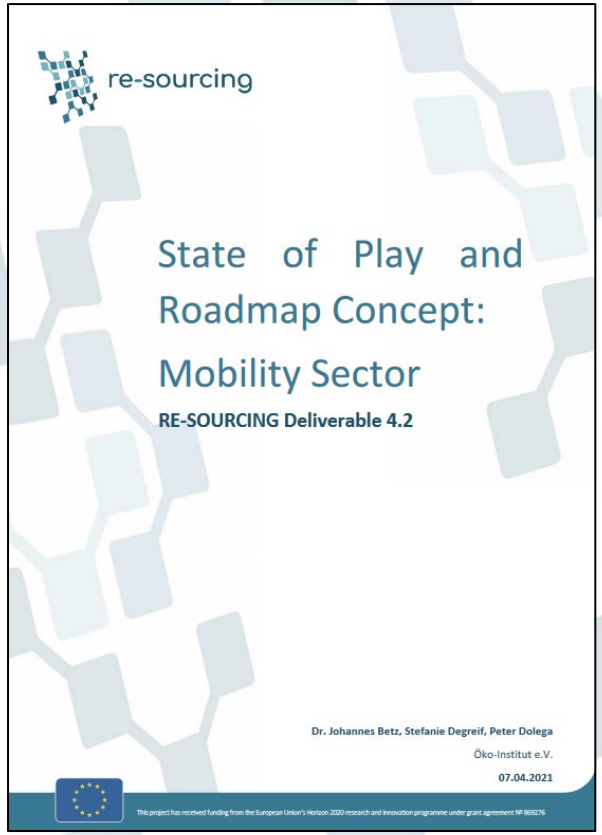
re-sourcing

Mobility Roadmap Workshop 28th of October 2021

The Mobility Sector & Responsible Sourcing

Summary of work to date

Dr. Johannes Betz, Oeko-Institut e.V., Germany


re-sourcing

State of Play and Roadmap Concept: Mobility Sector

RE-SOURCING Deliverable 4.2

Dr. Johannes Betz, Stefanie Degreif, Peter Dolega

Öko-Institut e.V.

07.04.2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 869276

See „State of Play and Roadmap Concept“ on the RE-SOURCING website here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 869276

re-sourcing

Overall schedule of the mobility sector

State of Play with roadmap concept published

(April 2021)

Roadmap Workshop

(28th of Oct)

Roadmap Stakeholder Consultation

(Spring/ Summer 2022)

Roadmap Mobility Sector publication

(Summer 2022)

Flagship Cases: Contact Representatives and Validation

(July - Oct)

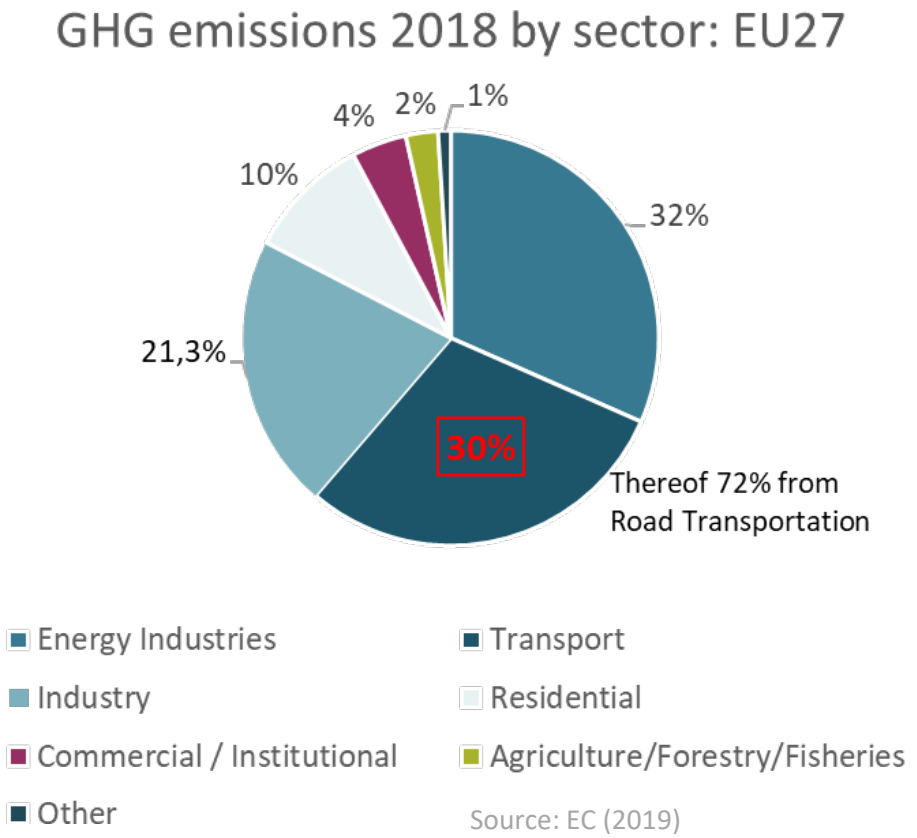
Flagship lab & Good practice guidance doc

(beginning 2022)

