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Material Flow Analysis as a Base for Benchmarking in Waste Management

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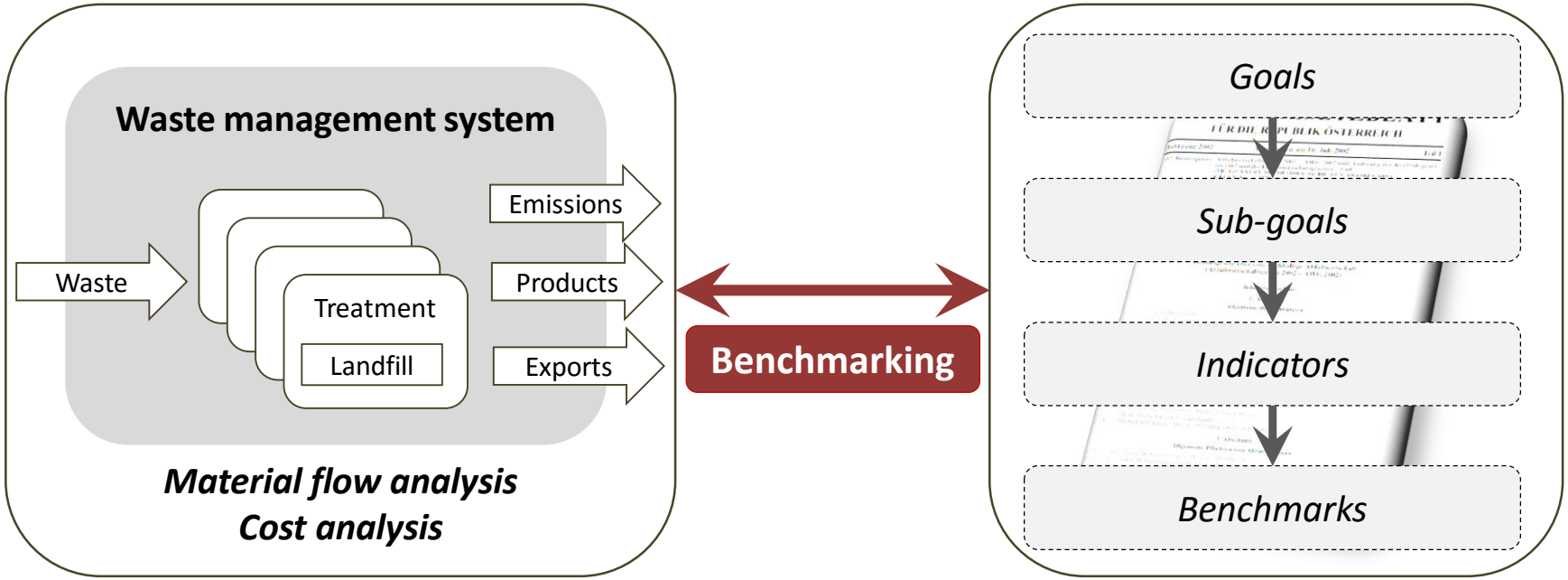
2 Main Messages

- **Benchmarking in Waste Management**
  - *Is a well suited assessment tool to compare and optimize waste management systems from different regions and countries.*

