Raw Materials for Europe's Battery Revolution

Sourcing and recycling insights

Batteries are key enablers of the European Green Deal ambition for achieving a climate-neutral economy by 2050, and particularly the mobility and clean energy sectors' transformation.

The World Bank in 2017 projected that **1000% more metals** will be needed for batteries on a global scale.[1]

Source: [1] World Bank (link)

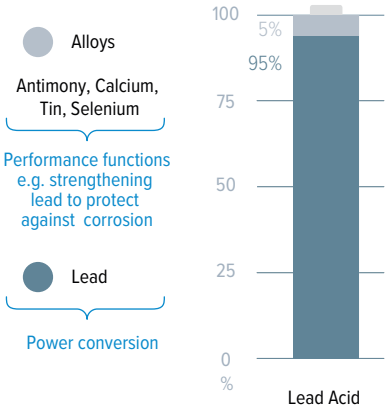
Batteries chemistries on the market

Europe's battery market is dominated by two main technologies: lead-acid and lithium-ion. Other availability includes Nickel-based, Sodium-based, Vanadium-based and Zinc-based chemistries.

Different Li-on battery chemistries are named based on the component metals in their cathodes and the ratios thereof. E.g. **NMC 5:3:2** = Nickel 5 : Manganese 3 : Cobalt 2. (Other metal abbreviations: A - Aluminium, F - Iron and P - Phosphate)

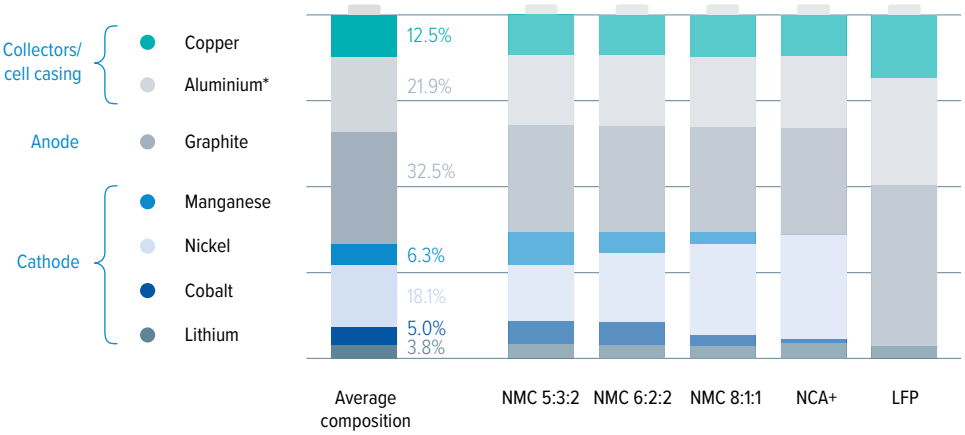
LEAD-ACID BATTERIES[1] (% composition of metals)

430 GWh global installed capacity, 2019[3]



LITHIUM-ION BATTERIES[2] (% composition of metals)

160 GWh global installed capacity, 2019[3]



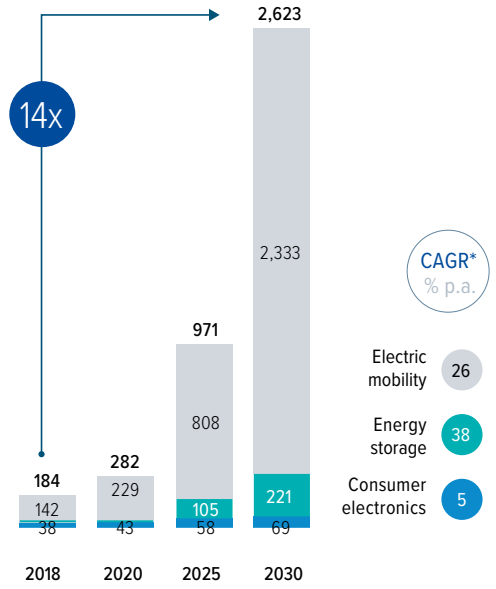
Source: [1] ILA, [2] Based on Transport & Environment report (link), [3] Avicenne - market report, 2020, *some aluminum in the cathode for NCA batteries

