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Sustainability and Second Life:

Integrating the circular economy into the cobalt and lithium supply chains

Cobalt and lithium are essential minerals for the development and deployment of green energy technologies, and are most significantly used in lithium-ion batteries in electric vehicles (EVs).

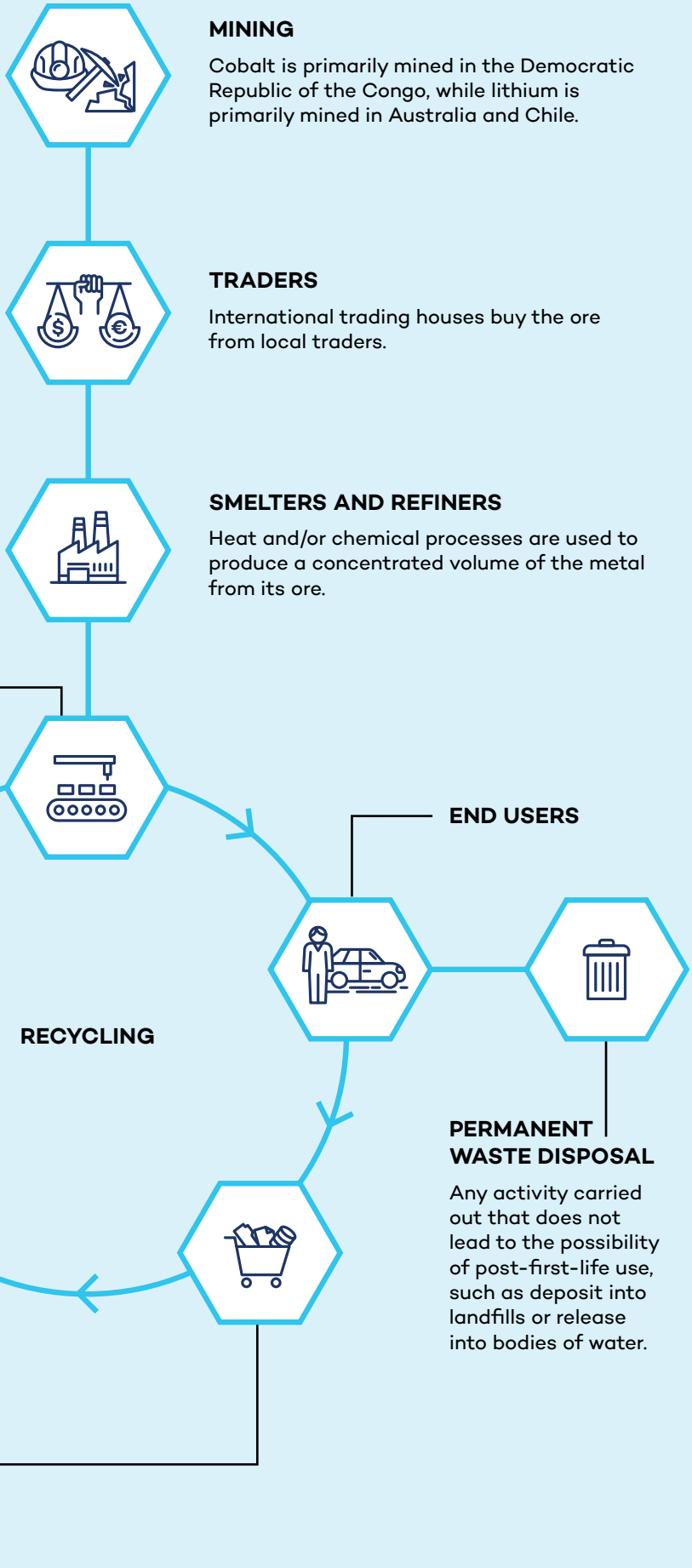
However, the secure and sustainable supply of these minerals could be jeopardized by projected supply shortages, price fluctuations, energy- or waste-intensive extraction and production processes, or a lack of responsible sourcing along each mineral's supply chains.

As part of the circular economy, mineral recycling has the potential to overcome many of these supply chain issues by extracting metals and minerals from products and infrastructure no longer in use.

Lithium and cobalt can also enter post-first-life uses through reuse or remanufacturing. Reuse refers to using a product again for either its original purpose or one similar without significant modification; remanufacturing refers to the process of retrieving the individual components of a product and restoring them to as-new condition.[1]

[1] World Steel Association. (2016). Steel - The permanent material in the circular economy. Brussels: World Steel Association. Kampker, A., Heimes, H. H., Ordung, M., Lienemann, C., Hollah, A., & Sarovic, N. (2016). Evaluation of a Remanufacturing for Lithium Ion Batteries from Electric Cars. World Academy of Science, Engineering and Technology, 10(12).