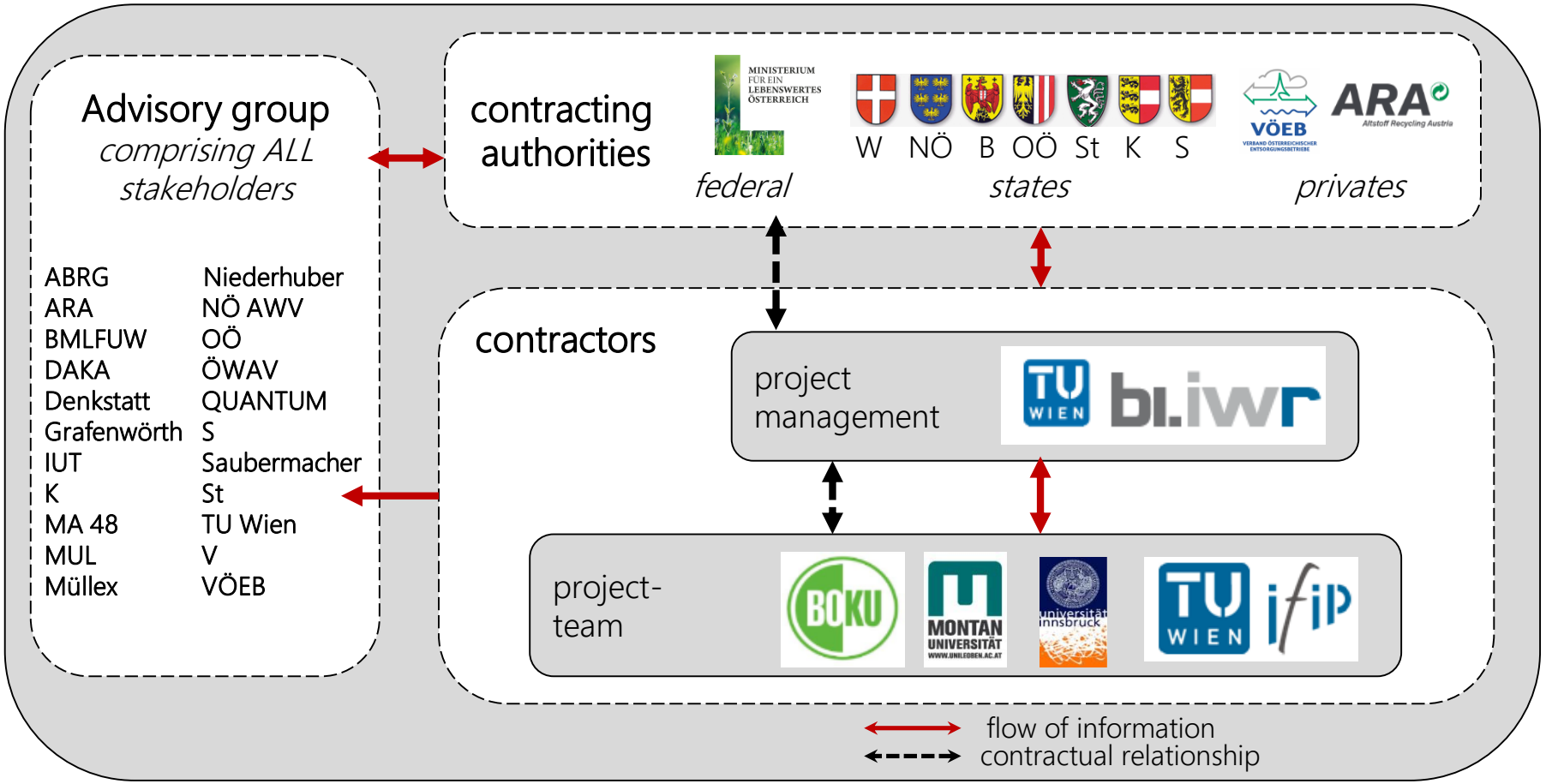
- **Material Flow Analysis**
  - *A science-policy interface for technical and scientific input to policy decisions.*

Project Goals

- **Evaluate the waste management system**
- **Assess if given goals are achieved**
- **Assess the economic viability**
- **Support decision makers and serve as a strategic base**

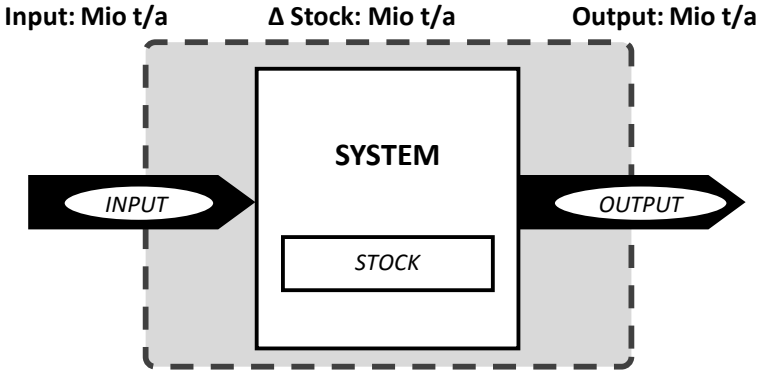


Science-policy dialog requires all stakeholders



Why material flow analysis for benchmarking?

