

Für Mensch & Umwelt

13. Deutsch-Japanisches Umwelt- und Energiedialogforum (UEDF)

Mapping the anthropogenic stock – Pathways to a national Urban Mining Strategy

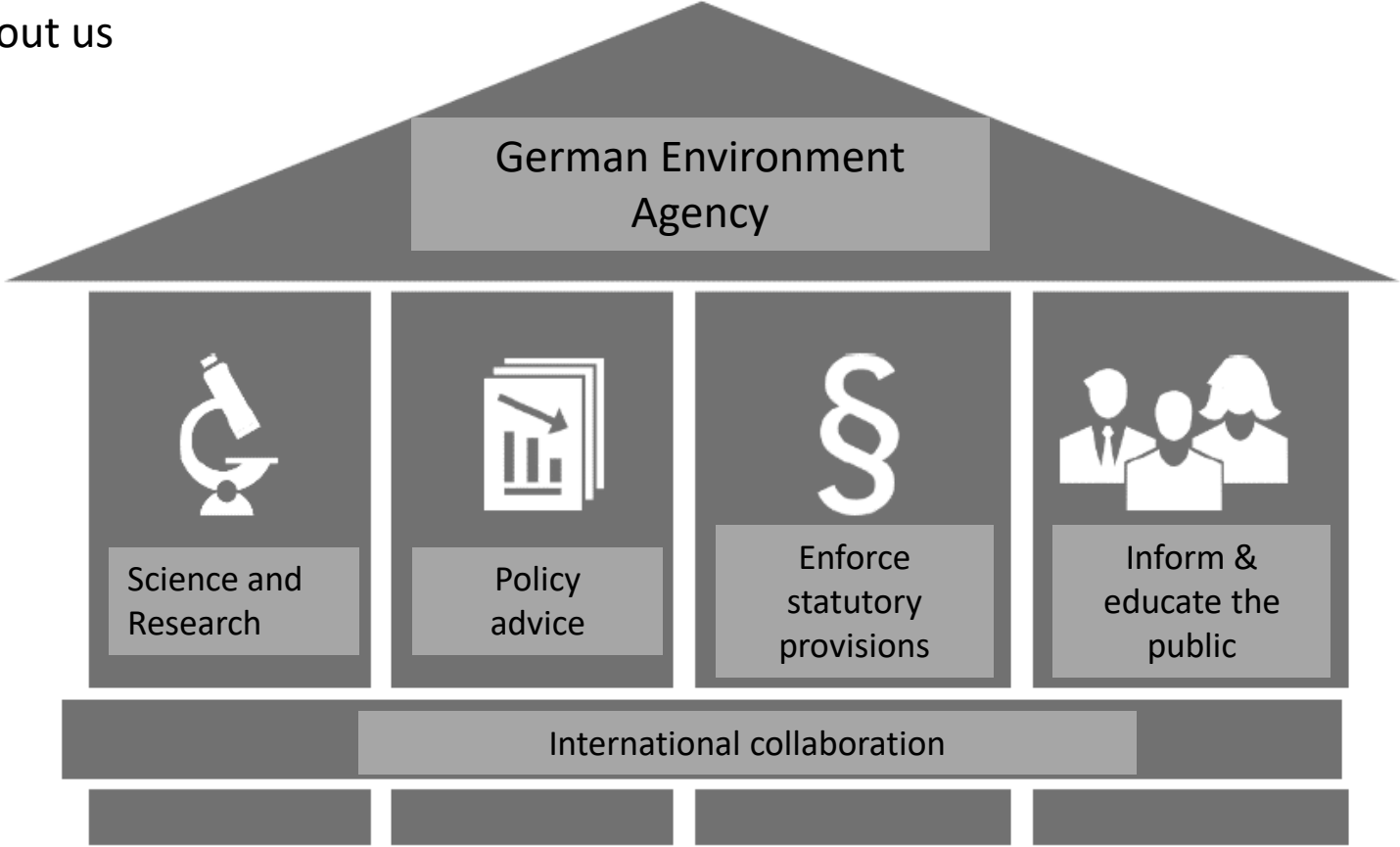
Felix Müller

III 2.2 Resource Conservation, Material Cycles, Minerals and Metal Industry

25.-26.th of January 2024, Kawasaki, Japan

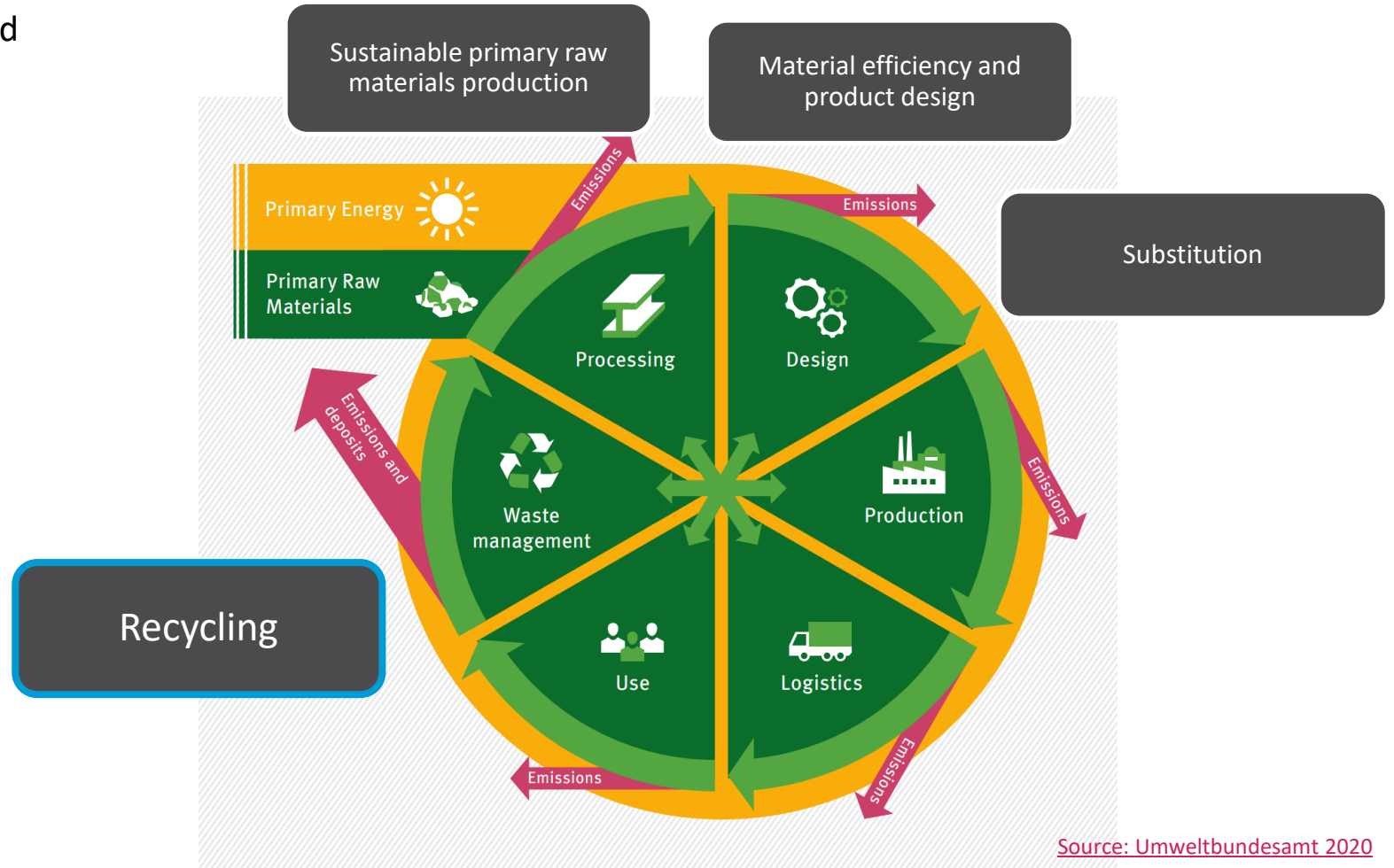
The German Environment Agency

