The European Commission's Raw Materials Information System

RMIS - a knowledge management & monitoring tool

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EC Joint Research Centre

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Outline

RMIS: policy context, goal & scope

Supply Chain Viewer

Strategic industrial value chains: batteries

Material dependencies for dual-use technologies

Example of value chain analysis: chromium

Vulnerability & resilience to raw materials supply shocks

Material System Anlysis

LCA / supply-chain approach to plastic products

EC/JRC RMIS (Raw Materials Information System)

supporting the EU Raw Materials Knowledge Base

Since 2015, RMIS is the EC's knowledge platform on non-fuel, non-agricultural raw materials from primary (extraction/harvesting) to secondary (recycled/recovered) sources, along their entire value chains.

RMIS acts as the reference access point to the EU Raw Materials Knowledge Base and facilitates the availability, coherence, and quality of knowledge required by specific EU raw materials policies and EC services.

Endorsed by the Circular Economy Action Plan and Horizon 2020, the EU's research programme.

RMIS

support to the new European Commission's priorities

A Green Deal for Europe

- Pillar dedicated to sustainable production and consumption
- A new Circular Economy Action Plan
- Mobilising research and fostering innovation

A stronger Europe in the World

- Secure and sustainable value chains
- Fair trade and responsible sourcing

A Europe fit for the Digital Age

- Competitive industry
- Industrial Strategy Package


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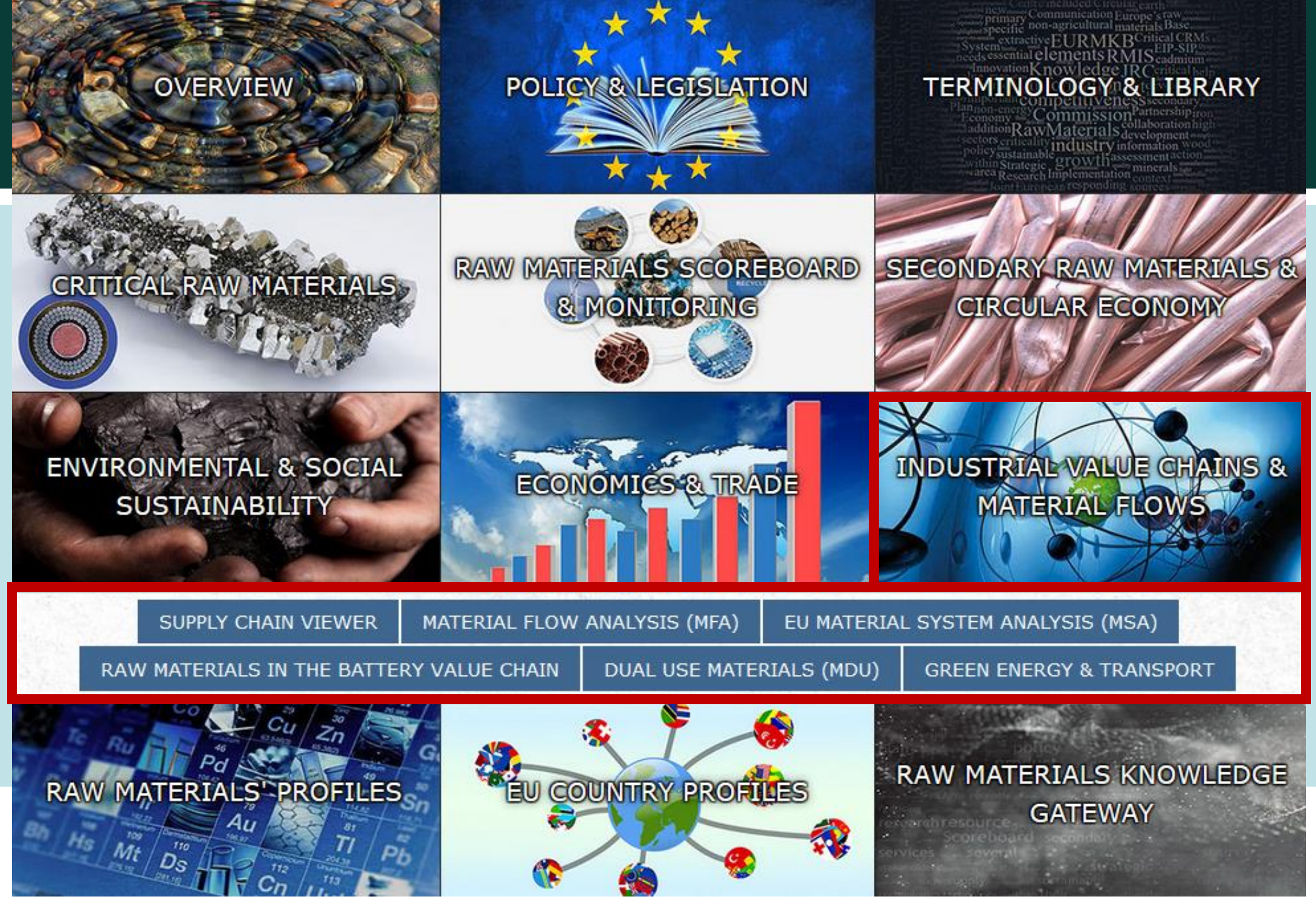
Raw Materials Information System (RMIS)
European Commission > JRC > RMIS > Resilience
OVERVIEW
POLICY & LEGISLATION
TERMINOLOGY & LIBRARY
CRITICAL RAW MATERIALS
RAW MATERIALS SCOREBOARD & MONITORING
SECONDARY RAW MATERIALS & CIRCULAR ECONOMY
ENVIRONMENTAL & SOCIAL SUSTAINABILITY
ECONOMICS & TRADE
INDUSTRIAL VALUE CHAINS & MATERIAL FLOWS
RAW MATERIALS' PROFILES
EU COUNTRY PROFILES
RAW MATERIALS KNOWLEDGE GATEWAY


OVERVIEW
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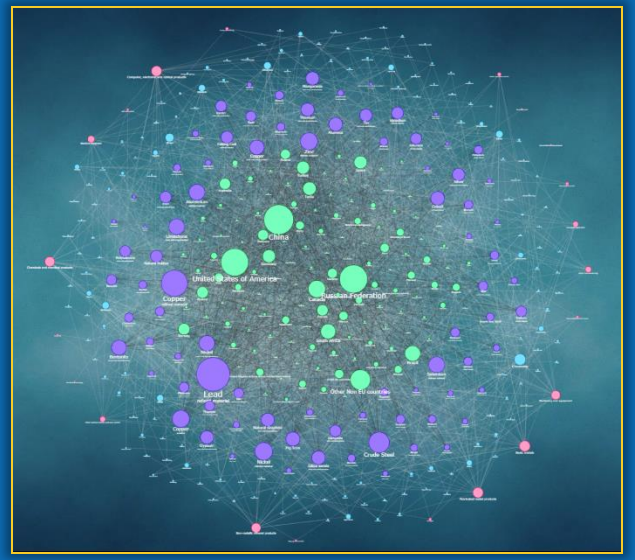
INDUSTRIAL VALUE CHAINS & MATERIAL FLOWS
SUPPLY CHAIN VIEWER
MATERIAL FLOW ANALYSIS (MFA)
EU MATERIAL SYSTEM ANALYSIS (MSA)
RAW MATERIALS IN THE BATTERY VALUE CHAIN
DUAL USE MATERIALS (MDU)
GREEN ENERGY & TRANSPORT
RAW MATERIALS' PROFILES
EU COUNTRY PROFILES
RAW MATERIALS KNOWLEDGE GATEWAY

