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Striving for responsibly sourced & circular battery materials

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Umicore

Global material technology- & recycling group

~ 11000 people, 50 production sites & 15 R&D technical centers, 3,2 bn € revenues*

1

One of three global leaders in emission control catalysts for light-duty and heavy-duty vehicles

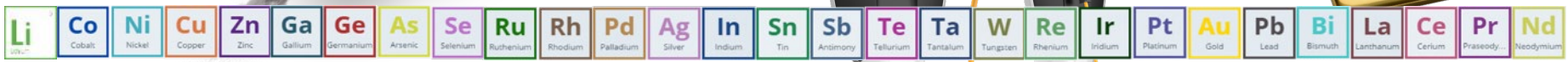
2

A leading supplier of key materials for rechargeable batteries and fuel cells

3

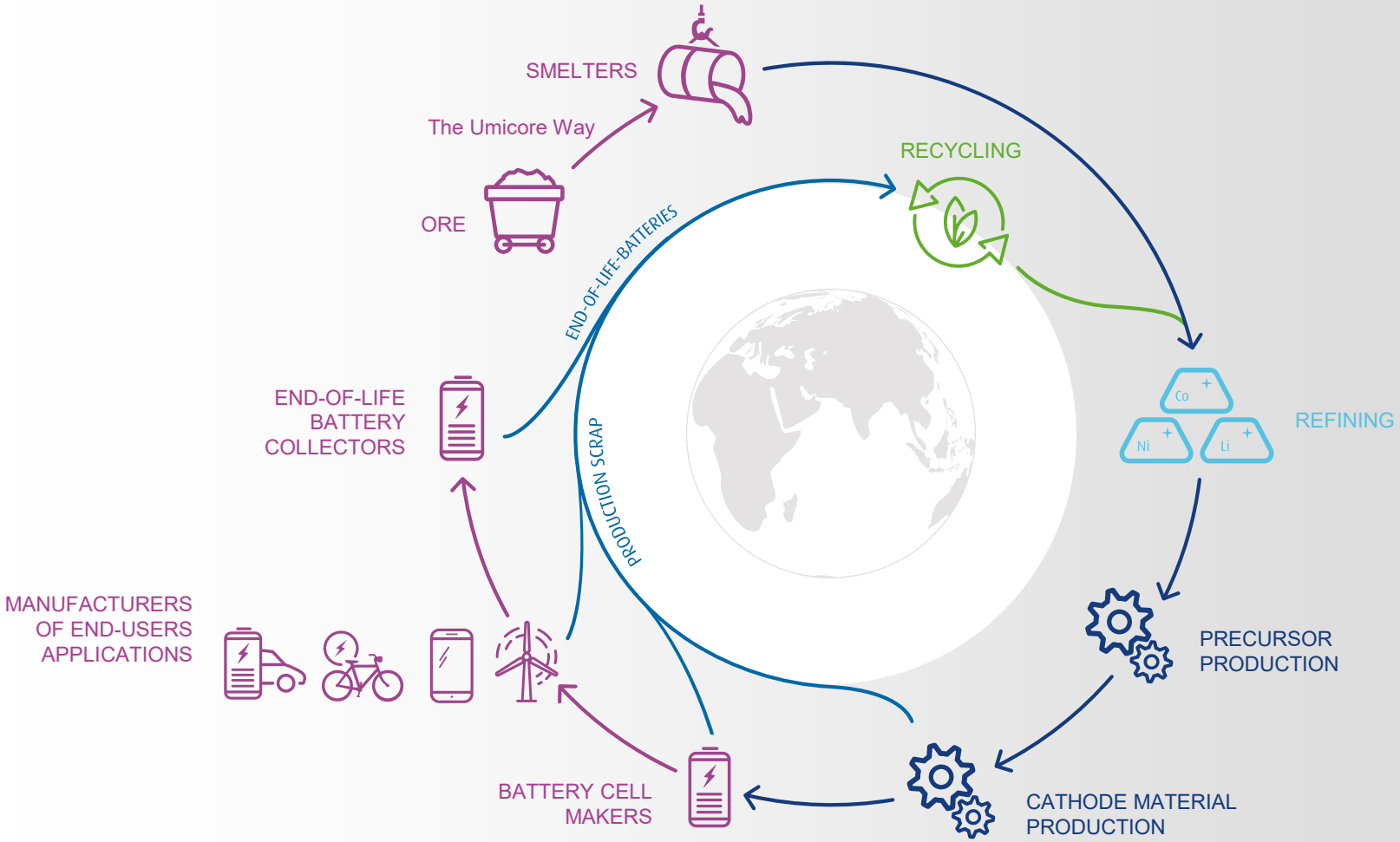
The world leading recycler of complex waste streams containing precious and other valuable metals

