

Materials design and selection for circular economy

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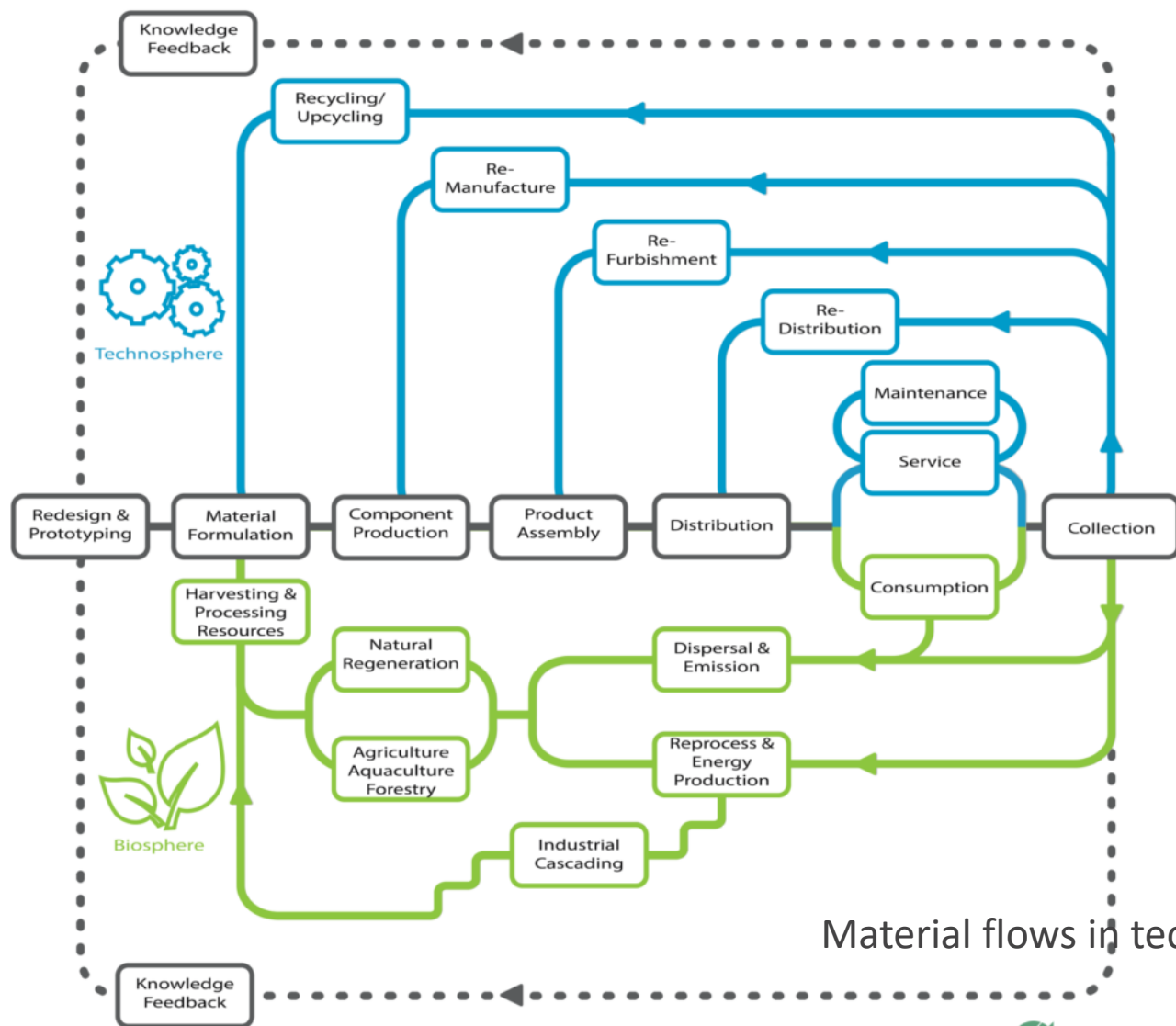
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Metrics and tools to quantify circularity

1. Sankey diagrams of materials flows: showing the amount of materials extracted, imported, recycled or disposed, as well as the related emissions
2. Circularity rates: measuring the contribution of recycled materials/secondary raw materials towards the overall use of materials.

