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eit RawMaterials
Connecting matters
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Recovery of lithium from waste Li-ion batteries

[1] **Weronika Urbańska**, Faculty of Environmental Engineering, Wrocław University of Science and Technology, Wrcolaw, Poland

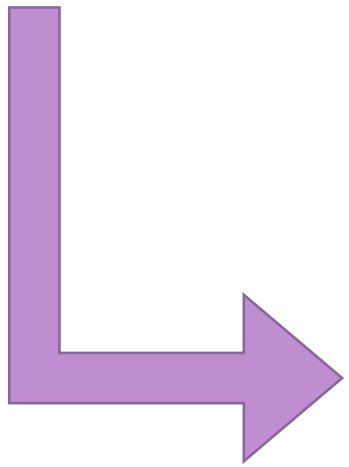
[2] Ewa Borowska, The College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences (MISMaP), University of Warsaw, Extremo Technologies, Wroclaw Technology Park, Poland

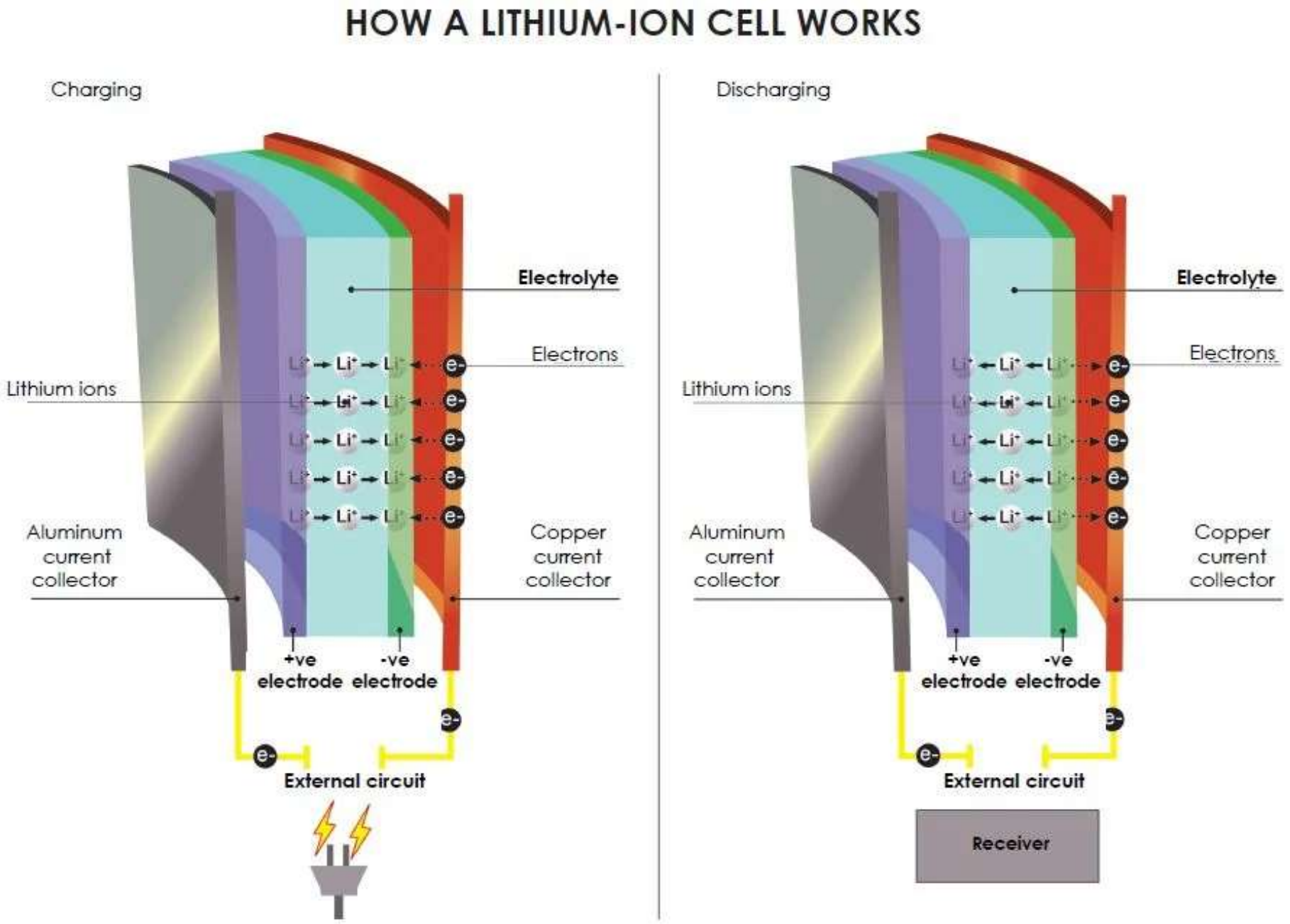
1) weronika.urbanska@pwr.edu.pl

Wrocław University of Science and Technology

UNIVERSITY OF WARSAW

EXTREMO TECHNOLOGIES





Credit: https://www.planete-energies.com/en/medias/close/how-do-lithium-ion-batteries-work

Critical raw materials for battery tech

The cost of each raw material
(per tonne)

