



Multi-regional input output frameworks

59th LCA Forum, Zürich, Switzerland,
Friday 12 June 2015

Prof. Arnold Tukker, CML, TNO



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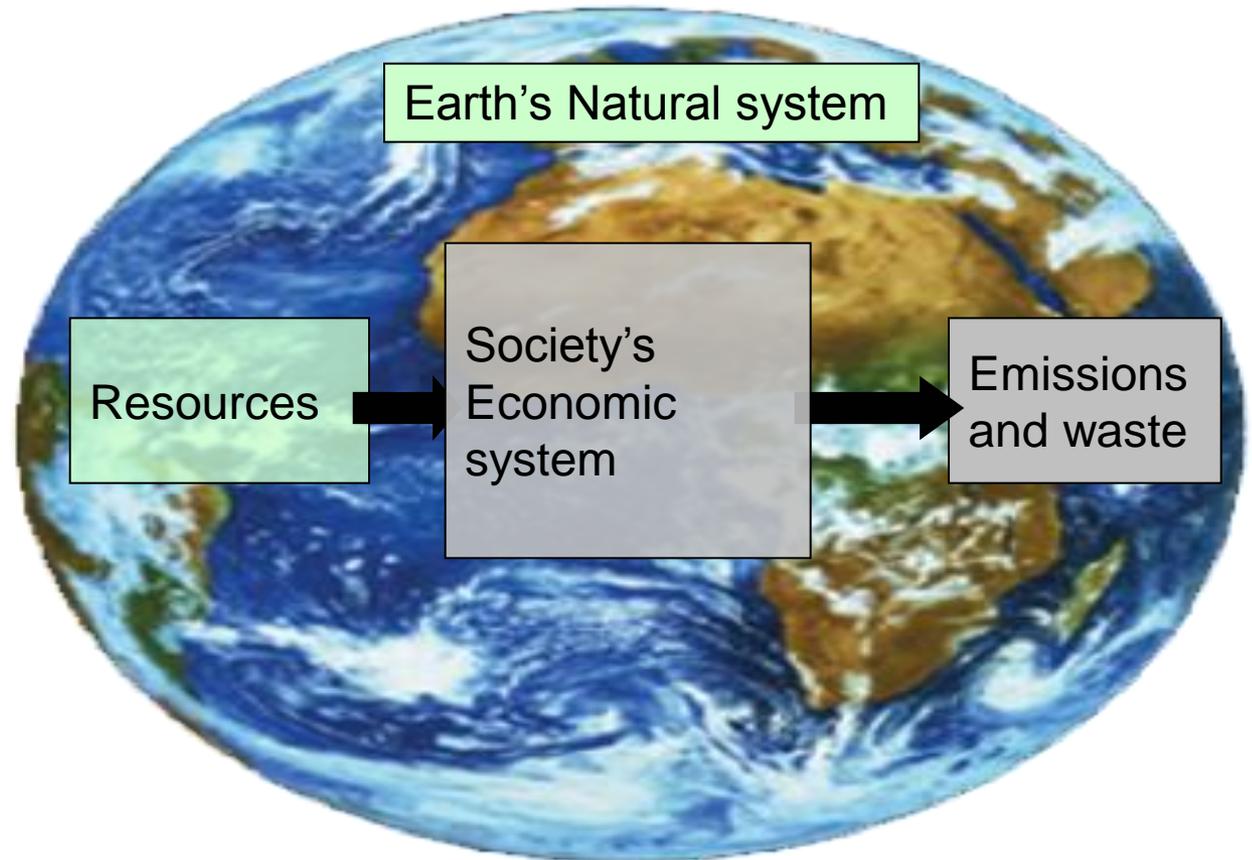


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The sustainability problem

- 35% of biomass is used
- 80% CO2 reduction needed by 2050
- All arable land is used
- We have water scarcity
- We have depleted fish stocks





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Some thoughts about footprint limits by 2050: carbon, water, land, materials

- Carbon: IPCC, UNEP Emissions gap report: 18-25 Gt CO₂-eq. by 2050
- Water: Hoekstra/Wiedmann: blue water 1100/4500 billion m³ / year; Water resources group: 40% reduction (now 250 m³/cap)
- Land: now 88 Mio km² agri+forest land, maybe 1.5 Mio km² expansion possible (Vuuren/Faber 2009)
- Materials: no good basis for targets (energy, biotic, metals, building materials differ too much)
- Future population: 9.5-10 bio people in 2050

Footprint	Target
Carbon (t CO ₂ -eq./cap)	2-2.5
Water , blue (m ³ /cap)	150
Land (ha/cap)	0.9-1
Materials	?