Strategic Industrial Value chains

Supply Chain Viewer (SCV)

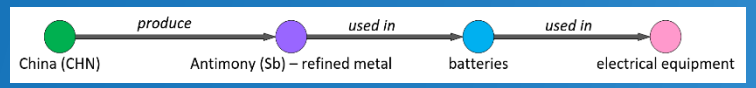
- SCV shows the flows (size in volumes) between nodes of the supply chain of a specific raw material
- Nodes can be trade partners, industrial sectors or products along the supply chain
- Future development based on Material Flow Analyses updates

The RMIS Supply Chain Viewer (SCV)



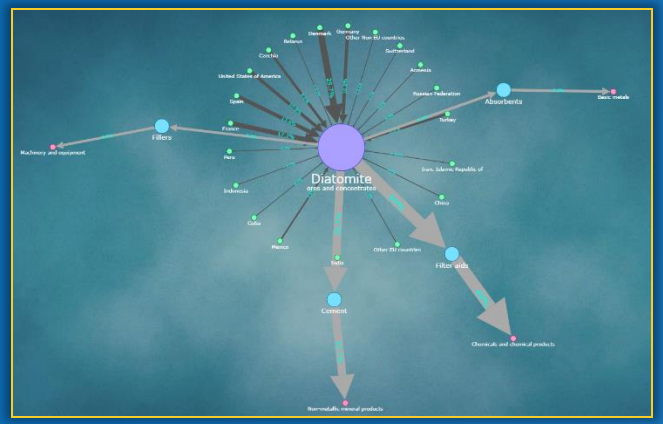
The SCV provides an overview of networks of selected raw materials supply chains, consisting of supplying countries, material products, product applications, and economic sectors using such products and materials.

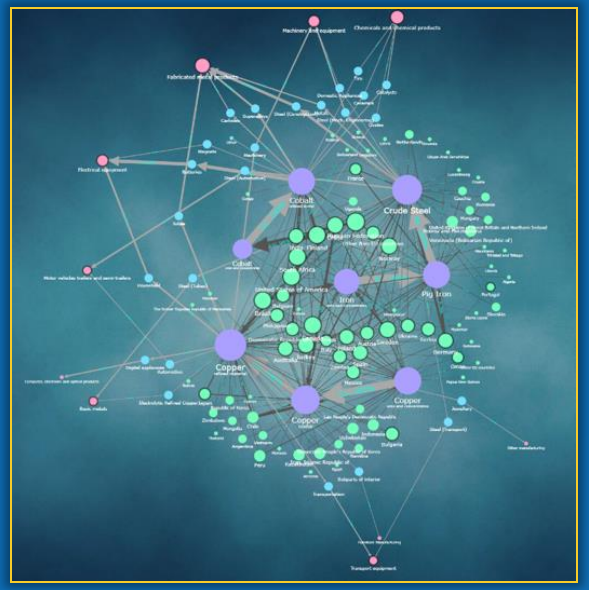
A single material flow represents a chain of nodes and links starting from a country node, passing through a material node, an application node and ending to a sector node, each node being connected to the next one by a directed link .



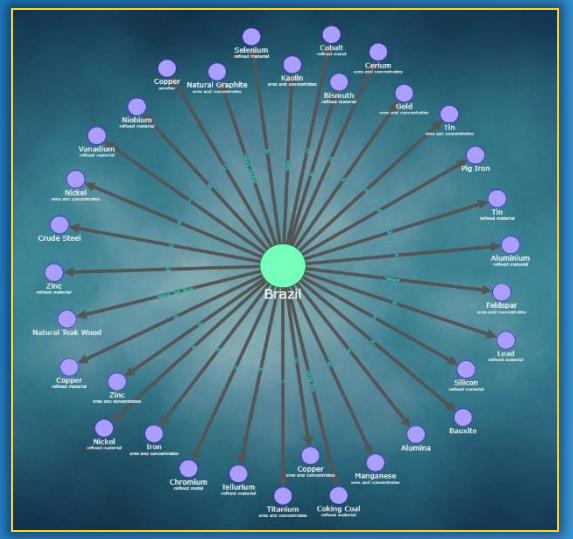
The SCV is based on a data model consisting of a network of material flows. The underlying data mapped to fit this model - extracted from the CRM 2017 exercise.

- 4 different view types that enable analyse various aspects
- 85 material chains (8 with multiply production stages)
- 133 supplying countries
- 21 NACE-2 economic sectors
- 152 product applications





The individual node views section contains three sub-modules (**Countries**, **Applications**, **Sectors**) that present a view to the whole supply chain network from the perspective of singular country, application or sector node, highlighting the interlinkages among different raw materials supplies or uses, but does not look at any material supply chain individually.



The **Overlaid** view provides interconnection information among combined multiple supply chains. It can help to highlight the fact that materials are interlinked at various stages of their supply chain and that certain countries, materials, products, and sectors might be of greater importance for a defined set of materials, simply because of their increased interlinkage in the network, or large share in contributing to material flow

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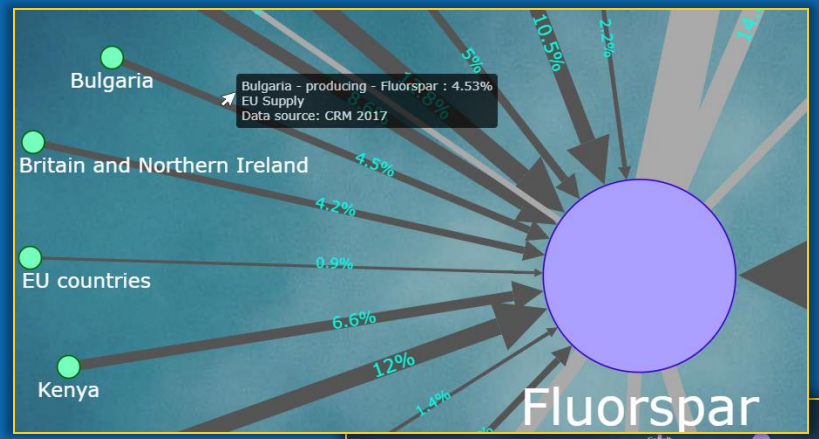
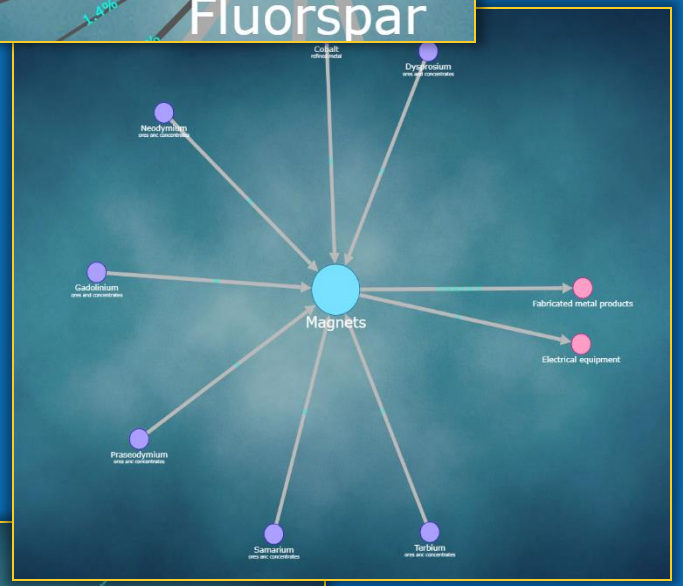
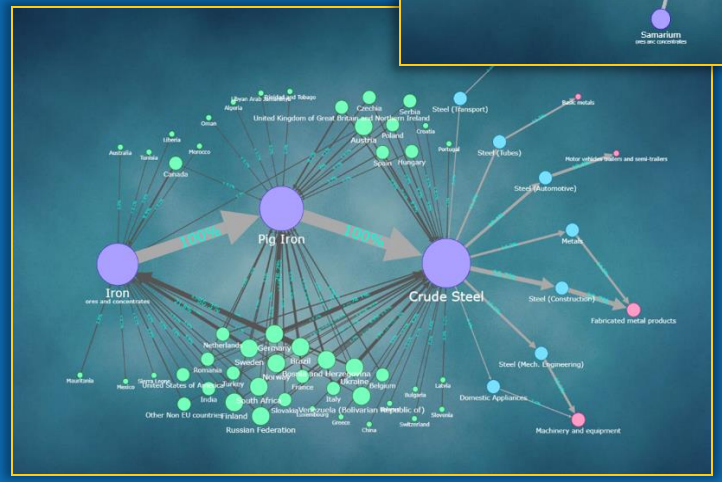
The RMIS Supply Chain Viewer