$10,000/$3,500	$10,000	$20,000 (China) $10,000 (other places)	$27,000

Nowadays

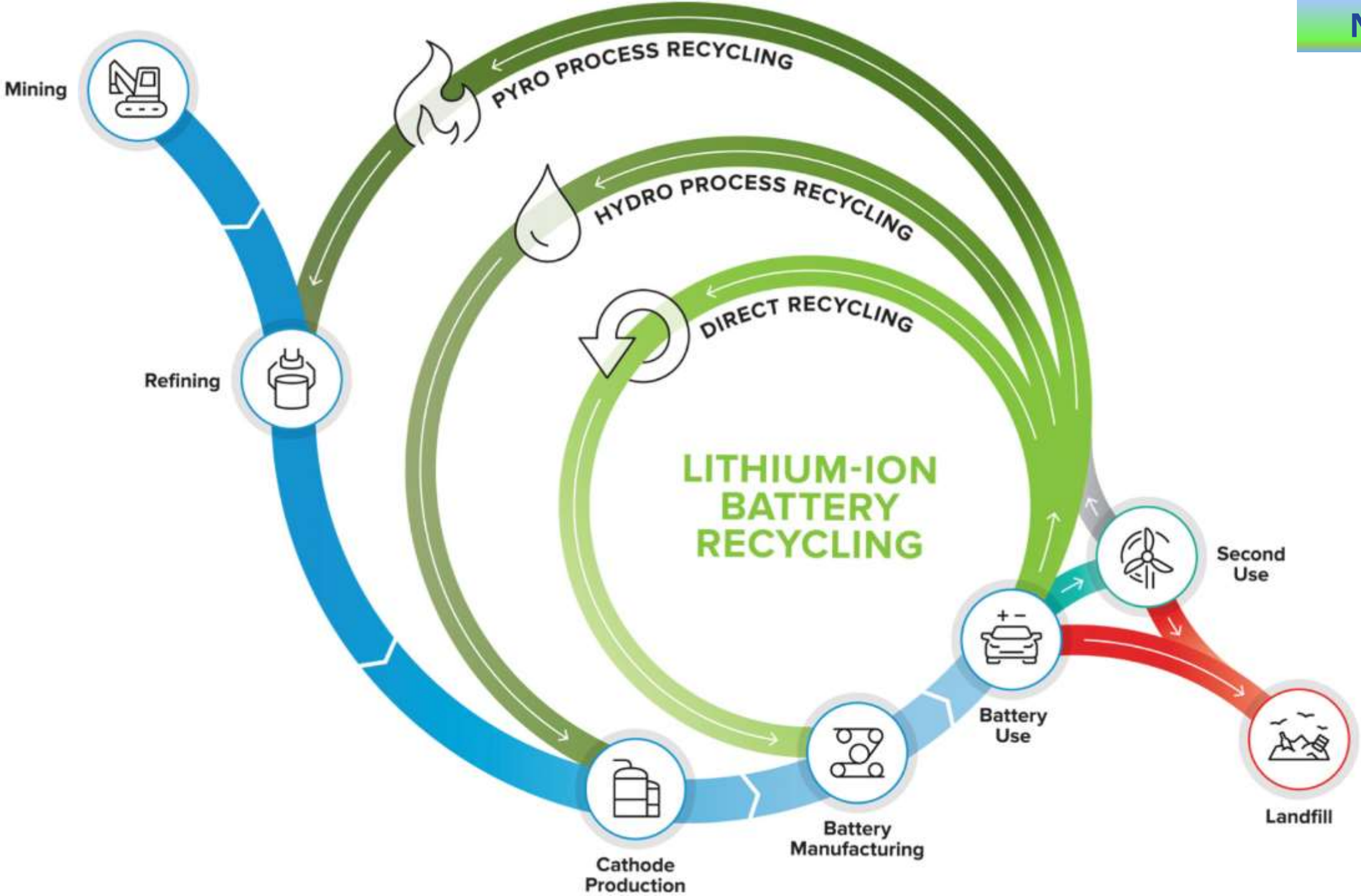


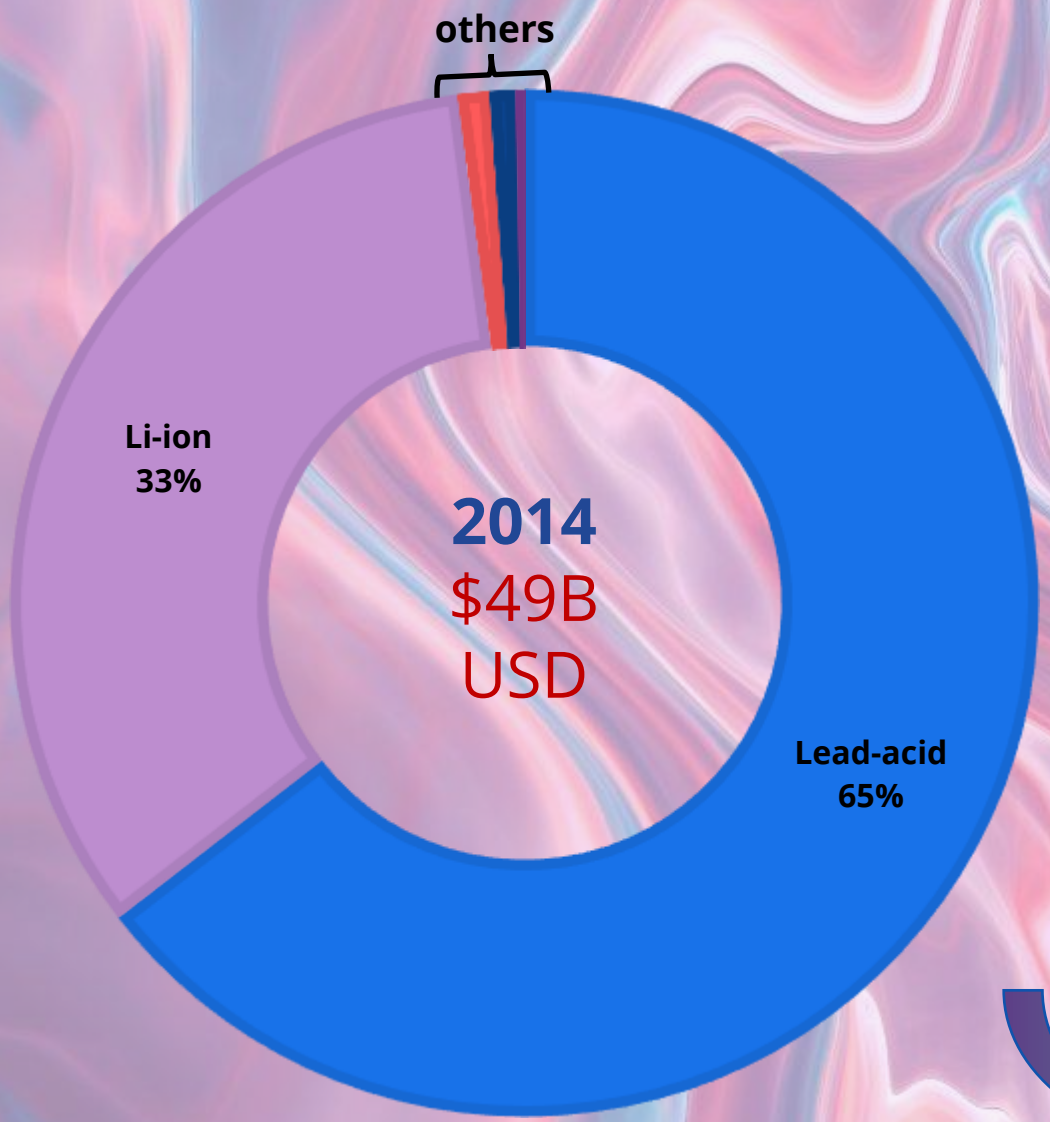
Image credit: ReCell Center

