Databases for resource-efficiency assessments: The CREEA project

Prof. Arnold Tukker, CML, Leiden University and TNO, Delft, Netherlands

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Arnold.tukker@tno.nl

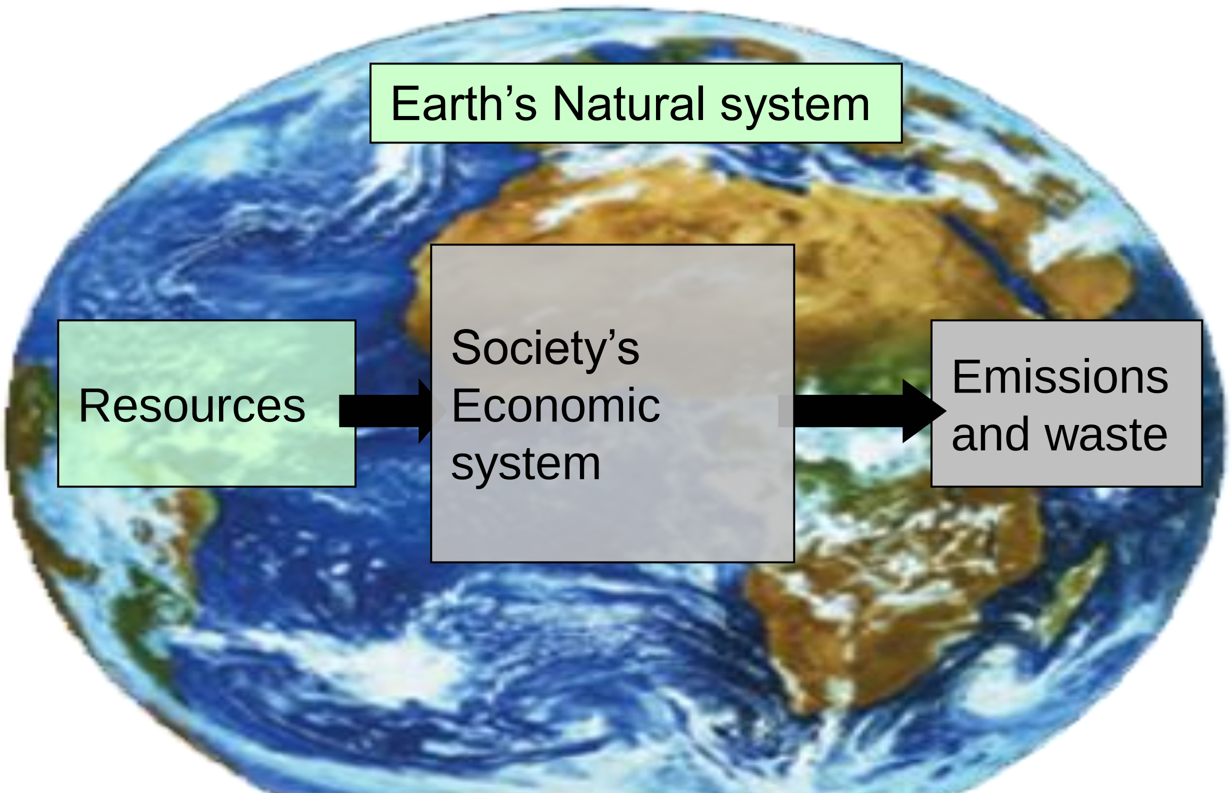
This work and other key projects on Global MR EE IO have been just published in a Special Issue of *Economic Systems Research*, 2013 (25) 1, edited by Arnold Tukker and Erik Dietzenbacher

CREEA backgrounds


Introduction

- CREEA: Compiling and refining environmental and economic accounts
- EU FP7, 2011-2014, 3.5 Mio Euro
- Partners TNO, CML, WI, SERI, EU DG JRC IPTS, NTNU, 2-0 LCA, ETH, TU Twente, CBS, SCB, EFI
- This and other key projects on MR EE IO just published in a Special Issue of *Economic Systems Research*, 2013 (25) 1

The sustainability problem



Footprint > 1 Earth
We deplete water, mineral & energy stocks
We use 35 % of biomass production
We have depleted fish stocks

GHG => 4-6 °C temp. Rise
Traffic emissions…
…etc.