- **Mass balance principle**
  - *Transparent way to inform stakeholders and researchers*
  - *Complete and consistent database for subsequent assessment*

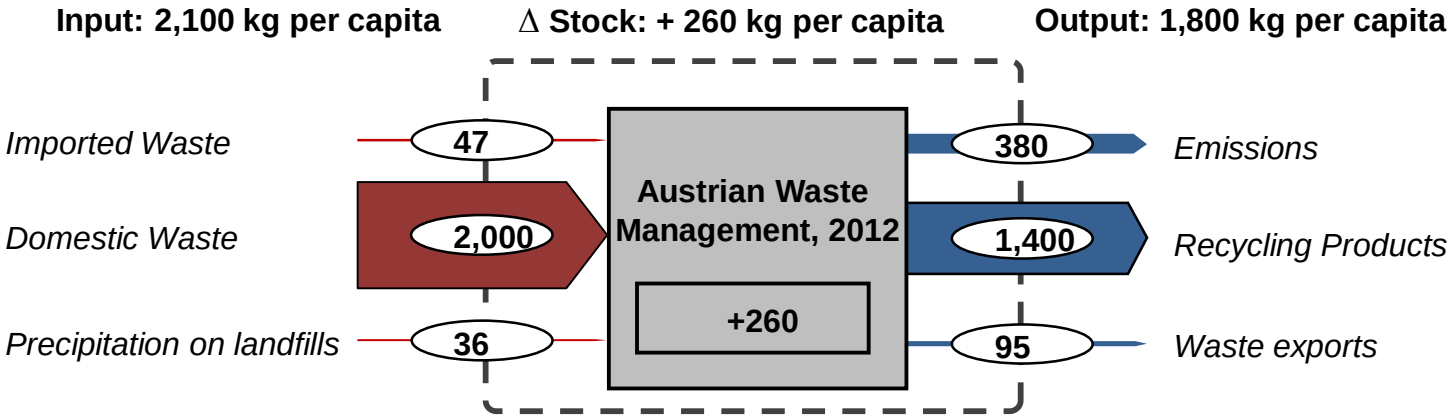


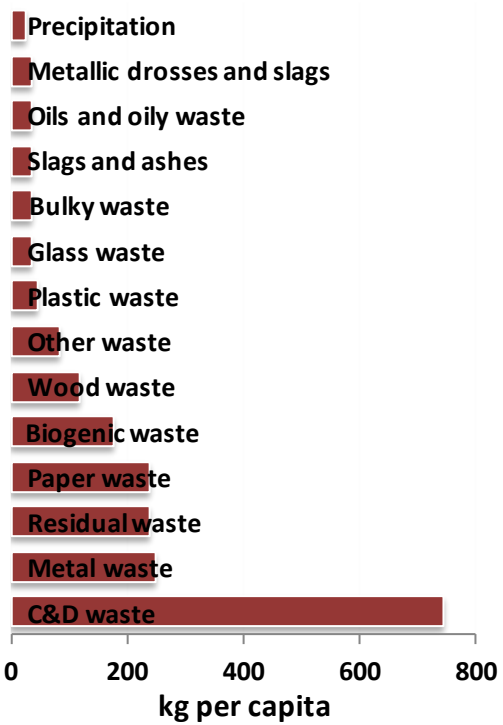
$$Input = Output \pm Stocks$$

- **Common uniform base**
  - *As a base for evaluation*
  - *For planning and operating systems and developing strategies*