~ An analytical webtool ~







- Valuable analytical tool for assessing the product complexity belonging to various material supply chains, key countries supplying different raw materials or node interconnections at the level of end-use applications and industrial sectors.
- Cutting-edge underlying graph database technology
- Modular architecture – the application can be extended by displaying various indicators or by adding more stages, categories, relations, computations within the supply chain network
- Interactive IT application – allows for a flexible search of aspects of interest along a specific value chain, enhancing the attractiveness of the raw materials information base and easing the knowledge management activities.

Using the *degree centrality** of the nodes several economic aspects an be assessed:

- Country nodes with a large number of outgoing linkages (out-degree centrality) produce a larger variety of materials than countries with a smaller out-degree. This can indicate the **importance** of a country in the overall supply of materials.
- Material nodes, an increasing in-degree indicates that there are multiple supplier countries. On the other hand, increasing out-degree indicates that a material is used in multiple downstream uses. This highlights the overall **importance** of materials for downstream uses.
- Product application nodes, the number of incoming links represents their reliance on multiple materials (**product complexity** or dependency on different materials)
- Economic sectors nodes for which the number of incoming links (in-degree) indicates the **sector's dependency** on different products and, hence, materials. Nodes with a high degree centrality may be more likely to encounter a **disruption** simply because of their position and interconnectedness within the network.

** Degree centrality measures the number of direct ties to a node. Depending on flow (direction) these can be incoming (in-degree) and out-going (out-degree). Visually, this is quantified by the relative size of the nodes.*

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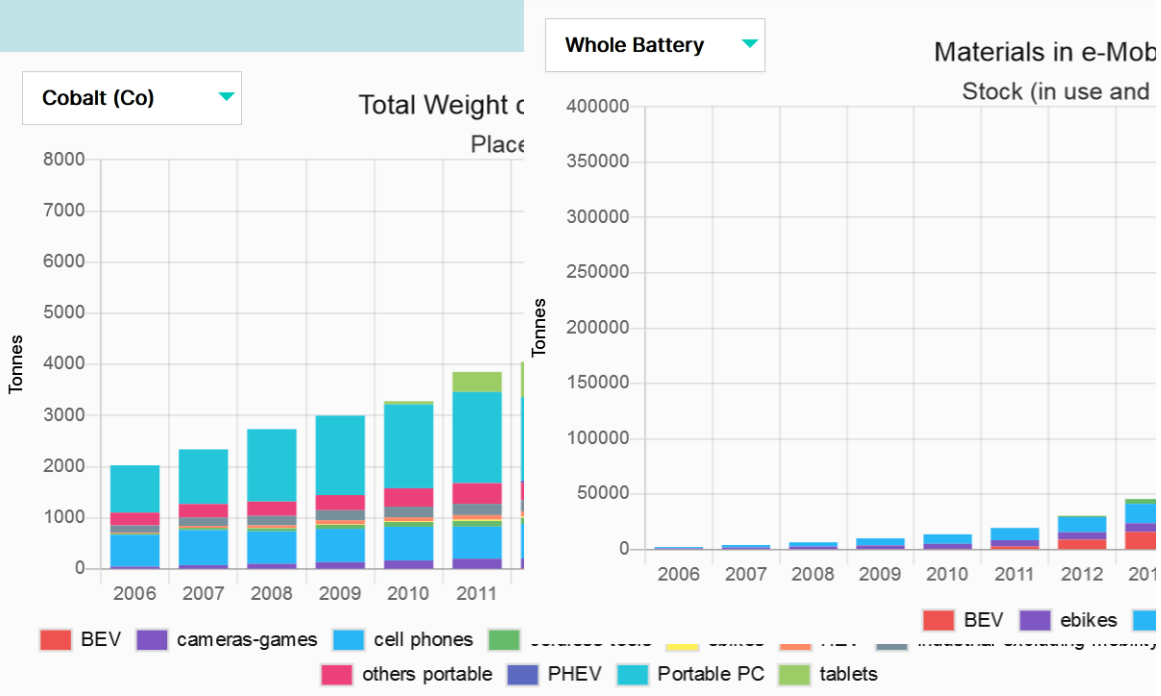
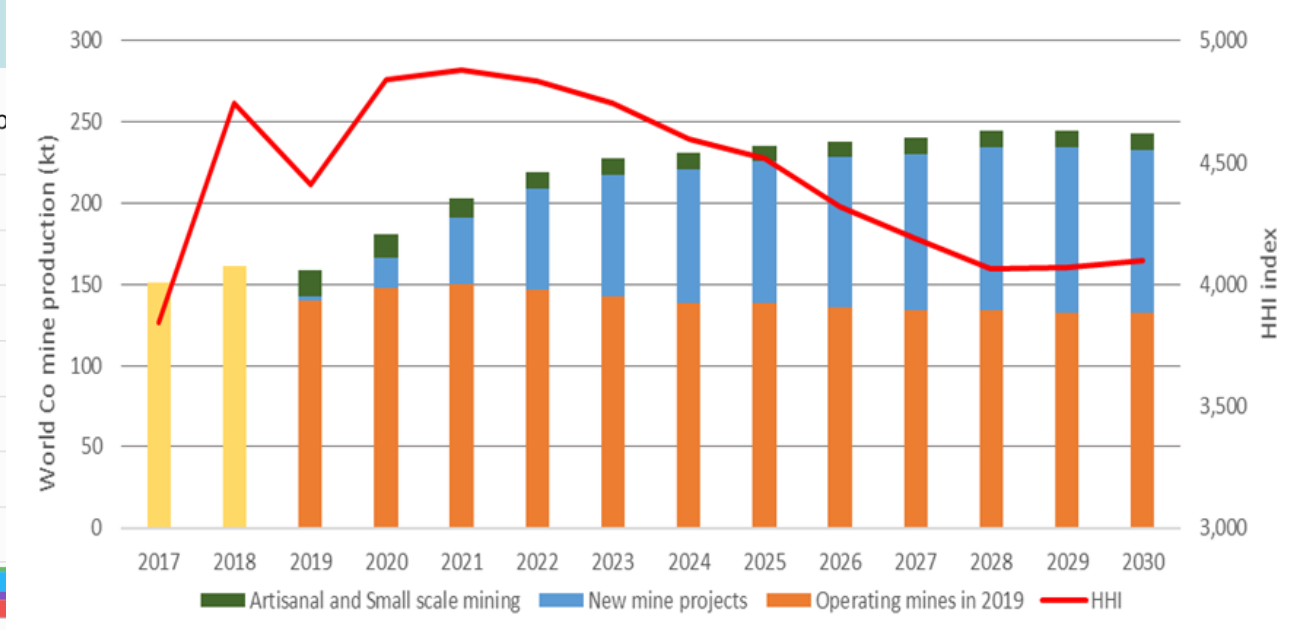
Strategic Industrial Value chains

