Batteries & Recycling – BATCircle2.0

Why is circular economy of batteries crucial?

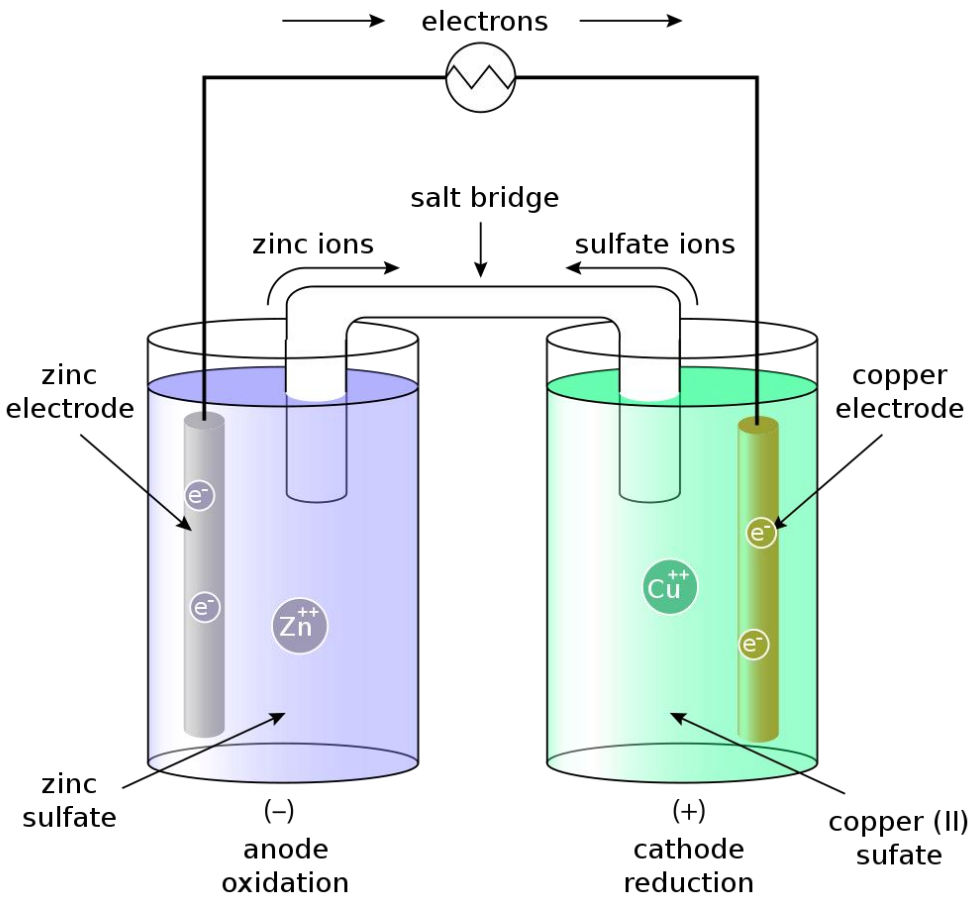
30.4.2023

Batteries

Dissasembled batteries taken by Eren Oztekin 17.11.2021

- Primary batteries are one-use, and cannot be recharged
- Secondary batteries are used to store and release electrical energy in small devices and large energy storages
- Wireless and rechargeable batteries enable applications such as electric vehicles and mobile phones
- Main parts produced from metals
  - Source of power, material, and produced emissions determine ecological and sustainability aspects of a battery

Working principle of battery



Accessed 28.4.2023: https://commons.wikimedia.org/wiki/File:Galvanic_cell_labeled.svg

- Using batteries depletes charge: Galvanic cell
  - Cathode material is reduced while anode is oxidized
  - Electrons flow from anode to cathode
  - Chemical energy → Electric energy
- Charging batteries is the opposite: Electrolytic cell
  - Anode material is reduced while cathode is oxidized
  - Electrons flow from cathode to anode
  - Electric energy → Chemical energy
- Different cathode and anode material combinations have different properties for parameters including weight, size, cost, power, durability, charge speed, safety, temperature, lifecycle…
  - ➢ No one battery to rule them all!