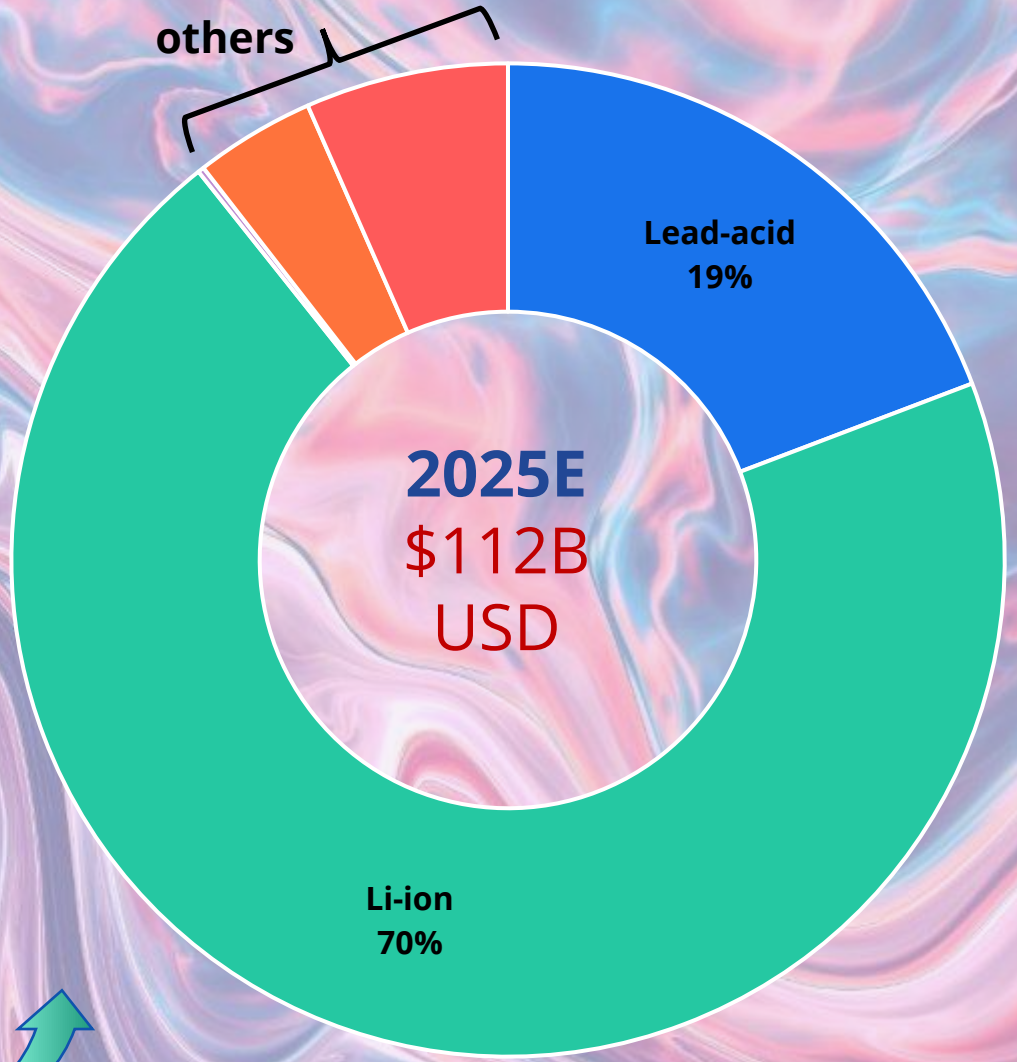
Recycling of used Li-ion batteries - current state