Umicore metals portfolio



*2020 without metals

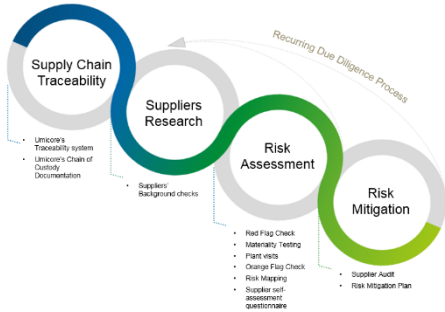
Umicore in battery materials - from mine to wheel



Responsible sourcing becoming a key requirement

Umicore's Procurement Framework for Cobalt

- Internal checks and Chain-of-custody systems implemented since 2004.
- Assuring that Umicore's cobalt supply chain is free of sustainability abuses:
  → human rights, environment, health & safety, bribery & corruption, artisanal mining
- Applied to all purchases of cobalt in Umicore, based on understanding of risks related to sourcing & handling of cobalt
- Third-party validated and OECD's Due Diligence aligned Framework
- Strong involvement in **Global Battery Alliance** (World Economic Forum), promoting a responsible battery value chain.



http://www.umicore.com/en/cases/sustainable-procurement-framework-for-cobalt/

Umicore → Newsroom → News & stories →

EV supply chain majors pilot Re|Source, a blockchain solution for end-to-end cobalt traceability

20 May 2021 Umicore.com

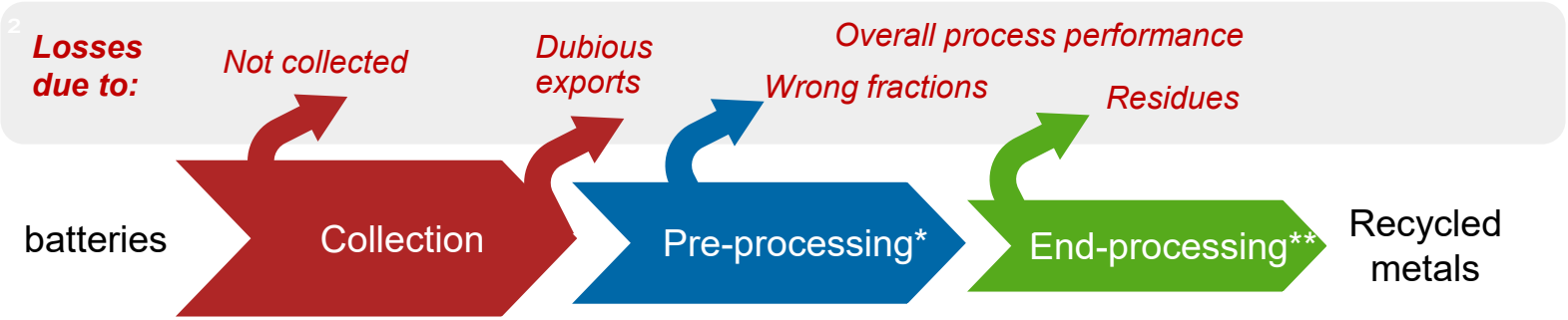
Major metals and mining companies CMOC, Eurasian Resources Group (ERG) and Glencore in collaboration with battery material supplier Umicore are piloting ReISource, a solution to trace responsibly produced cobalt from the mine to the electric car. A global EV pioneer and one of the world's leading battery makers are also part of the pilot. …

Umicore recycling process for Li-Ion-batteries

industrial pilot plant

Energy efficient recovery of metals in battery quality

Effective recycling requires optimised chains



* manual-mechanical
** chemical-metallurgical

Recycling efficiency determined by weakest link in the chain (usually collection)

e.g. Co yield: *70%* *X* *90%* *X* *95%* = *60%*

Collection rate

recycling rate

Physical circularity rate if suitable for new products

Main recycling drivers: Economic value, business models & legislation (if well enforced)