Battery composition and materials – Li-ion battery

1. Positive terminal

– Fe/other metals/polymers

2. Outer metal casing (=negative terminal)

– Fe/other metals/polymers

3. Positive electrode (=cathode)

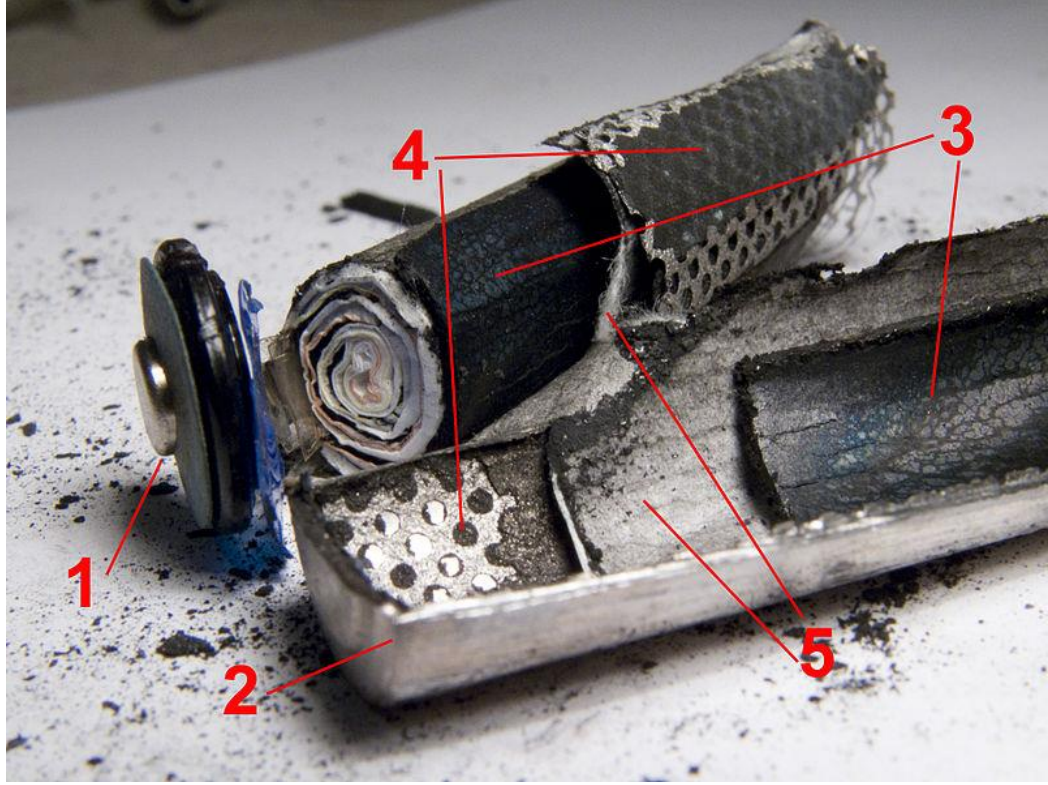
– Al as current collector, Co, Li, Ni, Mn as active materials, binders

4. Negative electrode (=anode) with current collector (metal grid, connected to metal casing)

– Cu as current collector, graphite as active materials binders

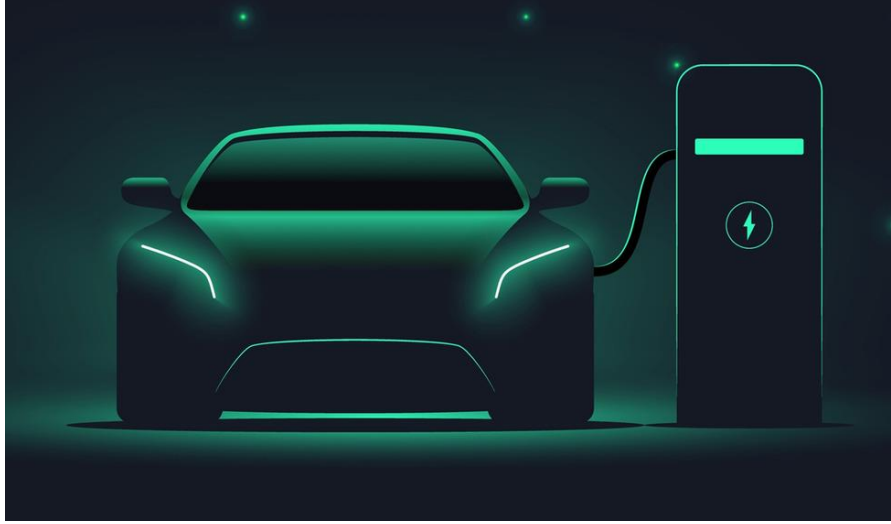
5. Separator (between electrodes)

