From MFA to SEEA to SMM

Material Sado-Masochism for Beginners

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A story of industrial entropy

Resource Stocks

62 Gt

Reservoirs

Atmosphere
49 Gt of GHG

Water
22 Mt of P

Terrestrial
12 Gt of Waste

Source: OECD/IEA data, OECD Materials Report
Planetary accounting level

Global Extraction

Global Extraction Used (GEU) = Global Material Consumption (GMC)

Unused Global Extraction (UGE)

- Mining overburden
- Harvest residues
- Fishery by-catch
- Soil erosion from agriculture

Waste

Reusable
62 Gt of material resources extracted in 2008

- Fossil Energy Carriers: 12.7 Gt
  - Unused Extraction: 70%
  - Used Extraction: 30%

- Metals: 8.2 Gt
  - Unused Extraction: 50%
  - Used Extraction: 50%

- Biomass: 20.3 Gt
  - Unused Extraction: 10%
  - Used Extraction: 90%

- Minerals: 20.8 Gt
  - Unused Extraction: 10%
  - Used Extraction: 90%

Source: OECD Material Flow Analysis Data, SERI
National accounting level

- Domestic Extraction
- Domestic Extraction Used (DEU)
- Unused Domestic Extraction (UDE)
- Waste
- Reusable / recycled
But nations trade; from DEU to DMC

Australia

Exports 0.7 Gt

Domestic Material Consumption (DMC)
1.0 Gt

Imports 0.08 Gt

China

Exports 0.4 Gt

Domestic Material Consumption (DMC)
17.8 Gt

Imports 1.1 Gt

Source: OECD computations based on UN COMTRADE data.
Global material resource extraction, 1980-2008

Source: OECD Material Flow database and SERI (Sustainable Europe Research Institute)
Regional shares – all have increased

1990

Biomass 16.3 billion tonnes
- OECD 29%
- BRIICS 39%
- RoW 32%

Fossil fuels 9.2 billion tonnes
- OECD 30%
- RoW 27%
- BRIICS 41%

2008

Biomass 20.2 billion tonnes
- OECD 23%
- BRIICS 42%
- RoW 35%

Fossil fuels 12.7 billion tonnes
- OECD 38%
- RoW 33%
- BRIICS 29%

1990

Metals 4.1 billion tonnes
- OECD 38%
- BRIICS 33%
- RoW 33%

Minerals 14.5 billion tonnes
- OECD 72%
- BRIICS 14%
- RoW 14%

2008

Metals 8.2 billion tonnes
- OECD 43%
- BRIICS 33%
- RoW 24%

Minerals 20.8 billion tonnes
- OECD 56%
- BRIICS 26%
- RoW 18%

Source: OECD Material Flow database and SERI (Sustainable Europe Research Institute)
Total material exports (direct flows)

Total material exports, Million tonnes

Source: OECD Material Flow database and SERI (Sustainable Europe Research Institute)
The System of Environmental-Economic Accounting (SEEA) – A framework for measuring interactions between the environment and the economy
SEEA Conceptual Framework

**Territory of reference**

**Economy**
- **Actors**
  - Enterprises
  - Households
  - Government
  - Non-profit institutions
- **Activities**
  - Production
  - Consumption
  - Accumulation
- **Instruments**
  - Financial/Monetary
  - Taxes/subsidies
  - Financing
  - Resource rent
  - Permits

**Environment**
- **Natural Resources (stocks)**
  - Land
  - Water
  - Ecosystems
  - Soil
  - Etc.
- **Natural Resource flows**
  - Materials
  - Energy
  - Water
  - Ecosystem services
  - Etc.

**Analytical and Policy Frameworks**
- Productivity analysis
- Natural resource management
- Climate change
- Green Growth/Green Economy

**Outside territory of reference**

Land / Resource use / Ecosystems

Emissions / waste
SEEA Central Framework was adopted as the international statistical standard in 2012; Efforts are needed to implement it to ensure consistency and comparability of measures.

More and improved data are needed on...

- stocks and flows of non-energy minerals
- stocks and flows of waste secondary raw materials
- better data for MFA including trade
- changes in key stocks and flows
- land valuation
- social values of resources
- subsidies regulatory instruments
- Physical side
- Valuation
- Policy tools
Global distribution of phosphate rock reserves, 2010

- Morocco and Western Sahara: 77%
- China: 6%
- Algeria: 3%
- Syria: 3%
- South Africa: 2%
- USA: 2%
- Jordan: 2%
- Other countries: 5%

Global distribution of rare earth oxides by end-use, 2008

- Glass industry: 22%
- Magnets: 20%
- Ceramic: 6%
- Catalysts: 21%
- Other: 6%
- Batteries: 9%
- Phosphors: 7%

Source: Adapted from BGS (2010) and Goonan (2011).
Copper mine grades and recoveries

Source: Citigroup (2011)
Energy consumption across the conventional milk production and consumption system
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Thank you