About us



Raw materials management strategies

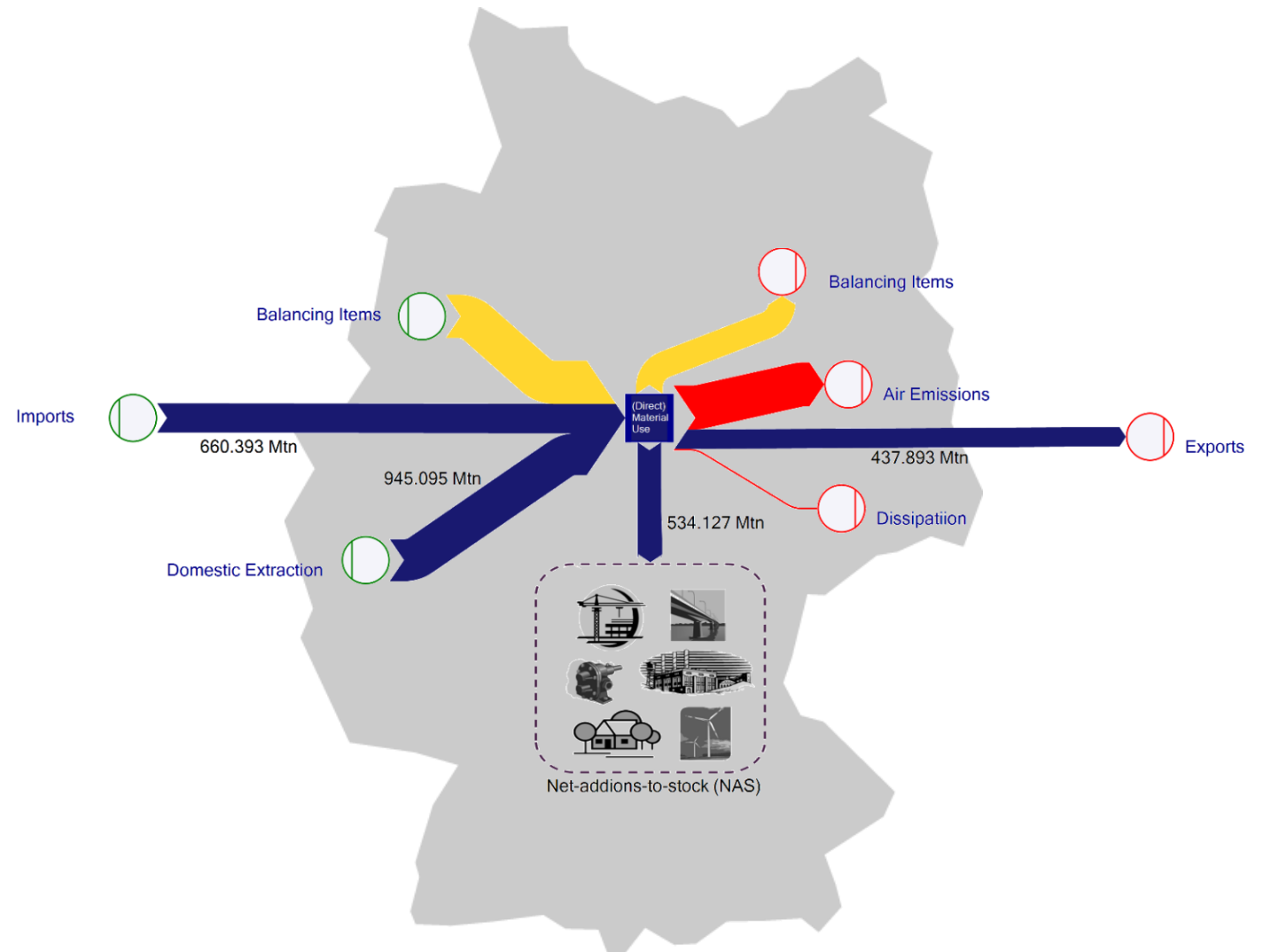
1. Germany is heavily dependent on imports of raw materials, especially fossil fuels and metals (100%)
2. 4 core strategies:
 - Sustainable primary raw materials production and supply chains
 - Material efficiency and product design
 - Substitution
 - Recycling
3. Recycling of secondary raw materials can increase self-sufficiency



