Global warming, energy and circularity – the top-down approach

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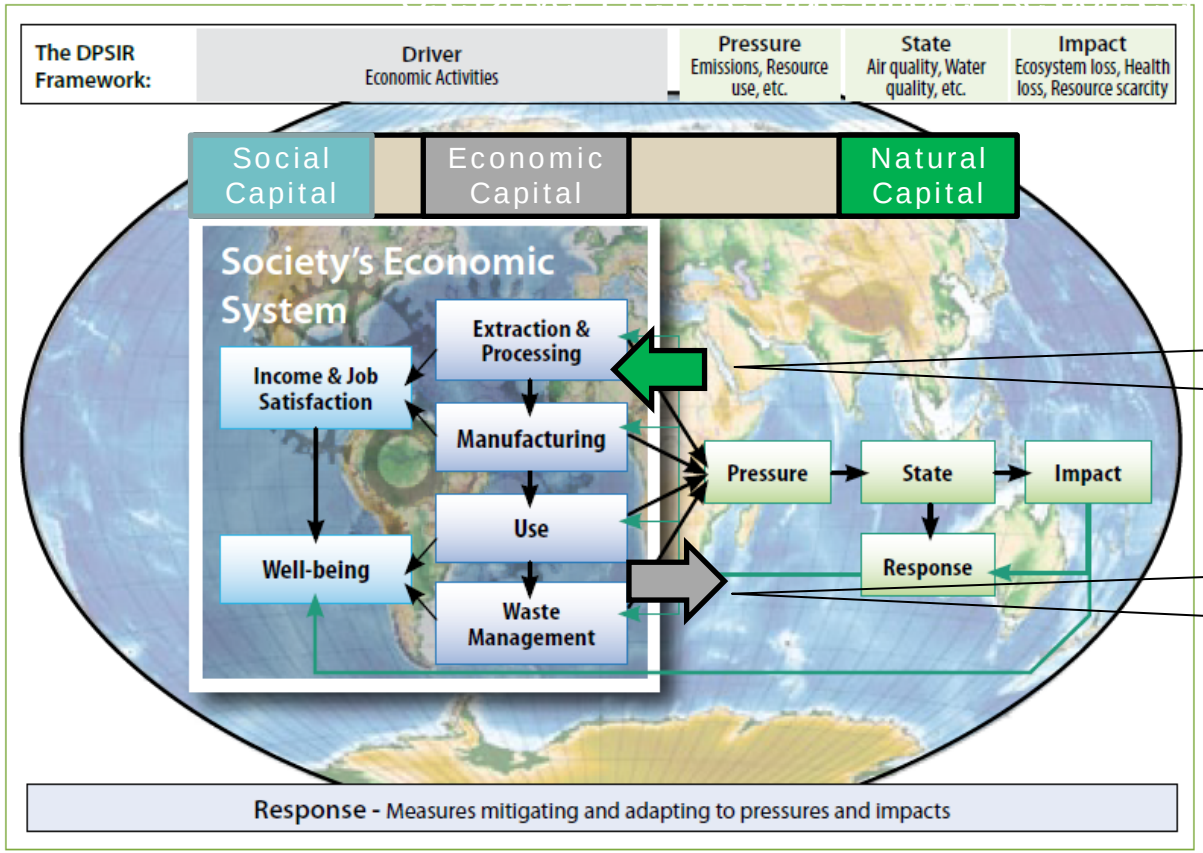
Introduction

- Some top-down tools developed by the IE community
- Some results of analyses
- Some policy implications