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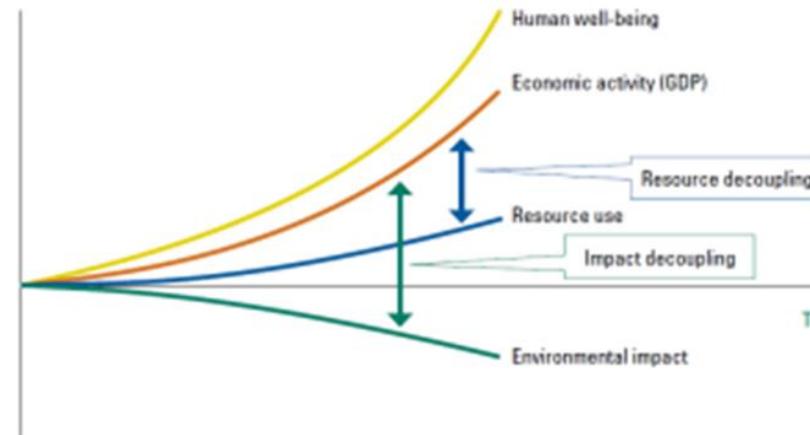


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Policy answer: doing more with less

- EU Raw Materials Initiative
- EU Resource Efficiency Roadmap
- EU Circular Economy Communication
- China's Circular Economy Legislation
- Japan's Reduce, Re-use and Recycle (3R) policy
- OECD Green Growth Initiative
- UNEP Resources Panel





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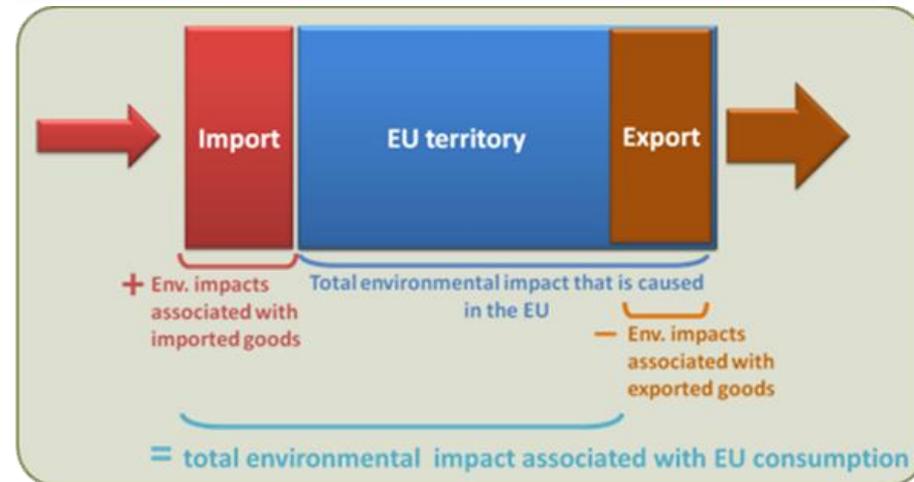
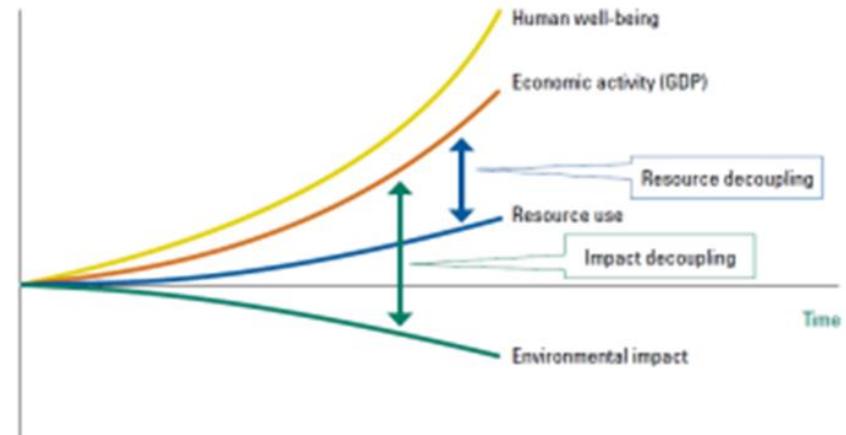


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For this, you need monitoring

- Human Well-being
- GDP
- Resource use.....
- ...and emissions
- But including pollution in imports!