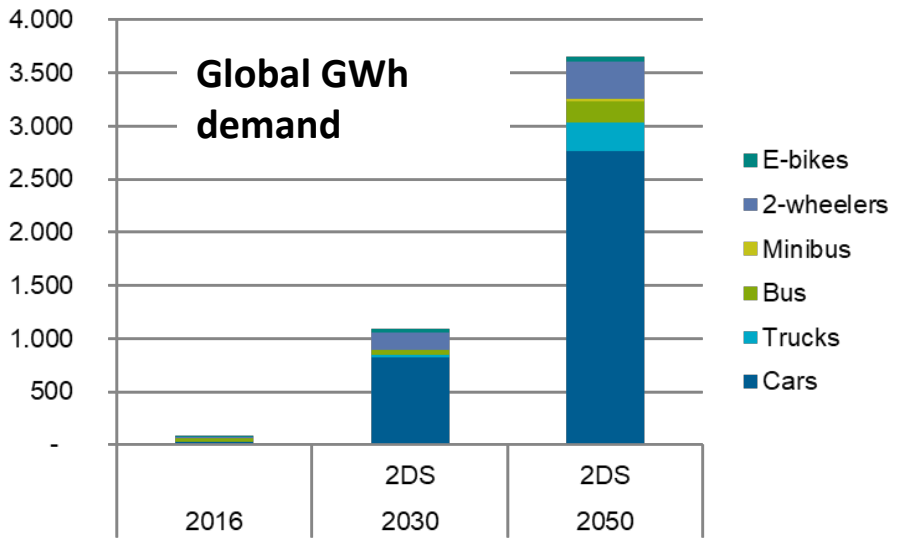
1

Introduction – Focus in the mobility sector

Relevance of road transportation in the EU



Source: EC (2019)