Example of Batteries

- Analyses of CRMs in batteries value chains
- Security of supply, recycling features, technology dependence
- Foresight and trends via supply – demand balances per material:

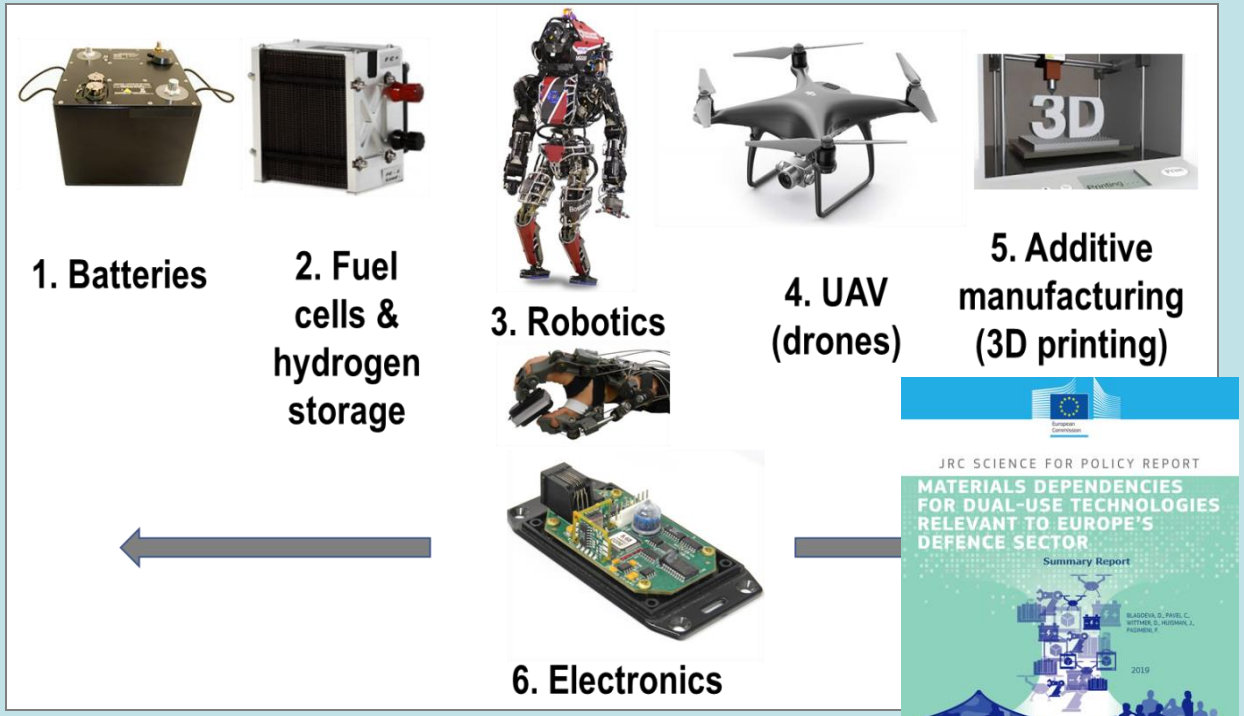


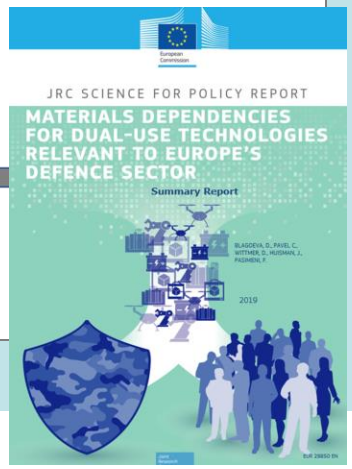


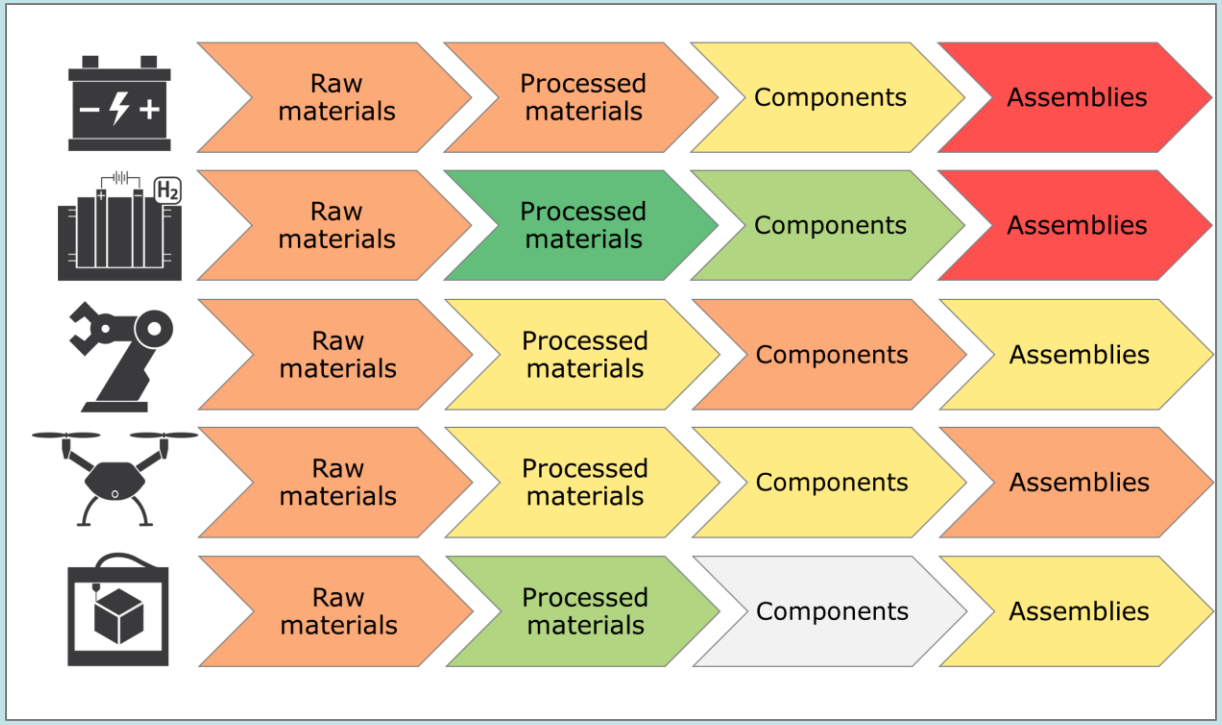
Global cobalt supply forecast until 2030 including shares of ASM and new mine projects. Future supply concentration is highlighted on the secondary axis (HHI) (dominated by a high dependency on the DRC)