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EXIOBASE – the vision

- Builds upon 15 Mio of EU funded projects (EXIOPOL, CREEA, DESIRE)
- Uses
 - National Economic Input-Output tables
 - International trade data
 - Resource extraction data (USGS, FAOSTAT, IEA)
 - Emission data
- To create a harmonized 'MR EE IO'
 - 43 countries, 180 sectors
 - 80 resources, 40 emissions, land , water
 - Time series 1995-2015 (DESIRE, 2016)
- Key players: TNO, CML, NTNU, WU, 2-0 LCA, WI

		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					
g		g_A	g_B	g_C	g_D					
C & L	Capital	C_A	C_B	C_C	C_D					
	Labor	L_A	L_B	L_C	L_D					
Environ Ext	NAMEA	$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
	Agric	$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
	Energy	$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
	Metal	$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
	Mineral	$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
	Land	$Land_A$	$Land_B$	$Land_C$	$Land_D$					



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- Illustrative results:
‘The Global Resource Footprint of Nations’

- Launched at the EU GreenWeek
- Carbon, land, water and material footprints of 43 countries
- Endorsed by FoE Europe and World Resources Forum

Arnold Tukker, Tatyana Bulavskaya, Stefan Giljum, Arjan de Koning,
Stephan Lutter, Moana Silva Simas, Konstantin Stadler, Richard Wood

The Global Resource Footprint of Nations

Carbon, water, land and materials embodied in trade and final consumption





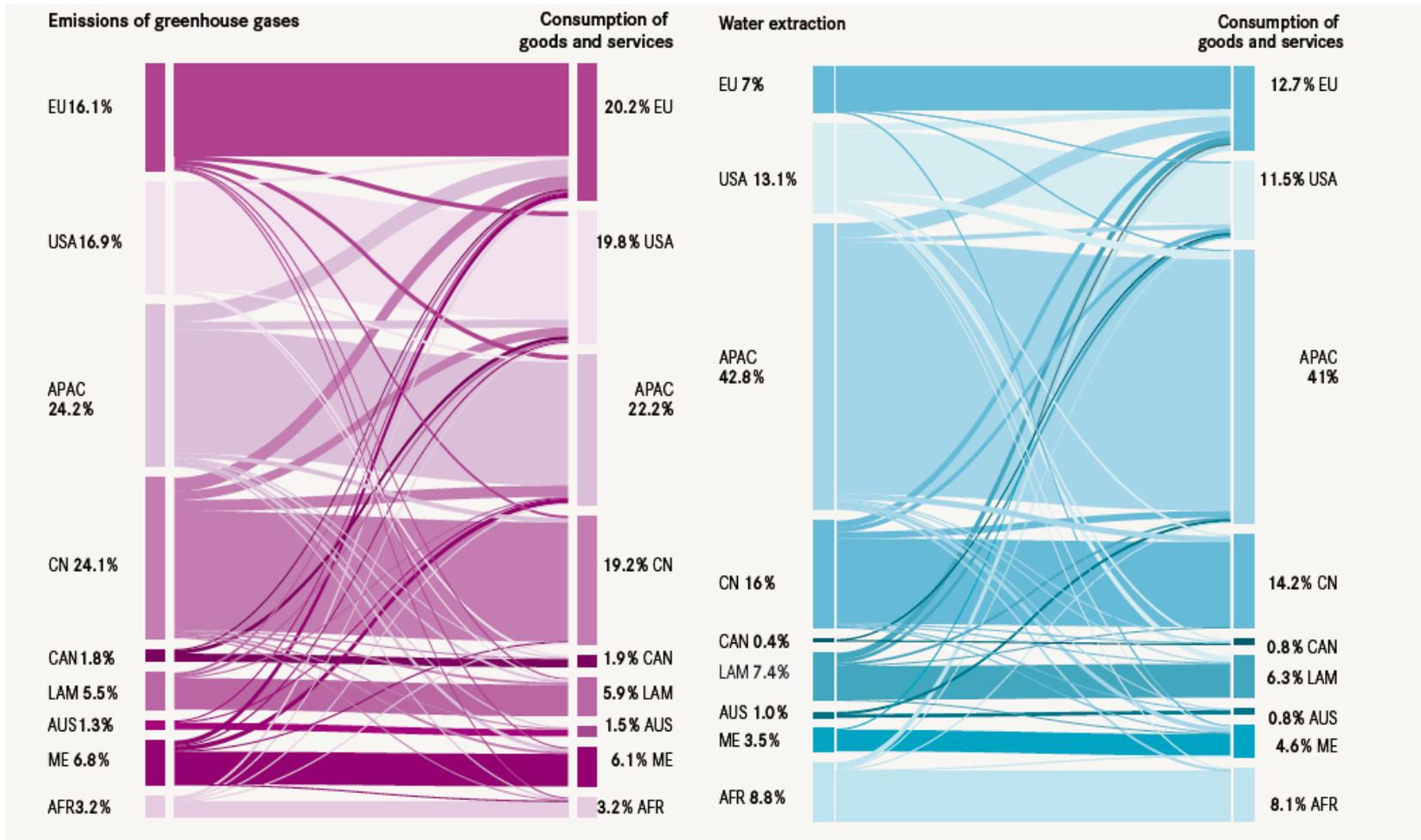
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Carbon and water footprints