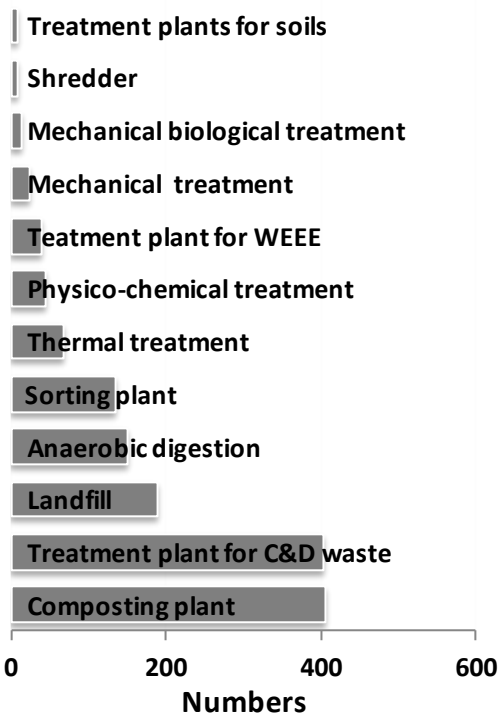
- **MFA on goods and substances level**
  - *For comprehensively assessing if a chosen system reaches designated waste management goals*

MFA - Why level of goods?