Main challenges: Insufficient collection, dubious waste exports, sub-standard treatment

Circular Economy Initiative Deutschland (CEID)

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Politics

Bundesministerium für Bildung und Forschung

Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit

Bundesministerium für Wirtschaft und Energie

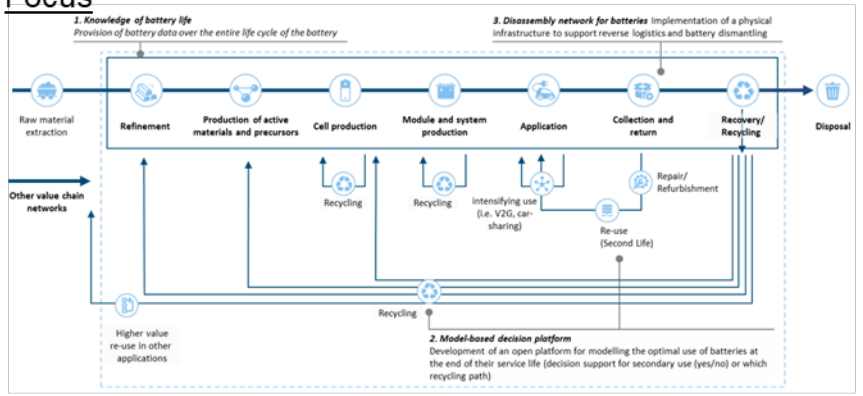
Coordination

acatech – DEUTSCHE AKADEMIE DER TECHNIKWISSENSCHAFTEN

SYSTEMIQ

Working Group Traction Batteries

Focus



Members

Industry

ACCUMOTIVE, BMW, covestro, interseroh zero waste solutions, DAIMLER, PEM MOTION, RLG REVERSE LOGISTICS GROUP, SAP, SIEMENS, TRUMPF, umicore

Science

Fraunhofer IPK, KIT Karlsruher Institut für Technologie, RWTH AACHEN UNIVERSITY, Technische Universität Braunschweig, Helmholtz-Institut Freiberg für Ressourcentechnologie, HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF, TU Bergakademie Freiberg, Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology, Technische Universität Berlin, TU Clausthal

Civil Society & further Institutions

Agora Verkehrswende, GRS BATTERIEN GEMEINSAMES RÜCKNAHME SYSTEM, Dr. Michael Krausa, Geschäftsführer von KLiB, NPM

https://www.circular-economy-initiative.de/publikationen

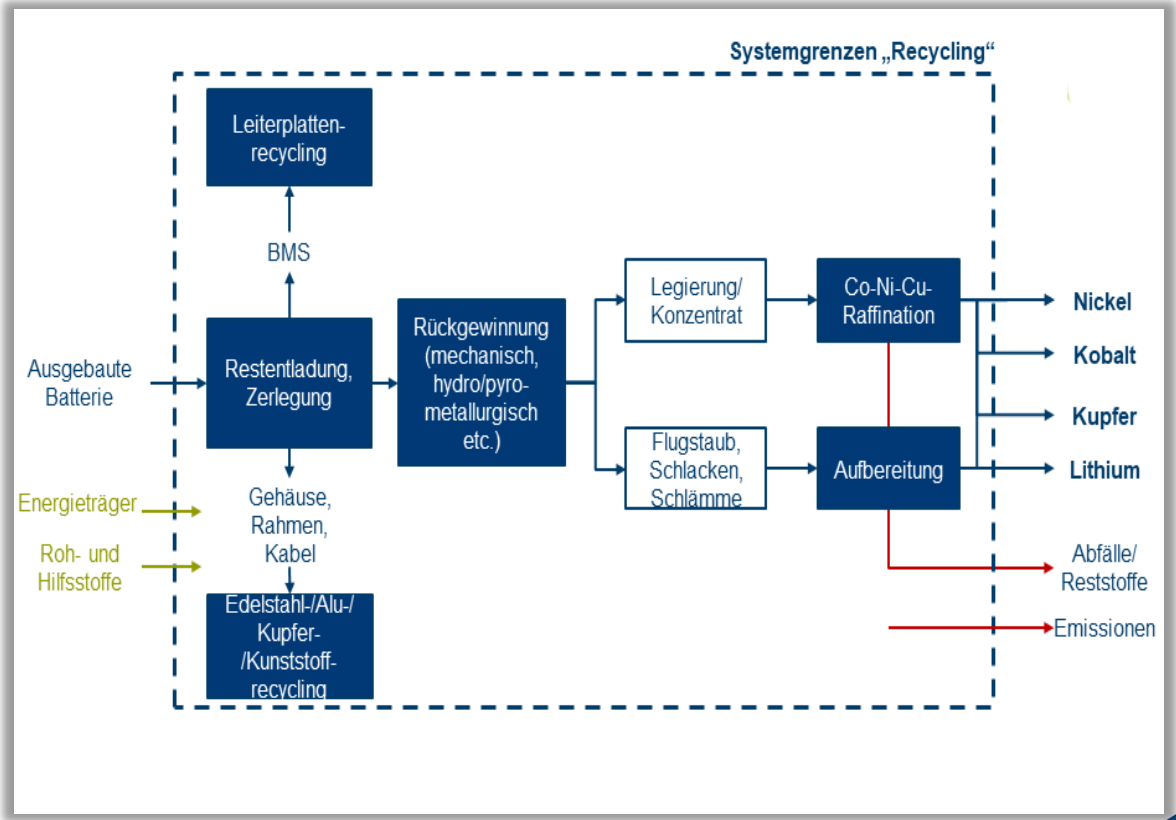
https://www.circular-economy-initiative.de/english