Notes:

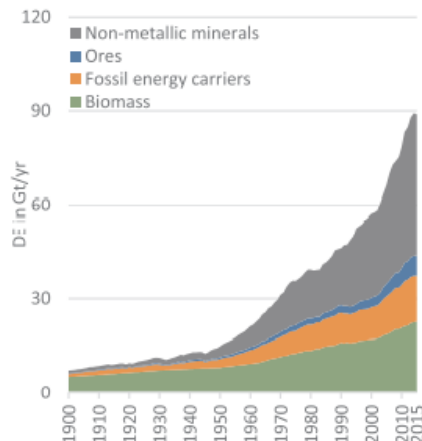
- With circularity rate only the production of secondary raw materials is considered (backfilling excluded: [see Glossary](#))
- Import/export flows are treated differently (Sankey diagrams does not take into account import/export, whereas circularity rates include exported waste).



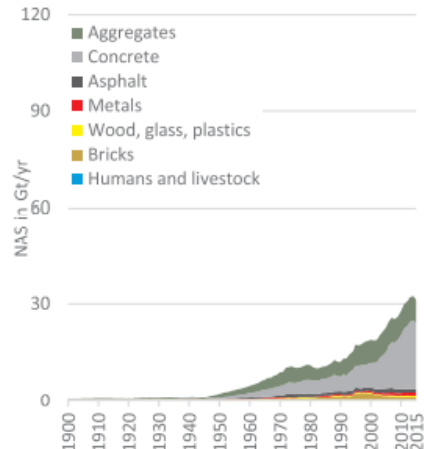
Material flows in technosphere and biosphere

Global materials flows

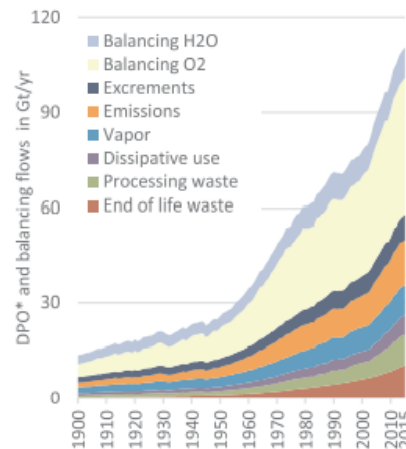
A Extraction (DE)



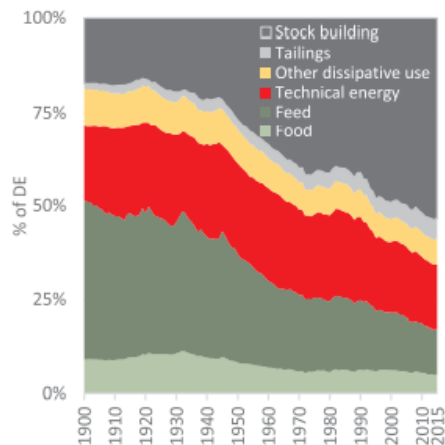
C Net addition to stocks (NAS)



