The MinFuture project in the context of raw materials intelligence

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Motivation

Problem:
Securing access to raw materials is critical for many countries and industries.

Solution:
Strategies for ensuring a sustainable supply of raw materials for the EU need to be informed by robust knowledge about **global material cycles**.

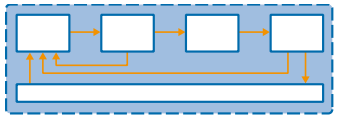
Barrier:
The **knowledge** about global material cycles is highly **fragmented** and varies significantly by mineral, by stage in the supply chain, and by country.
→ Lack of a common “language”

Overcoming the barrier:
The integration of the existing knowledge requires a **common approach to material flow analysis (MFA)** and **international co-operation**.
→ The purpose of MinFuture is to establish an international platform for MFA, consisting of key data providers, data users, and research institutions.
→ Development of a “common language” (data structure)

Objective

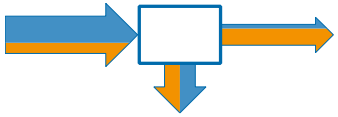
MinFuture is the Proof of Concept for a "Google Maps" of the global physical economy in four dimensions

Four dimensions

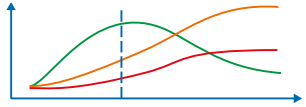


1. **Stages**
   Integrate primary and secondary resources

2. **Trade**
   Integrate international trade with production and consumption for analyzing global supply chains



3. **Layers (linkages of materials, energy, value)**
   Capture linkages of metals at all stages



4. **Time**
   Historical development and future scenarios

MinFuture consortium

Partners

NTNU
Norwegian University of Science and Technology

University of Cambridge

Ritsumeikan University

University of Southern Denmark

Massachusetts Institute of Technology

TU Wien
Technische Universität Wien

Charles University

CSIRO

NERC
Science of the Environment

UAB
Universitat Autònoma de Barcelona

eco logic

ifeu
Institut für Energie- und Umweltforschung Heidelberg

bio Intelligence Service

MinPol GmbH

Norges Geologiske Undersøkelse
NGU

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Johannes Drielsma, Euromines

Stefan Bringezu, WI

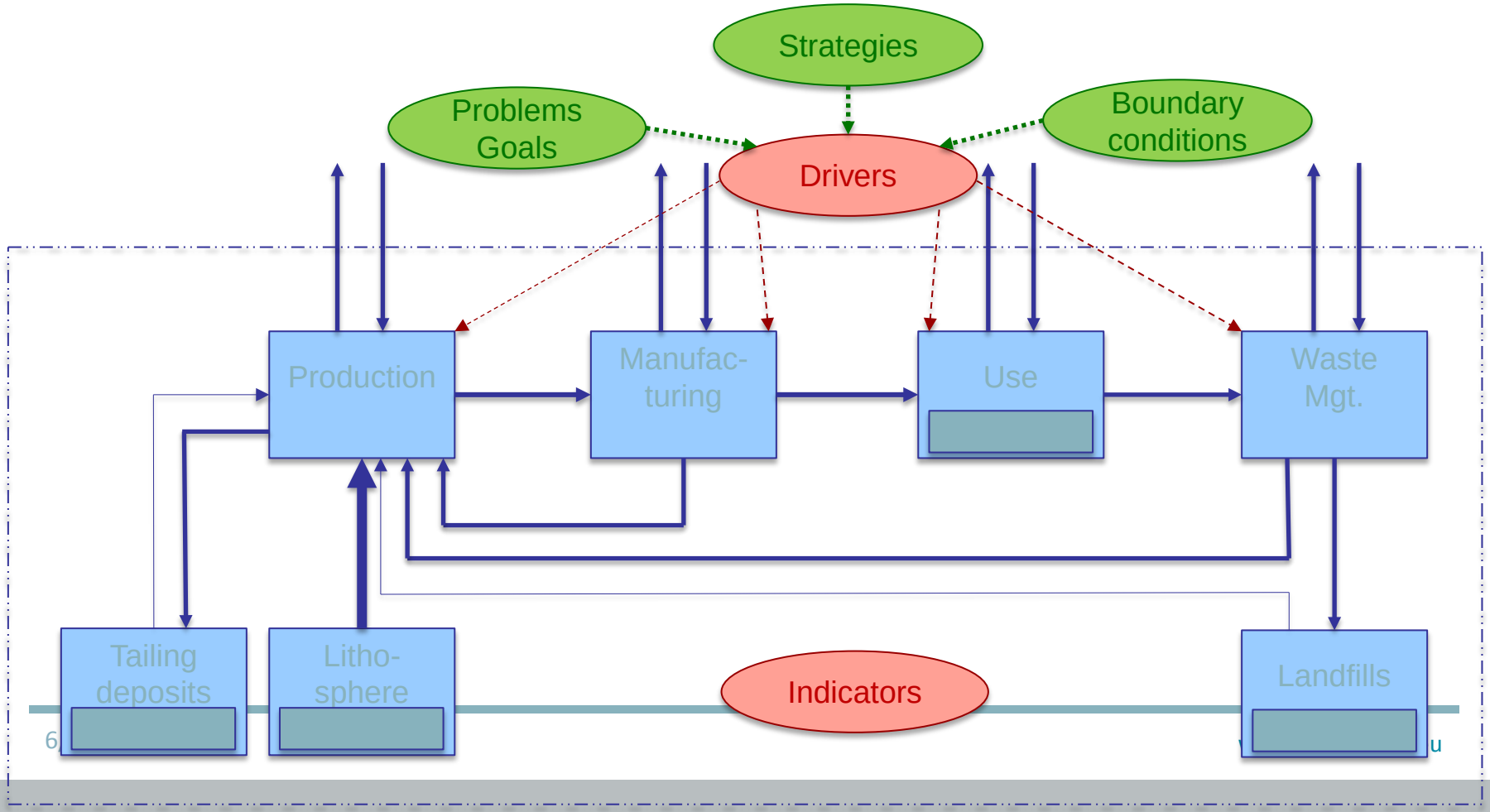
Karen Hanghøj, KIC EIT RM

Ronald Jansen, UN Statistics

Sigurd Heiberg, Petronavit AS

Constantin Ciupagea, JRC

1. ~~System definition to integrate relevant parts (physical stocks and flows)~~
2. Model development for robust demand and supply forecasting
3. Scenario development to address relevant questions