New JRC study on Materials dependencies for dual-use technologies relevant to defence sector

Aim: Identification of bottlenecks in the materials supply chain for dual-use technologies







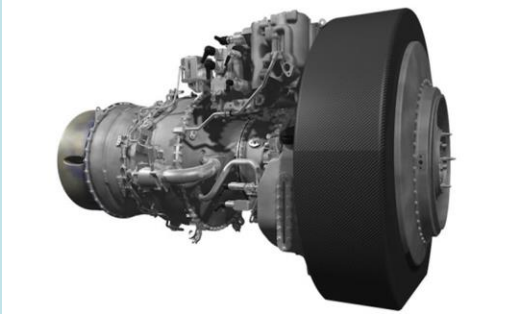
Source: Blagoeva, D., Pavel C., Wittmer, D., Huisman, J. and Pasimeni, F., Materials dependencies for dual-use technologies relevant to Europe's defence sector, EUR 29889 EN (https://publications.jrc.ec.europa.eu/repository/bitstream/JRC117729/kjna29850enn_online.pdf)

Materials for dual-use applications example 3D printing

3D printed seat structure with 40 % weight reduction

A350 3DP titanium brackets used in series production

3DP will shift manufacturing significantly and **increase demand for more exotic materials** and alloys!



Helicopter engine injection nozzles 3D printed with 50% weight reduction

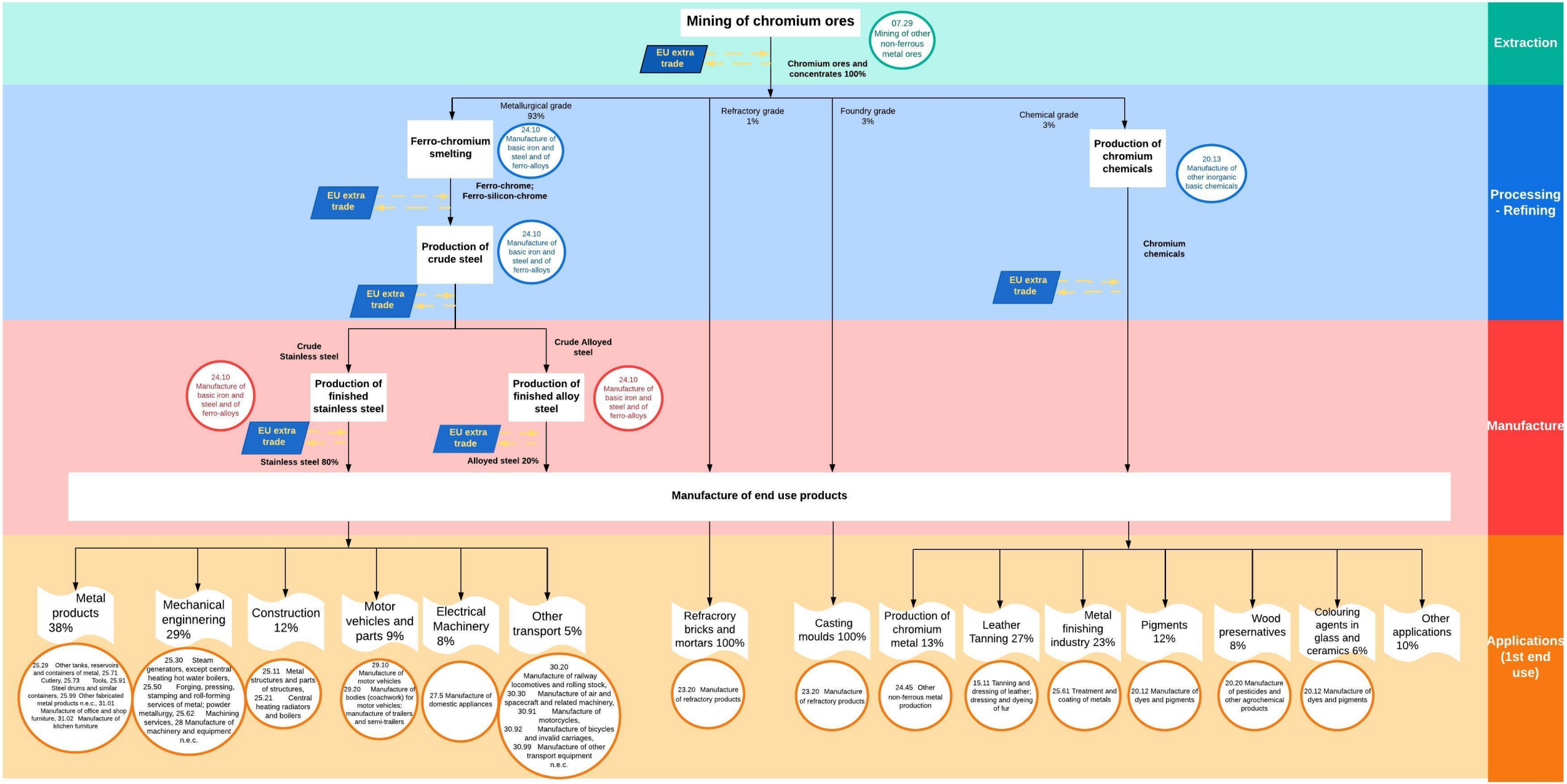
'New materials' create new opportunities!

Mastering the quality of 3DP materials in relation to 3DP technologies is the key **to future competitiveness.**

2017 global Supply risk for 15 selected materials in MDU technologies

Material	Technologies					Supply Risk 2017
LREEs*						5.01
HREEs*						4.90
Magnesium						3.98
Niobium						3.08
Borates						3.01
Natural graphite						2.88
Scandium						2.87
PGMs*						2.52
Tungsten						1.75
Cobalt						1.62
Vanadium						1.56
Lithium						1.04
Silicon metal						0.99
Chromium						0.86
Titanium						0.33
**Grouped*	*Critical Raw Material*			*Non-Critical Raw Material (2017)*		

Example: **The chromium value chain**



Application of the **resilience concept** on **raw material supply chain** issues

Aim:

Identification of bottlenecks of a secure raw material supply, serving as basis to **develop strategies** to cope with shocks or persistent structural changes.