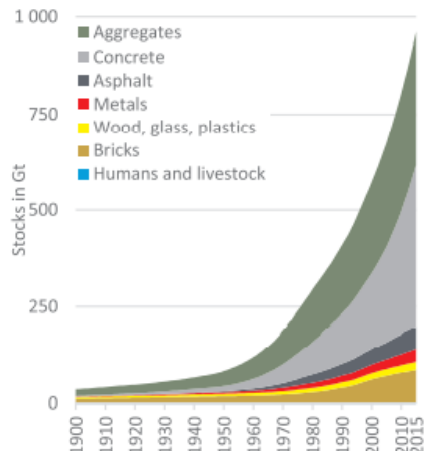
E Domestic processed output (DPO)*



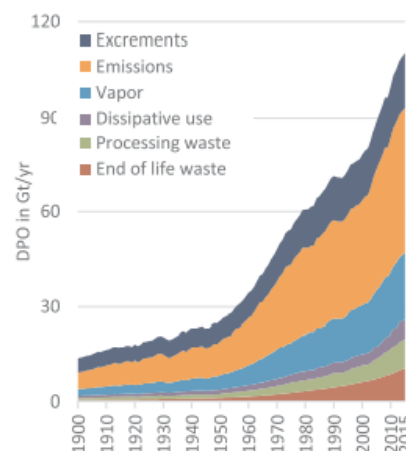
B Material use



D Stocks



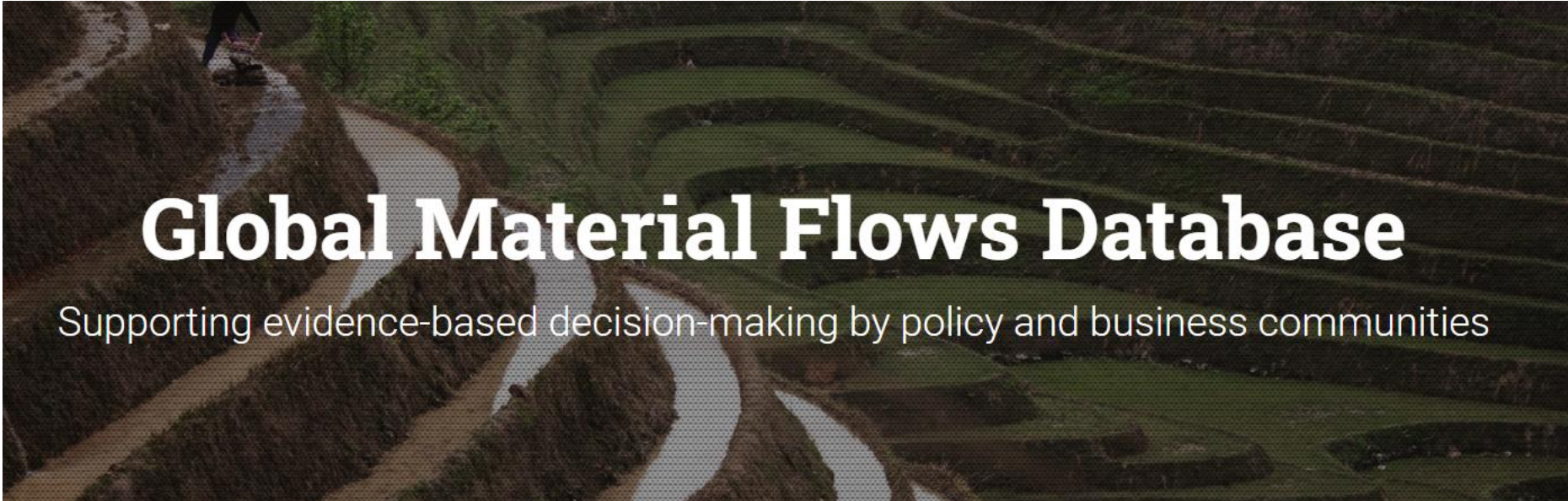
F Domestic processed output (DPO)



Building stock is a term that is used to describe the total number of **buildings** in a country, region, municipal area or estate.

https://www.designingbuildings.co.uk/wiki/Housing_stock/_building_stock

Global material flows in Gt/yr and stocks in Gt from 1900 to 2015. A: material extraction by main material group; B: share of major use types in total extraction; C: yearly net additions to stock (NAS); D: stocks of humans, livestock and manufactured capital in Gt; E: the fraction of domestic processed output that actually originates from DE (DPO*) separate from balancing oxygen and water F: DPO by main type including balancing oxygen and water. Source: Global Environmental Change 52 (2018) 131.