Accounting for resource use & impacts

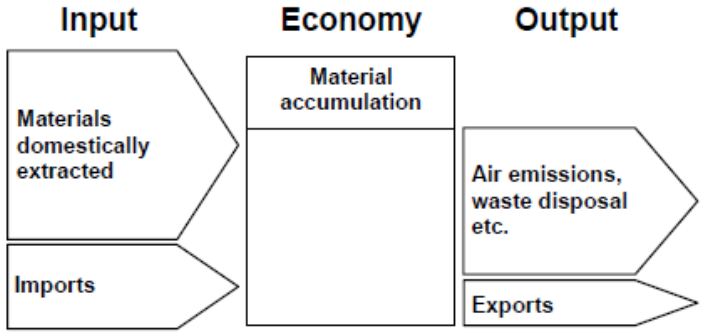


Resources

Emissions and waste

Some top-down tools of the IE community on measuring circularity

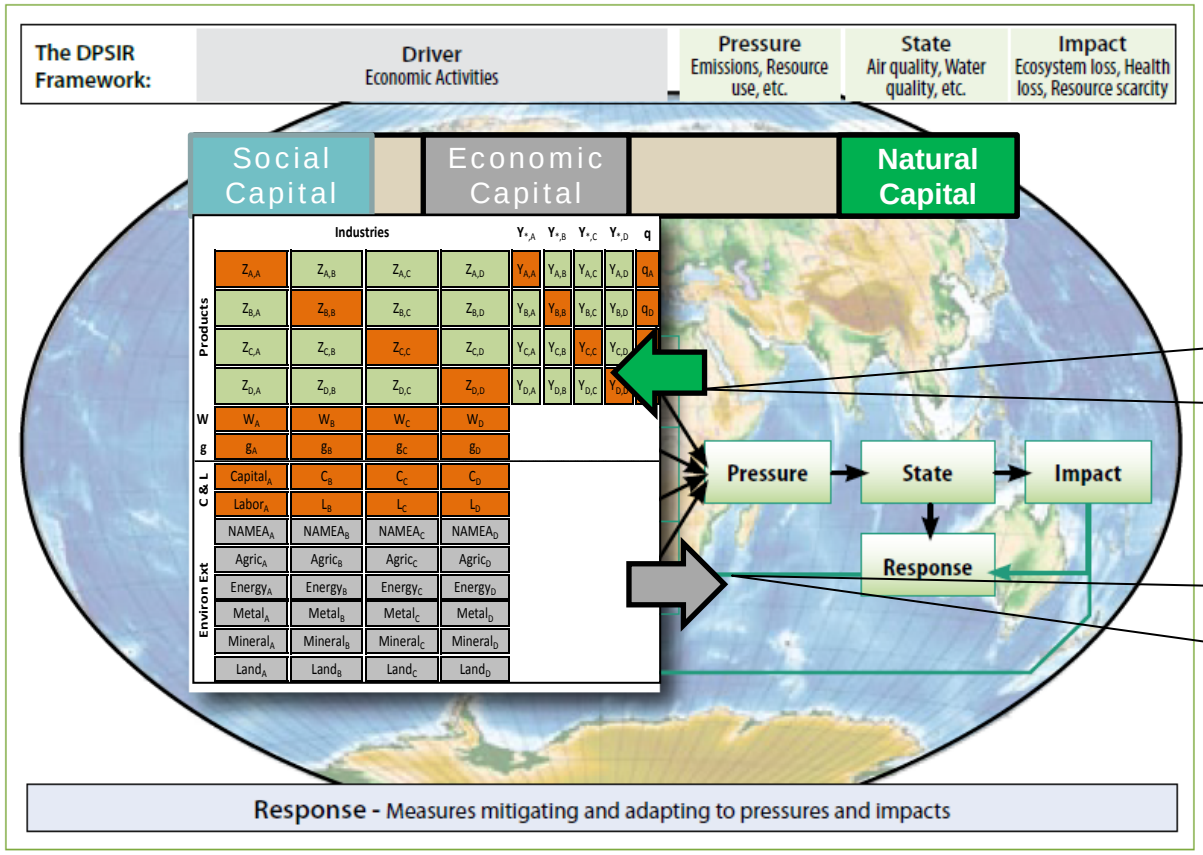
- Economy wide material flow analysis
  - Country level
  - Circularity -> reductions of material inputs visible
- Environmentally extended input-output analysis (EE IO)
  - Sector level (full countries or international)
  - Can identify resource use at sector level



		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$	$Y_{C,D}$	q_C
		$Z_{D,A}$	$Z_{D,B}$	$Z_{D,C}$	$Z_{D,D}$	$Y_{D,A}$	$Y_{D,B}$	$Y_{D,C}$	$Y_{D,D}$	q_D
W		W_A	W_B	W_C	W_D					
ϖ		g_A	g_B	g_C	g_D					
C & L		$Capital_A$	C_B	C_C	C_D					
		$Labor_A$	L_B	L_C	L_D					
Environ Ext		$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
		$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
		$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
		$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
		$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
		$Land_A$	$Land_B$	$Land_C$	$Land_D$					