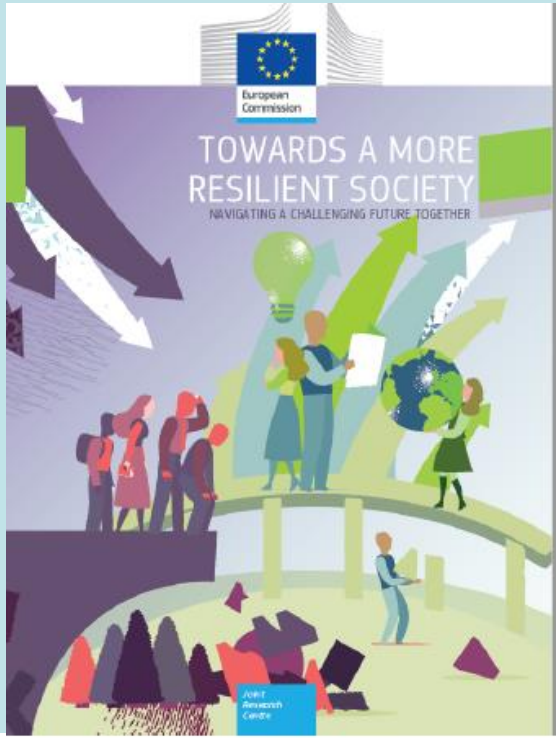
Synthesizing and elaborating well-developed JRC D.3 work areas:

- Raw Materials analyses of specific **products value chains** (strategic industrial value chains)
- Criticality assessment
- Material System Analysis (**MSA**)
  - material flow analysis at EU level
  - 31 MSAs already published
  - 14 MSAs currently under preparation

The approach builds on and connects to JRC transversal project "JRC work towards a more resilient EU society" (under preparation)

Societal challenge: Supply security of strategic resources

- Chapter on policies enhancing EU resilience in facing supply disruptions, with a focus, amongst others, on **critical raw materials**
- Illustrative prototype dashboard, based on Raw Materials Scoreboard issued by DG GROW and JRC jointly



Vulnerability and resilience
to raw material supply shocks

JRC - Dashboard on vulnerability and resilience to raw material supply shocks

- description of current status of vulnerabilities and resilience capacities of the EU Members States (selected challenges / shocks)
- provide a visual summary on EU member state level, compared to others
  - exposition to these challenges (vulnerability), and
  - readiness to face these challenges (resilience)

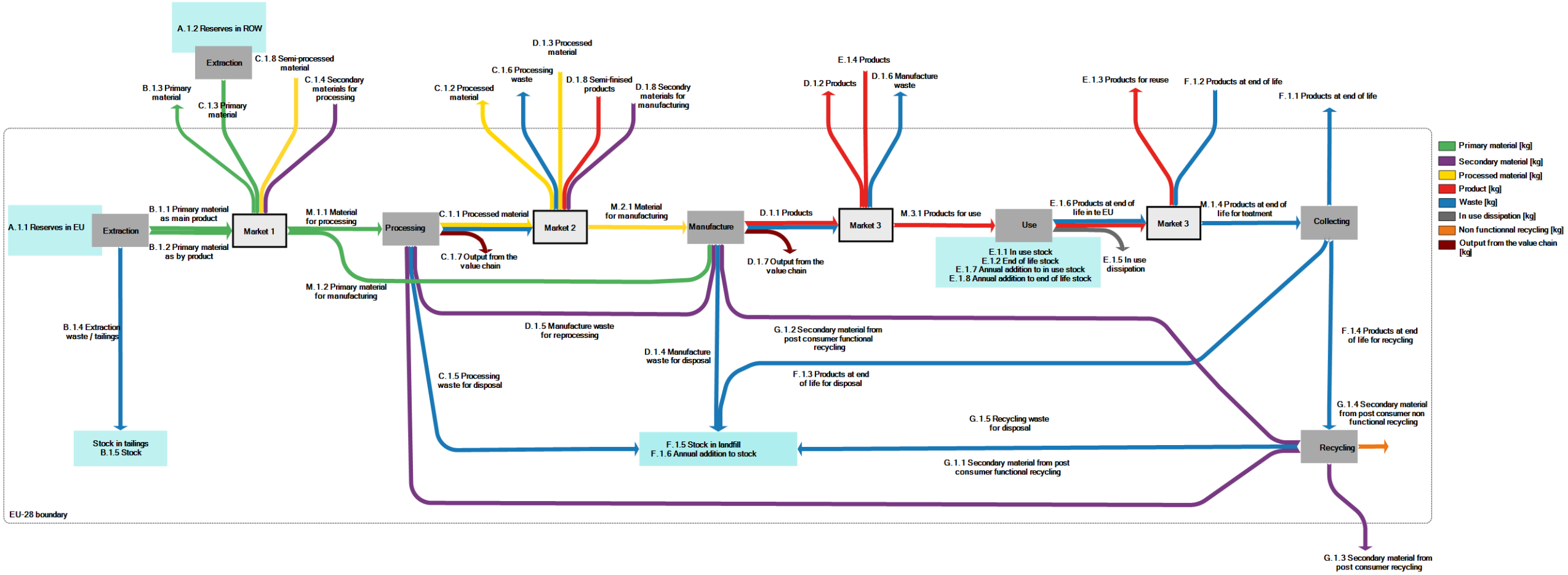
Vulnerability

- material demand;
- import dependence;
- Import dependence at different stages of supply chains;
- supplier concentration;
- economic importance

Resilience

- domestic extraction;
- involvement of recyclable raw materials within-EU trade;
- importance of circular economy and other aspects of improved resource efficiency
- public awareness;
- technological innovation and substitution

MSA


A.1.2 Reserves in ROW
Extraction
C.1.8 Semi-processed material
B.1.3 Primary material
C.1.3 Primary material
C.1.4 Secondary materials for processing
D.1.3 Processed material
C.1.6 Processing waste
C.1.2 Processed material
D.1.8 Semi-finised products
D.1.8 Secondry materials for manufacturing
E.1.4 Products
D.1.2 Products
D.1.6 Manufacture waste
E.1.3 Products for reuse
F.1.2 Products at end of life
F.1.1 Products at end of life
Primary material [kg]
Secondary material [kg]
Processed material [kg]
Product [kg]
Waste [kg]
In use dissipation [kg]
Non functionnal recycling [kg]
Output from the value chain [kg]
A.1.1 Reserves in EU
Extraction
B.1.1 Primary material as main product
B.1.2 Primary material as by product
Market 1
M.1.1 Material for processing
Processing
C.1.1 Processed material
Market 2
M.2.1 Material for manufacturing
Manufacture
D.1.1 Products
Market 3
M.3.1 Products for use
Use
E.1.6 Products at end of life in te EU
Market 3
M.1.4 Products at end of life for teatment
Collecting
C.1.7 Output from the value chain
D.1.7 Output from the value chain
E.1.1 In use stock
E.1.2 End of life stock
E.1.7 Annual addition to in use stock
E.1.8 Annual addition to end of life stock
E.1.5 In use dissipation
M.1.2 Primary material for manufacturing
B.1.4 Extraction waste / tailings
D.1.5 Manufacture waste for reprocessing
G.1.2 Secondary material from post consumer functional recycling
F.1.4 Products at end of life for recycling
D.1.4 Manufacture waste for disposal
C.1.5 Processing waste for disposal
F.1.3 Products at end of life for disposal
G.1.4 Secondary material from post consumer non functional recycling
G.1.5 Recycling waste for disposal
Stock in tailings
B.1.5 Stock
F.1.5 Stock in landfill
F.1.6 Annual addition to stock
Recycling
G.1.1 Secondary material from post consumer functional recycling
EU-28 boundary
G.1.3 Secondary material from post consumer recycling

MSA Why?

- **In the context of the EU Raw Materials Initiative.**

- **Create a comprehensive data inventory of material flows and stocks through the EU economy. Main Uses:**
  - Informed decision making on material supply.
  - Help in identifying key opportunities to secure resources for the EU economy.
  - Support the calculation of monitoring indicators e.g. EoL-RIR, EU Import reliance .
  - Information on raw materials important for key technologies/sectors e.g. batteries.
  - Basis for environmental and social assessment.

