintain the value of products and materials** for as long as possible within the cycles of use, minimizing the use of natural resources and garbage generation.



How to prevent something from becoming waste?

Through decisions that lead to **greater prevention** and **less waste disposal**.

Hierarchy matrix for decision-making:



Prevention: Avoid premature deterioration of batteries. Example: *Maintenance and proper driving*



Reuse: Use of the parts of the battery that at the end of their useful life are still functional. Example: *Do manual discharge and disassembly of batteries under controlled conditions to avoid accidents and then identify functional modules to give them a second "life" in lower power applications such as solar panels.*



Recycling: Recover as much raw materials as possible from batteries through a careful process that prevents fires and contamination. Example: *Fractions such as polymers, aluminum, copper, black mass that can be sold as industrial raw materials and even used for the production of new batteries.*



Recovery: Extract minerals from the black mass and metal fractions through smelting processes. Example: *By incinerating certain fractions, electricity and heat can be generated.*



Disposition: Establish legal obligations on the part of electric bus manufacturers and suppliers to carry out proper management at the end of their useful life. Example: *Countries could consider environmental and social criteria during bidding processes to learn about their suppliers and their potential environmental and social impacts in another part of the world.*

Source: Öko-Institut e.V.

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What are the differences between conventional buses and electric buses?

Both contain: **steel chassis, glass windows, rims, cables, refrigerants, metal and plastic interior fittings (railings, chairs, buttons).**


Electric buses contain: **batteries, electric motors, electrical and electronic components**, including other auxiliary devices such as charging ports and cables.




These batteries are composed of:



**It is suggested to require manufacturers of electric buses that the following elements should not come into contact with users: lead, cadmium, mercury, chromium VI.*

 They can have considerable **negative impacts on human health and the environment** if not properly managed at the end of their useful life.

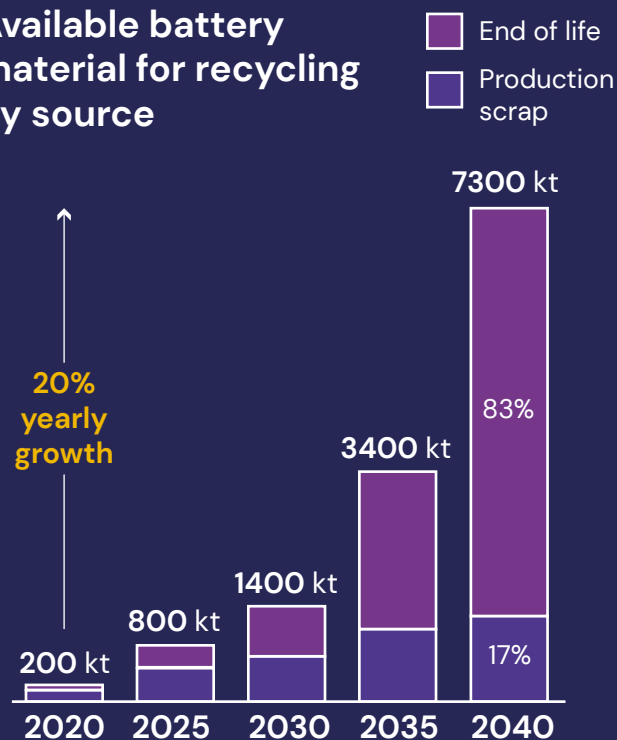
 They contain raw materials that are considered critical to **the economy, development and expansion of green energy technologies.**

 They have risks of presenting **chemical instability** and therefore of **causing fires.**

The batteries of one electric bus can weigh up to **3 tons**. Considering that the volume of this waste will grow considerably in the coming years, it is essential to make **the appropriate management for the end of its useful life.**

Source: Öko-Institut e.V.

Available battery material for recycling by source



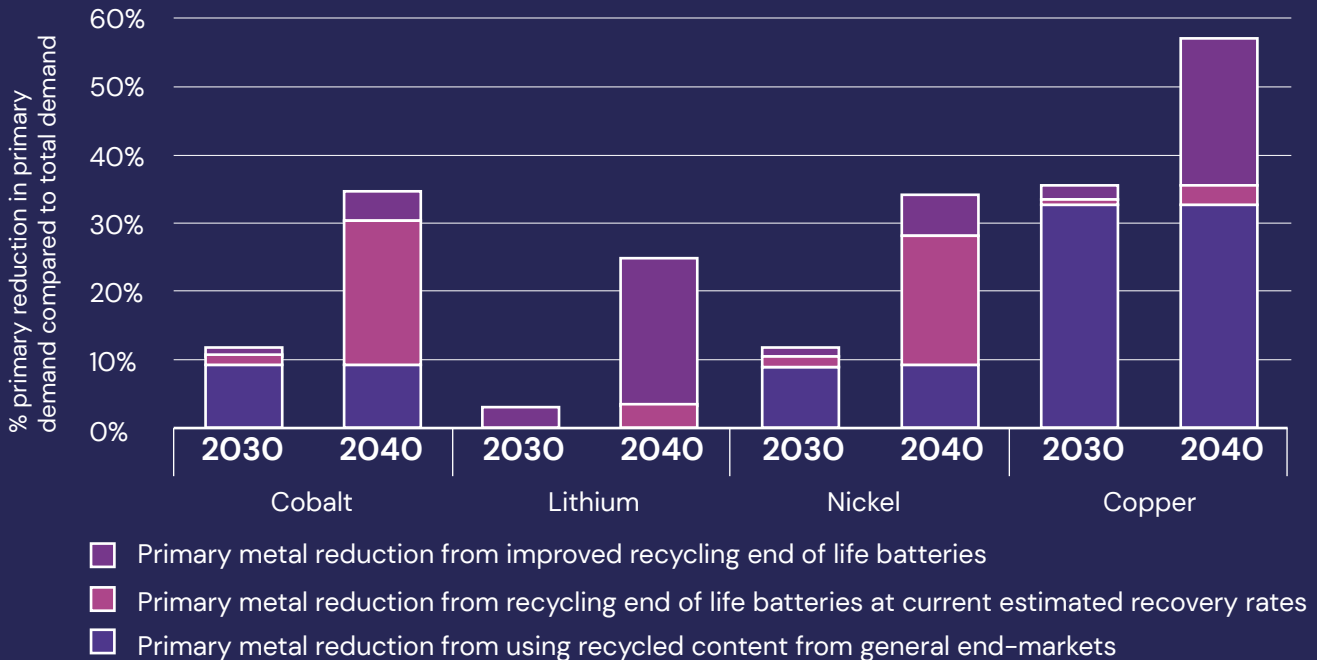
**Values represent an average across all battery types. Source: McKinsey Battery Insights, 2022*



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Impact of recycling on reducing primary metal demand



Source: Institute for Sustainable Futures, 2021

Battery usage cycle



First life of the batteries:
Use on the bus.



Second life of the batteries:
Unloading and dismantling.
Identify functional modules.
Reuse functional modules in stationary applications such as solar panels.
Recycle non-functional modules.



Recycling:
Preprocess
Separate materials and refinement process.
Recover raw materials for industrial production.

Source: Öko-Institut e.V.

Barriers to implementation in Latin America:



Some Latin American countries have a **limited supply of energy**.



A **robust industry** for battery recycling that can cater to the volumes that lie ahead in the coming years.



High costs for safe transportation, reuse process and recycling of electric bus batteries.