Global Material Flows Database

Supporting evidence-based decision-making by policy and business communities

- The **Global Material Flows Database** provides data to help governments, policy researchers and interested stakeholders understand and trace the linkages between economic growth and raw material usage.
- Such information is **basic for the development of effectively targeted sustainable consumption and production strategies**.
- It also builds a **strong quantitative basis** upon which the success or failure of those strategies in lowering resources use can subsequently be assessed.

<https://www.resourcepanel.org/global-material-flows-database>

Useful (web) resources and tools

National 4+ categories
material flows

National 13+
categories material
flows

National material
totals and ratios

Filter countries
Clear filter

Filter categories
Clear filter

Filter flow types
Clear filter

Italy x

Metal ores x

IMP (Imports, t) x

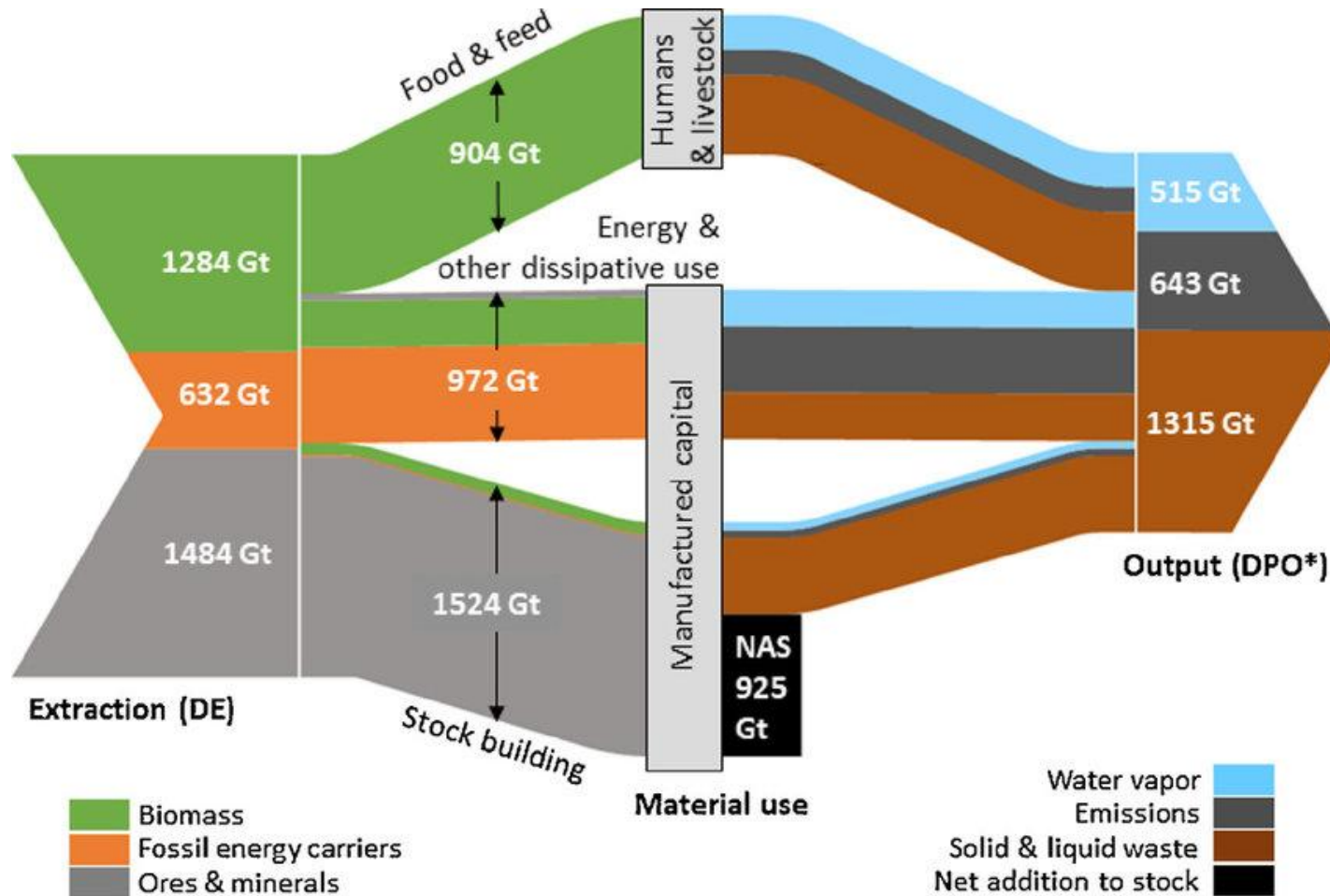
Country ^	Category ^	Flow ^	2014 ^	2015 ^	2016 ^	2017 ^	2018 ^	2019 ^
Italy	Metal ores	IMP	34.546.134	36.090.478	37.623.668	31.269.093	31.956.096	31.216.364