Expected battery market

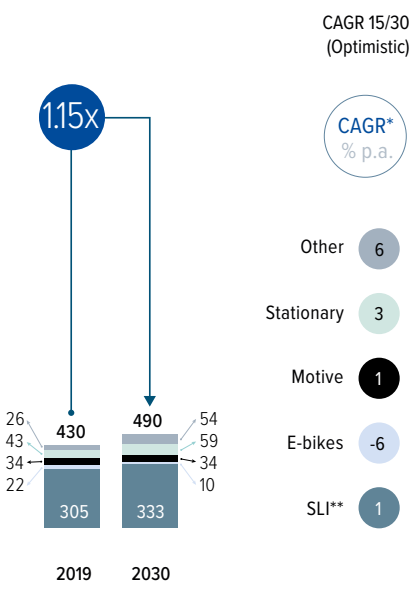
2030 global battery demand expectations: lithium-ion to grow by a **factor of ~14.0**, lead-acid by a **factor of ~1.15**

Global lithium-ion battery demand by **application**[1]

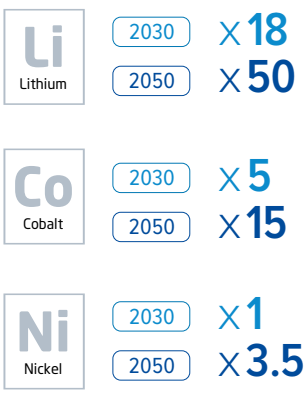
GWh in 2030, base case



Global lead-acid battery demand by **application**[2]



EU **demand increase** per metal[3]



Forecasts reflect market penetration of all Li-on batteries chemistries.

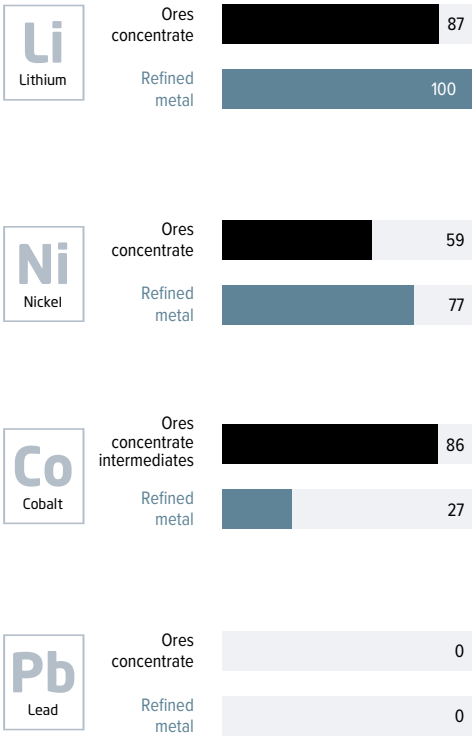
* CAGR - Compound Annual Growth Rate ** Starting, lighting, and ignition

Source: [1] A Vision for a Sustainable Battery Value Chain in 2030 (link), [2] Avicenne - CBI market report, 2020, [3] European Commission, Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020 (Link)

External sourcing of battery metals

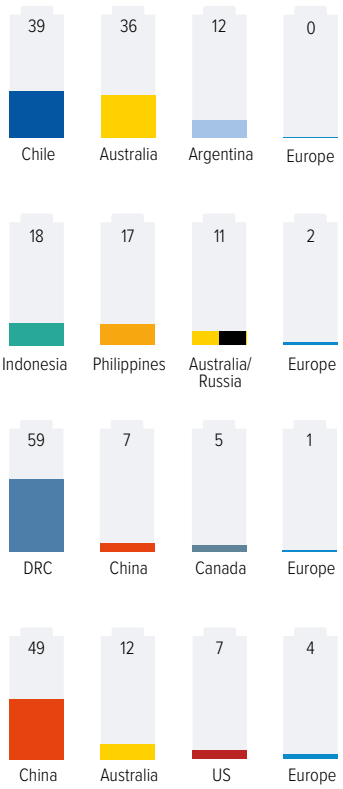
Ethical and responsible sourcing schemes in place: CIRAF (Cobalt Industry Responsible Assessment Framework), Cobalt - Responsible Minerals Initiative, Joint Due Diligence Standard Copper, Nickel, Lead, Zinc.