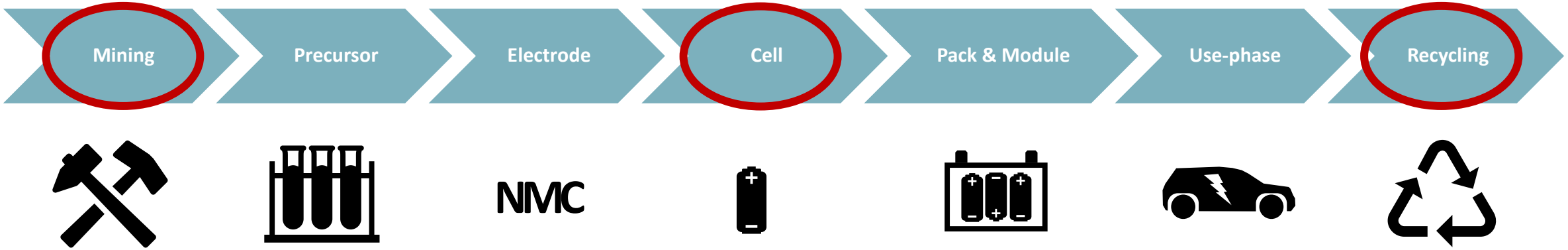


Sources: Eurostat; Figure: Oeko-Institut 2019

- **Focus of the project on lithium ion batteries**

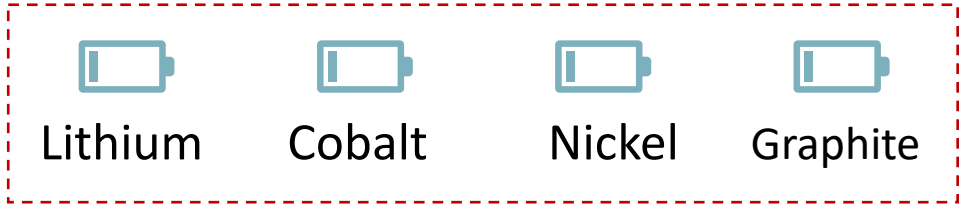
re-sourcing

Focus on the lithium-ion battery value chain



Focus along the value chain

- **Mining** of selected materials
- **Cell production**
- **Recycling**

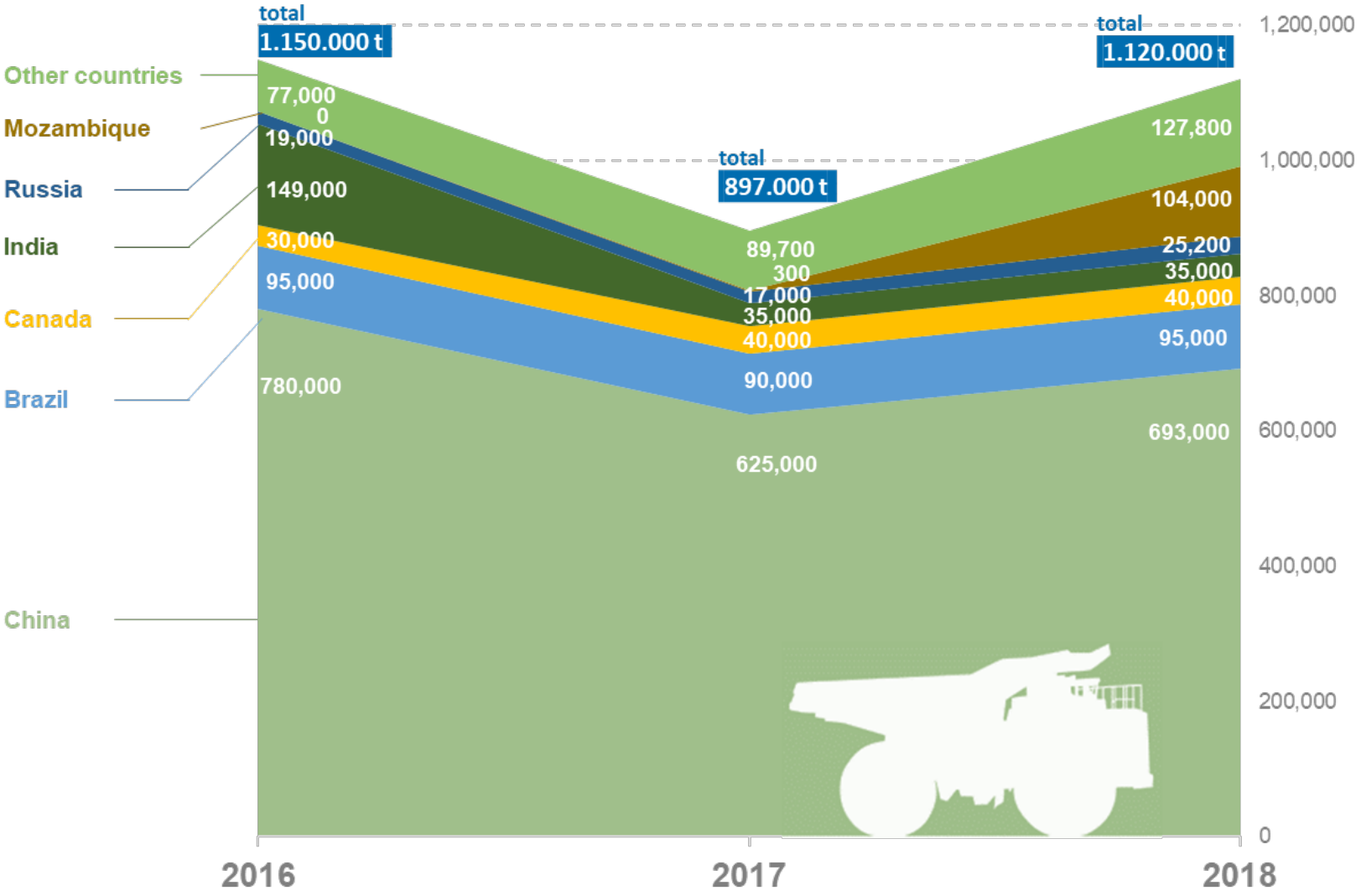


2

Mining – Graphite as example

re-sourcing

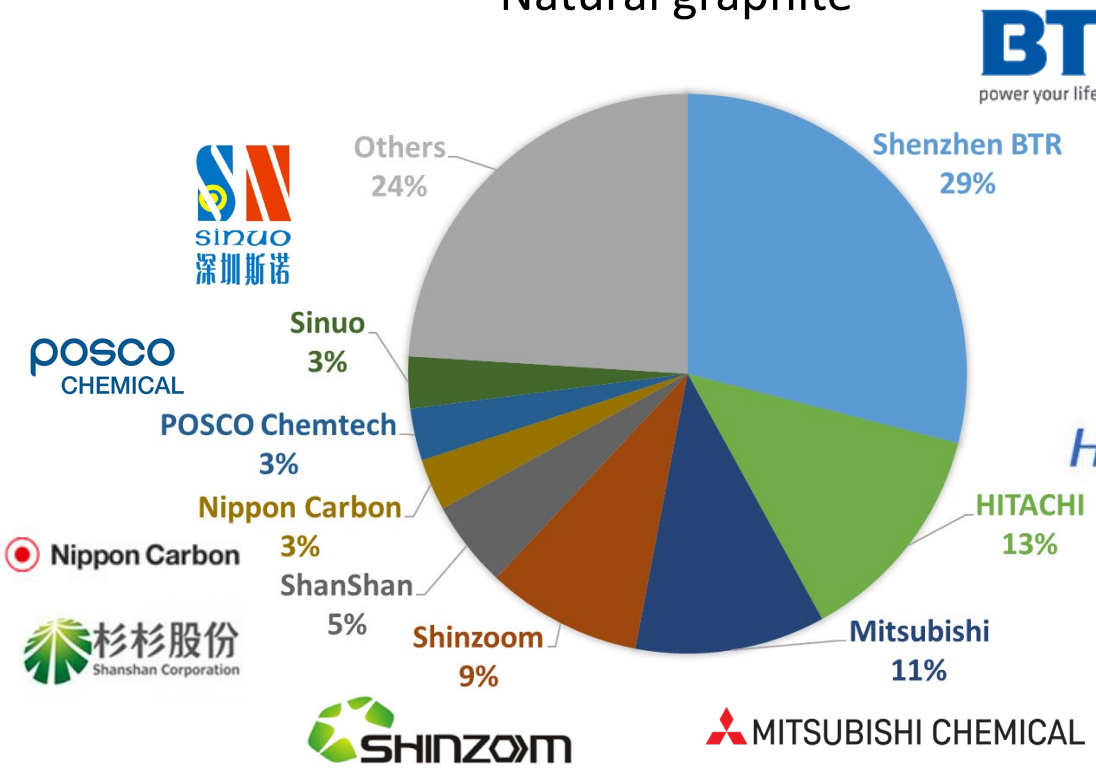
Country overview for natural graphite



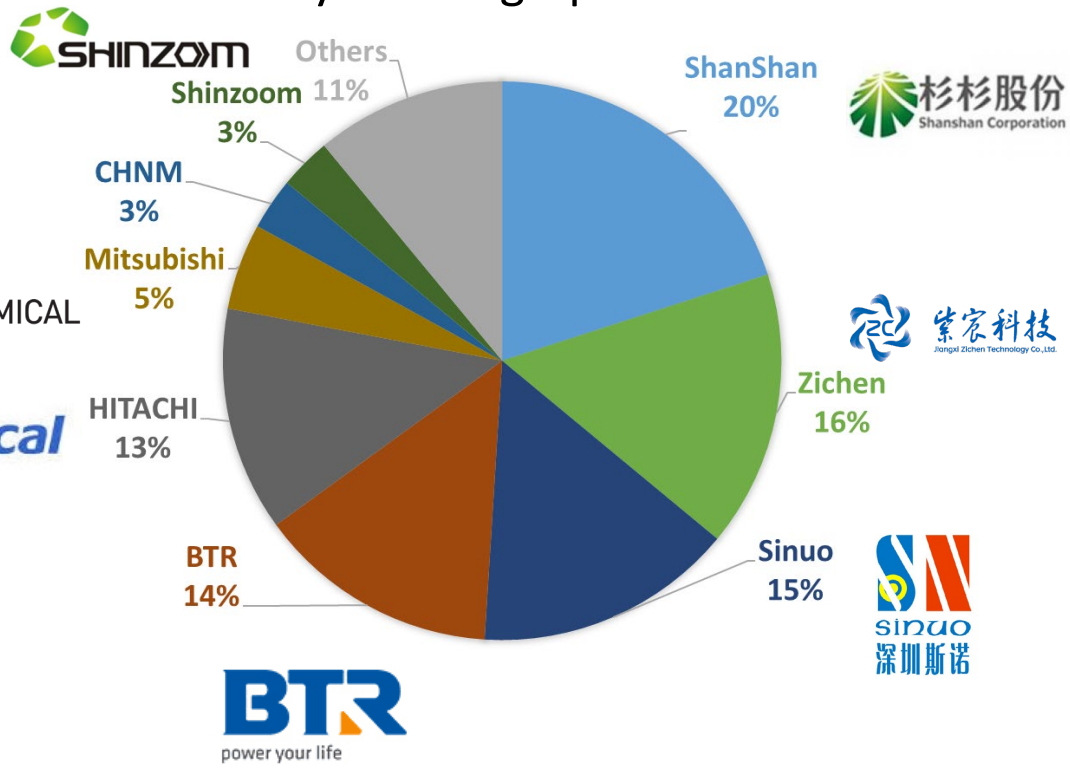
Data source: USGS Mineral Commodity Summaries, 2018 (https://bit.ly/3mmezgB), 2019 (https://bit.ly/32xEnyB), 2020 (https://on.doi.gov/33paCiI)

Companies involved in graphite production

Natural graphite



Synthetic graphite



Data source: Pillot. (2019): Pillot, C., The Rechargeable Battery Market and Main Trends 2018-2030. Avicenne Energy.

Companies involved in graphite production (EU)

Natural graphite

- Talga Resources
  - based in Australia, mining in Sweden, processing in Germany
- Zavalyevskiy Graphite
  - mining at the largest mine (flake graphite) in Europe, the Zavalye graphite field in Ukraine
