re-sourcing

Mobility Roadmap Workshop 28th of October 2021

Cell production session

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

Noé Barriere, Vienna University of Economics and Business , Austria

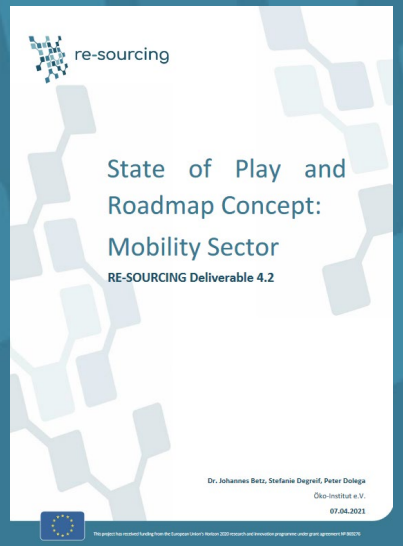
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 869276

re-sourcing

Agenda for the working group sessions

13:40-13:45	Short break & change to Working Groups		
Working Groups 1) Mining 2) Cell production/OEMs 3) Recycling		Moderators: **Stefanie Degreif** (Oeko-Institut) **Dr. Johannes Betz** (Oeko-Institut) **Tobias Wagner** (Oeko-Institut)	Facilitators: **Marie-Theres Kügerl** (Montanuniversität Leoben) **Noé Barriere** (Vienna University of Economics and Business) **Patrick Nadoll** (EIT RawMaterials GmbH)
13:45-14:00	**Introduction** *Current state of play and major challenges*	Working group moderators	
14:00-14:30	**Round of individual statements** *Your major inputs for the roadmap*	Participants	
14:30-15:45	**Roadmap development** *Brainstorming and prioritisation of topics, temporal arrangement*	Participants	
15:45-16:00	Coffee break & change to main conference room		

Current state of play and major challenges


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.

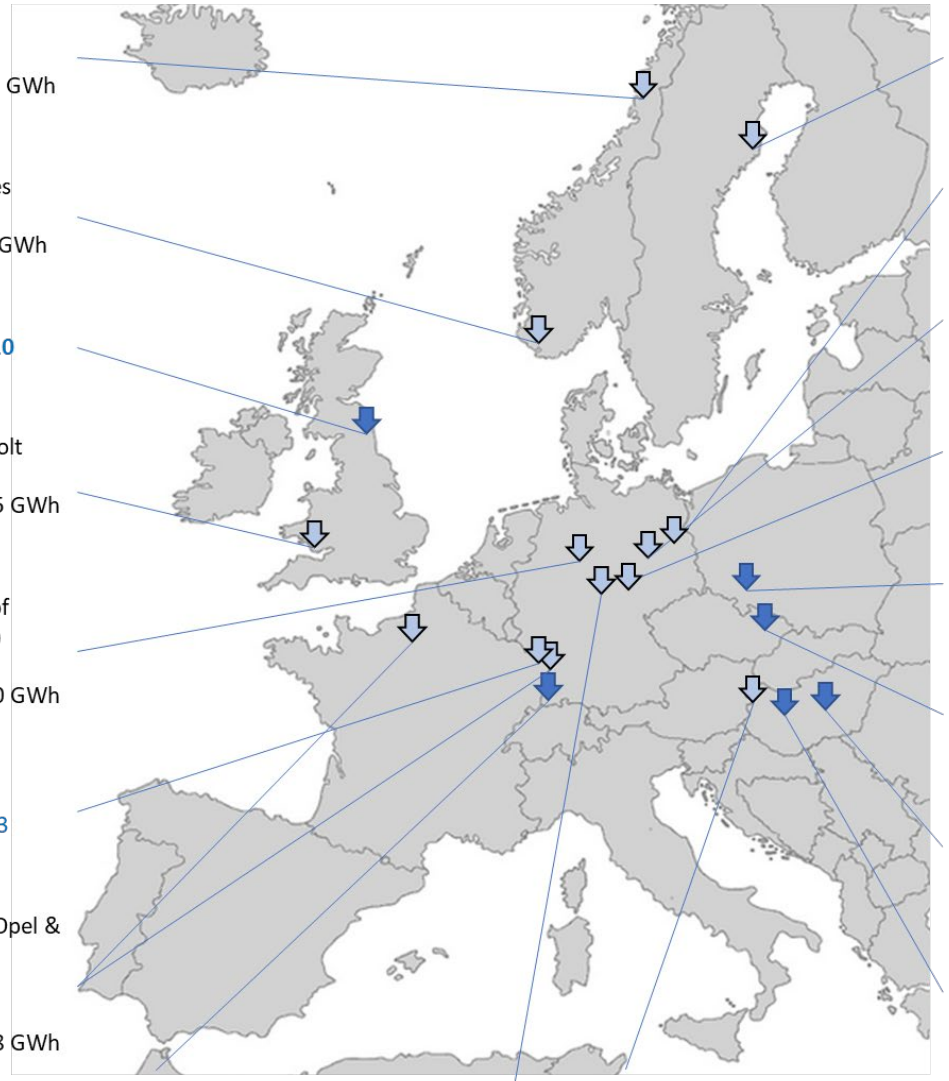
07.04.2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 869276