Environmentally extended input output analysis

- Some 4 global databases available
- EXIOBASE by consortium of undersigned
  - Includes physical global flows
  - 43 countries, 163 sectors, 80 resources, 40 emissions

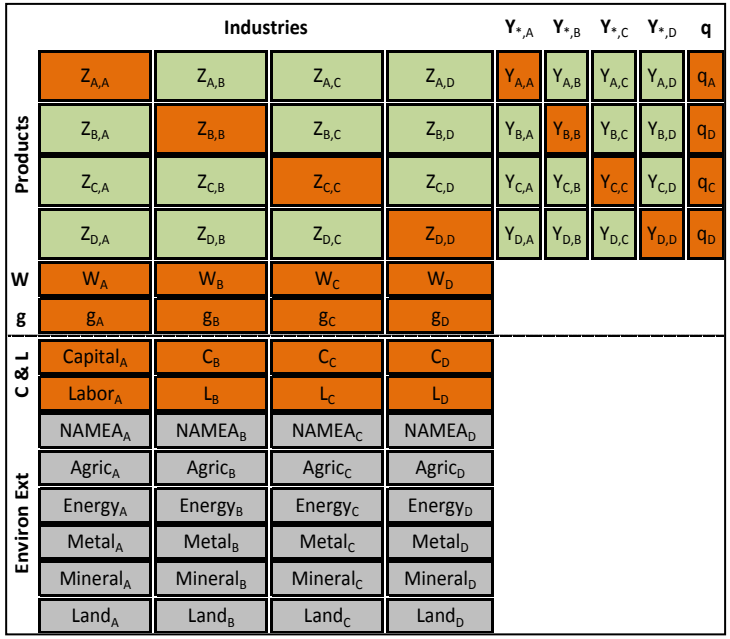


Resources
- By sector, country

Emissions and waste
- By sector, country

EE IO can analyse consumption drivers and relations (climate, materials, etc.)

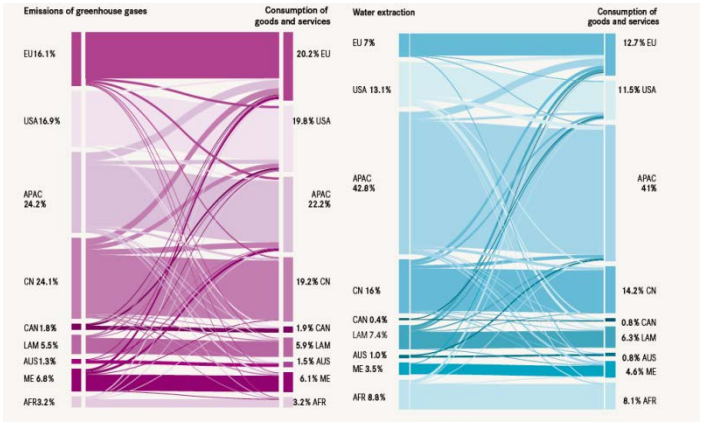
- Relates production to consumption
  - Example: 5 Euro coffee at Starbucks
    - 3 Euro for Starbucks = Restaurant
    - 1 Euro for roaster = Food industry
    - 0.5 Euro for transport = Transport
    - 0.25 Euro for farmer = Agriculture
    - 0.25 Euro for fertiliser, etc.
    - Impacts per sector/country per Euro known
    - Multiply -> you see how impacts of production relate to consumption



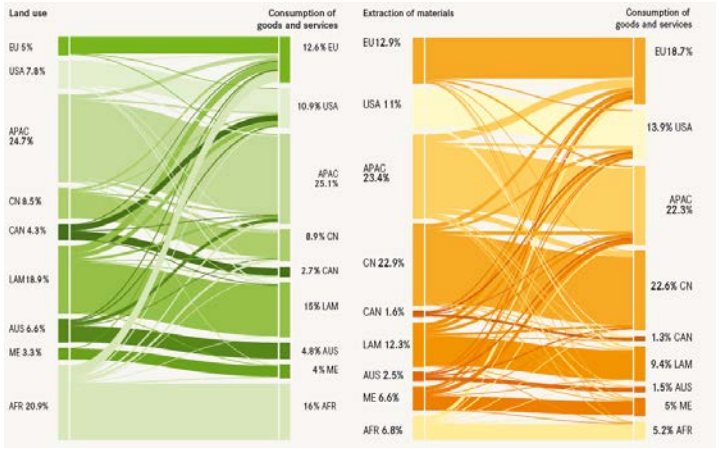
- In essence you re-distribute global territorial emissions to consumption