Showing 10 of 1 entries

Export selection
Export full dataset
More detailed data

<https://www.resourcepanel.org/global-material-flows-database>

Sankey diagrams



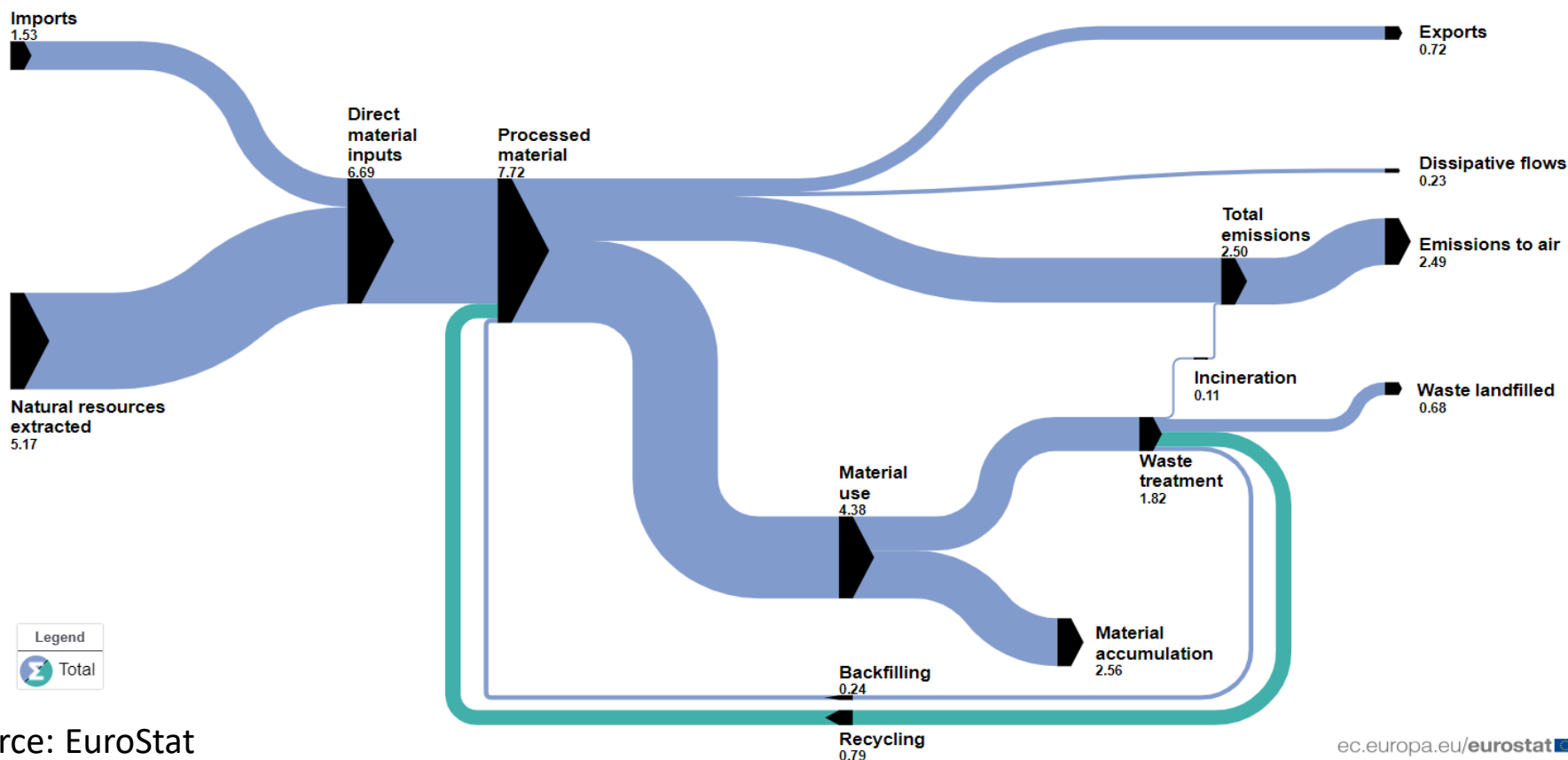
Sankey diagram showing the cumulative flow of materials through the global economy from extraction to use and output of wastes and emission. Note that NAS of humans and livestock (1 Gt) are not visible.