Source: Umweltbundesamt 2020

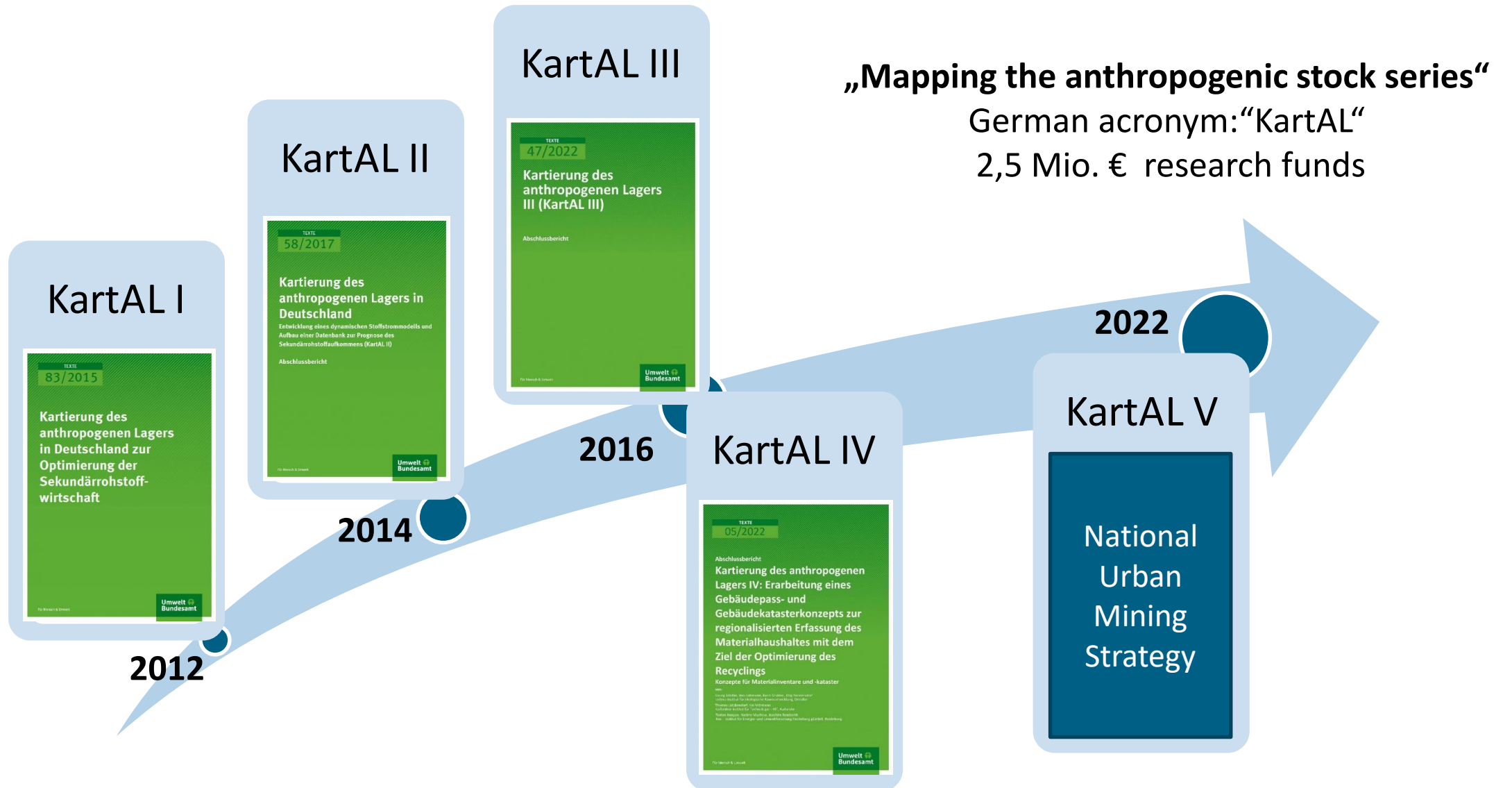
Physical growth in Germany

1. One third of Germany's direct material input leads to net stock increases in the anthropogenic stock
2. These relative increases occur in long time series
3. In absolute terms, net additions to stock decrease over decades