- Leading Edge Materials
  - graphite production at the Woxna Graphite project
  - also involved in REE and lithium mining
- Mineral Commodities Ltd (MRC)
  - operates the Trælen mine in Norway
- Grafitbergbau Kaisersberg
  - mine in Austria producing amorphous graphite
- Graphit Kropfmühl
  - subsidiary of Dutch Advanced Metallurgical Group N.V. (AMG)
  - one mine in Bavaria, Germany

Synthetic graphite

- SGL Carbon
  - German company with sites around the world
  - produces synthetic graphite and other carbon products

re-sourcing

Production of graphite

Synthetic graphite:

- High energy consumption and higher cost
- Precursors resulting as side products from crude oil or coal production

Natural graphite:

- Mined both in open cut and underground mines
  - Similar problems as mentioned before
- Purification often conducted by acid treatment (hydrofluoric acid and others) → Water pollution, if not sufficiently monitored

(1) Schmuch, R.; Wagner, R.; Hörpel, G.; Placke, T.; Winter, M., *Nature Energy* **2018,** 3, (4), 267.

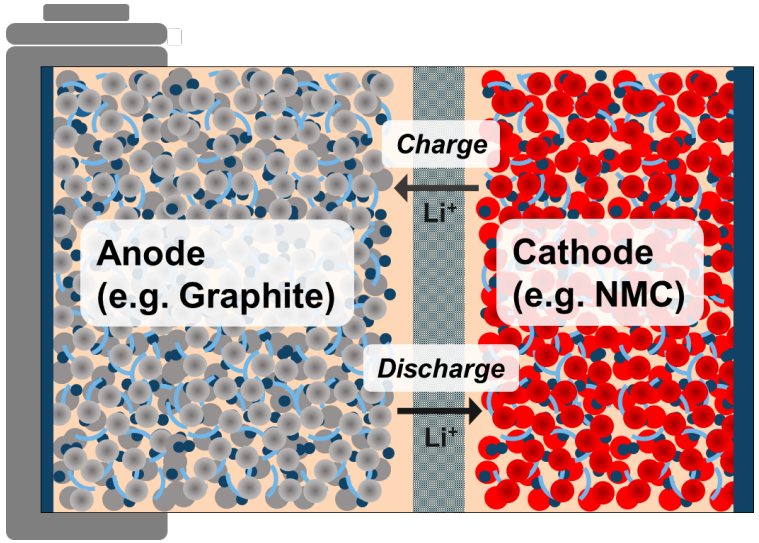
(2) The Washington Post: In your phone, in their air. [https://www.washingtonpost.com]