Illustrative analysis (2007): production versus consumption

- European production versus consumption
  - Carbon: 16.1 % versus 20.2%
  - Water: 7% versus 12.7%
  - Land: 5% versus 12.6%
  - Materials: 12.9% versus 18.7%



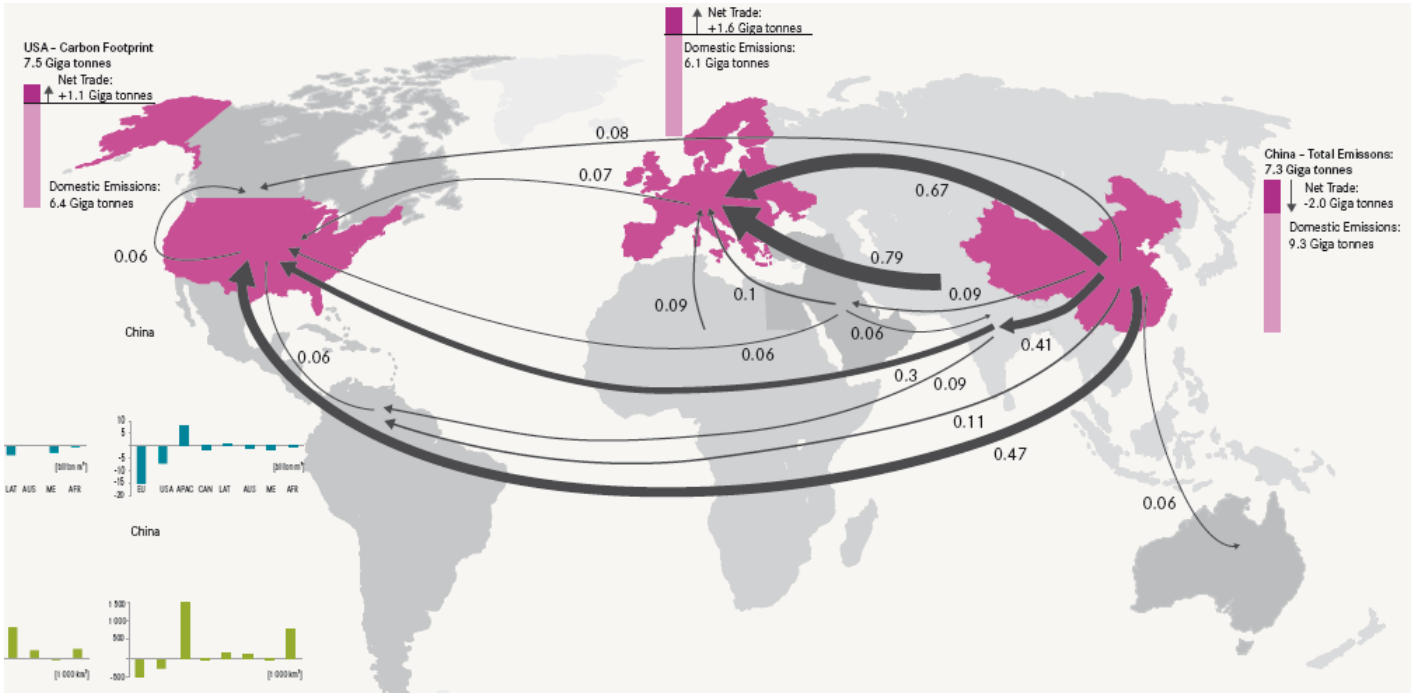
- Fraction of EU consumption pressures abroad
  - Carbon: 20%
  - Water: 45%
  - Land: 60%
  - Materials: 31%