EU-US-Japan Trilateral Conferences on Critical Raw Materials

FORAM
TOWARDS A WORLD FORUM ON RAW MATERIALS

STRADE

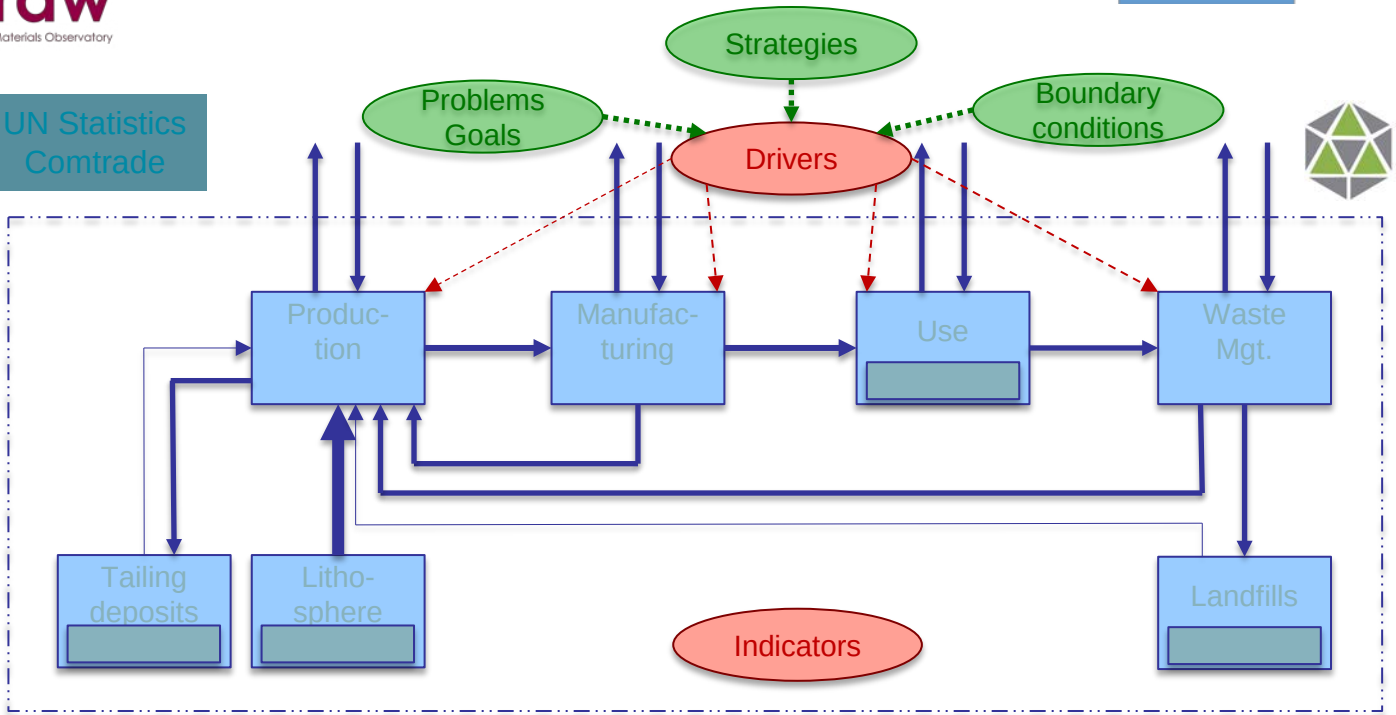
Intraw
International Raw Materials Observatory