Key sustainability agenda’s

1. SCP

“the use of services and related products which respond to basic needs and bring a ***better quality of life*** *while* ***minimizing the use of natural resources*** *and toxic materials as well as the emissions of waste and pollutants over the life-cycle so as not to jeopardize the needs of future generations*

2. Green Economy

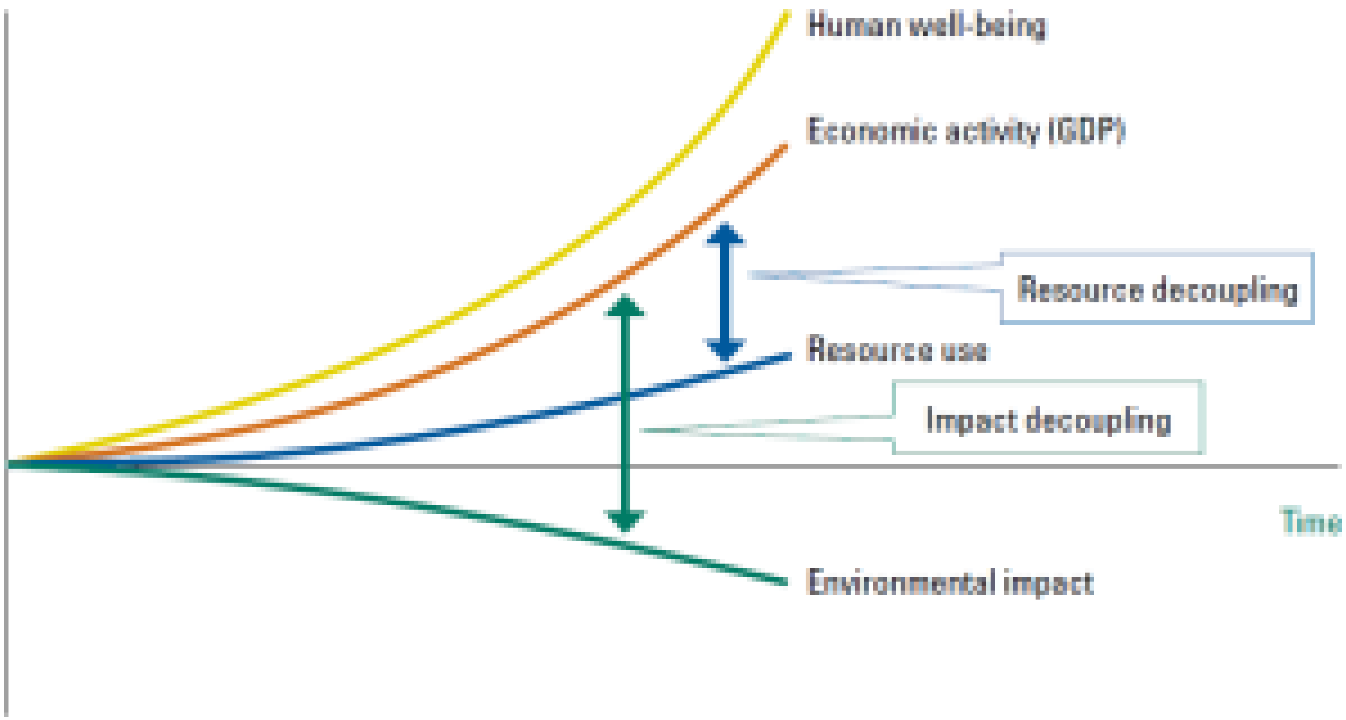
“one that results in ***improved human well-being*** *and social equity, while significantly* ***reducing environmental risks and ecological scarcities****”*