Integrating the Circular Economy into Cobalt & Lithium Supply Chains



MINING

Cobalt is primarily mined in the Democratic Republic of the Congo, while lithium is primarily mined in Australia and Chile.

TRADERS

International trading houses buy the ore from local traders.

SMELTERS AND REFINERS

Heat and/or chemical processes are used to produce a concentrated volume of the metal from its ore.

MANUFACTURERS

The metal is manufactured into its end-products, such as lithium-ion batteries for mobile phones, laptops and EVs.

END USERS

METAL RECOVERY

The metals are recovered and restored to a concentrated volume of metal, making them suitable for manufacturing processes.

RECYCLING

PERMANENT WASTE DISPOSAL

Any activity carried out that does not lead to the possibility of post-first-life use, such as deposit into landfills or release into bodies of water.

PROCESSING

The products are dismantled and sorted for recycling processes.

COLLECTION

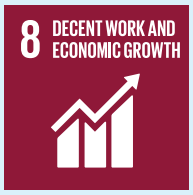
Instead of entering permanent waste disposal processes, the product is collected for post-first-life use.

Mineral Recycling for Sustainable Development

The Sustainable Development Goals (SDGs) aim to achieve peace and prosperity for communities and the environment, today and for future generations.

Increased and improved cobalt and lithium recycling contributes to the achievement of the SDGs, aligning most directly with the following goals:

Cobalt and lithium are critical to the development and deployment of green energy technologies, including lithium-ion batteries in EVs. The integration of mineral recycling into current supply chains is essential to improving material efficiency and contributing to an affordable and sustainable supply of clean energy technologies.



Job creation from mineral recycling—especially as it pertains to post-first-life electronics—far surpasses that of permanent waste disposal operations.[2] The recycling of electronics with lithium-ion batteries—and thereby of cobalt and lithium—could generate considerable and sustainable jobs, improve the safety of waste treatment employment and decouple economic growth from environmental degradation.

Incentivizing cobalt and lithium recycling would foster innovation in industrial sectors, as more actors seek to make the recycling process more tailored to lithium-ion batteries, more economically viable and more environmentally friendly. This innovation will result in retrofitting industries to make them more sustainable with increased resource-use efficiency.

In the year 2030, approximately 1.2 million EV batteries are expected to reach the end of their first-life.[3] The poorly managed disposal of electronic waste and batteries can have negative impacts on water quality and soil health. Recycling these batteries and the minerals within them would significantly reduce waste generation and ensure the sound management of chemicals.

Technologies like wind turbines, solar panels and advanced clean energy storage are essential to mitigate climate change, but they require significant cobalt and lithium inputs. In the face of impending projected supply shortfalls of both minerals, recycling has the potential to contribute to a stable supply of the materials needed for the development and deployment of these energy sources.

While much cobalt and lithium extraction takes place in a safe environment and contributes positively to socioeconomic development, points in both minerals' supply chains have been connected to conflict-affected and high-risk areas (CAHRAs). Increased mineral recycling can contribute to peaceful and inclusive societies by reducing pressure on CAHRAs while fostering supply chain sustainability.

Want to learn more about the potential, perils and promise of mineral recycling?

Watch for the launch of the report

Sustainability and Second Life: The Case for Cobalt and Lithium Recycling and its interactive webpage

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> "The circular economy is the gradual "decoupling [of] economic activity from the consumption of finite resources, and designing [permanent] waste out of the system," according to the Ellen MacArthur Foundation.[4]

[2] Colorado Assocation for Recycling. (2011). Recycling and the Economy: Grow Jobs and Increase Economic Development. Denver: Colorado Association for Recycling . Sampson, K. (2015, June 29). How Ewaste Recycling Is Creating A Lot of Jobs. Hummingbird International.

[3] Ribeiro, H., Kinch, D., Zhang, X., Franke, A., & Goldenberg, M. (2018, July). Recycling to be key for future battery raw materials supply. S&P Global Platts.

[4] Ellen MacArthur Foundation. (2017). *Concept:What is a circular economy? A framework for an economic that is restorative and regenerative by design*. Retrieved from Ellen MacArthur Foundation: https://www.ellenmacarthurfoundation.org/circular-economy/concept