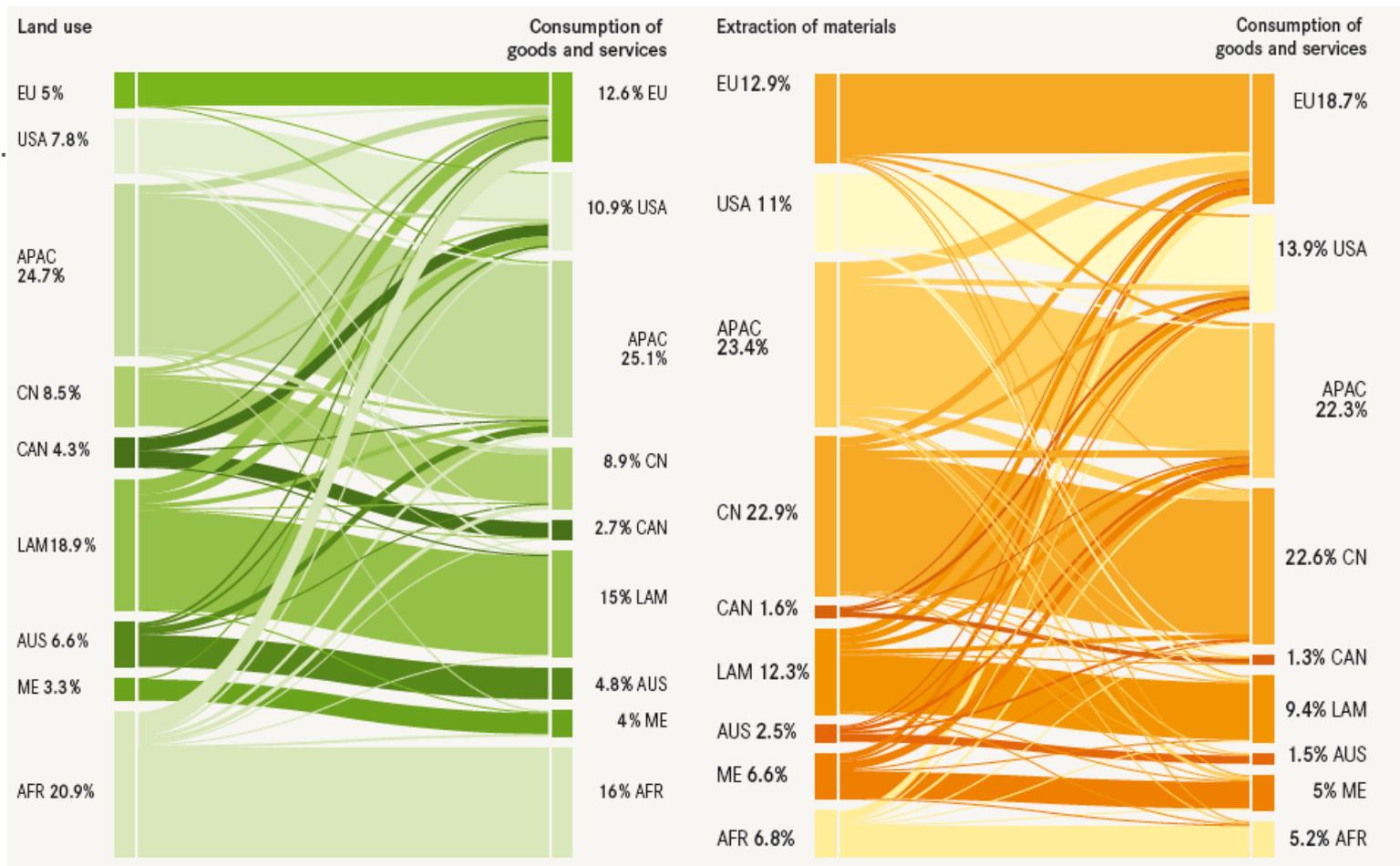
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Land and material footprints