3

Production of battery cells

LIB cell

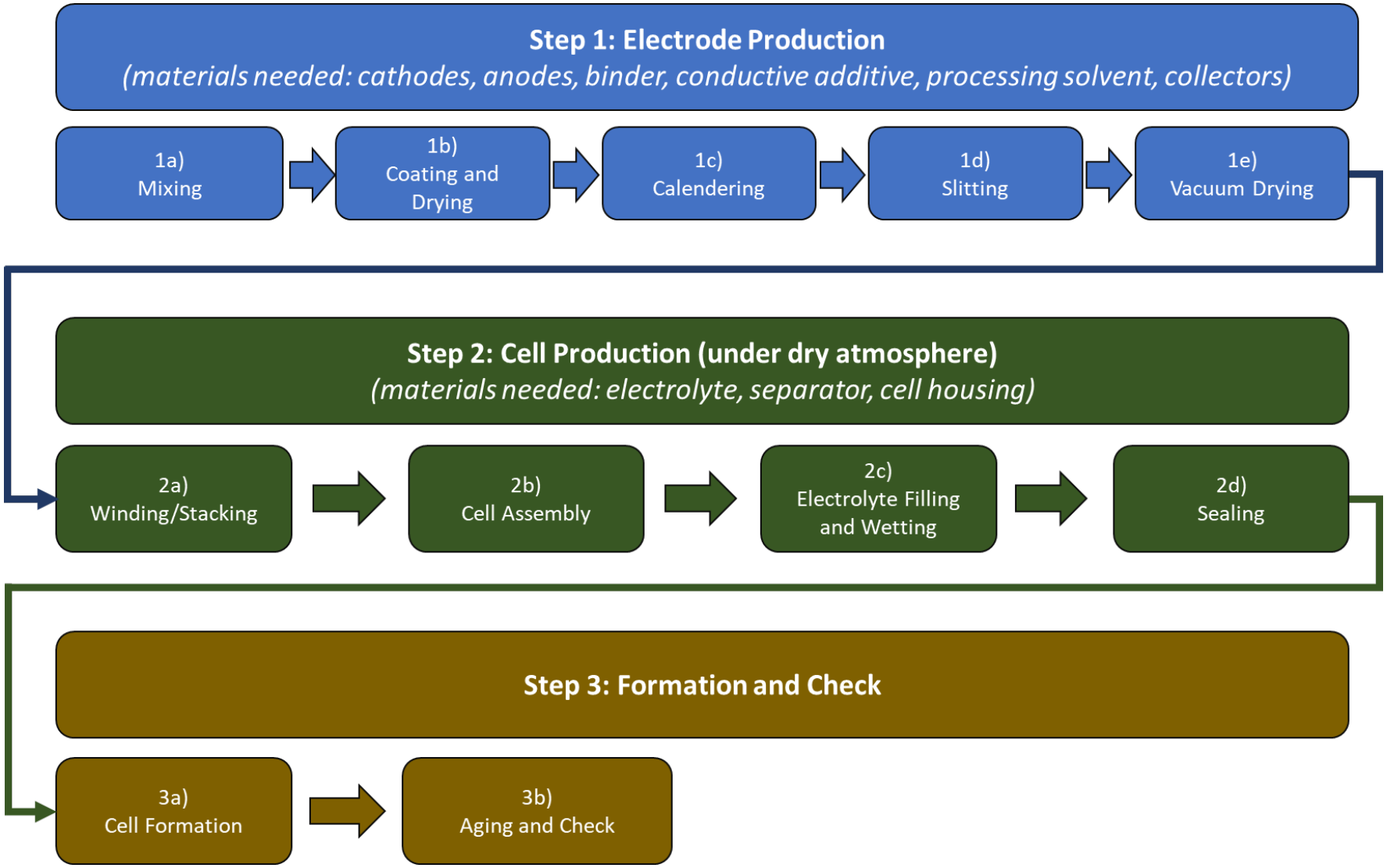
- Different cell formats
  - Pouch
  - Prismatic
  - Cylindric
- Cell stack
  - Combines both the electrodes on top of current collectors
  - Separator soaked in electrolyte



(1) Betz et al. (2019) Advanced Energy Materials, 9(6), 1803170.
(2) Winter et al. (2017): Elektromobilität – Was uns jetzt und künftig antreibt
http://www.bine.info/themen/publikation/elektromobilitaet-was-uns-jetzt-und-kuenftig-antreibt/