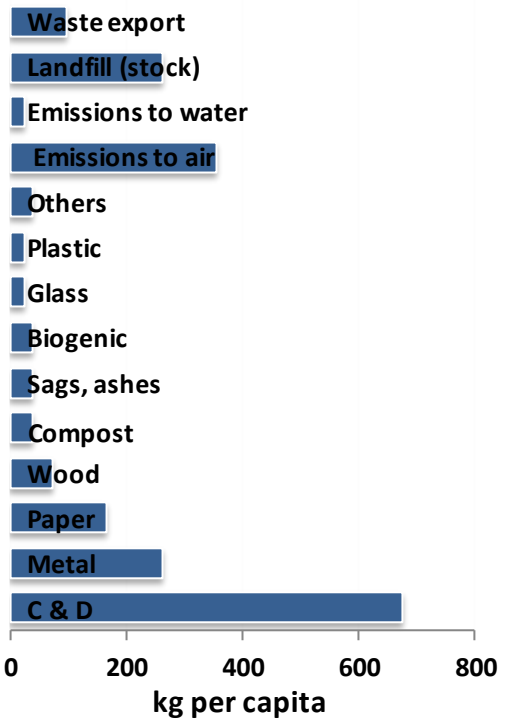




Inputs

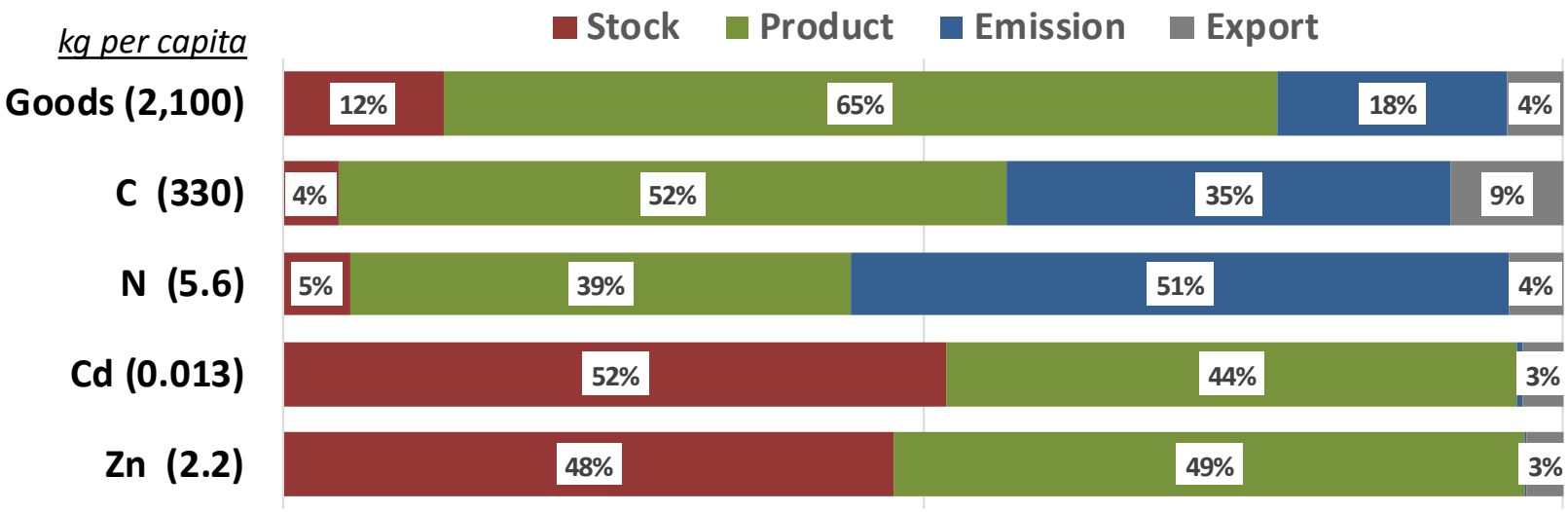


Treatment Plants



Outputs

MFA - Why level of substances?

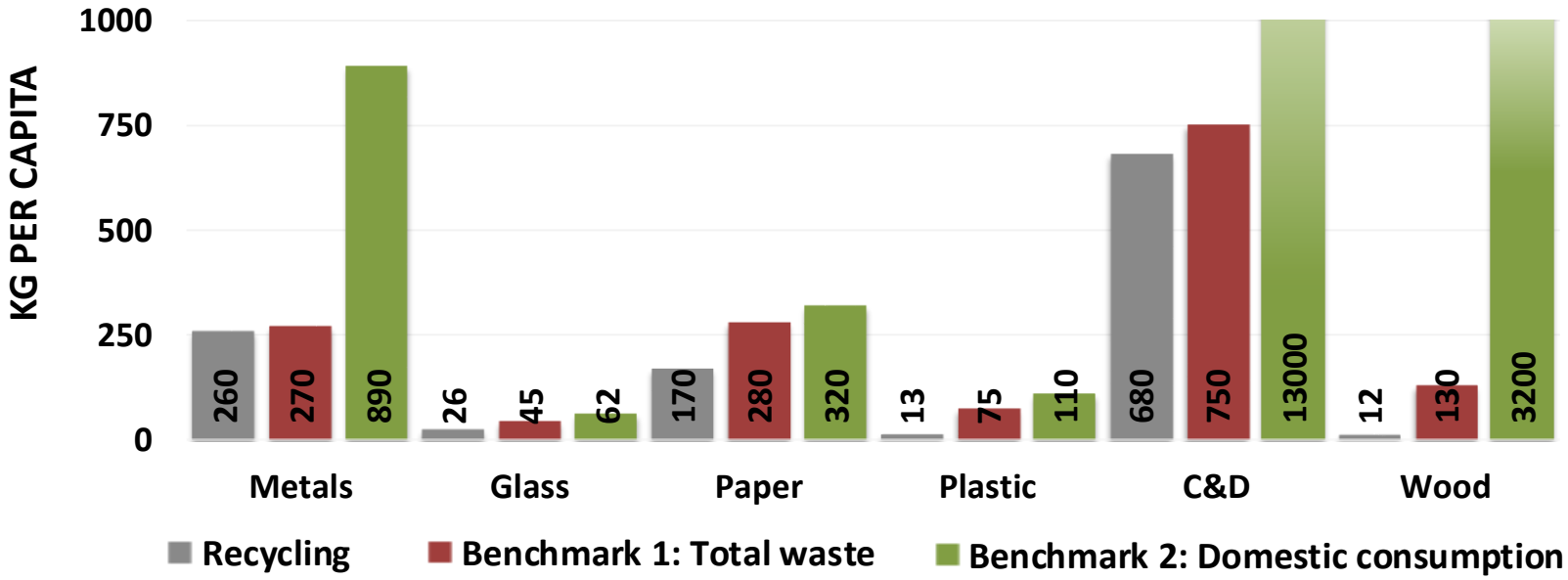


- To identify the distribution of beneficial and hazardous substances
- To identify changes in stock of beneficial and hazardous substances
- To characterize chemical compositions of waste and transfers to possible products
- To look for potentially hidden substances