International Resource Panel

UN Statistics Comtrade

MICA Mineral Intelligence Capacity Analysis

Metals Associations



Geological Surveys

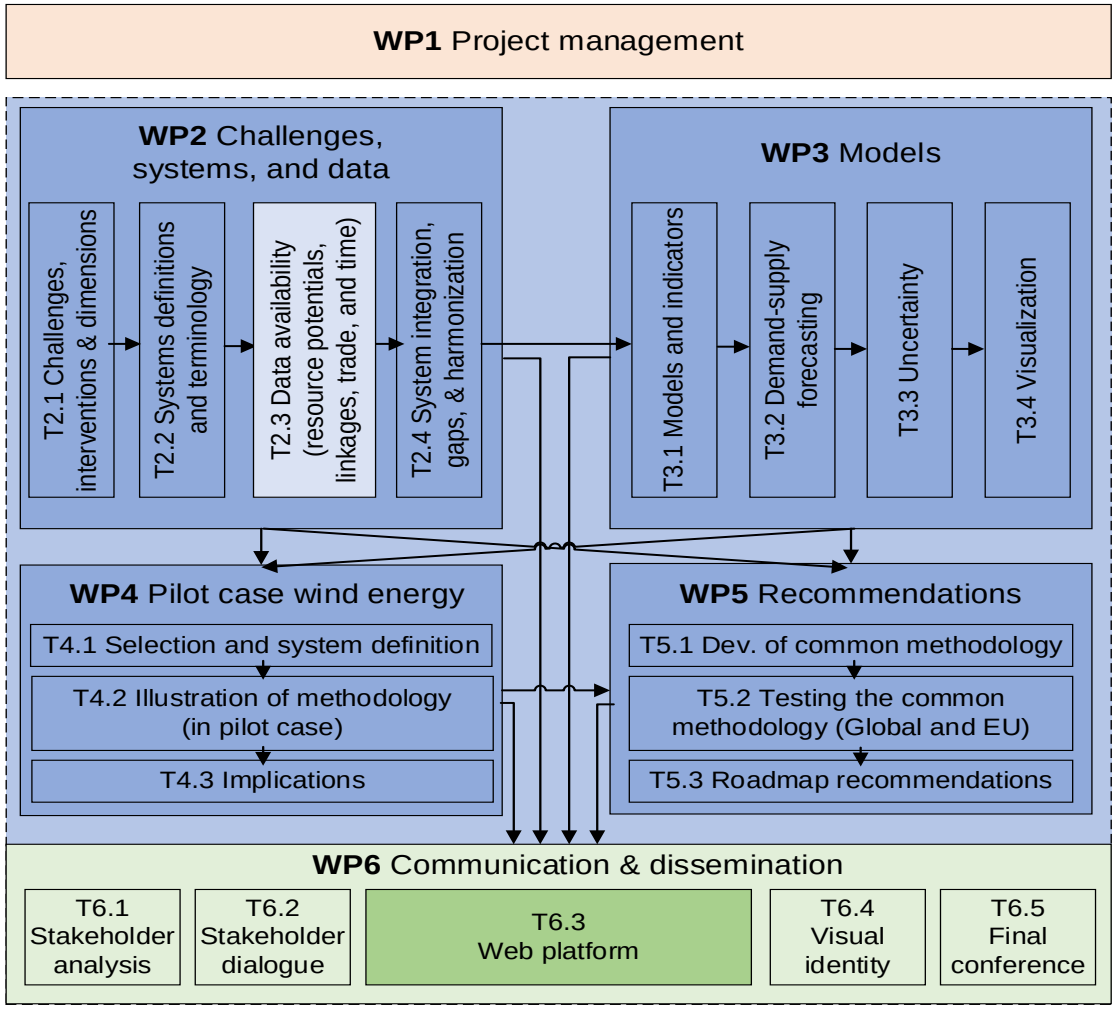
MINERALS4EU

eu

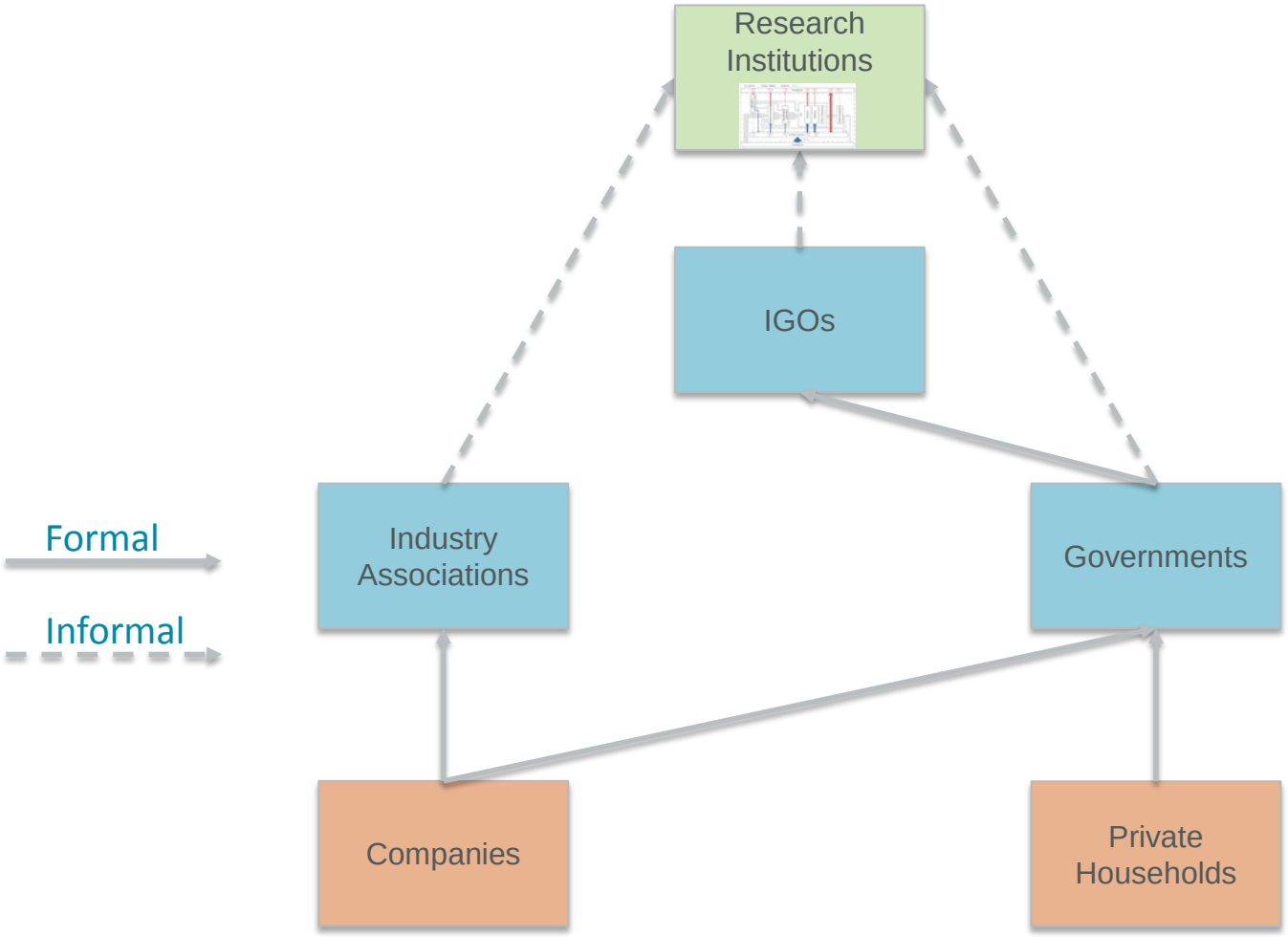
57-71 Rare sustainable exploitation

ProSUM