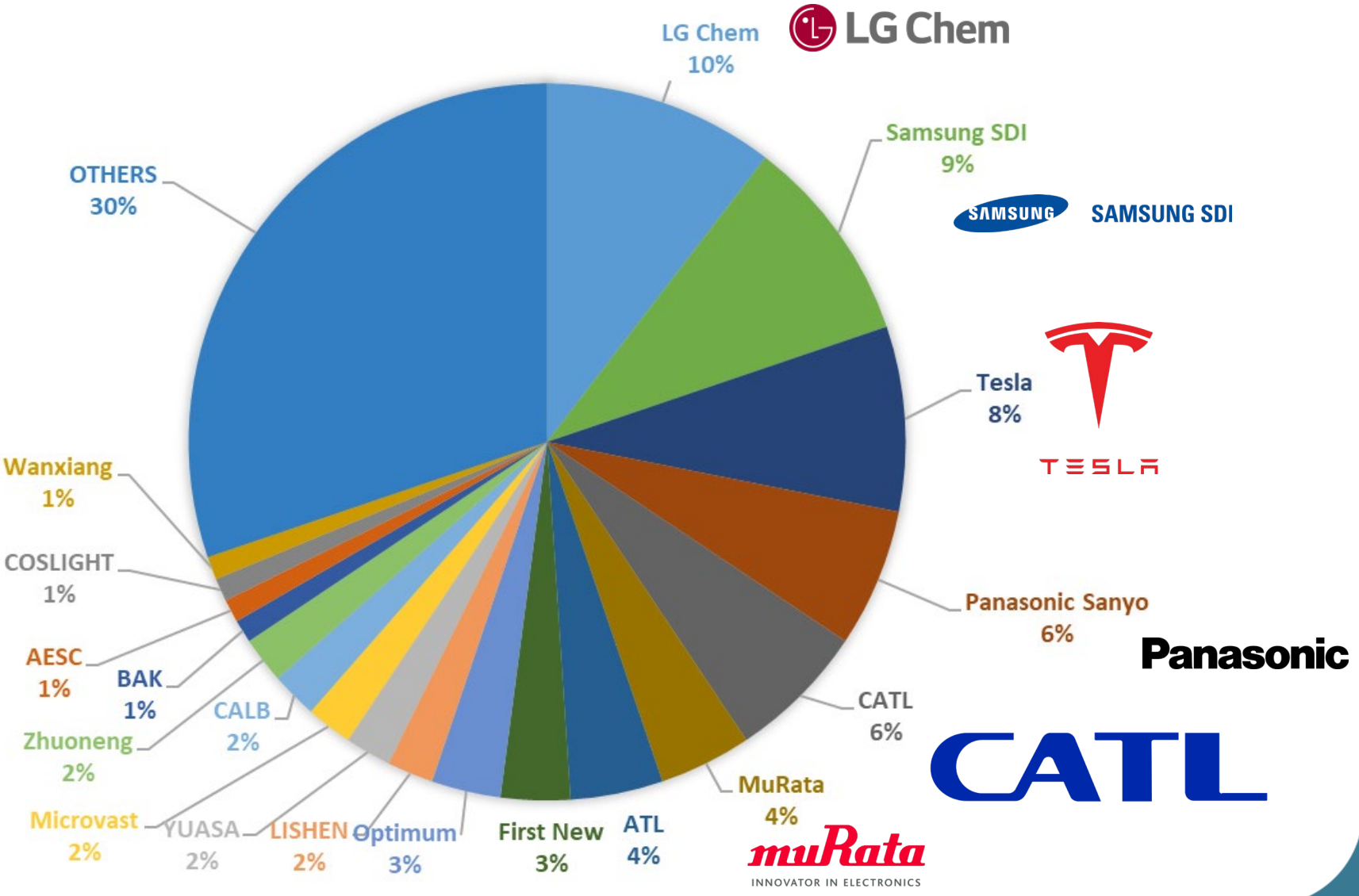
re-sourcing

Overview over cell production



re-sourcing

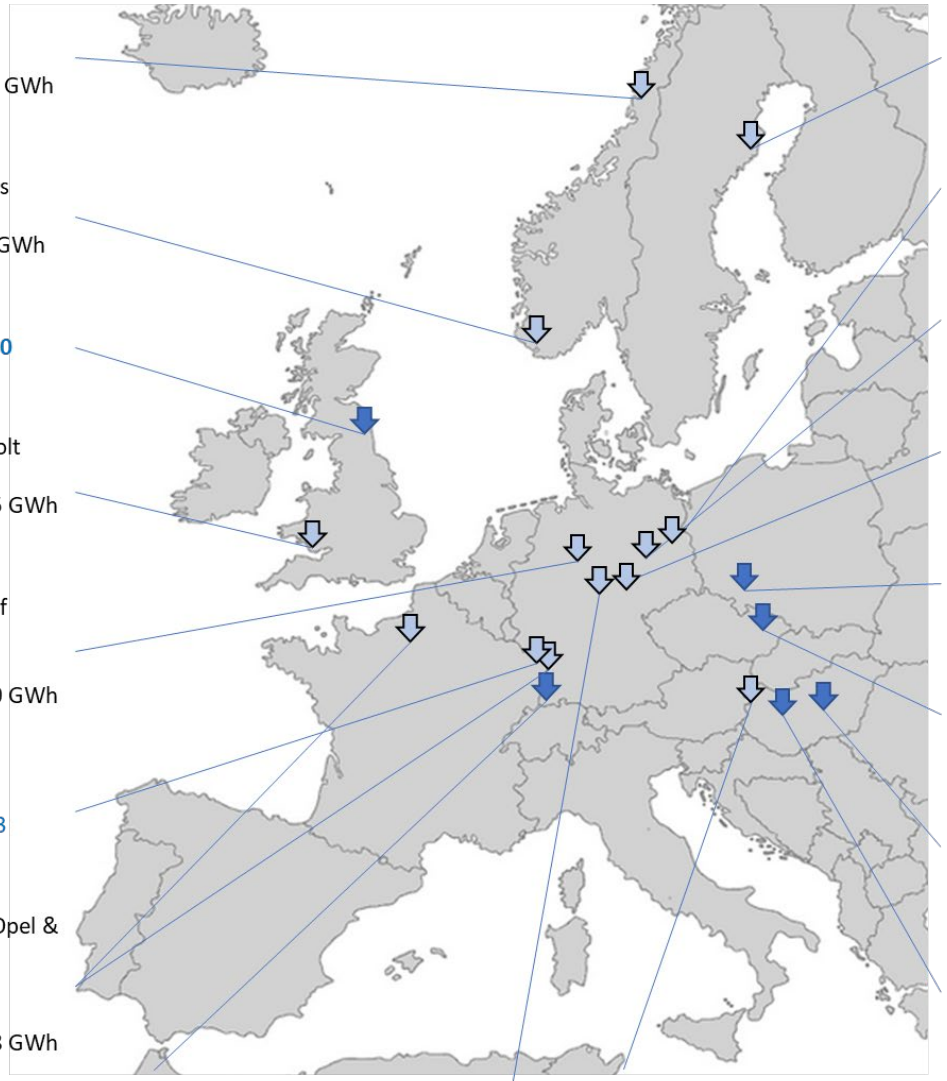
World lithium ion battery pack production 2018