CEID – Circular batteries require systemic innovation & supportive legislation

CEID Recommendations (selection)

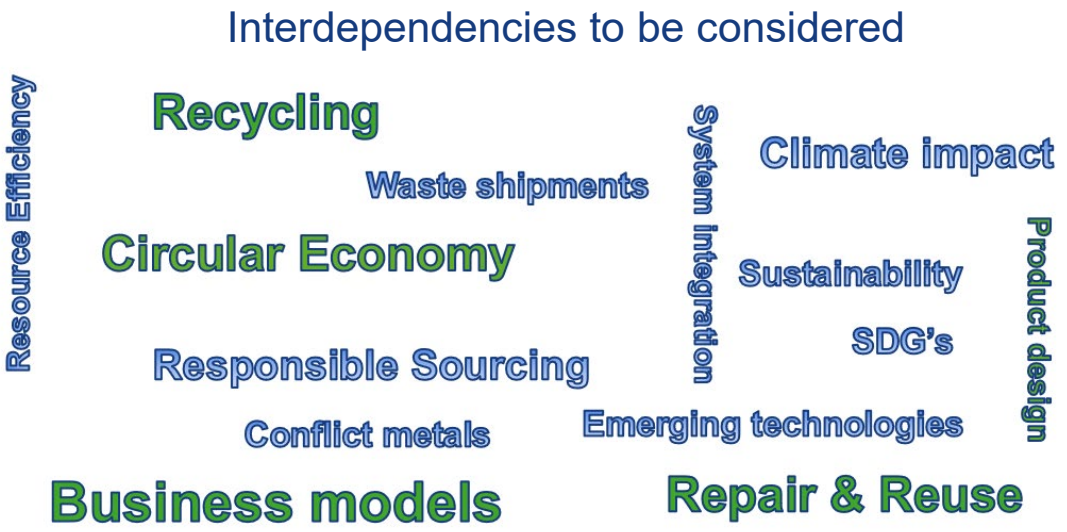
- Set clear definitions, system boundaries & ambitious but realistic (recycling) targets
- Design for Circularity
- Enable data availability for battery passport, digital twin etc. to create transparency
- Create economic incentives for circularity
- Foster circular business models (B2B & B2C)
- Better collaboration along value chains