MinFuture WP structure



Current information flows for MFA

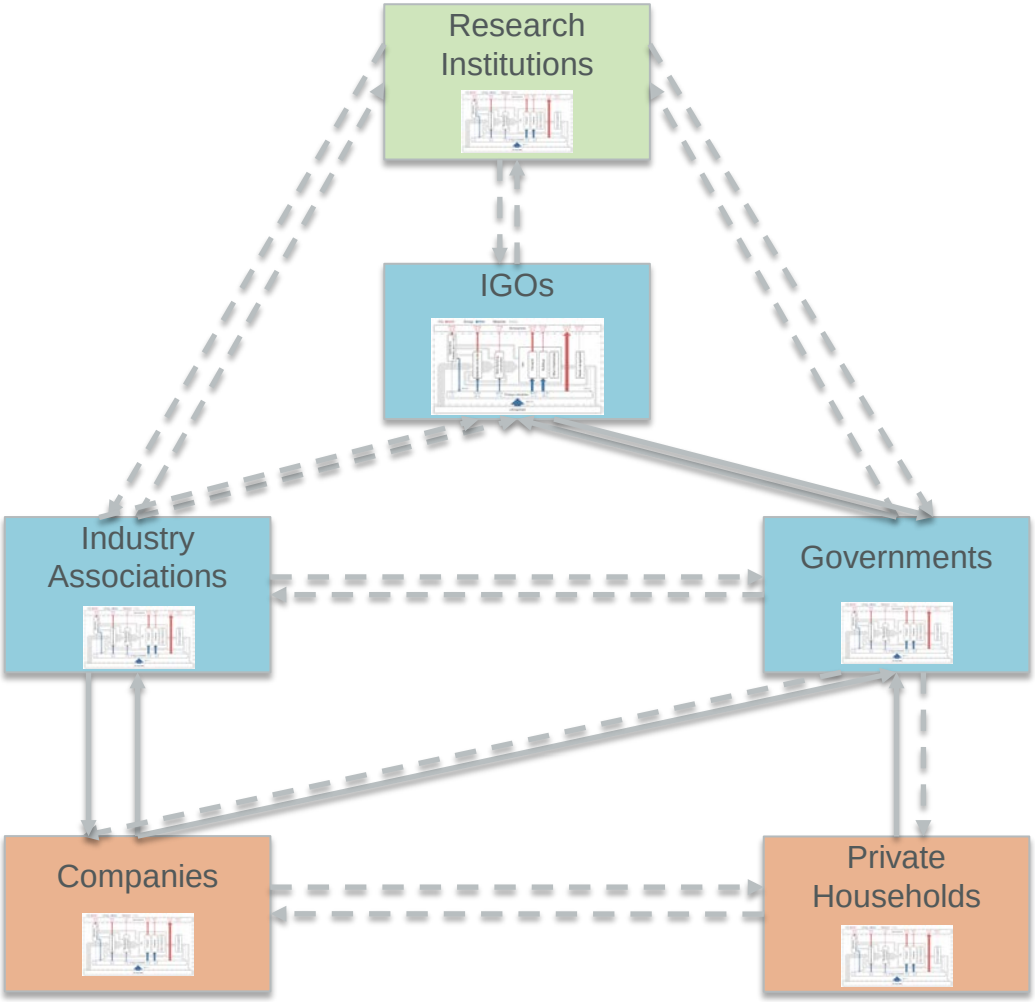


SEM analysis

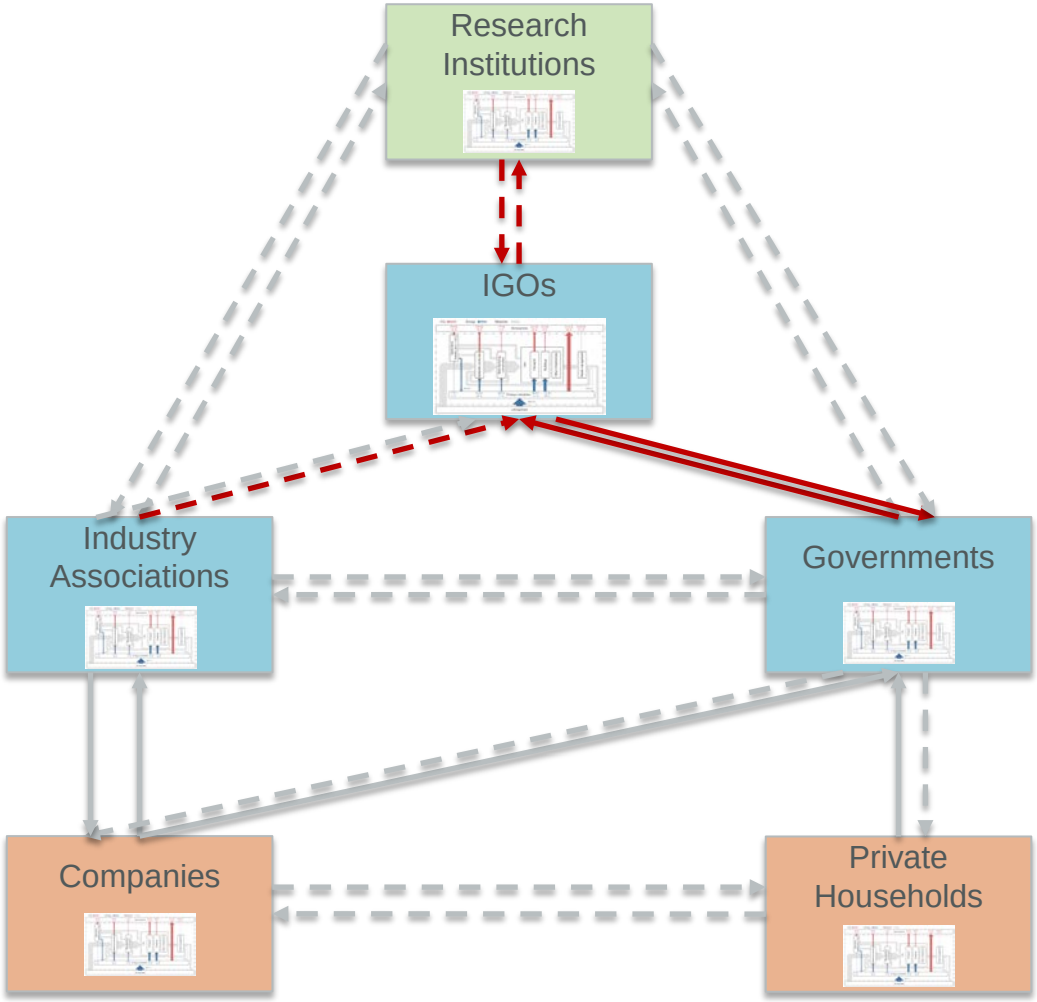
Data collection & public provision

Raw data provision

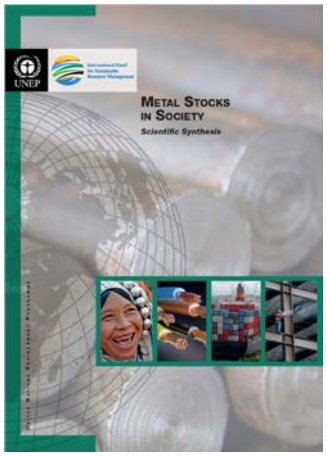
Future information flows for MFA

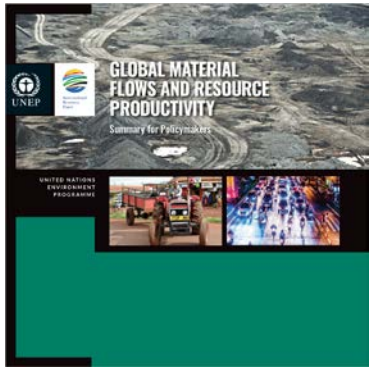