Source: Pillot. (2019): Pillot, C., The Rechargeable Battery Market and Main Trends 2018-2030. Avicenne Energy.

re-sourcing

Battery cell production announcements in the EU



FREYR
Mo i Rana, 2023
ramp up to 32+2 GWh

Morrow Batteries
Arendal, 2024
8 GWh, later 32 GWh

Envision AESC
Sunderland, 2010
1,9 GWh

AMTE & Britishvolt
St. Athan, 2023
10 GWh, later 35 GWh

Northvolt II (JV of Northvolt & VW)
Salzgitter, 2024
16 GWh, later 30 GWh

SVOLT
Überherrn & Heusweiler, 2023
later 24 GWh

ACC (Stellantis (Opel & Total (Saft))
Kaiserlautern & Douvrin, 2022
16 GWh, later 48 GWh

Northvolt
Skelleftea, 2021
32 GWh, later 40 GWh

Tesla
Grünheide, 202x
Capacity unknow

Microvast
Brandenburg, 2021
Ramp up to 8-12 GWh

FARASIS
Bitterfeld, 2022
6 GWh, later 10 GWh

LG Chem
Wroclaw, 2018
15 GWh, later 65 GWh

Magna Energy Storage MES
Horní Suchá CZ
1,2 GWh

SAMSUNG SDI
Göd, 2018
3 GWh, later 15 GWh

SK Innovation
Komarom 1+2, 2020
7,5 GWh + 9,8 GWh,
later 16 GWh

Leclanché
Willstädt, 2020
1 GWh

CATL
Erfurt, 2022
14 GWh, later 24 GWh

InoBat
Bratislava, 2024
Later 10 GWh

BYD
Europe, 202X
Capacity unknow

4

Recycling of battery cells

Recycling of lithium ion battery cells

- Recycling industry in the EU is expecting huge rise of input stream
- The reasons are:
  - Start of production of battery cell plants
  - Retraction of several thousand tons of faulty car batteries
  - Battery market rose strongly in the last years

→ Disposal of batteries could get very difficult, as recycling capacities are too small

Source: https://pixy.org/1378555/

Lithium ion battery recycler in the EU

Over 1000 tons per annum (t/a):

- Umicore (Belgium, 7000 t/a)
- Nickelhütte Aue (Germany, 3000 t/a)
- Accurec (Germany)
- Redux (Germany, 2000 t/a)
- VW (Germany, 1200 t/a)

Companies planning lithium-containing battery recycling plants in Europe:
Primobius, BASF, Northvolt (I+II), Fortum (Finland)

Under 1000 t/a:

- SNAM (France)
- EDI (France)
- TES-AMM (formerly “Recupyl”) (France)
- AkkuSer (Finland)
- Duesenfeld (Germany)
- Promesa (Germany)

Lithium ion battery recycler in the rest of the world

Over 1000 tons per annum (t/a):

- SungEel (South Korea)
- Kyoei Seiko (Japan)
- Dowa (Japan)
- Brunp (China)
- GEM (China)
- Huayou Cobalt (China)
- Ganzhou Highpower (China)
- Li-Cycle Corp (US)

Under 1000 t/a:

- Retriev (US)
- Kobar (South Korea)
- JX Nippon (Japan)
- Telerecycle (China)
- Guanghua (China)

Source: https://pixabay.com/de/illustrations/recycling-pfeile-netzwerk-gr%C3%BCn-4091876/

5

Regulation, Standards and Initiatives

re-sourcing

Regulation, Standards and Initiatives

Mining & Mineral Processing → Production → Disposal & Recycling

Mining & Mineral Processing

- IFC EHS Guidelines
- LME
- EITI
- Extractive Waste Directive
- TSM / TSM
- IRMA
- Global Tailings Review
- CTC
- China Responsible Mineral Supply Chain Due Diligence Management Guide
- CIRAF
- OECD Due Diligence Guidelines
- ARM
- ICMM Mining Principles
- Responsible Minerals Initiative
- ERMA
- Fair Cobalt Alliance
- World Bank Climate-Smart Mining Initiative
- Responsible Cobalt Initiative

Disposal & Recycling

- **ELV Directive**
- **Basel Convention**
- WEEE European Standard

Mobility / Battery-Specific Standards and Initiatives

Drive sustainability | EBA | GBA | **Proposed EU regulation on (waste) batteries** | EGVI

General Standards

EU Directive on safety and health at work	ISO 50001; 20400; 26000	UN Human Rights Principles; UN Global Compact
ISO 14000-series	GRI	EBRD Guidance
ISO 45001/OHSAS 18001	IFC EHS	OECD Multinational Enterprises
ISO 9001	ILO	SDGs

Colour: **Mandatory regulation;** mandatory standard; voluntary standard; guiding principle; initiative

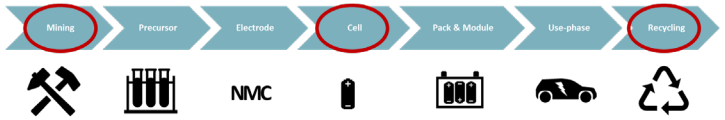
re-sourcing

6.