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

re-sourcing

Battery cell production announcements in the EU beginning of 2021



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

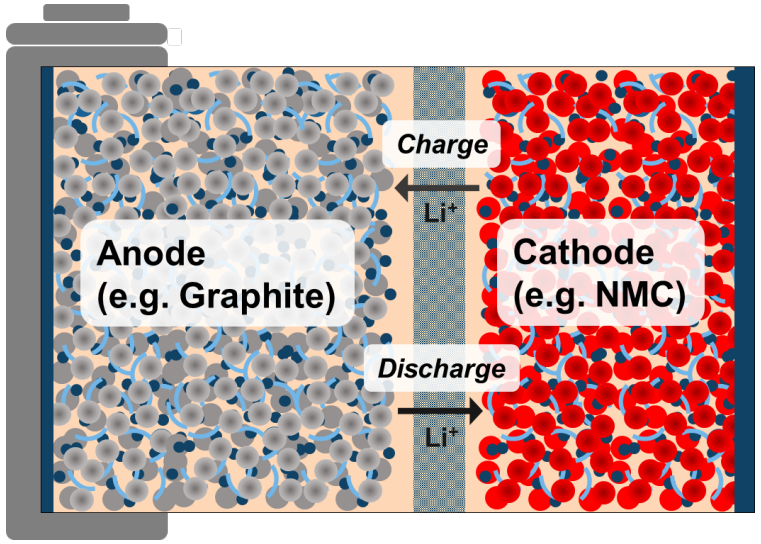
InoBat
Bratislava, 2024
Later 10 GWh

BYD
Europe, 202X
Capacity unknow

Further announcements by VW, Italvolt, Daimler, Porsche/Custom Cells, Verkor, LG and others