Industrial metabolism Germany 2022. Own illustration according to Destatis 2023

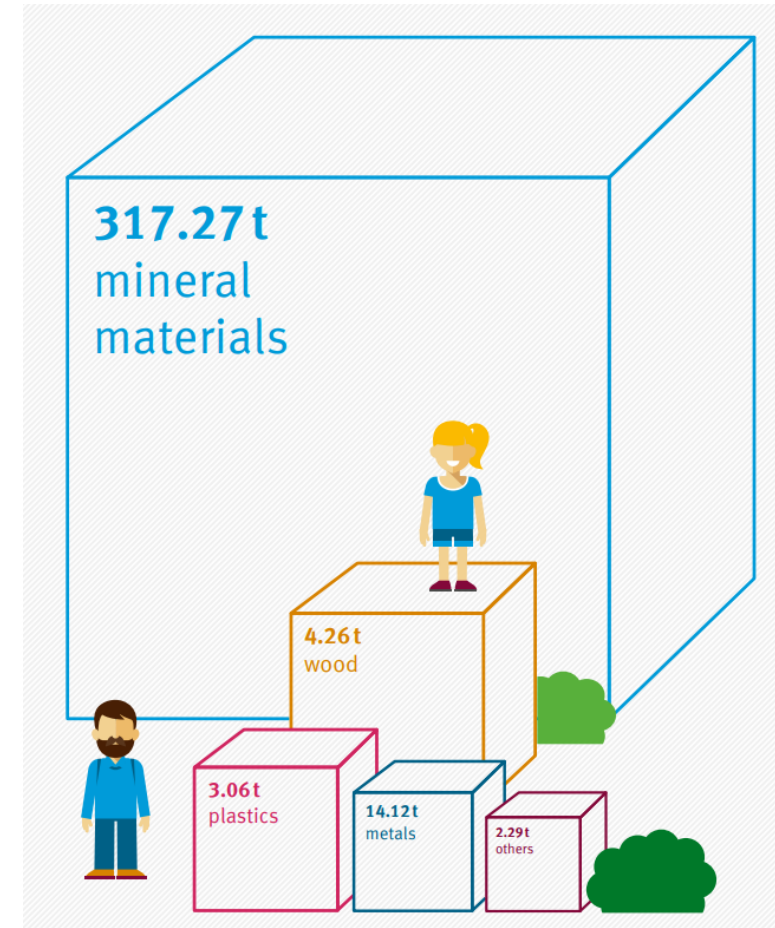
Long-term research series on urban mining – Evidence base for a strategy



Germany's anthropogenic stock research (KartAL I)

1. On the basis of historical cumulative stock growth, a material stock of 52 billion tonnes [2010] was calculated (top-down ewMFA).
 - In 2022, this corresponded to around 58 billion tonnes
2. Only around 53% (28 billion tonnes) can be allocated to goods by bottom-up analyses:
 - 55 % thereof is building construction
 - 1 % consumer and capital goods
 - 44 % civil engineering, **including 2% energy infrastructure** → **These contain 4% of the total metals in the anthropogenic stock, undergoing strong growth!**

Material stocks per capita in Germany [2010] – validated by bottom-up approaches

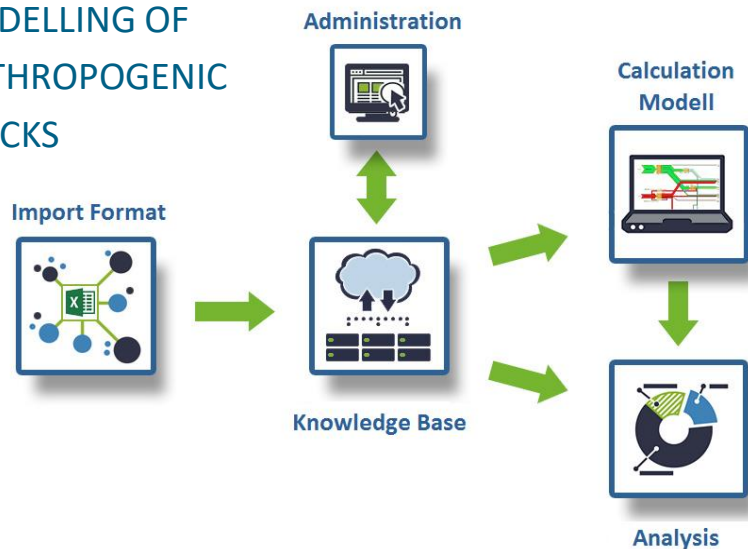


Source: Umweltbundesamt 2019

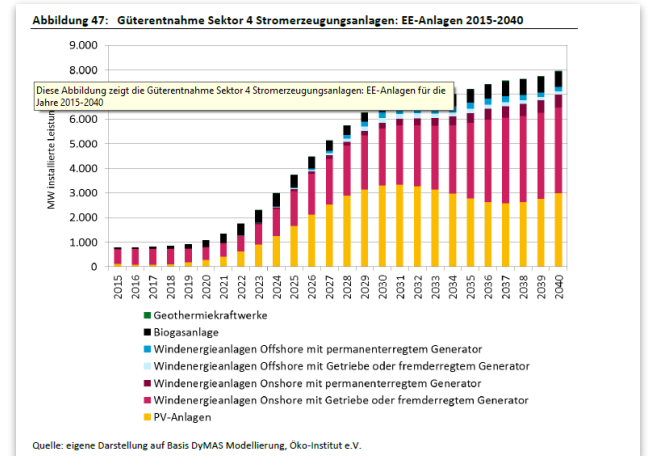
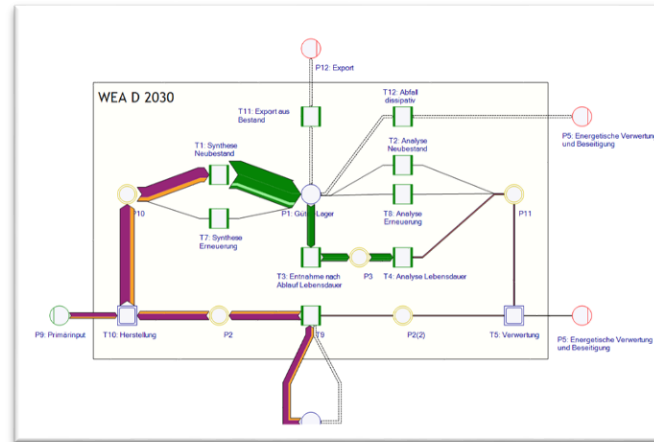
Challenge: Mastering the technology mix, market dynamics, lifetimes and dwell time distributions (KartAL II)