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Per capita footprints





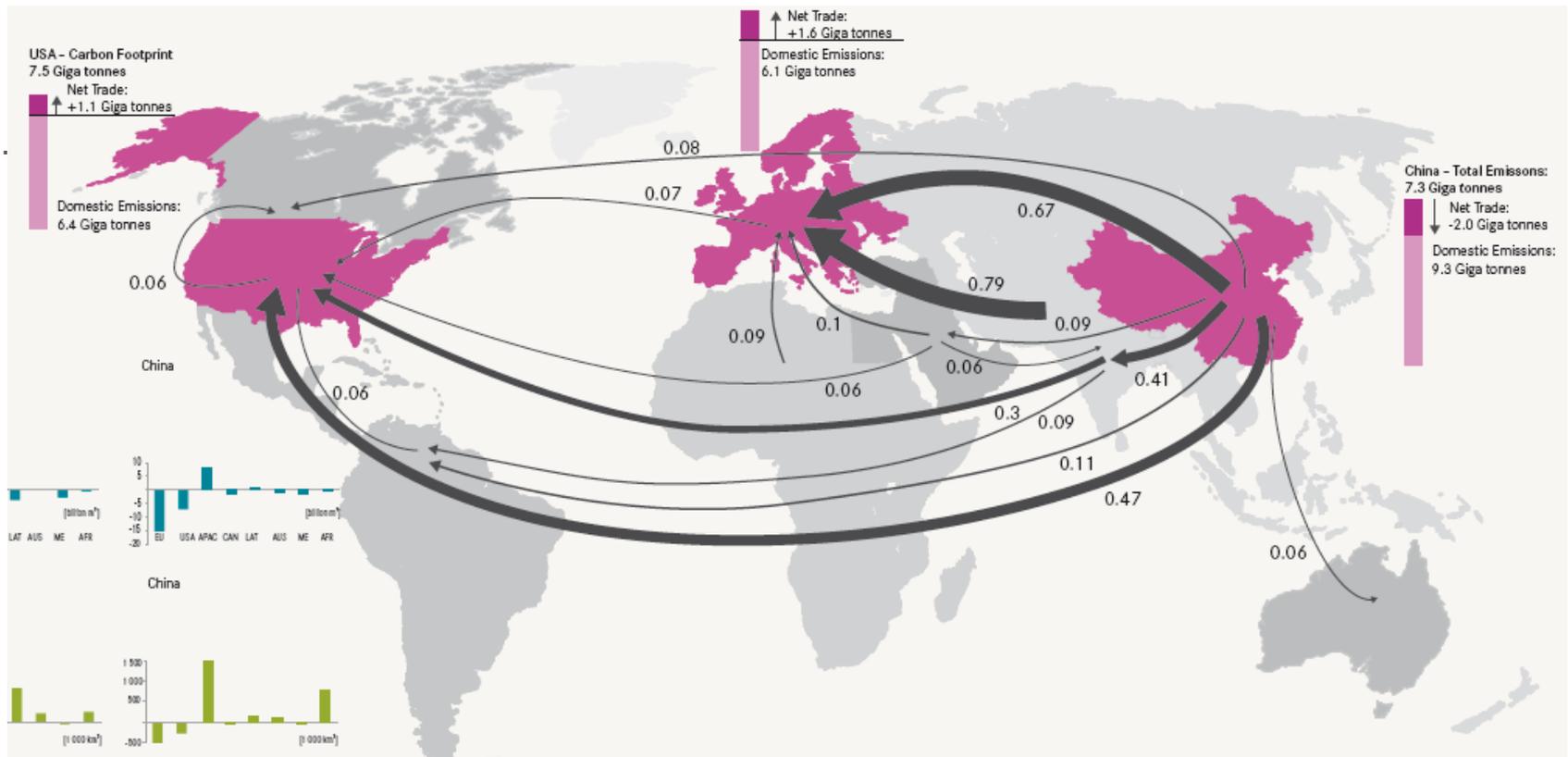