- **Policy needs covered:**

  - List of critical raw materials;
  - Circular economy monitoring;
  - Raw materials scoreboard;
  - Strategic action plan on batteries.

Existing MSAs and under development

MSAs developed in 2015 and 2017

Aggregates	Aluminium	Antimony	Beryllium	Borate	Chromium
Cobalt	Coking Coal	Copper	Dysprosium	Erbium	Europium
Fluorspar	Gallium	Germanium	Indium	Iron	Lithium
Magnesite	Magnesium	Natural Graphite	Neodymium	Niobium	Palladium
Phosphate Rock	Platinum	Rhodium	Silicon	Terbium	Tungsten
Yttrium	Baryte	Bismuth	Cobalt	Hafnium	Helium
Lithium	Manganese	Natural Graphite	Natural Rubber	Nickel	Phosphorous
Tantalum	Scandium	Vanadium			

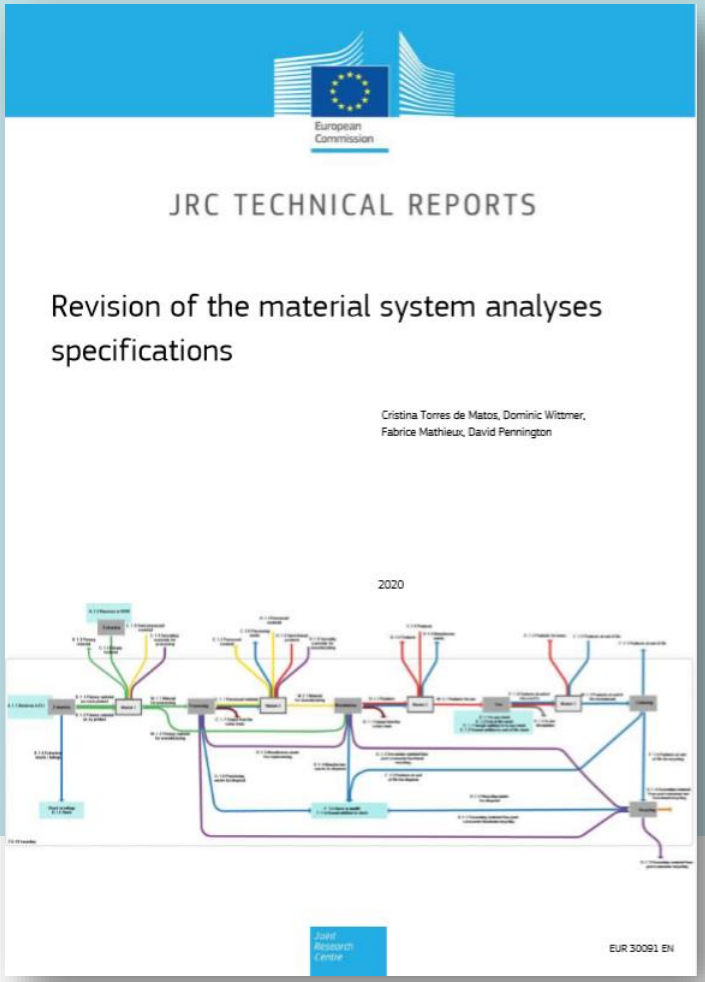
NEW MSAs in 2020

2020 Outputs:

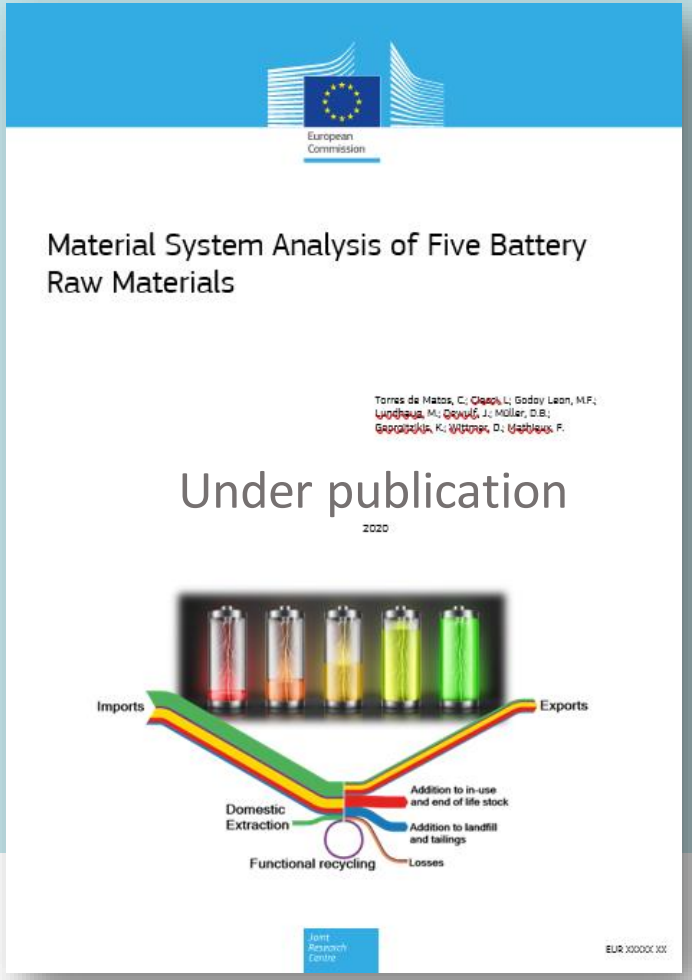
- Technical report: Review of the specifications for the MSAs;
- Report on MSAs for the selected materials relevant for the production of batteries and for decarbonising technologies;
- Reports on MSAs for the selected CRMs with missing MSAs.