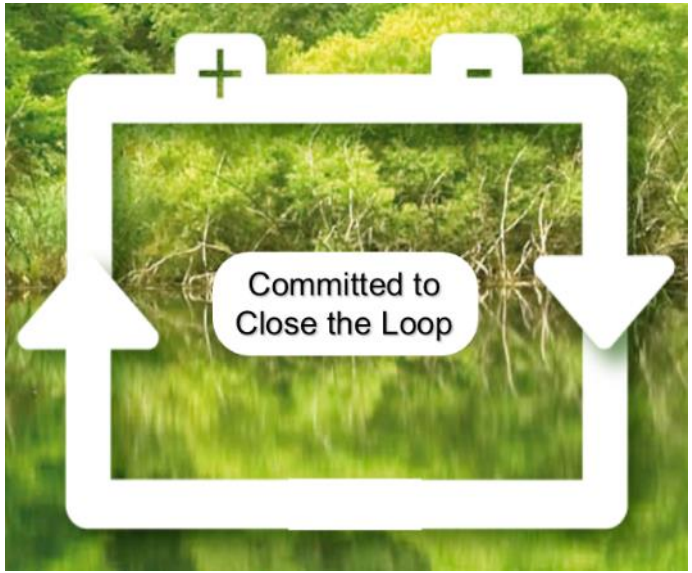
Fotos: Wikimedia.org | snappygoat.com



Source: Circular Economy Initiative Deutschland

E-Mobility – the ideal test case for clean materials in a circular economy





Thanks for your attention

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Publications: www.researchgate.net/profile/Christian_Hagelueken/contributions

Business as unusual – Anforderungen an eine Kreislaufwirtschaft von Li-Ionen Batterien, Müll und Abfall 5-20, 258-265

www.umicore.com

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CEID – proposed recovery rates based on clear definitions & calculation methods (physical loops)

Material	Recommended Recovery Rates	
	2025 – binding	2030 – aim
Total battery*	60 %	70 %
Lithium	50 %	85 %
Cobalt	85 %	90 %
Nickel	85 %	90 %
Copper	85 %	90 %
Steel	90 %	95 %
Aluminium (without Al-foils)	90 %	95 %

Recycling
entire process, from the deactivation of the battery to the complete extraction of marketable raw materials (recyclates) for the production of new battery materials, in a quality comparable to the primary material

Recyclate
Secondary raw material recovered by recycling of comparable quality to primary raw materials, can be used as input to manufacture new products

Recycling rate
… verified by appropriate audits or certification … covers the entire recycling process - whereby earlier steps in the process reduce the remaining maximum success rate …

**The proposed recovery rates for the entire battery are to be set flexibly, since organic and volatile materials (electrolyte, plastics, graphite) account for a significant proportion (approx. 30 to 40 percent). Often these cannot be recovered in adequate quality or only at great effort, which could be at the expense of the energy balance and yield of important battery materials. Since the latter have to be prioritized, strict minimum values for the entire battery or individually for electrolyte, plastics and graphite are unlikely to be constructive. Their recovery should only be targeted by ensuring the overall energy balance and the recovery of important battery materials in high quality.*

Source: Circular Economy Initiative Deutschland, Ressourcenschonende Batteriekreisläufe, 2020

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Circular economy requires fundamental changes

striving to close the physical loops for metals in products

- True CE requires a fundamental change in the way we develop, design, produce, use and recycle products that have a high relevance for (critical) raw materials.
- Both, recycling and approaches to lifetime extension need to be addressed in the CE strategy.
- Companies have to adapt their business models accordingly. New forms of stakeholder collaboration (“roundstream”) and product service models can be the game changer (“business as unusual”).
- Appropriate legal frame conditions & indicators needed to support CE strategies of companies.
- Special focus on CE strategies is required for green/clean products as they increase the demand for (critical) raw materials and need to be inherently sustainable by definition. E-mobility & batteries form an excellent test case.

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Mining & recycling - complementary for sustainable supply

- **Clean technologies** are boosting (critical) metals demand
- Competition for secure access to metals is likely to increase
- Initial metals feedstock usually comes from mining ("building up the inventory")
- Clean technologies need "clean" primary metals
  - Reduce CO_2 footprint of supply → make use of renewable energy, increase yields & energy efficiency, …
  - Minimise environmental impact of mining (on landscape, water, air & soil)
  - Improve social & health conditions of mining
  - Secure business ethics
  - Downstream users (… OEMs) have to insist on responsible sourcing and pay a fair price
- Clean technologies need to become circular
  - Product design has to consider longevity, repair & recycling
  - Create drivers and business models for comprehensive collection & high quality recycling
  - Need for "clean" secondary metals (see above) → responsible recycling!
  - OEMs have to insist on sustainable EoL-management of "their" products (adapt EPR systems)

Manage metals as a "renewable" resource in a global context
→ keep them in the loop once they enter the "technosphere", avoid metals dissipation