Source: TNO, NTNU, WU, UL-CML, CREEA project

Illustrative analysis: production versus consumption

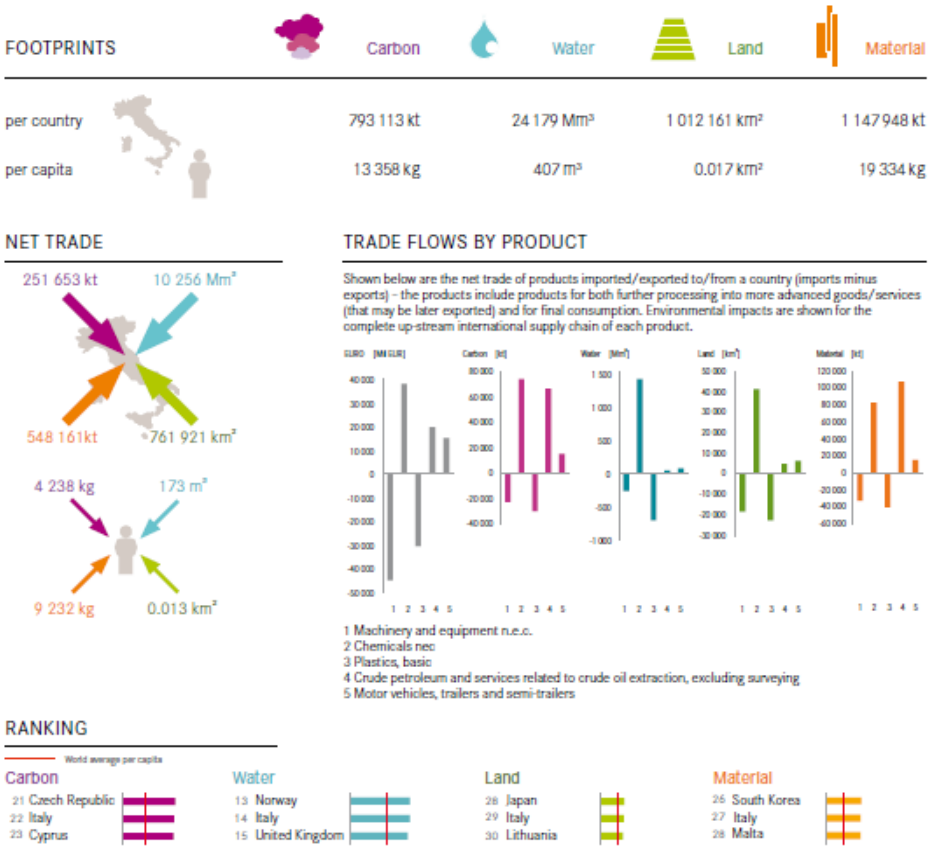
- 2 of 9 Gton of Chinese CO2 embodied US and EU imports