3. Resource Efficiency

using the Earth's limited resources in a sustainable manner while minimising impacts on the environment. It allows us to create more with less and to ***deliver greater value*** *with* ***less input***

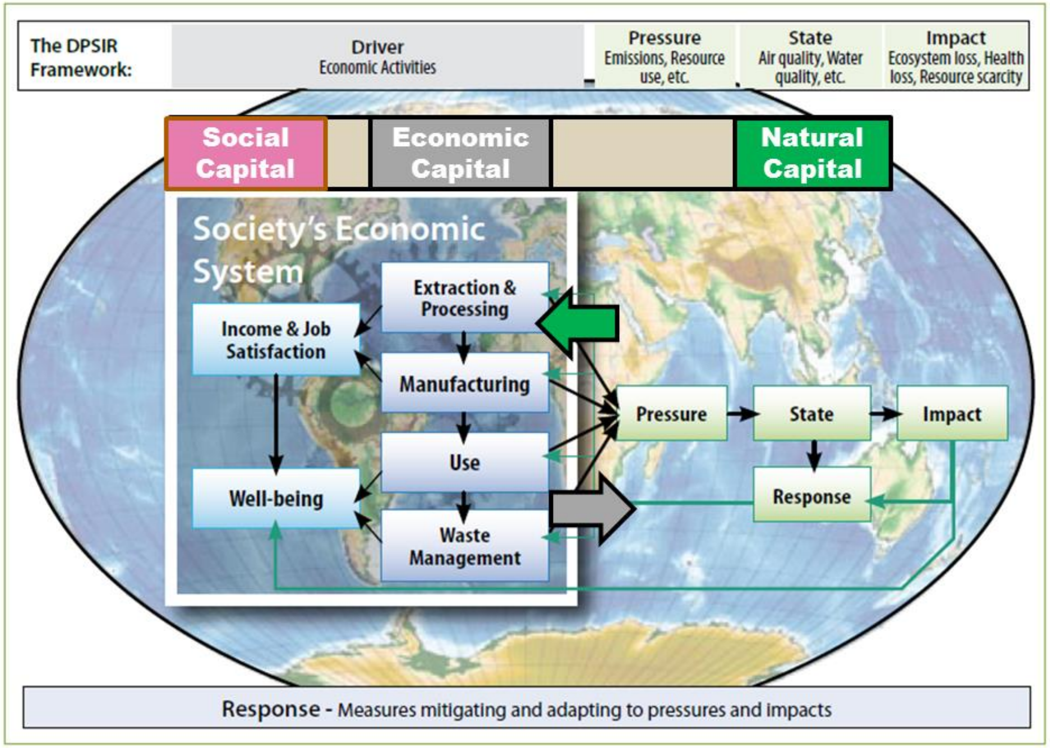
SCP, Resource Efficiency, Green Economy…

All aim at improved human well-being decoupled from resource use and emissions…for which accounting systems are needed