Latest trends in information flows



UNEP IRP:
Reports and database
for global material flows





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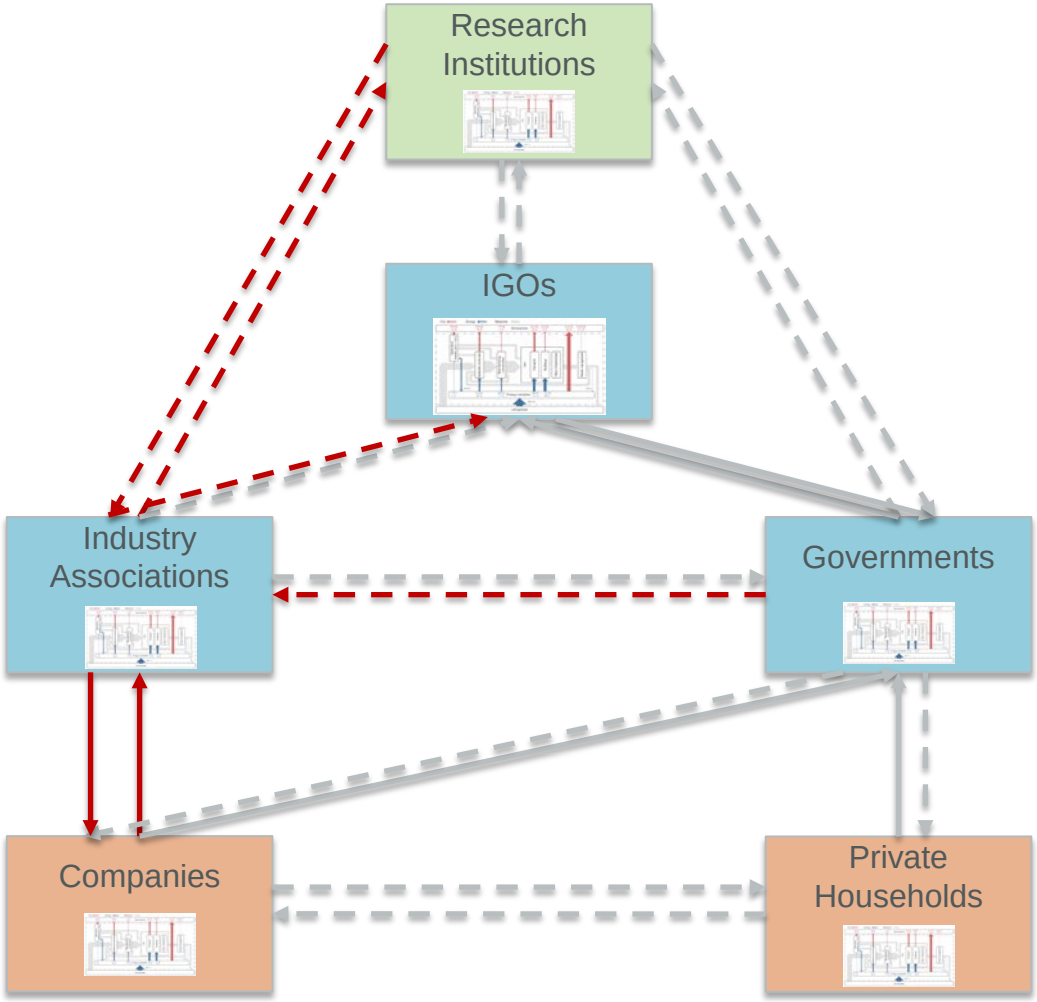
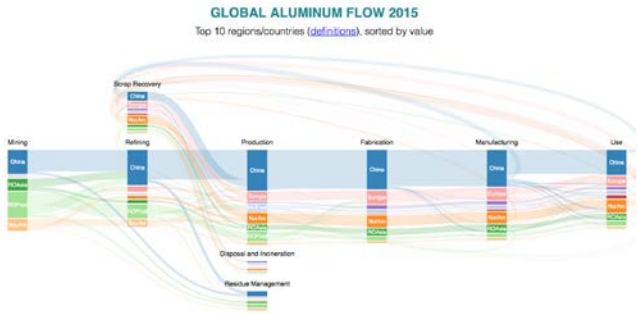
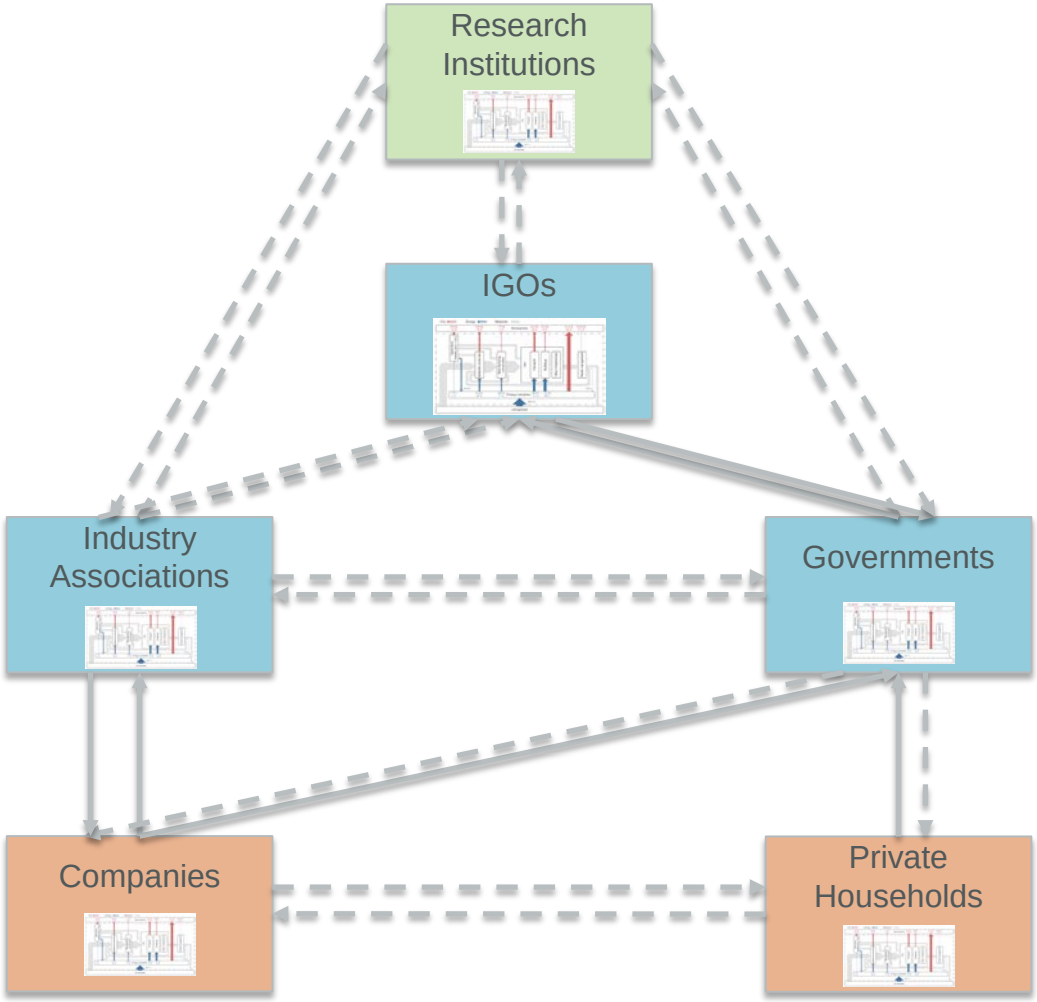


