

## SUMMARY

### Context and objectives

The challenge of securing access to metals and minerals has received public attention in Europe. Many of these materials are used in everyday applications and are essential for production of common goods, high tech products, or emerging innovations. To address this concern, the European Commission launched the European Raw Materials Initiative<sup>1</sup> and identified a list of raw materials considered as critical for Europe, based on their economic importance and their risk of supply interruption.

The present study aims to build knowledge and understanding of Europe's critical raw materials' flows. A data inventory of these material flows in industry and society for decision-making, a Material System Analysis (MSA) for 28 materials (26 critical raw materials, lithium, and aggregates) is developed.

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#### List of the 28 raw materials studied

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|-------------|--|
| Aggregates  | Lithium  |
| Antimony    | Magnesite  |
| Beryllium   | Magnesium  |
| Borate      | Natural Graphite   |
| Chromium    | Niobium  |
| Cobalt      | Selection of 3 Platinum Group Metals: Palladium, Platinum and Rhodium  |
| Coking coal | Phosphate Rock   |
| Fluorspar   | Selection of 6 heavy Rare Earth Elements and light Rare Earth Elements: Europium, Terbium, Neodymium, Dysprosium, Erbium and Yttrium |
| Gallium     | Silicon Metal  |
| Germanium   | Tungsten   |
| Indium      |  |

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More precisely, the project aimed to provide:

- a complete overview of existing data sources adapted or workable for MSA in Europe, with a specific examination of the Eurostat data base on trade of goods from the viewpoint of its usability for MSA,
- a detailed methodology on establishing MSA in the European Union,
- MSA for the 28 studied materials, with detailed data sources, assumptions and calculations and with main data gaps filled with experts' inputs gathered through direct consultations and organisation of workshops,
- recommendations for the maintenance and update of the MSA.

For each material, this first-ever EU-wide MSA consists of:

- a map of material flows (as raw materials, components, products) illustrating entry (extractions, imports into the EU) and movement (production, consumption, exports out of the EU) through the EU economy, additions to stock, and end-of-life disposal or recovery;
- information on security of supply (country concentration), substitutes, and projected future demand of materials.

The MSA includes the materials' entire life cycles of exploration, extraction, processing, manufacturing, use, and end of life disposal and treatment.

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<sup>1</sup> [http://ec.europa.eu/growth/sectors/raw-materials/policy-strategy/index\\_en.htm](http://ec.europa.eu/growth/sectors/raw-materials/policy-strategy/index_en.htm)

## Project implementation

This project was launched in January 2014 and finished in November 2015. The work was structured in five tasks:

- task 1: Complete overview and evaluation of data sources,
- task 2: Procedure for the development of MSA in Europe,
- task 3: Experts consultation,
- task 4: Development of MSA for the studied materials in Europe,
- task 5: Recommendations on maintaining and updating the MSA database.

## Methodology

The parameters aim to describe physical flows and stocks along the life cycle of the material, characterise the criticality of the material or forecast future supply and demand.