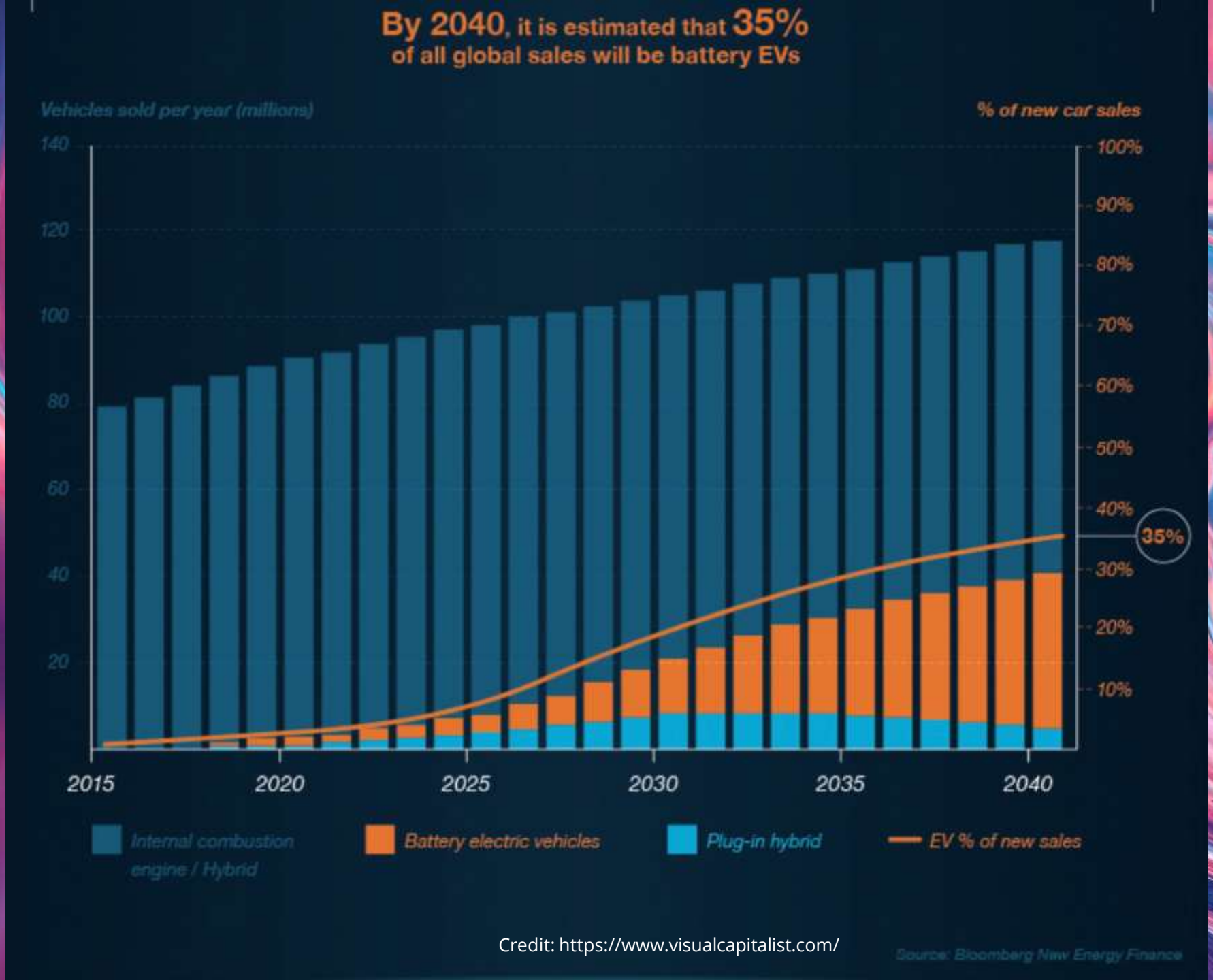
All current recycling technologies for used Li-ion cells are based on pyrometallurgical and / or hydrometallurgical methods.