IAI:
Global Aluminium Mass Flow 1962-2015



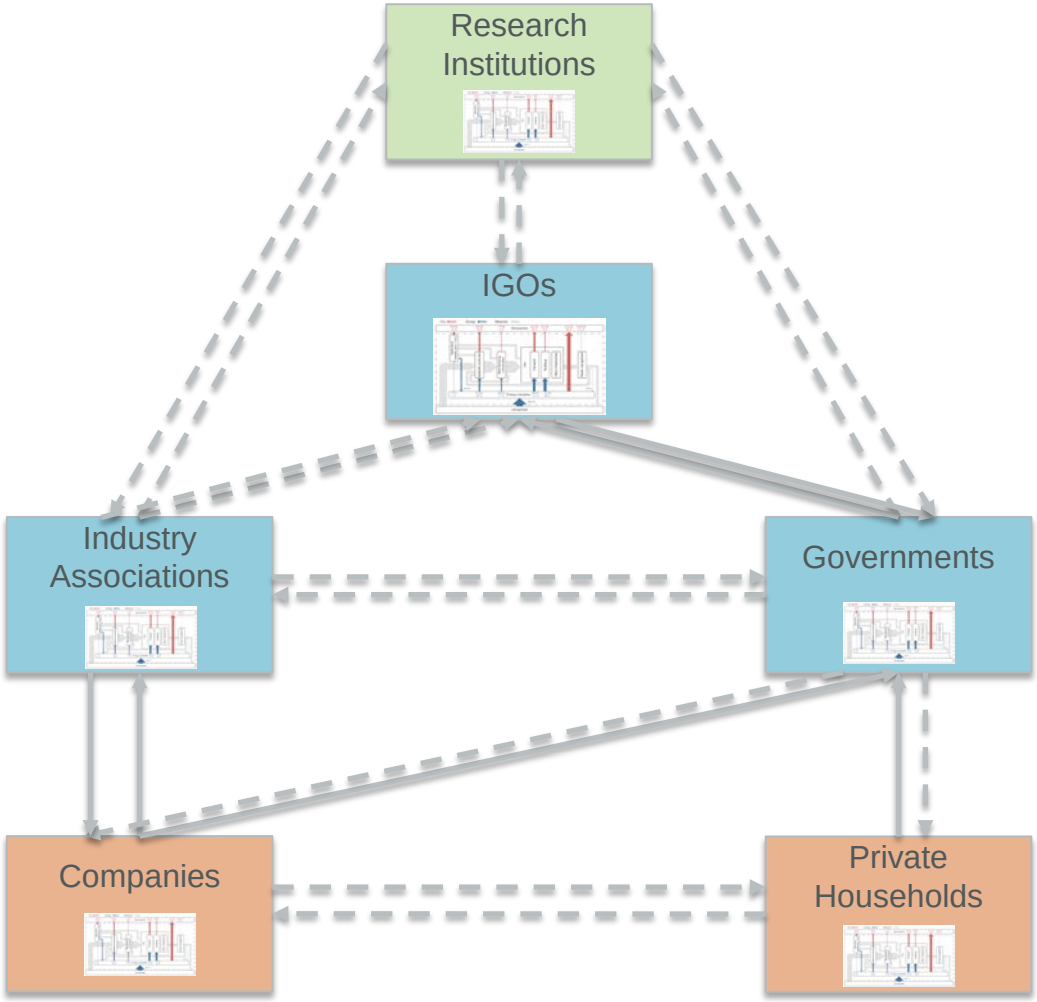
http://www.world-aluminium.org/statistics/massflow/

Questions arising



1. Who collects what information?
2. Who owns / shares which data?
3. Who needs which “maps”?
4. How can the ”map making” be facilitated?