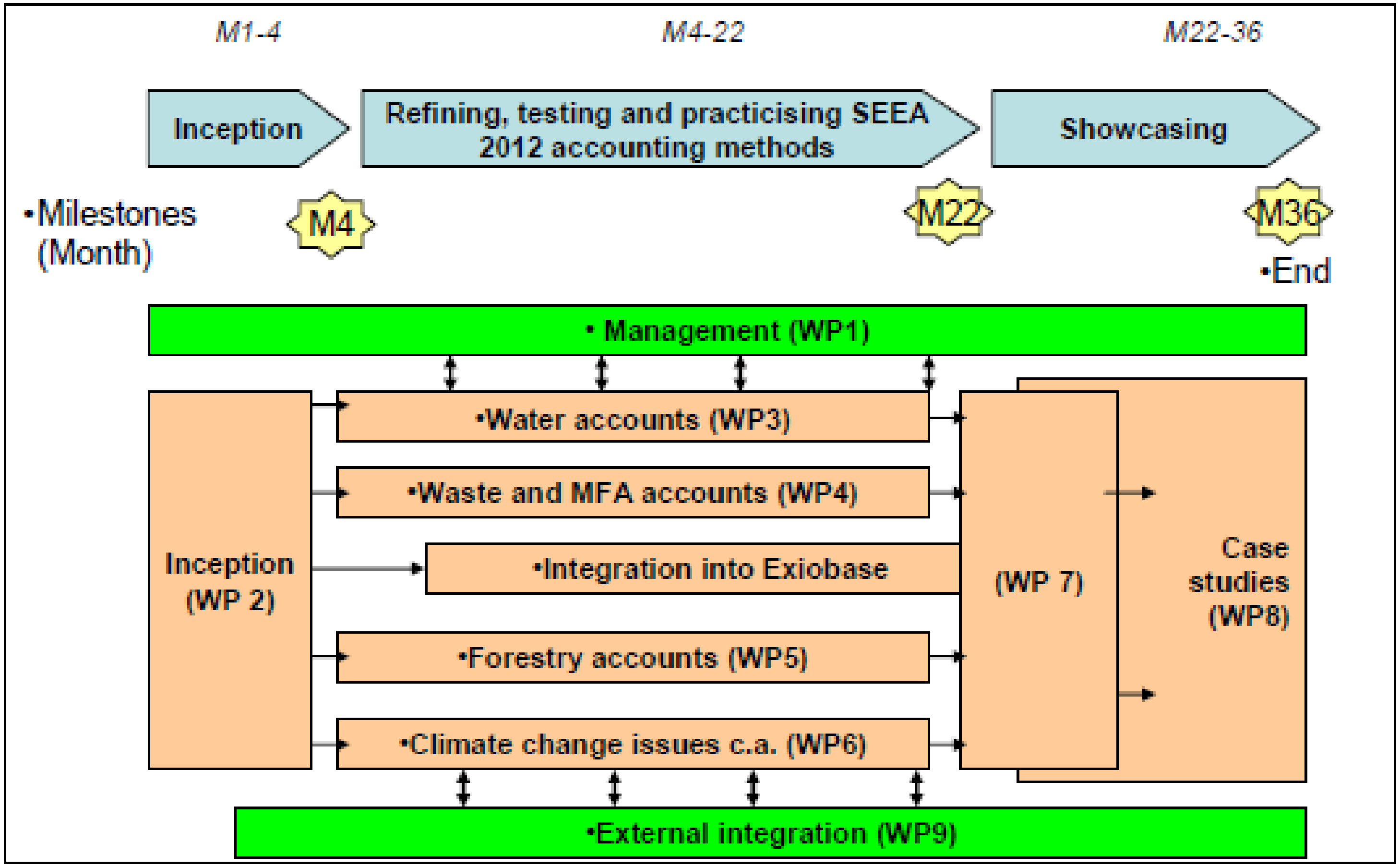


Coherent accounts: UN SEEA + DPSIR

- •Natural system and Socio-economic system
- •Driver-Pressure-State-Impact-Response chain
- •Natural-Economic-Social capital stocks
- •UN SEEA EE IO for economic/material flows and pressures
- •One data set for production & consumption based accounts



Contribution of CREEA



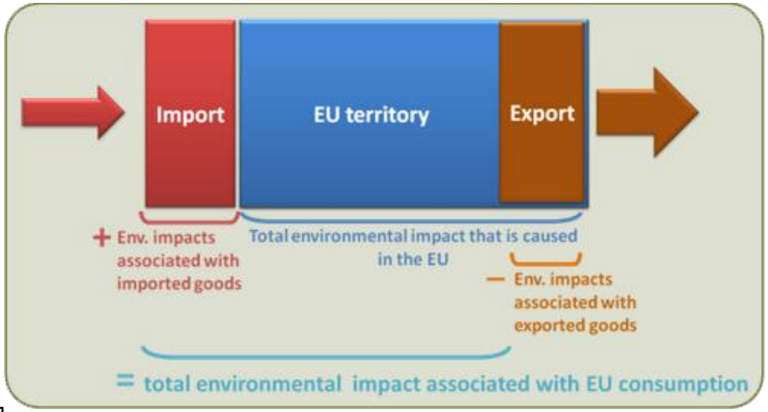
Supply and Use Table / Input Output Table

	Products	Industries			
Products		Use	Final use	Exports	Use of products
Industries	Make / Supply				Output of industries
	Imports cif	Value added			
	Supply of products	*Input of industries*			
		Extensions: - Primary Natural Resource input - Emissions output - etc.			