The **Eurostat Sankey diagram** of material flows shows the amounts of materials extracted, imported, recycled or disposed, as well as related emissions.

Figure 1 shows the flows of material in the EU economy in 2017. Some basic information to help you understand the diagram:

- the flow runs left to right;
- the width of the bands is proportional to the quantity of the flow, which is measured in billions of tonnes;
- the materials shown in the diagram are: biomass — used for food and fodder, clothing (wool, cotton, etc.), timber, etc.; metals; non-metallic minerals; fossil energy carriers, such as crude oil — used to produce fossil fuels or materials such as plastics.
- fossil fuel carriers and biomass (wood) produce air emissions — shown on the right side of Figure 1 — as a result of being burned to release energy.
- Water is not included, nor are renewable energy sources that do not involve material flows, such as electricity from photovoltaic panels or wind power.

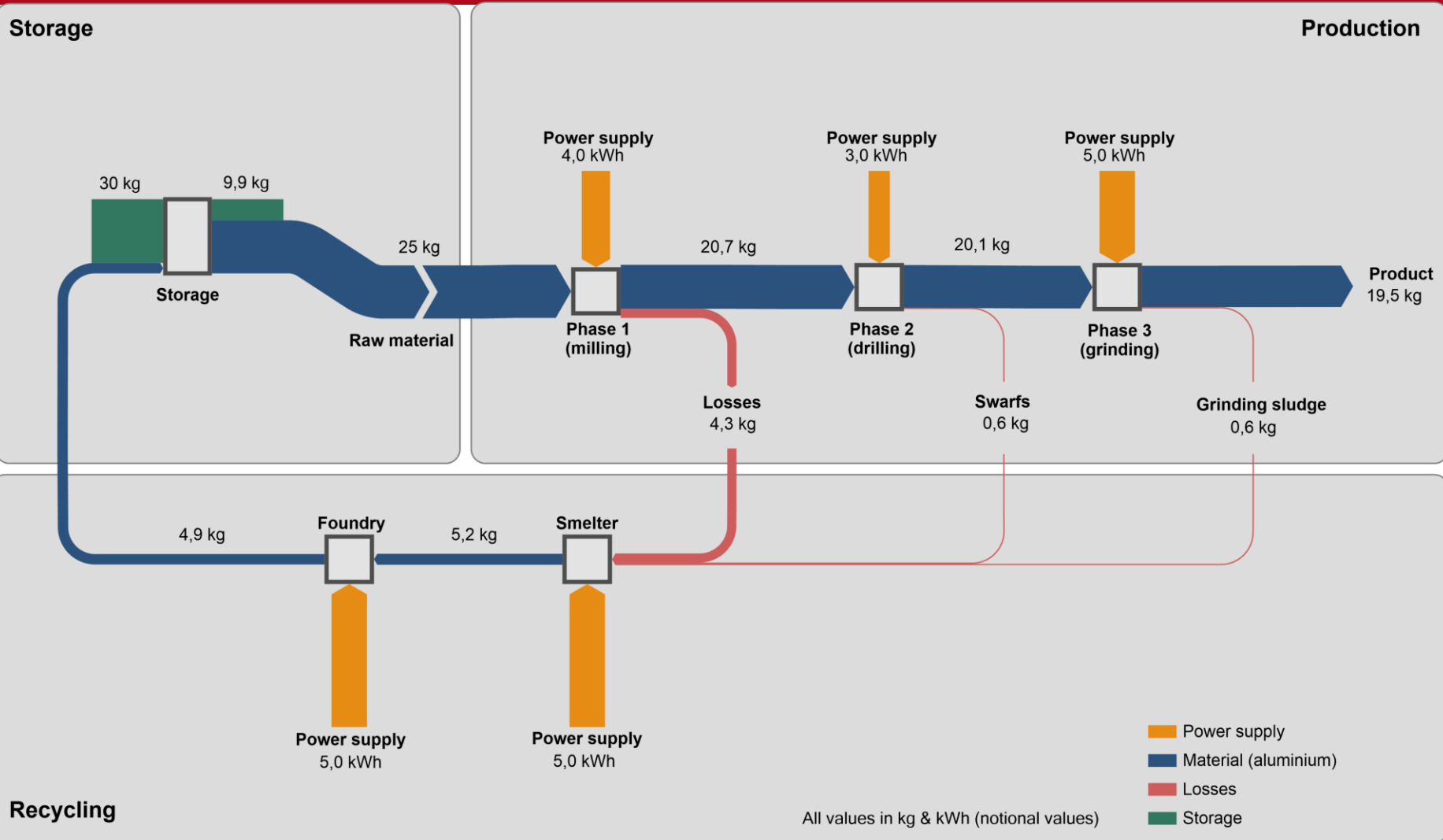
Sankey Diagrams



[Circular economy flow diagrams \(europa.eu\)](https://ec.europa.eu/eurostat/cache/sankey/circular_economy/sankey.html?geos=EU27&year=2020&unit=G_T&materials=TOTAL&highlight=0&nodeDisagg=0101100100&flowDisagg=false&translateX=200&translateY=70&scale=0.7&language=EN&xyz=89&material=TOTAL)