Questions arising



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Useful information is “lost in translation”

Challenges of monitoring and reporting

1. Lack of system understanding by modelers
   → Data are **wrongly interpreted**
2. Lack of systems thinking competency by industry and government
   → Data are not collected providing system context
3. Data gaps
   → Data need to be estimated or shown on **aggregate level**
4. Data inconsistencies (differences in reporting)
   → Data are **wrongly interpreted** or shown on **aggregate level**
5. Poor data quality
   → High uncertainties
6. Lack of a common data structure
   → Limits effective data exchange

→ Solution requires that 1-4 are addressed

Traditional MFA: placing data into a system

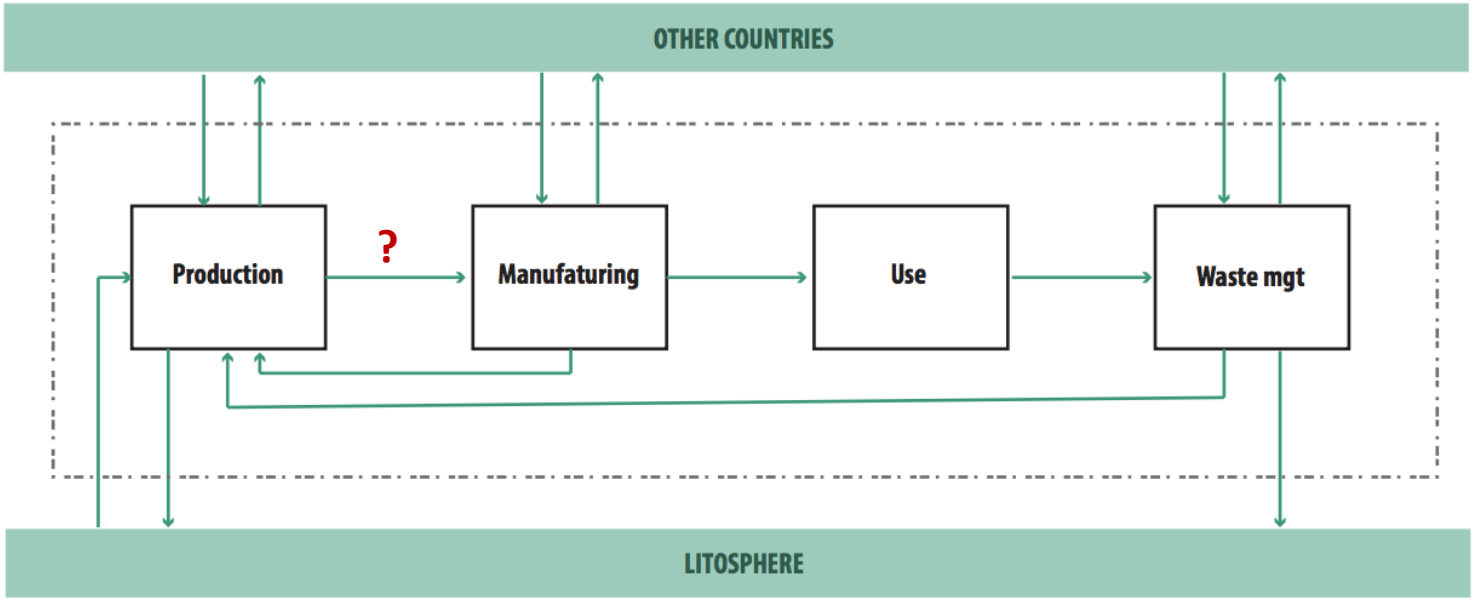
USGS Mineral Yearbook, 2017 Aluminum

Salient Statistics—United States:	2016e
Production:	
Primary	840
Secondary (from old scrap)	1,490
Imports for consumption	
Crude and semimanufactures	5,370
Scrap	610
Exports, total	3,000
Consumption, apparent[2]	4,840
Price, ingot, average U.S. market (spot), cents per pound	80.0
Stocks, yearend:	
Aluminum industry, stocks	1,350
London Metal Exchange U.S. warehouses[3]	370
Employment, number[4]	27,000
Net import reliance[5] as a percentage of apparent consumption	52

Crude maps with hidden gaps

Aggregate systems can be useful for providing a crude first overview, but relevant information is lost.