– Polymers



Battery waste from material bank, research of Annukka Santasalo taken by Valeria Azovskaya, 20.03.2019

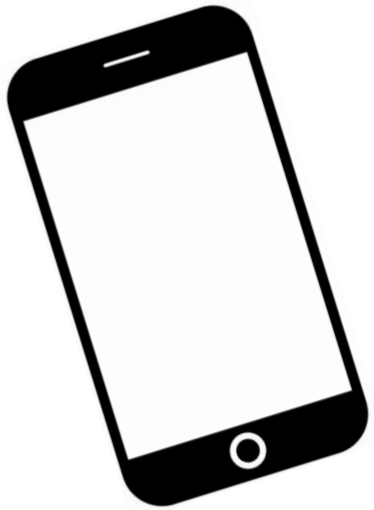
Applications



Accessed 28.4.2023: https://go-tou.com/en/news/electric-car-design-how-do-electric-cars-work

- Crucial for storing and releasing energy from fluctuating green energy sources
- Wireless devices such as mobile phones, power tools, and electric vehicles

Accessed 28.4.2023: https://www.vecteezy.com/vector-art/6624453-smartphone-icon-vector-design-phone-symbol

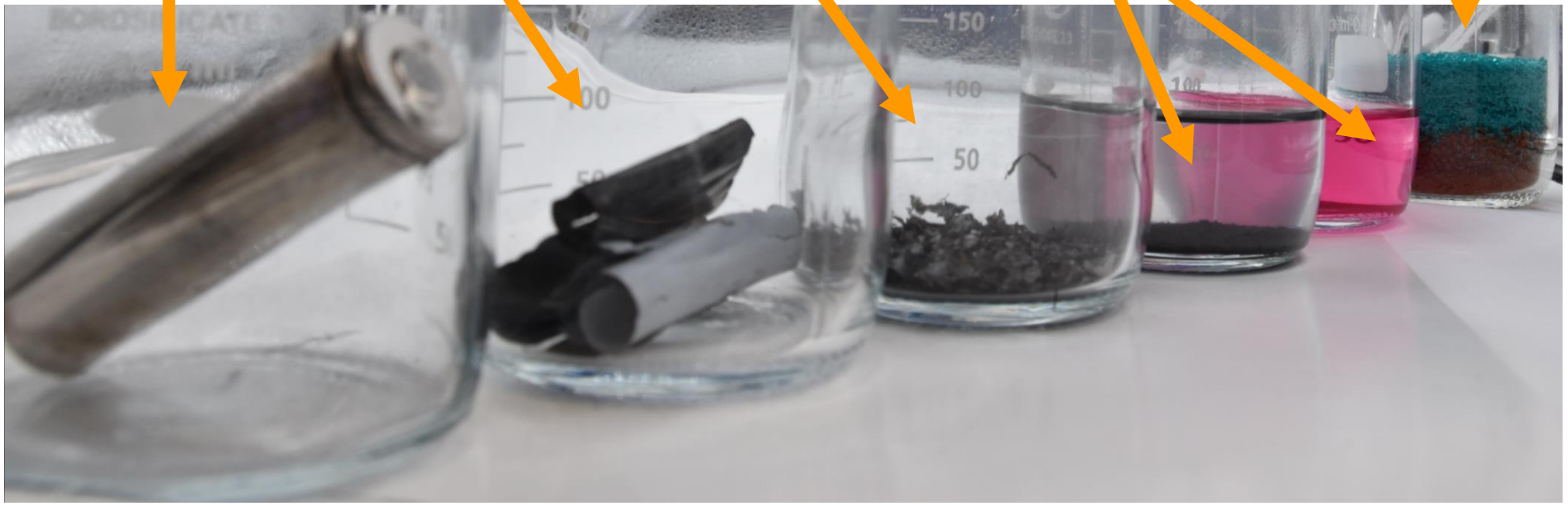


Accessed 28.4.2023: https://www.ionenergy.co/resources/blogs/energystoragesystems/