Framework for Benchmarking

Goal	Sub-goal	Indicator	
To protect humans, environment and animals	protect humans	human toxicity	kg/year
	protect environment and animals	acidification	kg $SO_{2\text{-equ}}$./year
		photochemical pollution	kg $NMVOC_{equ}$/year
		ozone depletion	kg CFC-11_{equ}/year
		eutrophication	kg P_{equ}/year
To minimize air pollution and gases affecting the climate	minimize air pollution	dioxins, Furans, SO_2, CO, NH_3, NO_x, fine dust	kg/year
	minimize gases affecting the climate	CH_4, N_2O, CO_2, FCKWs	kg $CO_{2\text{-equ}}$/year
To conserve resources	conserve landfill volume	landfilled waste	m³/year
	conserve resources	resources produced	kg/year
	conserve water	water used	m³/year
	conserve area	area used	m²/year
	conserve energy	energy produced	MWh/year
To ensure that only such waste remains as can be stored without danger for future generations	reduce heavy metals in landfills	heavy metals	kg/year
	obtain autarky	treatment/disposal capacity	t/year
	reduce long-term emission from landfills into water	TOC, NH4 and heavy metals	kg/year
	reduce long-term emission from landfills into air	CH_4, CO_2	kg $CO_{2\text{-equ}}$/year/m²
To ensure that the materials recycled do not present a greater risk than comparable primary raw materials		hazardous substances	mg/kg

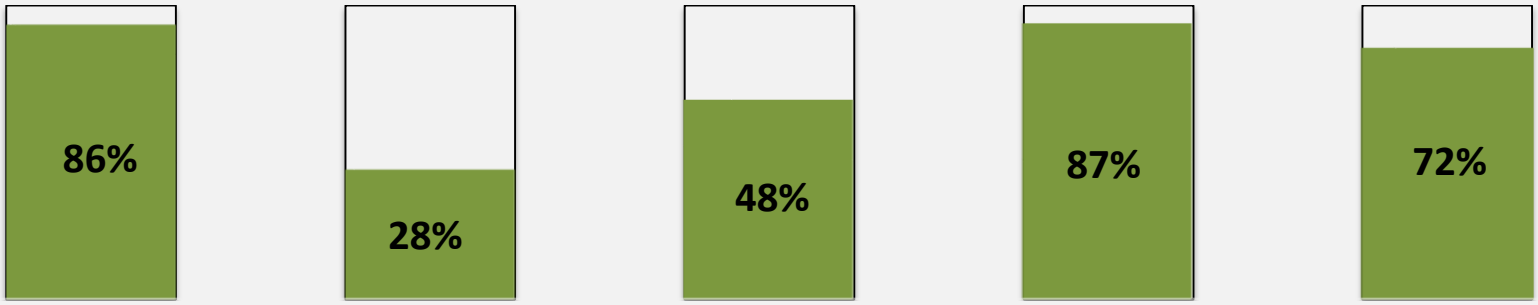
Benchmarking - Example: Conservation of resources



- **Recycling rates**
  10% – 90%

- **Fraction of domestic consumption**
  0.5 – 50%

Benchmarking - Overall results



- *Credits show importance of recycling (especially metals)*
- ***Human toxicity excluded***