DyMAS

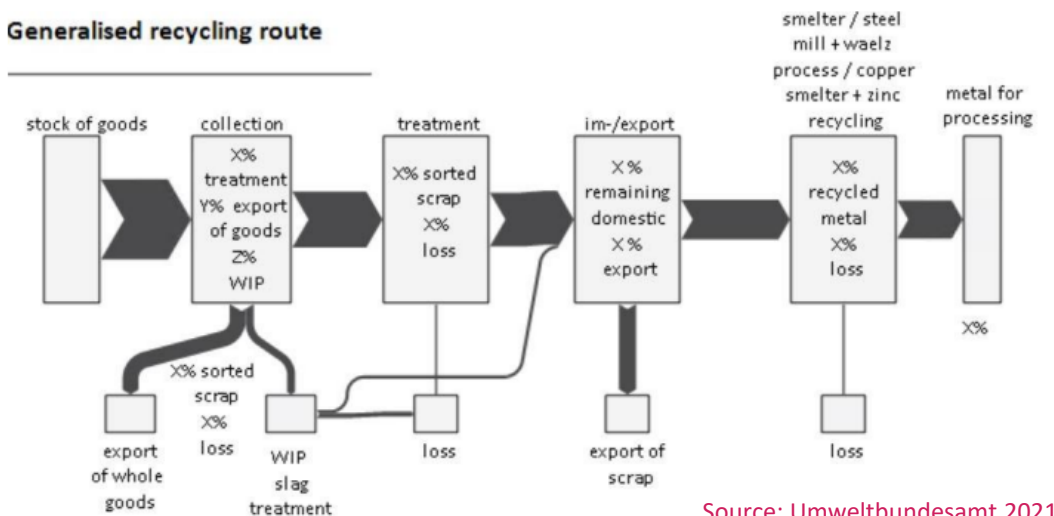
DYNAMIC
MODELLING OF
ANTHROPOGENIC
STOCKS



- Development of a strategic database for the forecast of flows and stock developments in Germany to support the urban mining strategy
- Diversified material inventories, dynamics via dwell time functions (e.g. Weibull) and modelling of the recycling system with efficiencies and losses