Vision

Vision

- How should the mobility sector look like in 2050?



→The vision builds on the basic assumption:

- international cooperation
- harmonized reporting systems

→ Further issues clustered in the sustainability pillars and three value chain steps

re-sourcing

Vision

Vision of the Mobility Sector

Environmental | **Social** | **Economic**

International Cooperation

Harmonised reporting systems; clear global criteria for responsible and sustainable practice

Targets across all value chain steps

Environmental	Social	Economic
• **Limiting Climate change to 1.5°C** • Carbon-neutral production and transport • Net-positive environmental impact • Net-positive contribution to biodiversity • Zero pollution of land and sea • Zero harmful emissions • Use of renewable energy sources • Resource efficiency (decreasing need for primary raw materials, no use of ground-water, energy efficiency, etc.)	• Zero human rights violations • Gender equality in all stages of the supply chain • Elimination of poverty & hunger • Secure access to food, clean air & water, sanitation, health care • Meaningful stakeholder engagement • Support of local development • Fair compensation for land-use • Respect for land rights • Occupational health & safety • Community health & safety • Local recruitment • Knowledge sharing & training	• Sustainable and responsible investments • Fair wages • Transparency • Zero financial crime • Fair compensation for land–use, minerals, etc. • "Unsustainability is unprofitable" • Companies accept their responsibility • Absolute decoupling of economic growth from resource consumption & environmental impact • Level playing field
Mining & Mineral Processing		
• Zero hazardous tailings discharge • Re-use of tailings & waste rock • Better-than-before reclamation • Efficient processing, incl. energy & water efficiency, improved recovery • Efficient use of deposit • Remediation of abandoned mines	• Formalisation of ASM sector & full integration in the supply chain • Cooperation between LSM and ASM • Conflict free mineral supply chains • Sharing of infrastructure (especially in remote areas) • Ensuring water availability & quality for neighbouring communities • Free prior informed consent	• Proof of origin & traceability of minerals • Transparent granting of mining licences • Use of new technologies & automation • Multi-stakeholder governance • Local content in value chain
Cell Manufacturing		
• Eco-design & collaboration of manufacturers and recycling plants • Responsible use of toxins, use of alternative substances if possible • Recovery of solvents • Increased input of secondary materials • Use of renewable energy • Reduced energy input (e.g. utilise waste heat)	• Local value creation • Occupational health & safety	• Abandonment of "the cheaper the better" philosophy • Support of responsible production practices upstream • Local sourcing where possible • Process optimization
Recycling		
• Circular economy—closed loop & zero waste culture • Recycling of all recyclable materials used in Li-ion batteries • Evaluate used Li-ion batteries regarding 2nd life opportunity • Eco-design & collaboration of manufacturers and recycling plants • No dumping of toxic materials in landfills	• Maintaining air quality • Maintaining water quality • Health and safety in collection, transport and recycling • Occupational health & safety	• Financially more attractive than primary raw materials • Landfilling is forbidden • Innovation friendly environment • Adequate legal basis for recycling • Local recycling & reuse

re-sourcing

re-sourcing

Vision

Overarching aims

Vision of the Mobility Sector

Environmental | **Social** | **Economic**

International Cooperation

Harmonised reporting systems; clear global criteria for responsible and sustainable practice

- **Limiting Climate change to 1.5°C**
- Net-positive environmental impact
- Net-positive contribution to biodiversity
- Carbon-neutral production and transport
- Zero pollution of land and sea
- Zero harmful emissions
- Use of renewable energy sources
- Resource efficiency (decreasing need for primary raw materials, no use of ground-water, energy efficiency, etc.)

- Zero Human Rights Violations
- Gender equality in all stages of the supply chain
- Elimination of poverty & hunger
- Ensure access to food, clean air & water, sanitation, health care
- Meaningful stakeholder engagement
- Support of local development
- Fair compensation for land-use
- Respect for land rights
- Occupational health & safety
- Community health & safety
- Local recruitment
- Knowledge sharing & training

- Sustainable and responsible investments
- Fair wages
- Transparency
- Zero financial crime
- Fair compensation for land–use, minerals, etc.
- "Unsustainability is unprofitable"
- Companies accept their responsibility
- Decoupling of economic growth from resource consumption & environmental impact

re-sourcing

THANK YOU

for your attention!

re-sourcing

Working group sessions

Mining – Cell production/OEMs – Recycling

- You will be automatically transferred into your session room.
- Working group sessions will be led by moderators and facilitators.
- Joint roadmap development with whiteboard-tool (Miro).
- You will be asked to give a short statement: “Why do I participate? What do I want the roadmap to contain?”
- After the working group session (15:45), you will be automatically transferred into the main room.

re-sourcing

Stefanie Degreif
Project Manager
s.degreif@oeko.de

Dr. Johannes Betz
j.betz@oeko.de

Tobias Wagner
t.wagner@oeko.de

Resources & Transport
Office Darmstadt
+49 6151 8191-0

Coordinated by:
Vienna University of Economics and Business,
Institute for Managing Sustainability
Welthandelsplatz 1A
1020 Vienna
Phone: +43-1-31336-5452
Email: info@re-sourcing.eu

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

www.re-sourcing.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 869276