Source: TNO, NTNU, WU, UL-CML, CREEA project

Illustrative analysis: embodied imports

- Italy, 2007
- At detailed product level

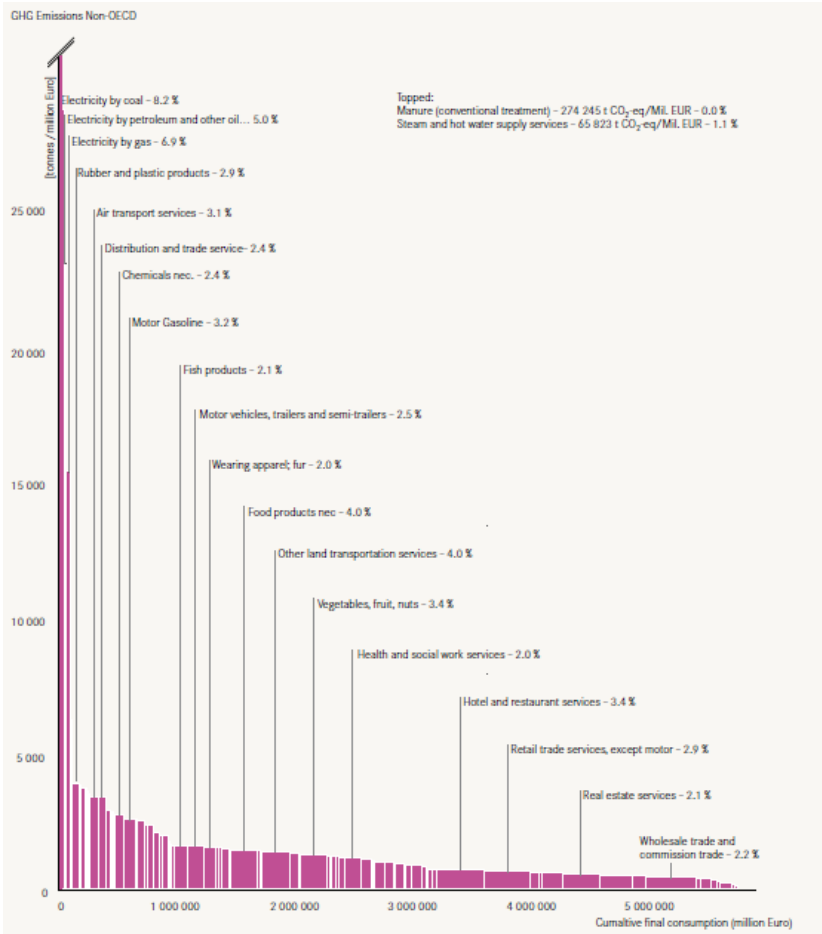


Source: TNO, NTNU, WU, UL-CML, CREEA project

Illustrative analysis: cleaning up energy is key

- Carbon per Euro final demand versus expenditure
- Non OECD, 2007

- Top areas
  - Steam and hot water supply
  - Electricity by coal
  - Electricity by oil
  - Rubber and plastics products
  - Air transport



Source: TNO, NTNU, WU, UL-CML, CREEA project

Illustrative analysis: climate scenarios related to resource-efficiency

- Assumptions
  - Exogenous GDP growth
  - Historical resource-efficiency gains per sector (same output, less input)
  - Various scenarios for low-carbor technologies

- Results
  - Technical fix is not sufficient
  - Change in consumption had too little impact
  - Reduction of consumption works

Table 2 The eight product groups whose production is responsible for about 20% of CO_2 emissions in the EU in TS

Product groups	Contribution to consumption-based CO_2 emissions (% of total EU consumption-based CO_2 emission)
Ceramic goods	0.4
Electricity by coal	0.6
Sea and coastal water transportation services	5.1
Other petroleum products	0.4
Bricks, tiles and construction products, in baked clay	0.5
Basic iron and steel and ferro-alloys	7.4
Cement, lime and plaster	2.8
Air transport services	5.3

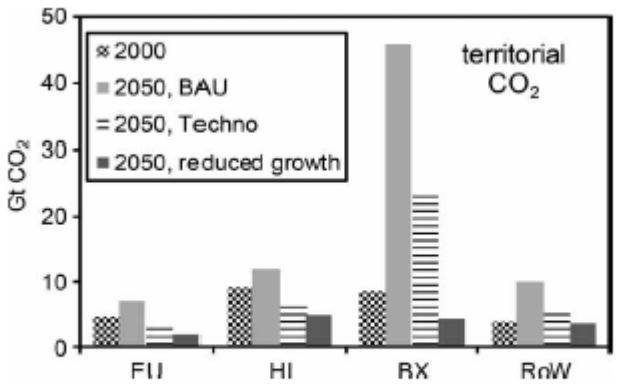


Figure 3 Territorial CO_2 emissions in the different scenarios in the four regions compared with our 2DS scenario where GDP growth is assumed to be reduced

Source: CML research, CECILIA 2050

Illustrative analysis: resource implications of climate scenarios

- Assumptions
  - Exogenous assumptions
  - IEA Blue map
  - Energy & transport with LCA; rest with EE IO

- Results
  - Demand rises with similar level in ALL scenarios….
  - ….except Nd and Dy…
  - For In cumulative demand 10 times reserves

Source: CML research, CECILIA 2050

Some policy implications

- Circularity is a global issue
  - Europe depends on resources from abroad – all of them
  - A circular Europe will not change production abroad, at best reduce some imports
- Climate and resources form a nexus
  - Resource efficiency can help realise climate goals…..
  - ….but not in full
  - Climate goals need resources for new technologies…..
  - ….but the challenge is not very different as from Business as usual
- Recycling processes and energy form a nexus
  - Recycling usually needs energy…..
  - …so in some cases only useful if we have clean energy available
- A carbon-neutral energy system is crucial…
- Insight in the physical economy is crucial !!

Thanks for your attention!

Possible analyses: fraction unused resource input per sector

- U + R is inputs
- V is useful output
- G and W are waste