EU DEPENDENCY(%)



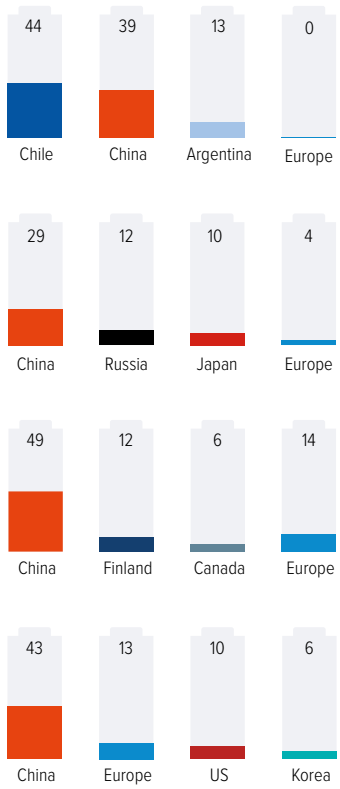
TOP GLOBAL PRODUCERS (%)

Mined /Concentrates



TOP GLOBAL PRODUCERS (%)

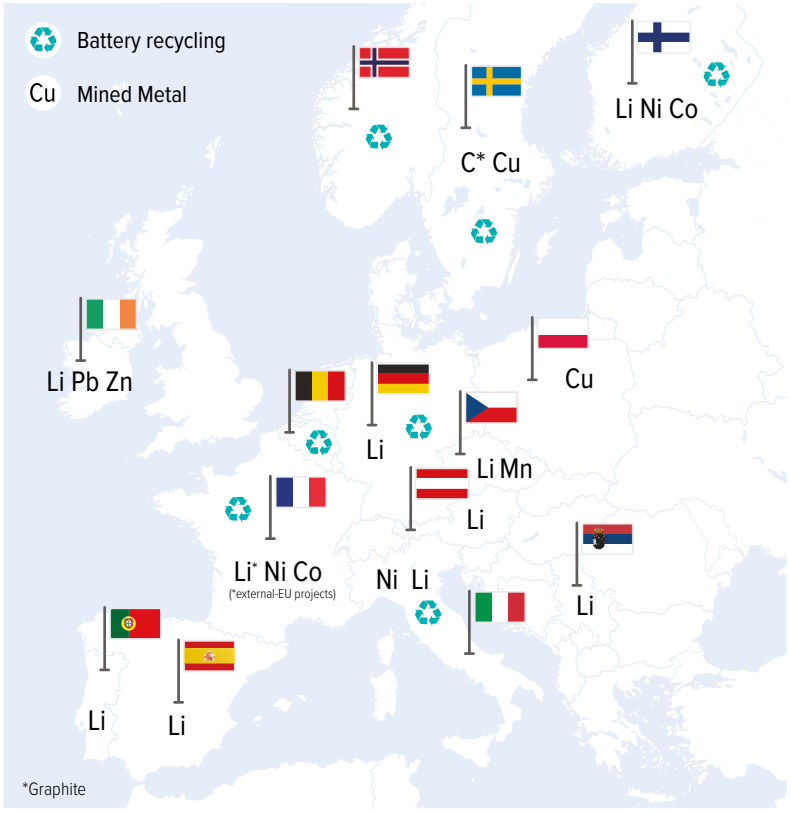
Refined/ Processed



Source: ILSZG, European Commission, Study on the EU's list of Critical Raw Materials (2020), Fact sheets on Critical and Non-critical Raw Materials (link),

Potential for future European investments

Mining, refining and recycling projects



Europe's battery recycling potential

LEAD-ACID BATTERIES

98% recycled in closed-loop

In the following countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain and Sweden.

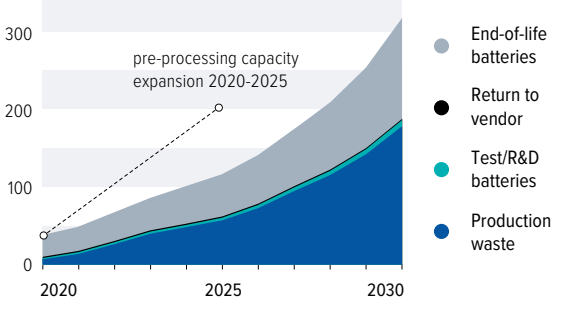
Source: ILZSG, IHS Study

LITHIUM-ION BATTERIES

2030 recycling forecast:

The EU market for EV lithium-based batteries is in a significant growth phase. The majority of batteries are currently in use and will only reach their end-of-life in approximately 10-15 years. By 2030, 300,000 tonnes of lithium-ion batteries will be available for recycling in Europe with a metals salvage value of $15-42 per kWh, depending on technology.

Total volume of LIBs **available for recycling** in Europe (thousands of tonnes)



Source: European Commission, Study on the EU's list of Critical Raw Materials (2020), Factsheets on Non-critical Raw Materials (link), Circular Energy Storage Research and Consulting (link)