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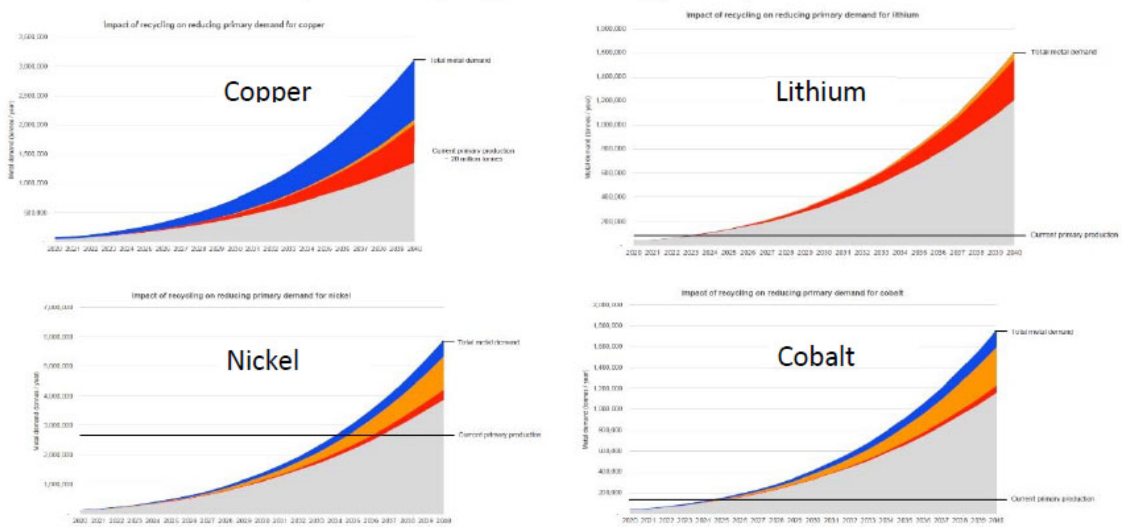
RECYCLING- A PART OF THE LIFE CYCLE OF MINERALS

Recycling has the potential to reduce primary demand (i.e., new mining) in 2040, by only 25% for lithium, 35% for cobalt and nickel and 55% for copper.

THE ROLE OF MINING IS UNDENIABLE.

Recycling is a part of the life cycle of materials and particularly metals. Some metals have been recycled for many decades. The re-use of metals such as steel, iron, aluminum and copper are proven to be economic and are regularly entered into the production stream of new materials. Precious metals are also regularly recycled, such as gold and silver (from electronics) and platinum and palladium (from catalytic converters). Recycling of many other metals is not easily accomplished economically or in some cases, is not even technically possible. When a metal is recycled, that quantity does not have to be mined. World population is growing. **Even with recycling, the demand for minerals, especially in electric vehicles and other clean energy technologies, as well as traditional uses of minerals, is expected to increase substantially over the next several years. Recycling will only be able to meet a portion of this demand. Thus, it will be necessary to continue to produce minerals from new and existing mining operations indefinitely.**

Impact of recycling on reducing primary demand



(Source: *Reducing new mining for electric vehicle battery metals: responsible sourcing through demand reduction strategies and recycling, p. 30-31)*

Of particular concern for recycling are the major and minor metals that are essential for manufacturing batteries, electric vehicles, solar panels, and wind turbines. These include:

- Electric Vehicle (EV) Batteries: Lithium (Li), Cobalt (Co), Nickel (Ni), Manganese (Mn), Graphite
- Solar Cells: Cadmium, Tellurium, Gallium, Germanium, Indium, Selenium, Rare Earths
- Wind Turbines: Steel (Major), Copper (5 – 17%), Aluminum (0 to 2%), and Rare Earths

Recycling metal-containing scrap and byproducts is an important component of metal life cycles. Economical recycling of reasonably high-tonnage-consumption metals is typically straightforward, e.g., iron, aluminum, copper, nickel, lead, zinc, chromium, magnesium, vanadium, titanium, tin, lithium, and antimony. These metals are blessed with the global availability of established high-tonnage plants that can reprocess these metals for reuse. Primary feedstock to the plants comes from mined raw materials (including brines) at relatively low cost. Scrap metals can be added to the mined primary materials to be processed into final products when the plant is designed to accept the scrap. Key to economic recycling is the ability of these plants to process secondary materials ("along for the ride"), thus economically recycling byproduct metals along with the primary metals.