Generalised recycling route

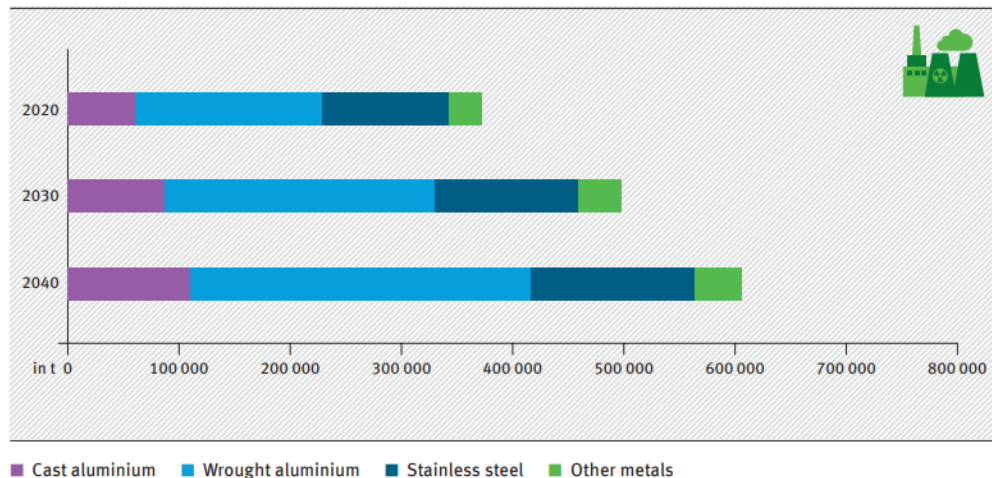


Source: Umweltbundesamt 2021

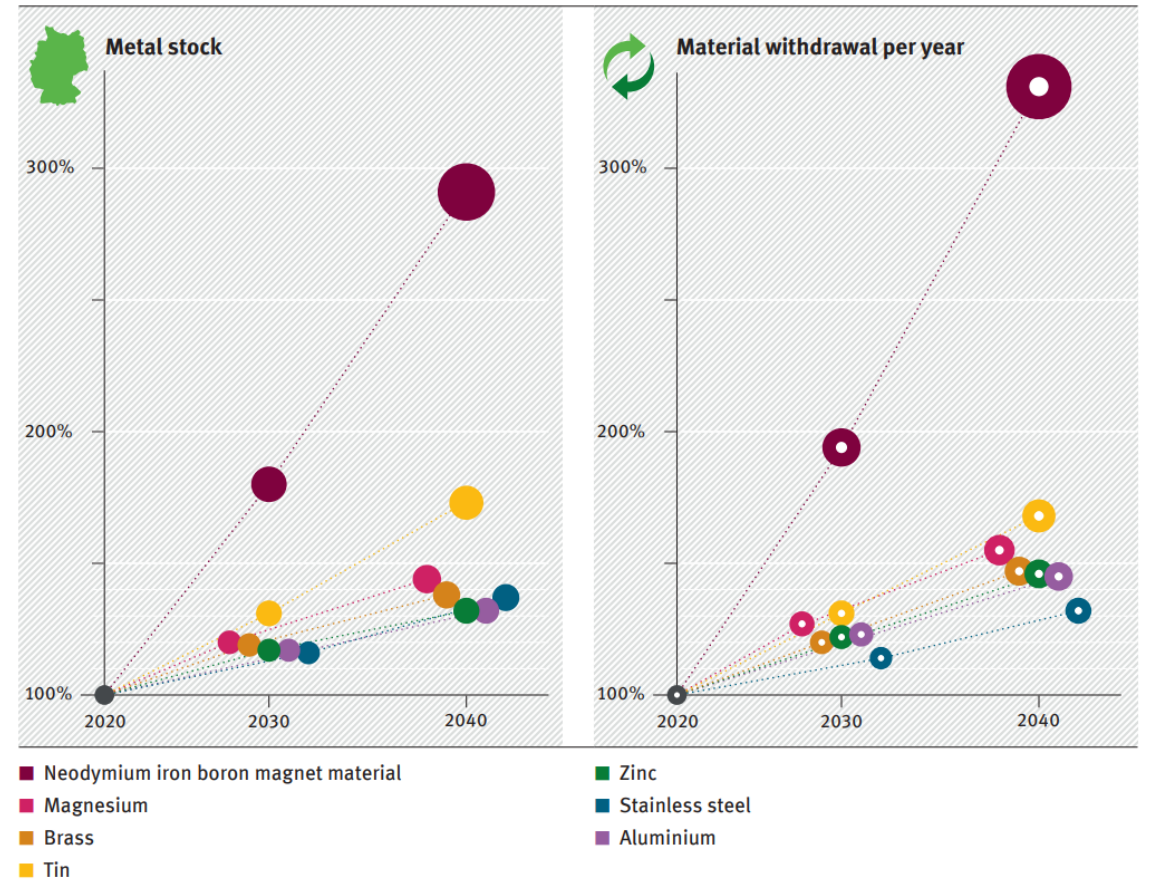
Germany's anthropogenic stock research (KartAL III)

1. Scenario analysis for relevant sectors such as transportation, housing, civil engineering etc.
 2. Alongside bulk materials and base metals:
 - Critical raw materials with major supply risks and vulnerabilities such as REE
 - Downcycled industrial materials
- ➔ For vehicles and power generation plants: tripling and doubling of material stocks by 2040

Material stock sector 4 power generation plants: conventional and renewable energy plants 2020–2040 in tonnes



Total material stocks and material withdrawal in Germany for the years 2030 and 2040
Percentage change from 2020



Source: Umweltbundesamt 2022

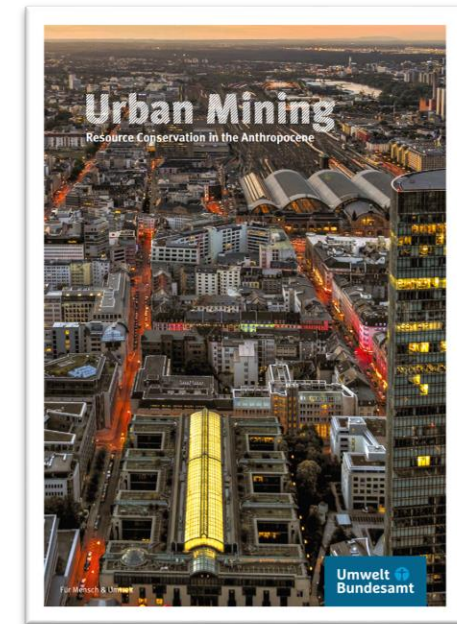
Key environmental policy question for the Urban Mining Strategy

Which net additions / compartments of the anthropogenic stock are available as secondary raw material reserves in the long term and how can they be managed?

Manifold motivations: Environmental relief and resource conservation, sound waste management, security of supply, competitiveness and domestic value added...