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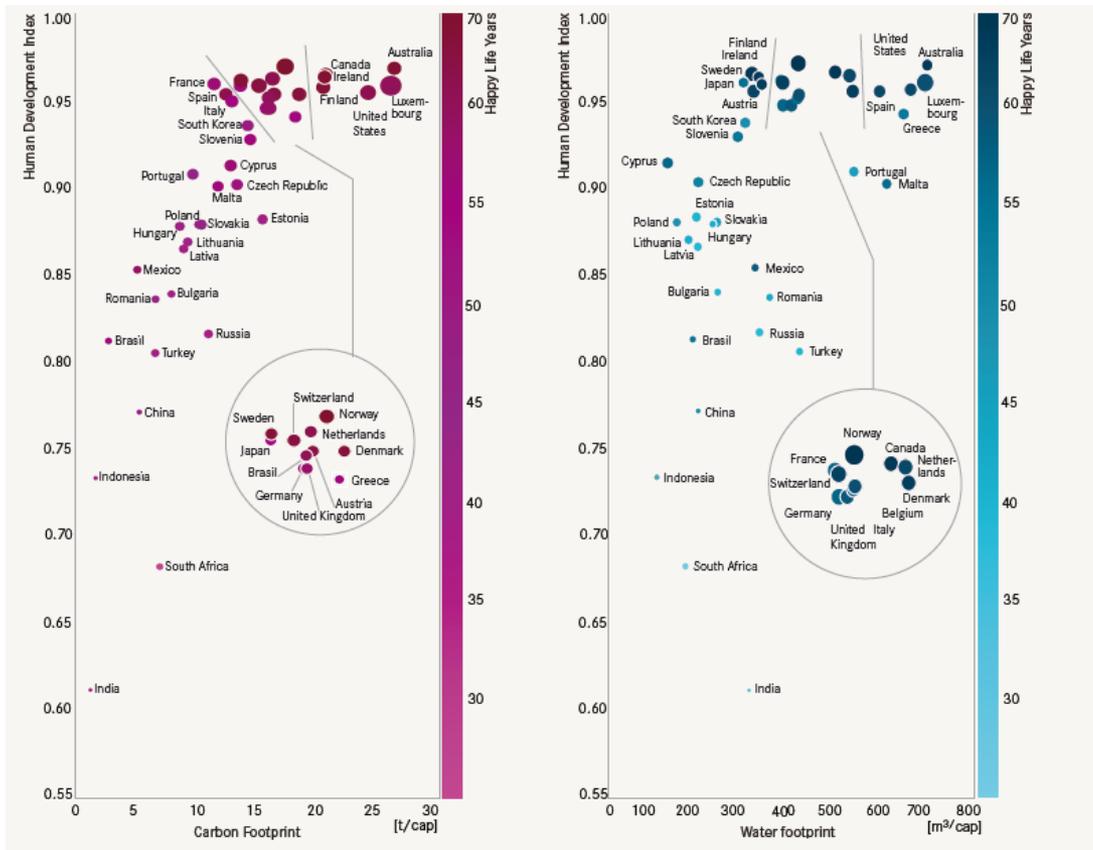