Economic recycling of the minor metals in solar panels (Tellurium, Gallium, Germanium, Indium, Selenium) is not easily accomplished because they are present in relatively low volumes and, as such, the intrinsic value of these elements from recycling operations is not economic. The primary source of these minor metals is as byproducts from other metal mining extractions, specifically primary copper and zinc operations

Low relative concentrations increase separation and purification costs. Collection, transport, labor, environmental factors and any special feed preparation requirements must be considered as part of the recycle economic evaluation. Exceptions are precious and platinum-group metals, that are sufficiently "noble" to facilitate economic recovery.

Projections of Electric Vehicle (EV) demand

Electric vehicles are being promoted as the 'clean energy' transportation of the future. The projected EV demand in 2030 is estimated at 18 times the 2020 production. This means the need for recycling the elements in lithium-ion batteries (LIB) will increase by that same amount. Approximately 71% of the current lithium production goes to LIBs that have a life of 15 to 20 years. According to a report from the International Energy Agency, global demand for minerals far exceeds supply — and the problem could worsen in the years ahead.

Lithium is an essential component of small batteries as well as the larger batteries used in EVs. At present, enough lithium is mined to satisfy some of the current demand for LIBs. As EV demand increases, the demand for lithium and cobalt (especially) is expected to increase beyond the capacity of existing mining production. The lag in developing new mines is 7 to 10 years in the U.S., less in other parts of the world. By 2040, demand for lithium is expected to increase 4,200 percent; graphite, 2,500 percent; nickel, 1,900 percent; and rare earths, 700 percent. **Recycling LIBs can contribute to the metal supply, but a significant increase of lithium and cobalt mining is required to satisfy the initial LIB stock demand for EVs and other applications such as wind turbines and solar panel support. More mining production will be needed for the foreseeable future to satisfy demand.**

Lithium (Li) and Other Battery Metal Recycling

Cobalt and nickel are presently recycled (from many sources other than LIBs) at a rate of approximately 60% worldwide. The lithium recycling rate is less than one percent. Projections are that 90% of the metals in LIBs can be recycled economically. There are more than 50 companies worldwide that recycle lithium-ion batteries at some scale, from small laboratory pilot plants to full-scale factories. In North America, one company in Canada presently recycles lithium and several other companies are developing lithium recycling processes.

Based on projected demand, recycling has the potential to reduce primary demand compared to total demand in 2040, by only *25% for lithium (all uses), 35% for cobalt and nickel and 55% for copper*.

THE ROLE OF MINING IS UNDENIABLE.

NEXT: Electricity is required to charge batteries. Where will the electrical power come from to recharge batteries in an expanding fleet of electric vehicles?

References

- Institute for Sustainable Futures. *Reducing new mining for electric vehicle battery metals: responsible sourcing through demand reduction strategies and recycling*. April 2021. Prepared for Earthworks. https://www.earthworks.org/publications/recycle-dont-mine/
- Global Energy Institute (U.S. Chamber of Commerce). *Will Lithium become the petroleum of the 21st century?* June 2021. https://www.globalenergyinstitute.org/will-lithium-become-petroleum-21st-century
- McKinsey & Co. *Lithium and Cobalt, A tale of two commodities*. Metals and Mining, June 2018. https://lithium.mckinsey.com/~/media/mckinsey/industries/metals%20and%20mining/our%20insights/lithium%20and%20cobalt%20a%20tale%20of%20two%20commodities/lithium-and-cobalt-a-tale-of-two-commodities.ashx
- U.S. Geological Survey. Mineral Commodity Summaries 2021. https://www.usgs.gov/centers/nmic/mineral-commodity-summaries
- The Truth about mining rare earth minerals and clean renewable energy. https://www.kiteandkeymedia.com/videos/the-truth-about-mining-rare-earth-minerals-and-clean-renewable-energy/
- Solving EV's Biggest Problem - Battery Recycling Explained. https://www.youtube.com/watch?v=6w78-aSTIDY