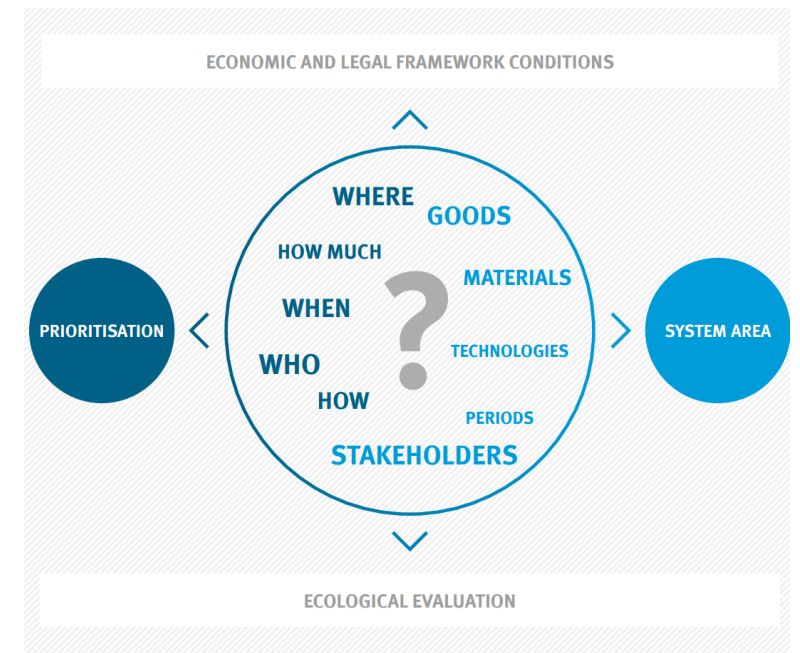
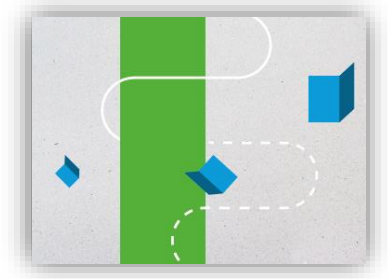
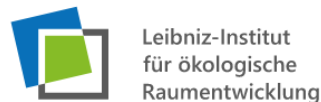
*"Urban Mining is a strategy for the integral management of anthropogenic resources with the aim of obtaining secondary raw materials from **durable products, buildings, infrastructures and deposits**. Urban mining aims at a material flow management system from **prospection, exploration, development and exploitation of anthropogenic resources to the processing** of recovered secondary raw materials."*



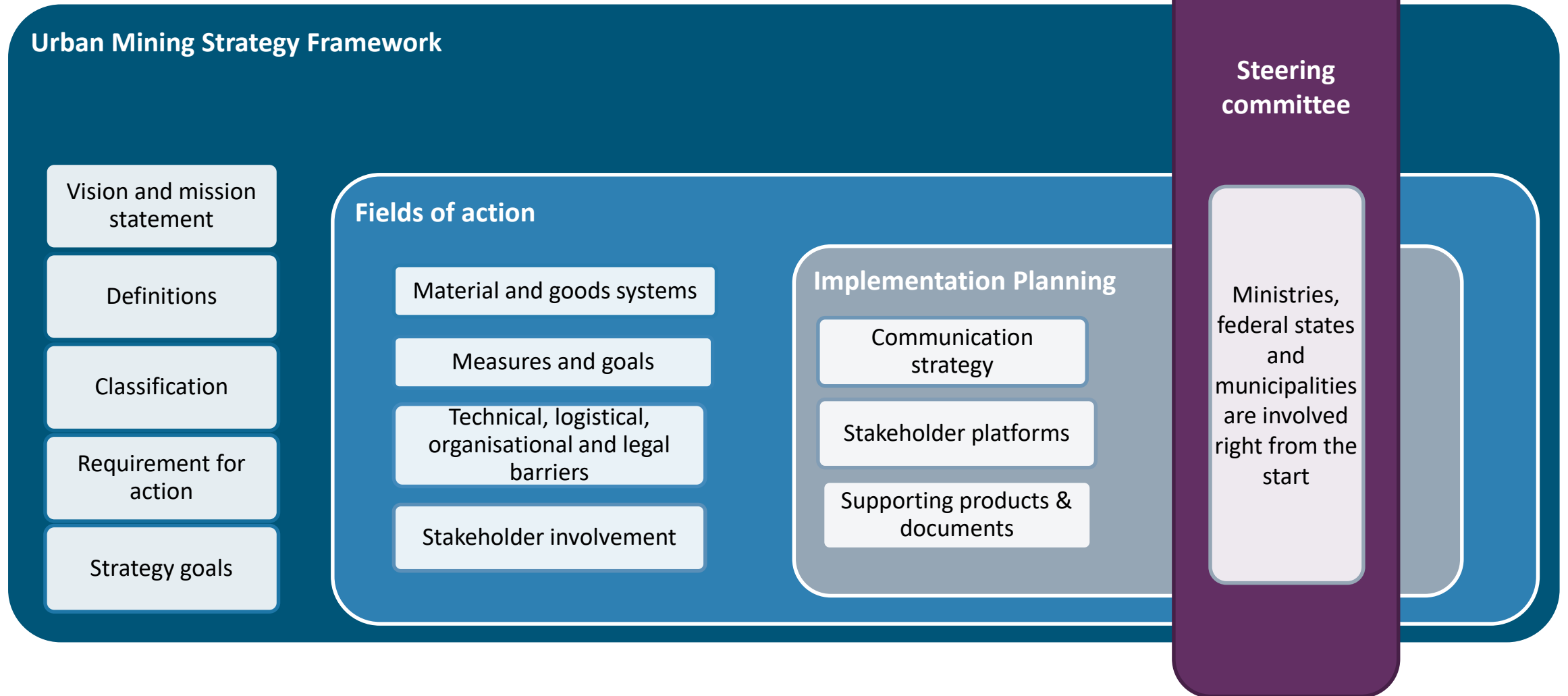
Source: Umweltbundesamt (2019)

Urban Mining Strategy under development (in KartAL V)

- Thematic, integrated overall strategy to support the Raw Materials Strategy, the German Resource Efficiency Programme and as a contribution to the National Circular Economy Strategy (NKWS)
- The strategy is intended to guide and coordinate the medium-term actions of various stakeholders in urban mining
- Systemic analysis of selected raw material and commodity systems for an effective material flow management
- Work programme from 10/2022 to 07/2025
- Involved research institutes: Öko-Institut, Ifeu und IÖR



Work programme for strategy development



Preliminary fields of action of the Urban Mining Strategy: Focus on transition technologies!