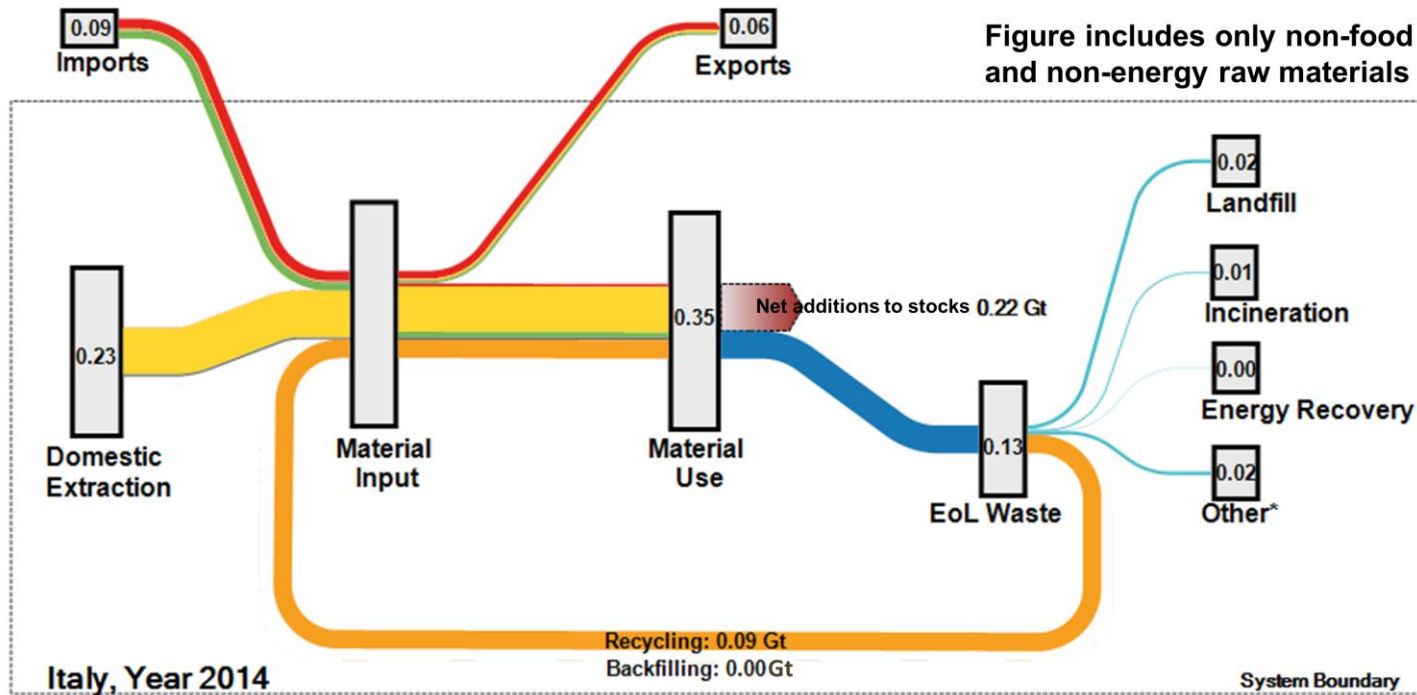
https://ec.europa.eu/eurostat/cache/sankey/circular_economy/sankey.html?geos=EU27&year=2020&unit=G_T&materials=TOTAL&highlight=0&nodeDisagg=0101100100&flowDisagg=false&translateX=200&translateY=70&scale=0.7&language=EN&xyz=89&material=TOTAL

Sankey Diagrams



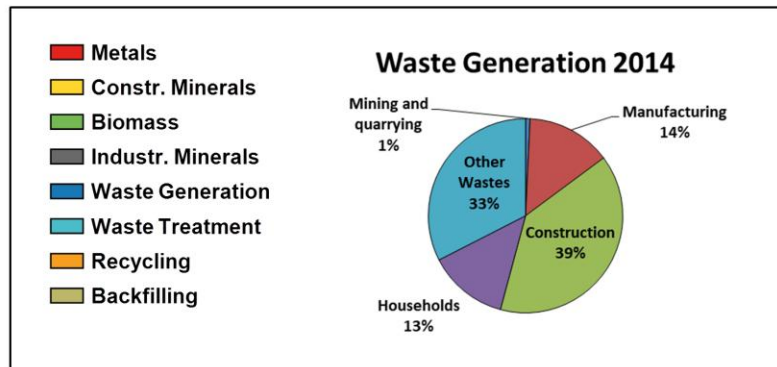
Source: https://www.ifu.com/fileadmin/_processed_/e/4/csm_Sankey-diagram-process-flow-with-recycling_030445d563.png

Global materials flows



The resulting Sankey diagrams can help to show the magnitude of material flows (domestic extraction, imports, and exports) and end-of-life waste generation and treatment for different EU countries.

Flows in Gt/yr



Source: Eurostat economy-wide material flow accounts (EW-MFA)