Source: https://doi.org/10.1016/j.est.2021.102690

A BATTERY MARKET



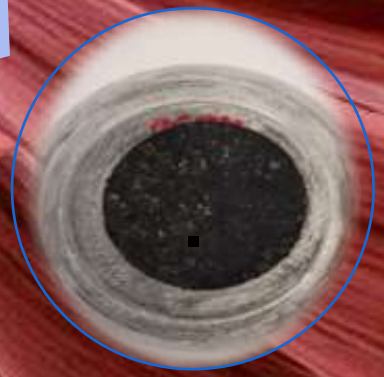




Credit: https://www.visualcapitalist.com/

What are we proposing?

Critical raw materials closed-loop recovery With innovative approach



Co, Li, Ni and other metals

Circular Economy
Zero Waste

By bioleaching based on geomicrobiology

Photo © Tim Van Der Linden

The importance of geomicrobiology

Bioleaching process (extremophiles usage)

First step

Bacteria

Acidithiobacillus thiooxidans

Photo credit: Khan et al., 2012

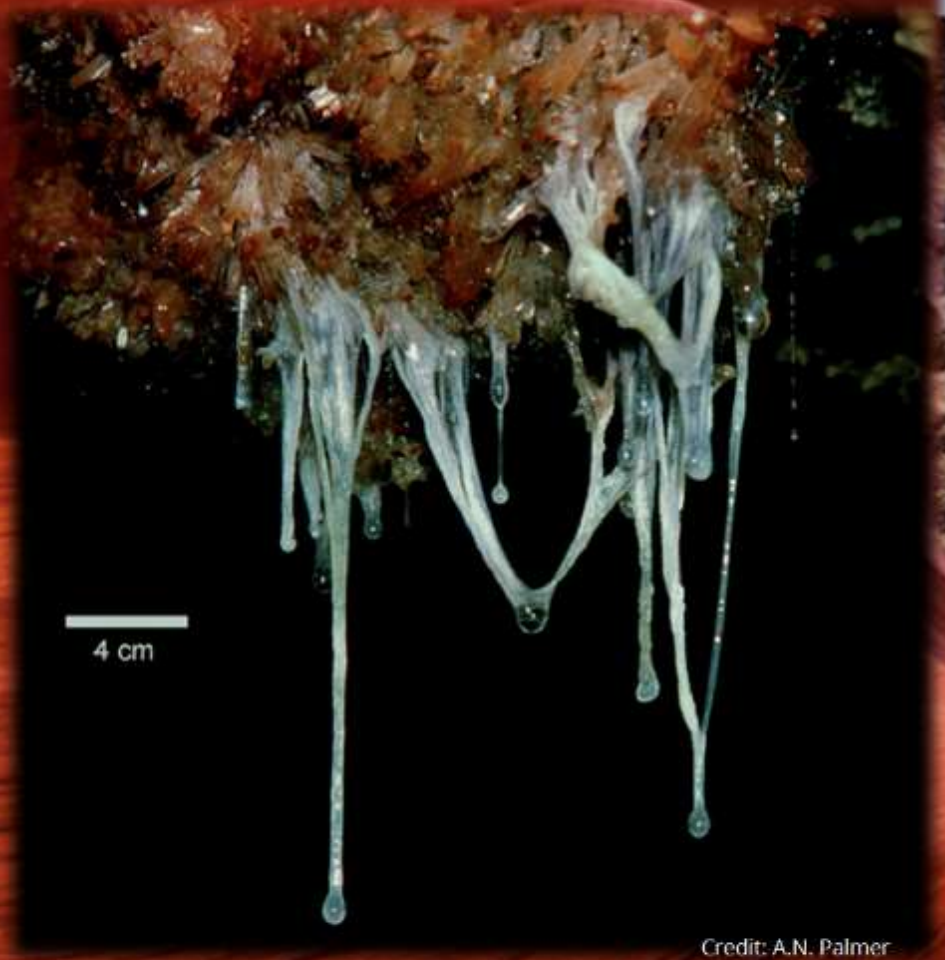
Second step

Volcanic red microalgae (different strains)

- Less harmful for the environment
- Method is based on natural geomicrobiological processes
- Possibility of simultaneous separation of metals with different properties thanks to the use of different microorganisms