Problem: Systems don't reflect reality of data collection



Alternative MFA: placing system around data

USGS Mineral Yearbook, 2017 Aluminum

Salient Statistics—United States:	2016e
Production:	
Primary	840
Secondary (from old scrap)	1,490
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Crude and semimanufactures	5,370
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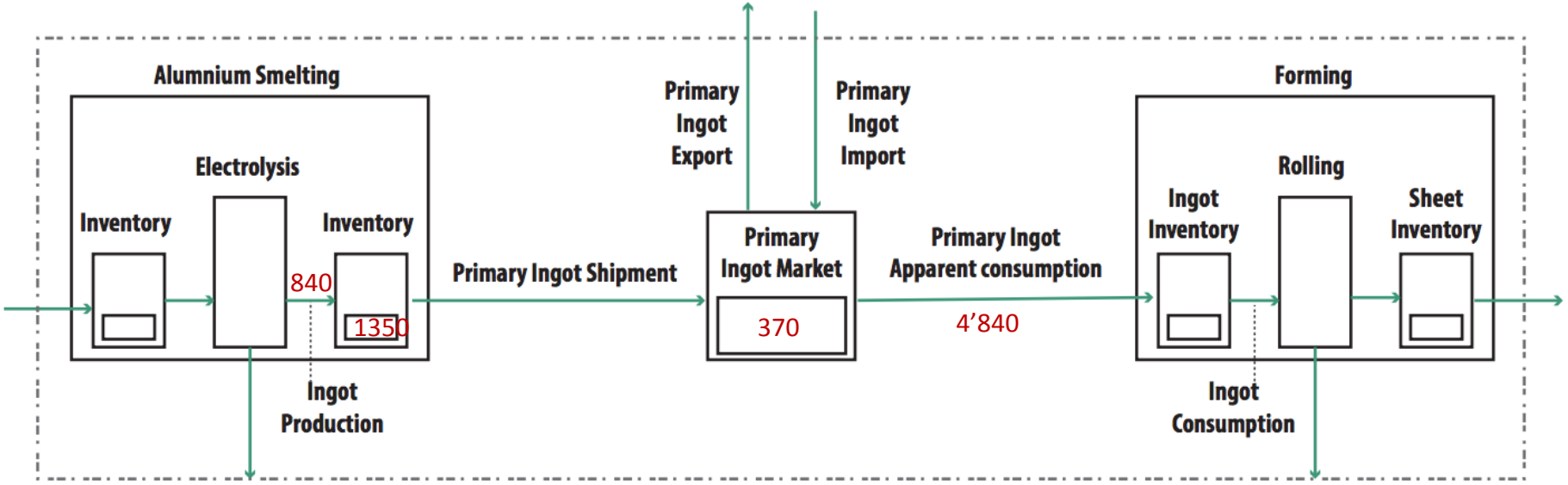
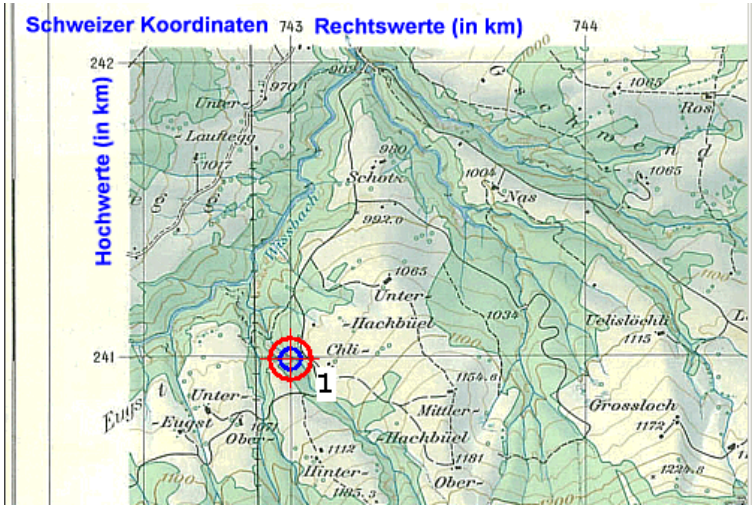
"Refined maps with explicit gaps"

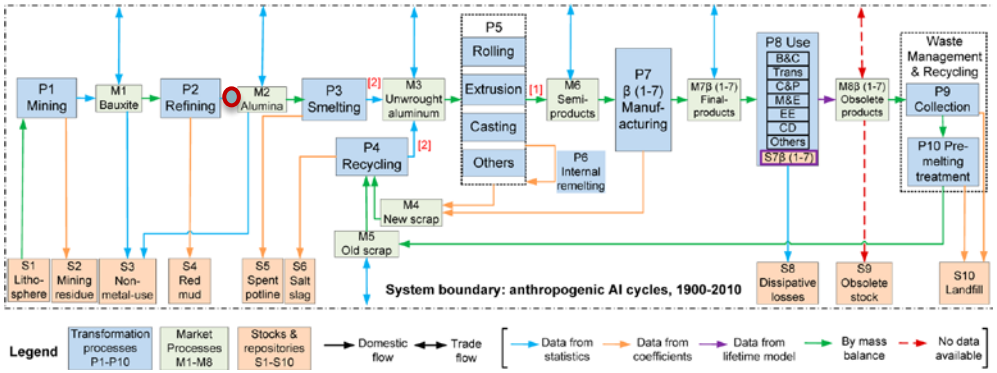
Refined system definitions can be made to reflect the exact location of the measurements.

The resulting explicit gaps make the system more complex, but also more robust.
→ The system definition requires knowledge of the institution collecting the data.



Maps – data points with coordinates





Elements of geographical maps:

1. Geo reference: coordinate system
2. Layers: information about points in coordinate system
   → E.g., elevation, land use, rivers, structures, borders…

Elements of metabolic maps:

1. System definition
2. Layers: information about the stocks and flows of the system
   → E.g., value, number of units, total mass, chemical elements, …

MinFuture approach: Add coordinates (system definition) to the data published
→ Bring specialists of the respective fields together (geological surveys, trade…)

Vision & next steps

Vision: Government and industry institutions will use **system approaches** for measuring, monitoring, and publishing their data (new standard)
→ European Minerals Yearbook

Hypothesis:

1. This standard would make data more **transparent** and **robust**, and it would greatly facilitate **data harmonization**, **data exchange**, and the compiling of **MFAs**.
2. Establishing this standard requires **MFA competency** in government & industry.

Next steps:

1. Develop first proofs of concept & design principles to map statistical data on country-level
   → Cooperation with NGU, BGS, USGS, JRC, IAI, UN Statistics (others?)
2. Develop additional systems on company/production site level
   → Cooperation with individual companies, geological surveys and industry organizations
3. Test the use of system approaches to support data harmonization.
   → Workshop with different data providers (C→G; C→I; C→C; I→I; G→G)
   → Refine system definitions for countries and companies
4. Develop first (generic) data structure
   → Cooperation with Yale/USGS, ISIE, (UNEP, OECD, EUROSTAT)
5. Develop a roadmap for mineral resource data management

Thank you!

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