Accessed 28.4.2023: Karina zhukovskaya https://www.pexels.com/photo/laptop-with-blank-screen-placed-on-table-6446709/

Steps of recycling

1. Discharging
2. Sorting
3. Dissassembly
4. Crushing
5. Metal extraction
6. Metal recovery



Battery recycling lifecycle taken by Aleksanteri Kupi 14.3.2023

Circular economy challenges

- ! Consumers' low motivation to return end-of-life products
- ! Complex design of batteries and battery systems requires multiple dissasembly stages
- ! Sorting of batteries and battery chemistries is challenging
- ! Complex and heterogenous raw material
- ! Not enough economically feasible recycling technologies
- ! Lack of legislations

Mixed battery scrap taken by by Eren Oztekin 17.11.2021

Solutions for more sustainability

Lab furnace operation by Eren Oztekin 17.11.2021

- Innovative processes
- Sustainable design for easier separation
- Different batteries for storage and power source usage
- Public awareness campaigns
- Policies to encourage regular and urban mining

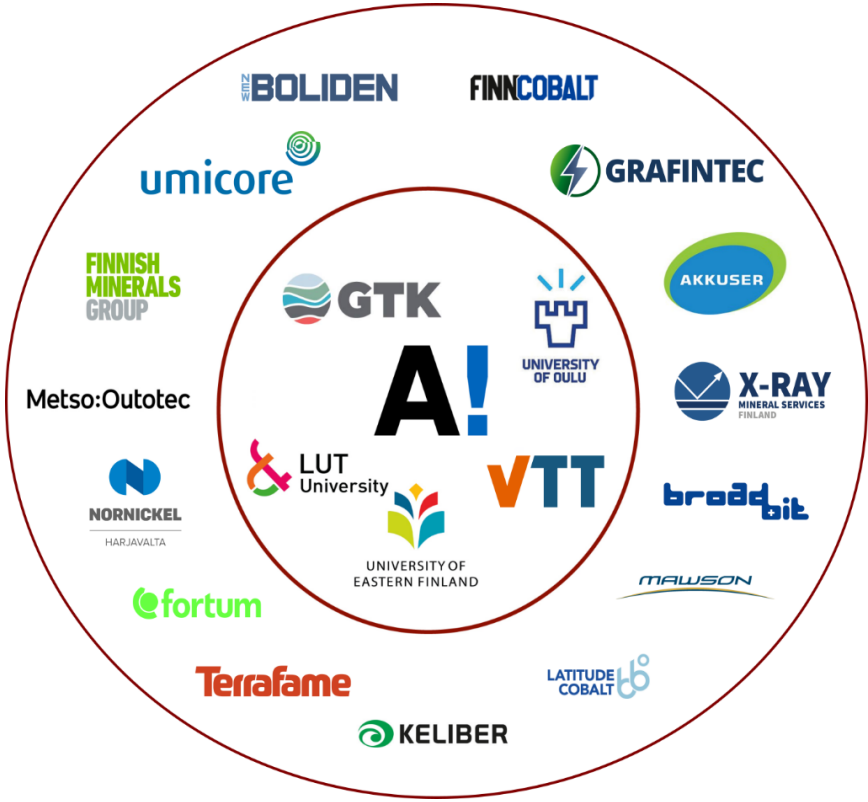
BATCircle2.0 – Consortium

BUSINESS FINLAND

Joint industry-academia project (2021-2024):

- 2nd phase after the 1st BATCircle phase (2019-2021)
- Coordinated by Aalto University
- Total budget of 19 M€ (funded by Business Finland)

1) Open research
   - Performed by 6 research organizations (ROs)
     - 4 universities and 2 research centers
2) Confidential R&D research
   - Performed by 15 companies



Goals:

- Improving the manufacturing processes of mining industry, metals and battery chemicals industries as well as developing innovations in the battery value chain
- Increasing the recycling of lithium-ion batteries
- Strengthening the cooperation between companies and ROs in Finland

BATCircle2.0 – Open research

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https://batcircle.aalto.fi/en

Check our brochure:

https://www.esitteemme.fi/batcircle/WebView

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