- During the growth of microorganisms, continuous recovery takes place, depending on the rate of biomass production
- The reduction of the formation of secondary pollutants (including no toxic gas emissions) - a positive impact on environmental protection; high level of safety during the process

The natural habitats of used microorganisms

Sulfur caves - bacteria



Credit: A.N. Palmer

Volcanic areas – volcanic algae

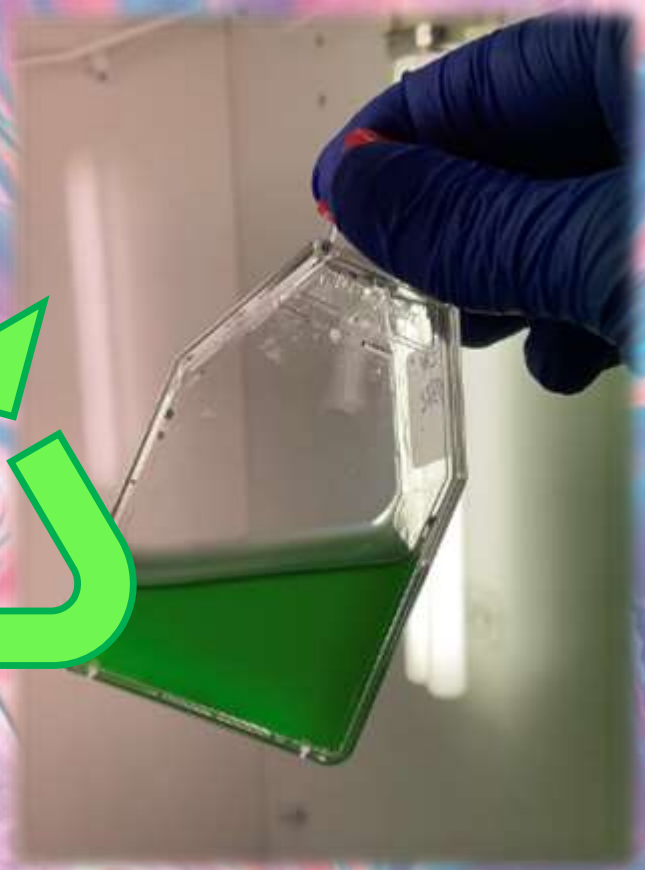
Ciniglia et al., 2014

Reeb&Bhattacharya, 2010

Natural biomates with biofilm

Su Yoon et al., 2006

Acidic environment (pH 0.05 – 4) | Temp. up to 56 °C | High concentrations of sulfur compounds, chlorides, heavy and transition metals as a: As, Pb, Cu, Ni, Cd, Zn, Hg, Cr



THANK YOU FOR YOUR ATTENTION !

"Microbes are doing things we didn't even know they could do 10 years ago."