2020 MSAs: Outputs so far

Review of the specifications for the MSAs

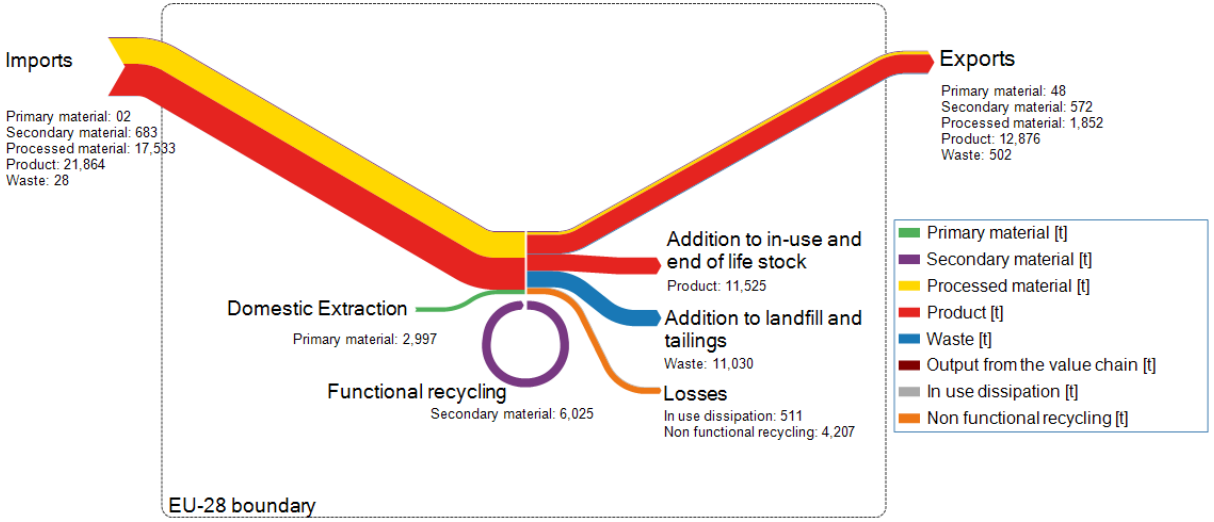


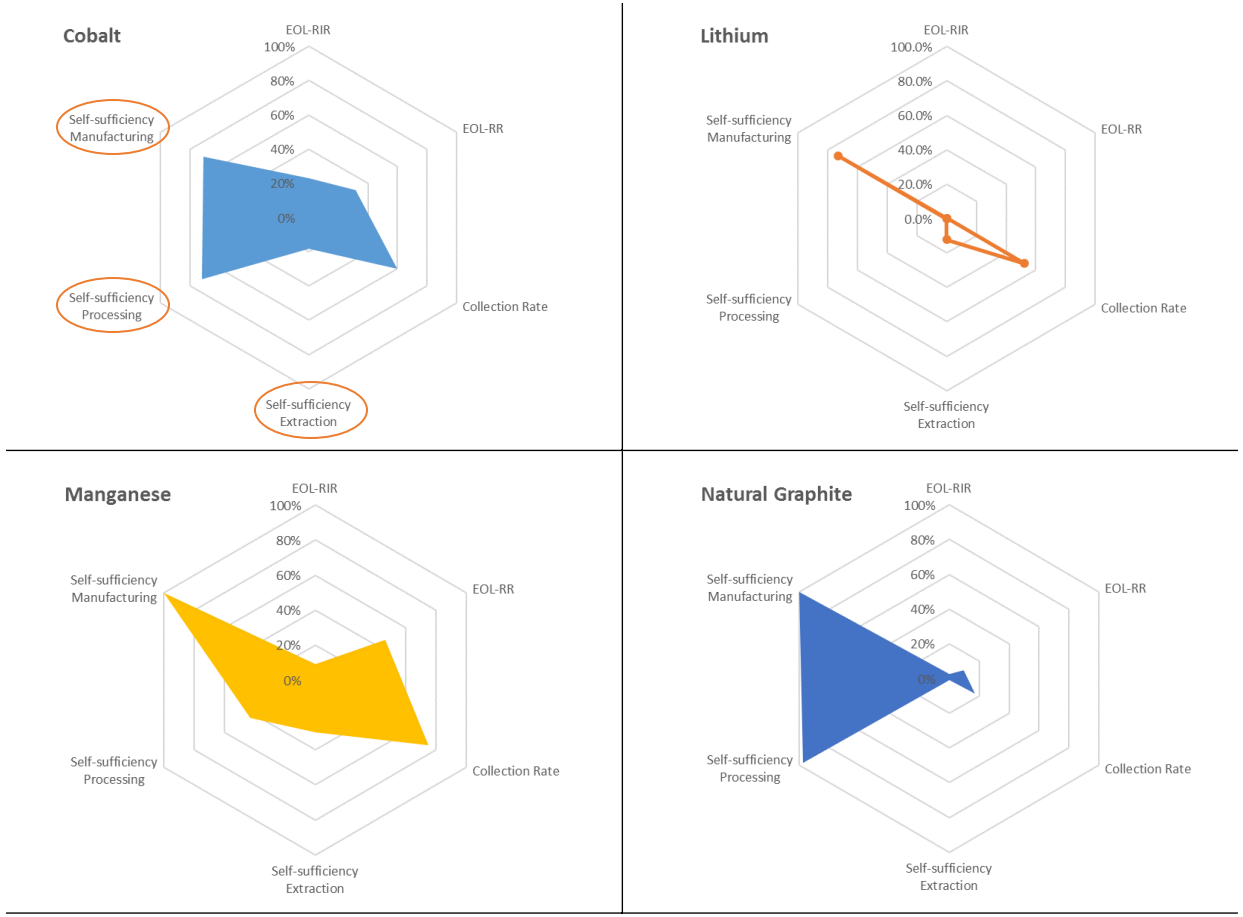
MSAs for five battery raw materials



MSAs: Main results

1. Complete material value chain;
2. Detailed information on EU flows, stocks, end uses;
3. Allowing for the calculation of supply risk indicators e.g EU Import reliance at each stage;
3. Sankey diagrams.





LCA: a supply-chain approach to (plastic) products

FOSSIL-BASED PLASTIC PRODUCTS

Oil & gas extraction → Refining → Monomer/ Intermediate production → Polymer production → Product manufact uring → Product Use → End of Life

BIO-BASED PLASTIC PRODUCTS

Biomass cultivation → Biomass processing → Monomer/ Intermediate production → Polymer production → Product manufact uring → Product Use → End of Life

Comparative LCA of alternative feedstock for plastics production

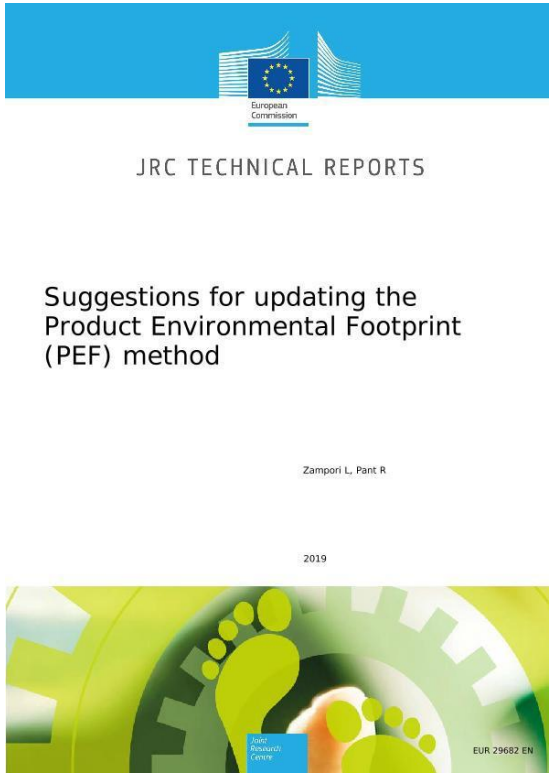
- Elaborate a consistent and robust **LCA-based method** to evaluate the potential environmental impacts of using alternative feedstock sources (biomass, plastic waste, CO_2) for plastic articles/polymers production, compared to using current fossil-based feedstock sources

- Demonstrate the applicability of the method through **10 LCA case studies** on selected plastic articles and including multiple feedstock/polymer scenarios

Plastics LCA: the Method

- Building upon general requirements/recommendations from the EC PEF (Product Environmental Footprint) method

- Enriched with modelling guidance/recommendations for additional relevant aspects, e.g.:
  - Modelling of waste/residual (bio-based) feedstock sources
  - Handling of captured CO_2 as a feedstock
  - End of Life modelling (e.g. biodegradation in biological treatments and on/in-soil)
  - iLUC (Indirect Land Use Change)
  - Macro-/Micro-plastics generation (preliminary framework)



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Thank you

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