Trade of embodied carbon





HDI and happiness versus footprint





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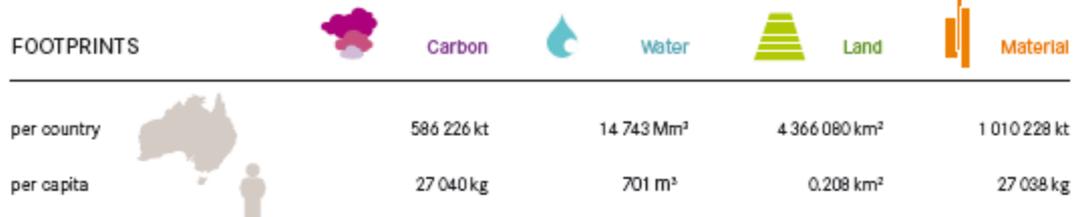


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Country fact sheets

FOOTPRINTS

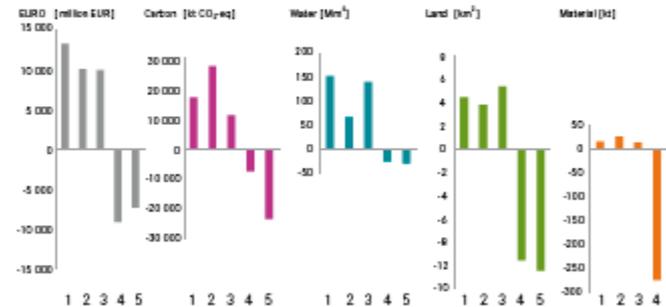


NET TRADE



TRADE FLOWS BY PRODUCT

Shown below are the net trade of products imported/exported to/from a country (imports minus exports) - the products include products for both further processing into more advanced goods/services (that may be later exported) and for final consumption. Environmental impacts are shown for the complete up-stream international supply chain of each product.



- Machinery and equipment n.e.c.
- Gas/Diesel Oil
- Radio, television and communication equipment and apparatus
- Iron ores
- Other Bituminous Coal

RANKING





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Europe is the only continent depending on embodied imports for all footprints

Indicator	Carbon-(%of-global-total)¤			Water-(%of-global-total)¤			Land-(%of-global-total)¤			Materials-(%of-global-total)¤		
	Terr.¤	Fp.¤	%-Cov.¤	Terr.¤	Fp.¤	%-Cov.¤	Terr.¤	Fp.¤	%-Cov.¤	Terr.¤	Fp.¤	%-Cov.¤
Region¤												
Europe-(EU)¤	16,1	20,2	80%	7	12,7	55%	5	12,6	40%	12,9	18,7	69%
United States of America-(USA)¤	16,9	19,8	85%	13,1	11,5	114%	7,8	10,9	72%	11	13,9	79%
Asia and Pacific¤	24,2	22,1	110%	42,8	41	104%	24,7	25,1	98%	23,4	22,3	105%
China-(CN)¤	24,1	19,2	126%	16	14,2	113%	8,5	8,9	96%	22,9	22,6	101%
Canada-(CAN)¤	1,8	1,9	95%	0,4	0,8	50%	4,3	2,7	159%	1,6	1,3	123%
Latin America-(LAM)¤	5,5	5,9	93%	7,4	6,3	117%	18,9	15	126%	12,3	9,4	131%
Australia-(AUS)¤	1,3	1,5	87%	1	0,8	125%	6,6	4,8	138%	2,5	1,5	167%
Middle East-(ME)¤	6,8	6,1	111%	3,5	4,6	76%	3,3	4	83%	6,6	5	132%
Africa-(AFR)¤	3,2	3,2	100%	8,8	8,1	109%	20,9	16	131%	6,8	5,2	131%
Global total-(%) * ¤	100	100	¤	100	100	¤	100	100	¤	100	100	¤
Global total-(absolute)¤	38-Gt-CO2-eq.¤		¤	1660-km3¤		¤	88-Mio-km2** ¤		¤	66-Gt¤		¤



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The big concluding picture

- Rising footprint , even more rise embodied in trade
- High footprint
 - When you are rich (US, Luxembourg, Australia)
 - Blue water: if you have agriculture in a dry country
 - Land: if you have land (US, Canada, Australia), or are small but have an industry relying on agricultural inputs (Netherlands)
 - Materials: If you are mining (Australia, Finland) or have a construction boom (Ireland)
- High footprints essential? No, above a threshold HDI does not rise anymore

Recommendations

- Now 2-3 major scientific databases
- Develop action within the international statistical community (UNCEEA, OECD, Eurostat)
- Use such a platform to harmonize indicators