Goods

- Lithium-ion batteries: Vehicles + Stationary applications
- Photovoltaic systems
- Electrical/electronic equipment
- Wind turbines
- Vehicles (bodywork)
- Electric motors + vehicle electrics/electronics
- Mineral building materials in building construction
- Roads and bridges
- Civil engineering, plastics in pipes and sewer systems
- Fossil and nuclear power plants for dismantling

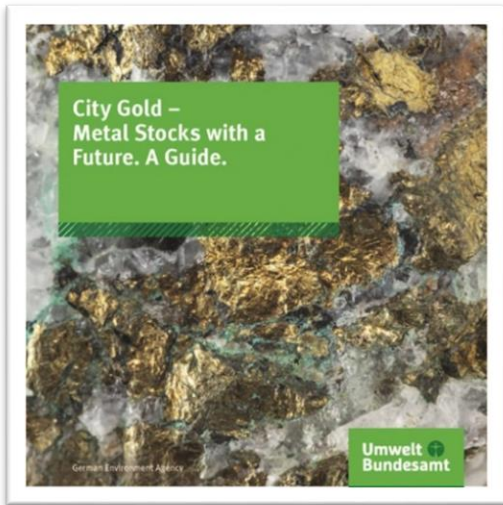
Cross-cutting issues

- Establishing regional material cycles
- Dealing with long-term storage / landfills
- Cleaning up pollutants and impurities in recycling

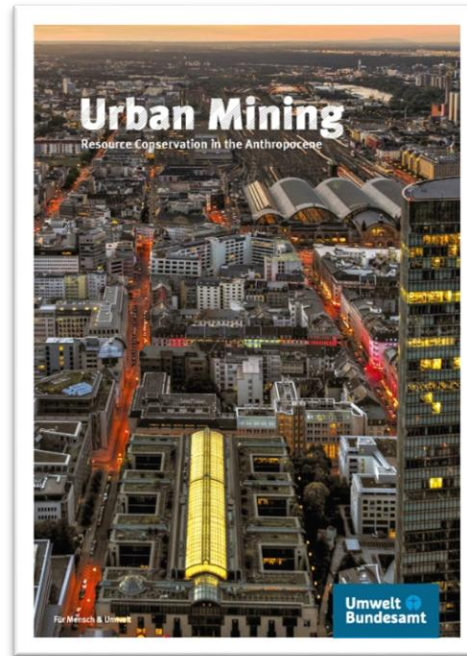
Lessons learnt

1. Urban mining is a strategy, a mindset and a management task on the way to a circular economy
2. Active management of the anthropogenic stock is the key to increasing the long-term supply of raw materials from domestic secondary sources.
3. Joint production of bulk material flows and small and critical raw materials out of anthropogenic stocks required (e.g. for energy transition technologies)
4. Recycling rates are formally high, but still great potential for far better recyclate qualities, preventing downcycling
5. Functional recycling requires planning certainty and
6. "Business as unusual": information exchange and creation of interfaces between collection/demolition, recyclers, primary producers and manufacturers/developers for quality assurance and supply agreements
7. The level of technology and automation in the secondary raw materials industry must continue to increase.

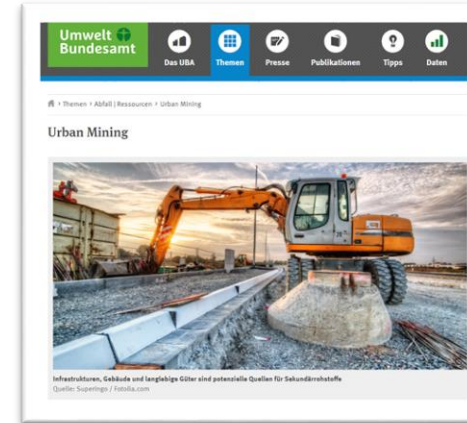
Literature Recommendations: Urban Mining & CE



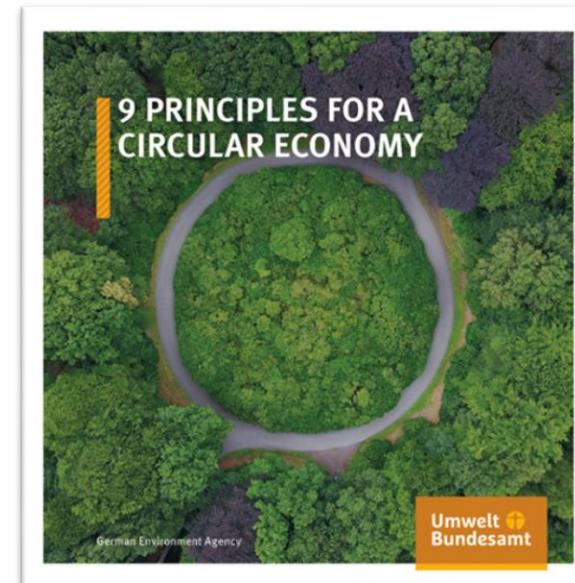
[Material flow management for metals LINK](#)



[Urban Mining Scoping Study LINK 2](#)



[Urban Mining Website LINK 3](#)



[Guideline for CE Link 4](#)

Thank you! Any questions?

Felix Müller

III 2.2 Resource Conservation, Material Cycles, Minerals and Metal Industry

felix.mueller@uba.de

<https://www.umweltbundesamt.de/themen/abfall-ressourcen/abfallwirtschaft/urban-mining>