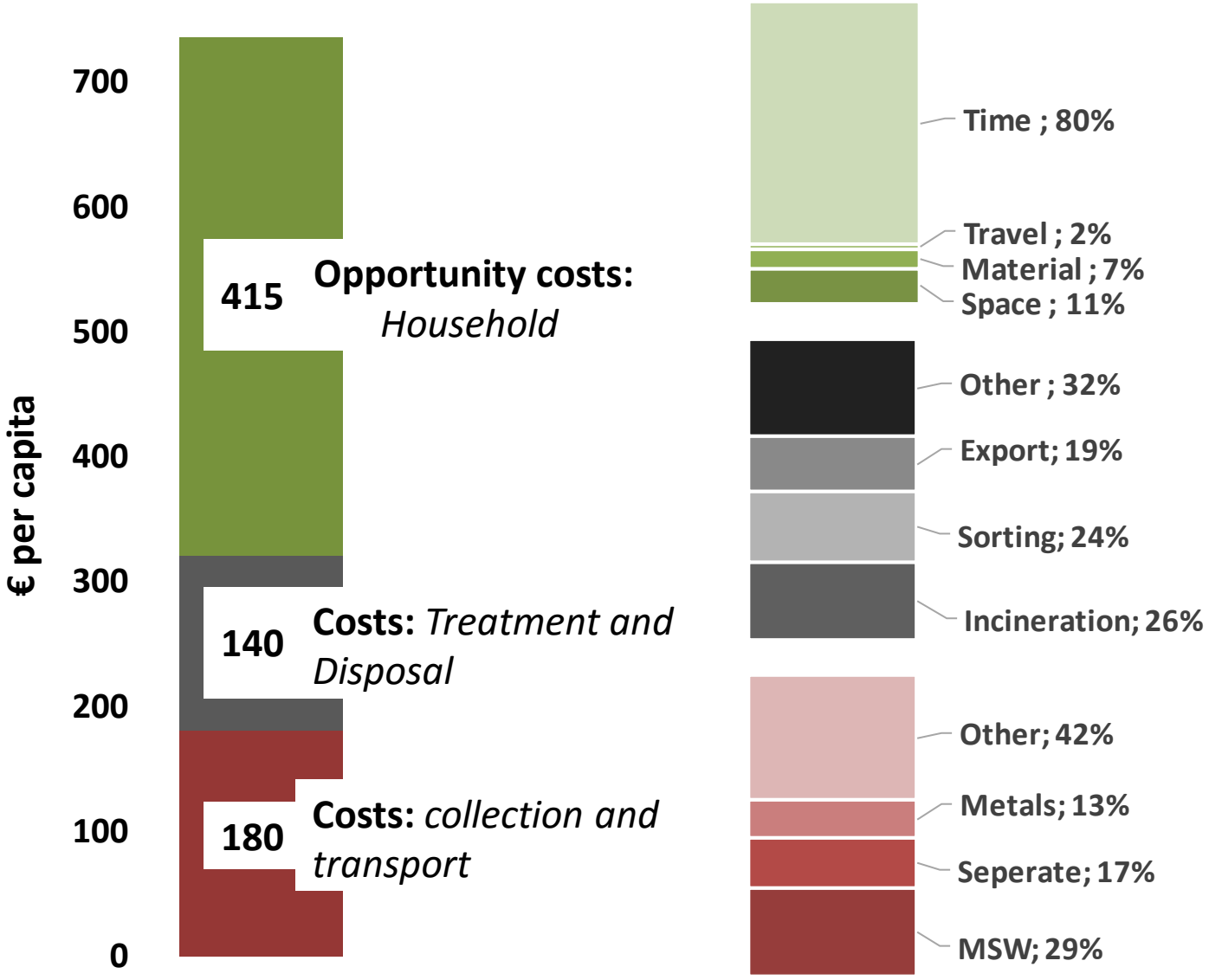
- *NO_x and SO_2: need for actions*

- *Competition between material and energy recycling (especially wood and plastics)*

- *C&D and wood: reduce pollution loads*
- ***Plastics excluded***

- *Gas: High emissions in the first 50 years*
- *Leachate: geogenic background concentrations are exceeded over hundreds of years*

Economic analysis



8.4 Inhabitants; 17 Million tons of waste

Conclusions

- **Material Flow Analysis**
  - Mass balance approach key for transparency and reproducibility
  - Presents excellent base for communication between stakeholders and researchers
  - Base for planning and operating of waste management systems
  - Provides background information in aggregated form and visualizes systems

- **Benchmarking – Methodology**
  - Tool to assess waste management systems
  - Interrelations become visible
    - between economy and waste management
    - between different goals
  - Improvements can be indicated for
    - Waste management stakeholders
    - Research community

→ provide evidence-based data for policymakers
→ Support policymakers with sound scientific methodology

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Thank you for your attention!