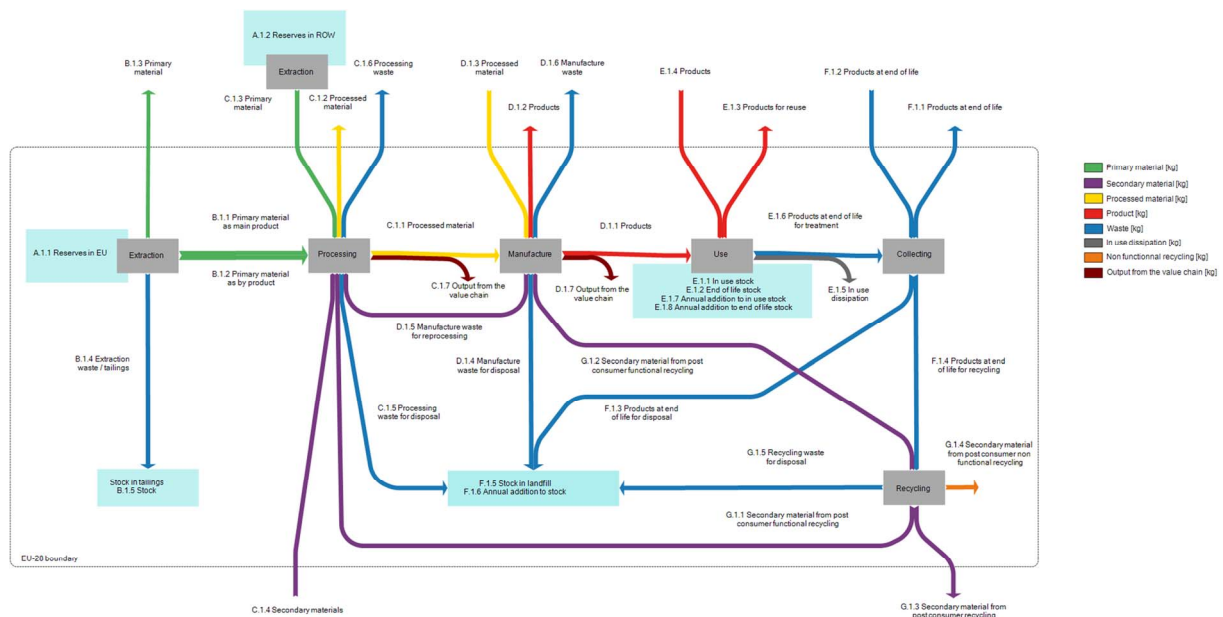


Figure 1: Flow chart of the MSA presenting the flow and stock parameters

The data collection has been carried out through literature review and stakeholders consultations.

Data on EU or world resources and reserves are generally provided by BGS Mineral Factsheets or USGS Minerals Yearbook. In the same way, data on EU production, imports and exports of primary (ores or concentrate) and processed materials, as well as semi-finished products and finished products containing a studied material, are also generally provided in BGS European Mineral Statistics, Eurostat (PRODCOM and ComExt databases) or industrial stakeholders and associations, but there are lots of data gaps and difficulties.

To overcome the difficulties raised by a product-based approach - lots of data gaps regarding the amount of the flows of specific types of semi-finished or finished products, mainly because of aggregated or missing codes in Eurostat databases or because of confidentiality of data; and the composition of the semi-finished and finished products, and in particular the contents of the studied materials, is generally not available- a more top-down approach, based on data on total EU production or total EU consumption of the studied material in the finished products and data on the shares of use of the material within the main sectors in EU has been preferred for the downstream steps of the life cycle.

The expert consultation, based both on bilateral exchanges and on workshops, was a key step for the development of the MSA, particularly valuable to fill the data gaps and to ensure the reliability of the results.

To ensure transparency on the level of reliability of the data used to calculate each parameter, a Data Quality Score has been assigned to each piece of data, from 1 (not reliable, based on a hypothesis) to 4 (reliable, based on a written source or experts).

## **Outcomes**

Obtained through literature reviews and stakeholder consultations, the results for each material are summarised in a list of quantitative and qualitative parameters as well as Sankey diagrams to provide an overall vision of flows and stocks. It is important to note that due to numerous difficulties not least lack data, the aim is to generate an overview (order of magnitude) of the full life cycles of the studied materials. Therefore, the results should not be taken as exact figures.

The detailed outcome of the study is included in a secured database (ECAS login) that will help identifying key opportunities to secure resources in the European Union, e.g. through recycling.

For each material, results include:

- a description of the value chain with the different forms of the material along the life cycle,
- a description of the main flows and stocks in order to provide an overview of the MSA,
- information regarding data sources, assumptions and reliability of results,
- two Sankey diagrams, which allow to visualise the results for the flows and stocks parameters:
  - a detailed Sankey diagram (access restricted), which aims to represent the entire life cycle of the material within the EU boundaries, from the extraction until the recycling step. All available flows and stocks parameters are displayed, which provide a detailed and complete representation of the current situation in the EU;
  - a simplified Sankey diagram (public), which depicts the main flows of the material and allows for a rapid understanding of the EU situation by comparing the main input flows or the main output flows.

## **Recommendations**

The following recommendations are made:

- Sensitivity issues due to public availability of some results of the MSA → In depth analysis of “sensitive parameters” of the MSA with representatives of trade associations to figure out if the results really could harm European material sectors and policies;
- Improvement of EU databases (ComExt, PRODCOM, waste database) with regards to the MSA’s needs:
  - Inaccuracy of the data → more internal controls on the values provided by Member States;
  - Non-harmonisation of units → conversion charts;
  - Lack of clarity of the name of codes → detailed guidance explaining each code;
  - Combinations of materials gathered in a same code → subdivide the existing codes;

- Lack of material content information in codes → publication of average material contents for codes;
- Differences of the availability of data in both PRODCOM and ComExt databases → harmonise the availability of data within the EU;
- Data missing or too general in Eurostat waste database → increase the number of types of waste, fill data gaps in treatment of waste, give concentration of materials in waste, assess extent and implications of illegal exports;
- Technical recommendations for updating and improving the MSA:
  - Systematically review the quality of the sources used ;
  - When data is scarce, consult experts instead of the bottom-up approach ;
  - Anticipate and secure budget for the purchase of (expensive) commercial literature ;
  - Ensure adherence to the principle of mass conservation all along the life cycle (mass balance);
  - Stakeholder and expert involvement via consultation and workshops.