LIB cell

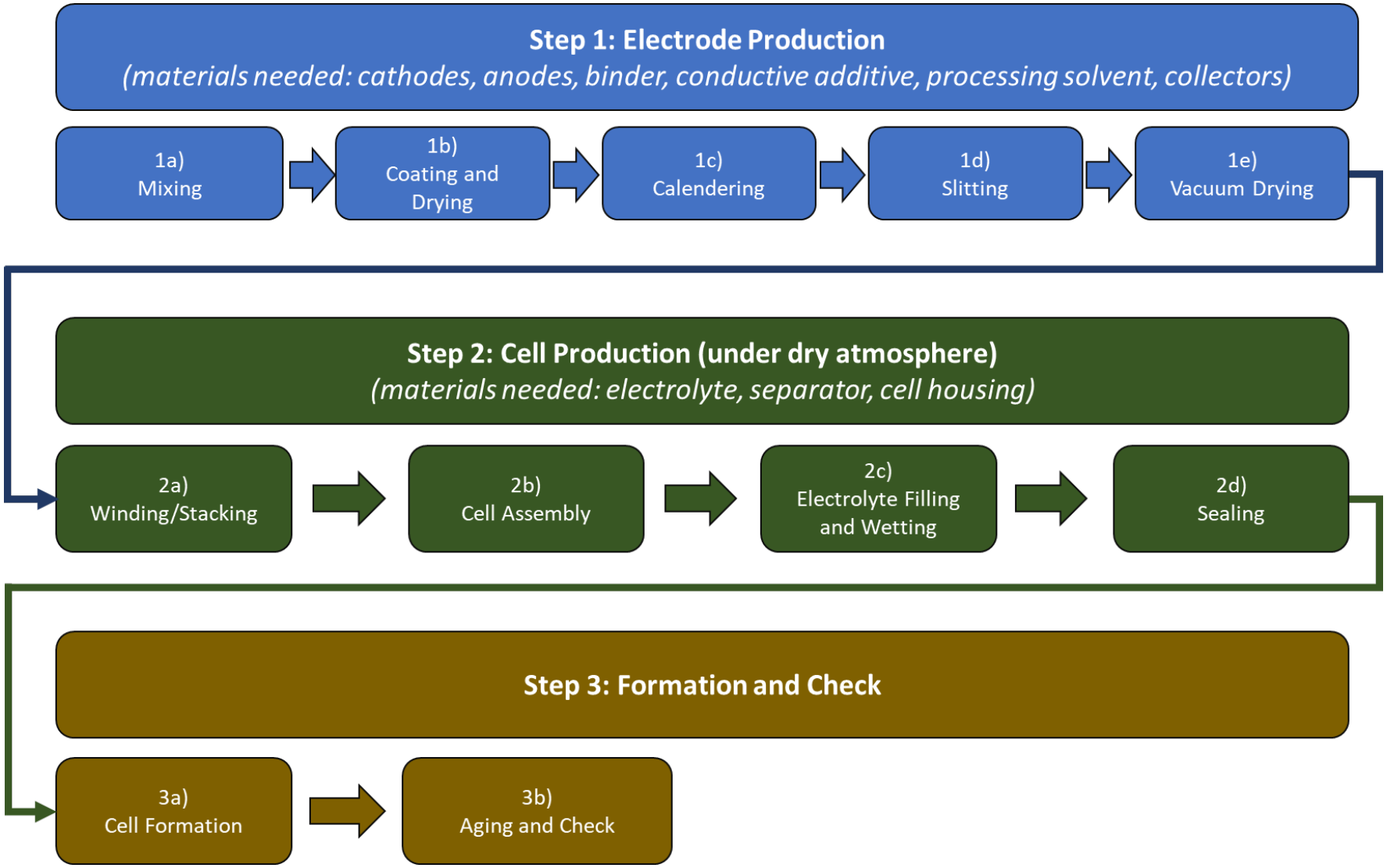
- Different cell formats
  - Pouch
  - Prismatic
  - Cylindric
- Cell stack
  - Combines both the electrodes on top of current collectors
  - Separator soaked in electrolyte



(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



Challenges of cell production

Very energy intensive processes, related to GHG emissions

- Dry room atmosphere
- Drying of electrodes after coating by convection drying
- Formation and aging of cells, including:
  - Temperature control
  - Charging/discharging
  - Recuperation necessary for energy savings

Challenges of cell production

Toxic substances as part of the battery cell:

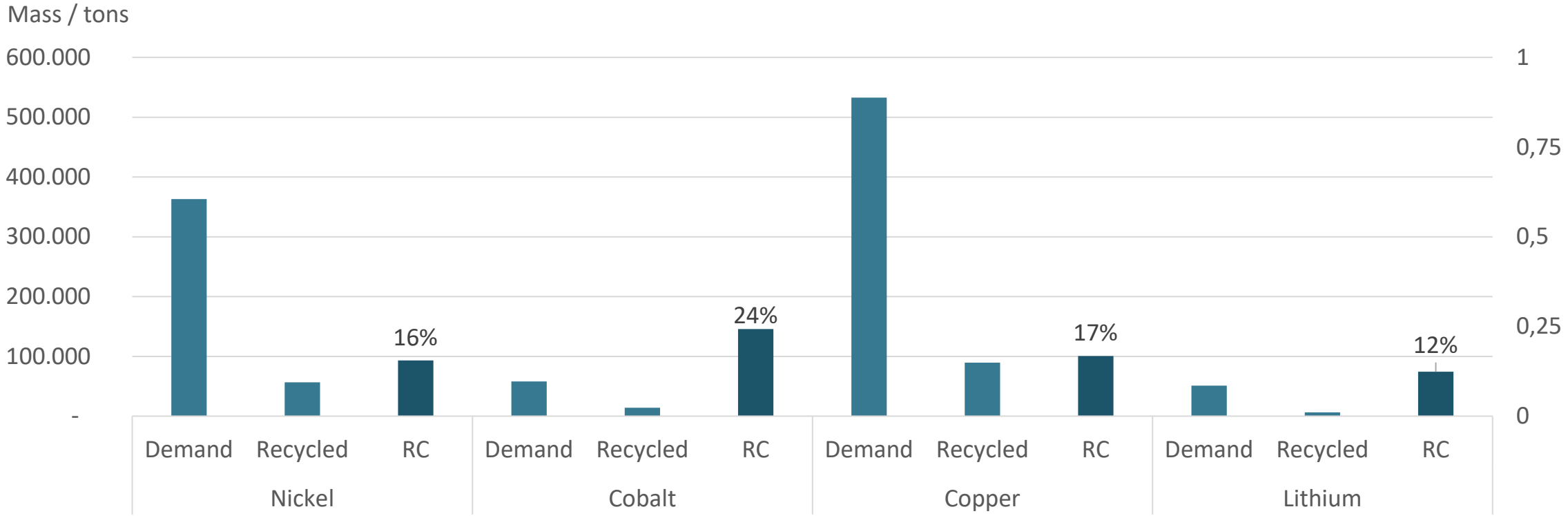
- Powders (anode, cathode, carbon black)
- Cathode itself (Co, Ni, partly toxic doping elements like Cr)
- Coatings on active materials
- Lithium salt in the electrolyte ($LiPF_6$)
  - Highly toxic decomposition products
- Often toxic processing solvents (NMP) for cathode
  - Should be recovered during drying phase
  - Release in the surrounding environment has serious consequences

Source: https://de.wikipedia.org/wiki/Global_harmonisiertes_System_zur_Einstufung_und_Kennzeichnung_von_Chemikalien

Challenges of cell production

- High susceptibility to errors leading to high scrap rates
  - Especially in the beginning of the production (5 – 40 %)
  - Material intensive production leading to a lot of waste
  - Recycling of wastes has to be established from the beginning
- Logistics is key
  - Dependency on material flows from around the world

EU-27 demand for battery materials in 2035 and potentials for recycled content (RC)



Values resulting from the battery impact assessment model accompanying the proposal for a battery regulation from the EC. It is based on the following recycling rates: Ni, Co, Cu: 95% Li: 70%. The graph also includes portable and industrial batteries, which have shorter use phases. Furthermore, no second life is considered here, which would reduce the RC even further. Taken from (Stahl et al. 2021).

Initiatives and standards

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

Vision

re-sourcing

Vision

Vision of the Mobility Sector

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

International Cooperation

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

Environmental

- **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.)

Social

- 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

Economic

- 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

Mining & Mineral Processing

Environmental

- 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—no high-grading
- Remediation of abandoned mines

Social

- 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

Economic

- Proof of origin & traceability of minerals
- Transparent granting of mining licences
- Use of new technologies & automation
- Multi-stakeholder governance

Cell Manufacturing

Environmental

- 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)

Social

- Local value creation
- Occupational health & safety

Economic

- Abandonment of "the cheaper the better" philosophy
- Support of responsible production practices upstream
- Local sourcing where possible
- Process optimization

Recycling

Environmental

- 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

Social

- Maintaining air quality
- Maintaining water quality
- Health and safety in collection, transport and recycling
- Occupational health & safety

Economic

- 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 – Cell manufacturing specific aims