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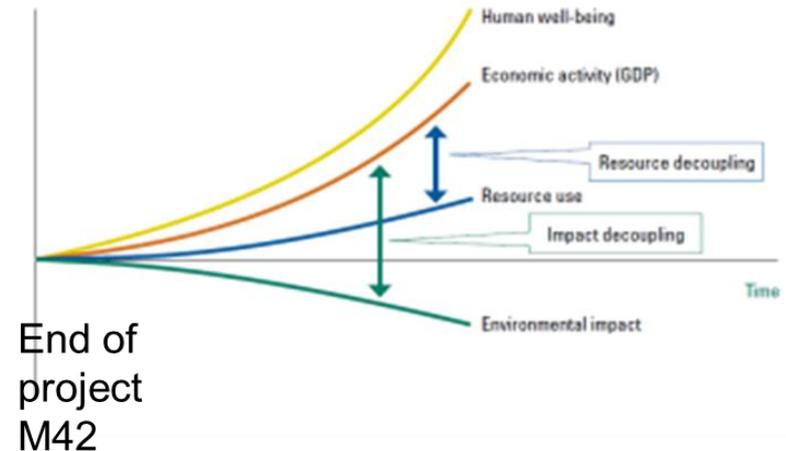
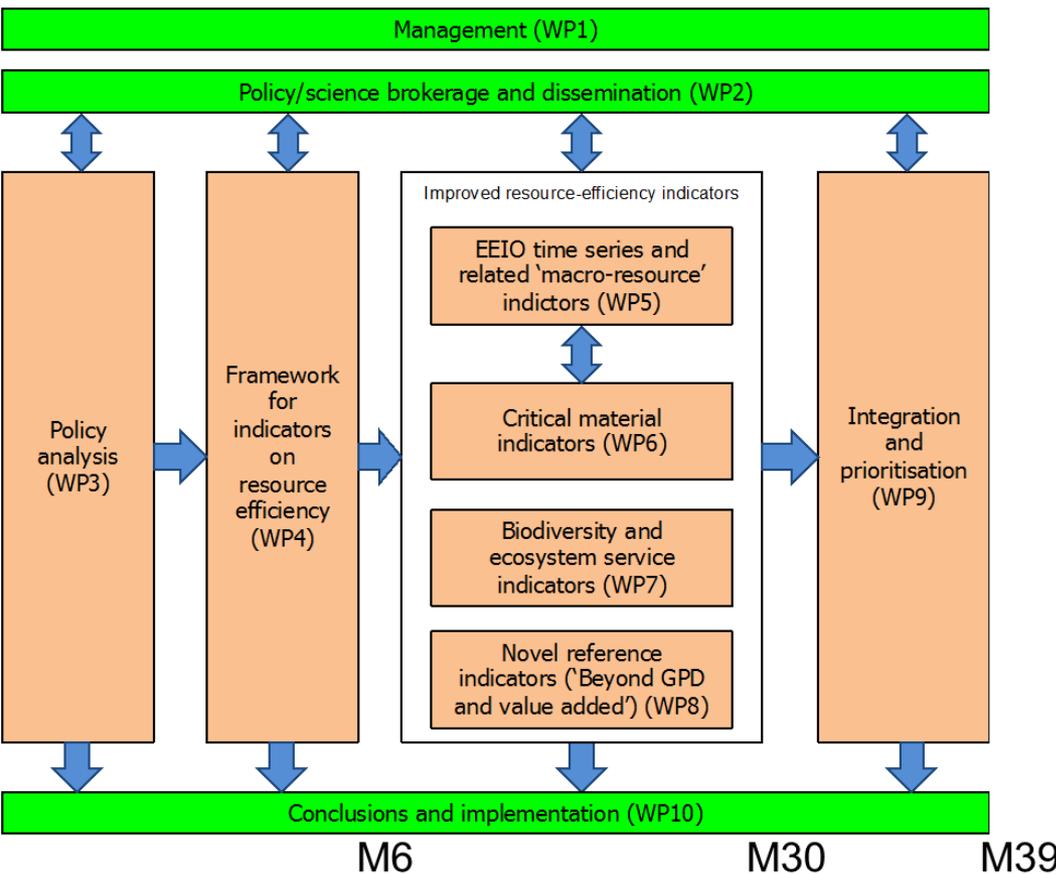


Thanks for your attention!



Current work in the EU DESIRE project

- Emphasis on **Time series, Critical materials, Biodiversity, Beyond GDP**





Indicator systems – a few too many?

- SCP Eurostat
- Resources EEA
- Resources DG ENV Eurostat
- Green economy UNEP
- Green economy OECD
- And many others UNECE, Eurostat, OECD

Headline indicator	Operational objectives and targets	Actions/explanatory variables		
	<i>Ressource use and waste</i>			
A Headline Indicators				
Proposed Headline Indicator	Definition	Strength	Weakness	
Index of natural resource use	Aggregated index of the changes in stocks of resources	Headline targets	Indicators	Data Quality Profiles (QP)

Framework and suggested indicators to measure sustainable development

Prepared by the
 Joint UNECE/Eurostat/OECD Task Force on
 Measuring Sustainable Development

27 May 2013