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

Introduction Round

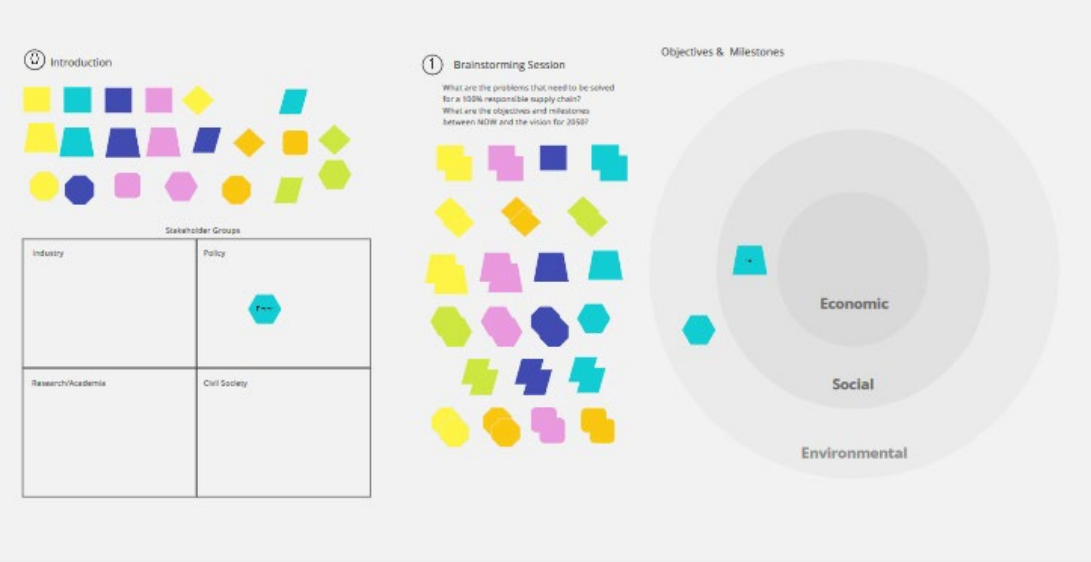
- Short introduction (1 sentence)
- Why do I participate? What do I want the roadmap to contain?

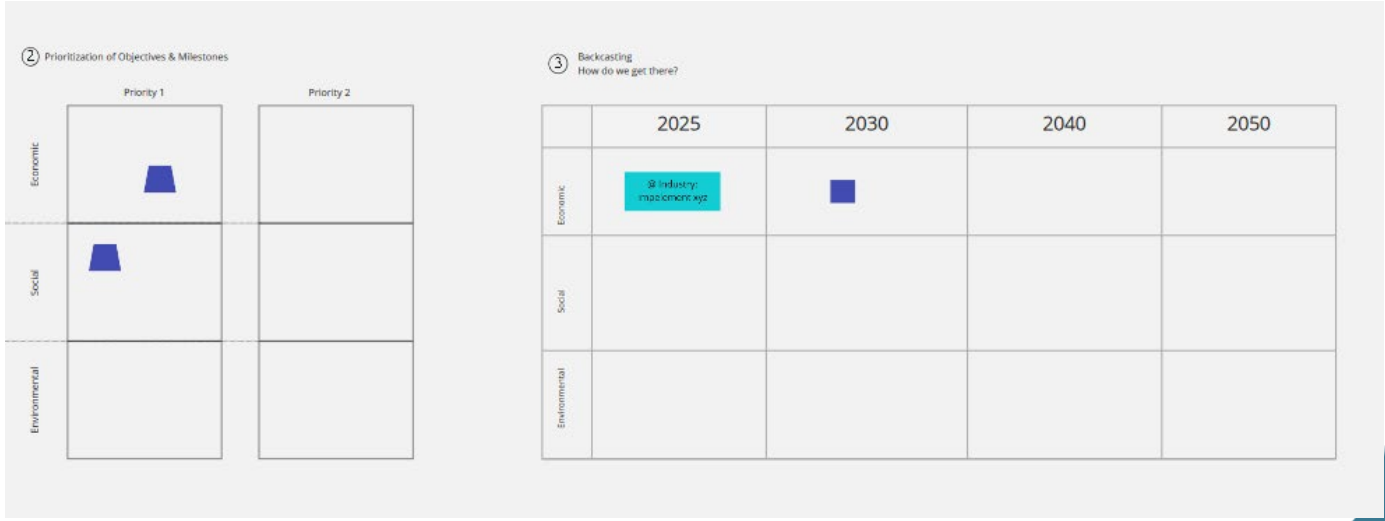
Roadmap Development

re-sourcing

Roadmap Development

- MIRO-Board; Please see link in the chat
- Everyone is invited to participate
- Use the sticky notes
- You can zoom and navigate with mouse
- Step 1: Objectives 2050
  - What do we want to achieve by 2050
  - What Milestones need to be implemented?
- Step 2: Setting Priorities via voting
- Step 3: Timeline
  - What are the concrete steps achieve the objectives?





re-sourcing

THANK YOU

for your attention!

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