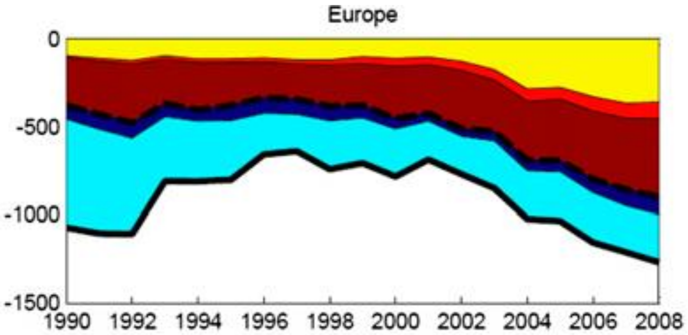
- EE SUT for a single country
  - Economic Supply and Use
  - By industry: emissions and primary resource use
- Can provide you
  - Per final use category: value added by industry
  - With impact per Euro per industry known: life cycle impacts per final use category
- Advantages
  - Inherently complete
  - Inherently consistent

Multi-Regional EE SUT SUT/IOT is essential

- Territorial accounting is too limited
- Of the global GDP >20% is trade
- Europe meets Kyotot targets, but thanks to export of industrial processes to Asia



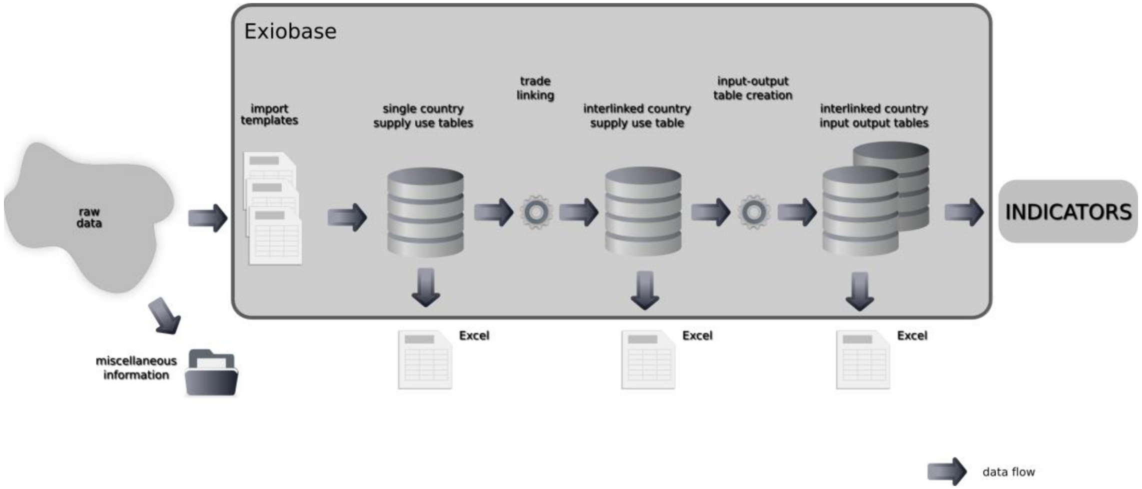
	Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products	$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
	$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
	$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$	$Y_{C,D}$	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	$Capital_A$	C_B	C_C	C_D					
	$Labor_A$	L_B	L_C	L_D					
Environ Ext	$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
	$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
	$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
	$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
	$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
	$Land_A$	$Land_B$	$Land_C$	$Land_D$					



Net carbon trade EU. Peters et al, PNAS, 2010

CREEA: most detailed consistent MR EE IOT

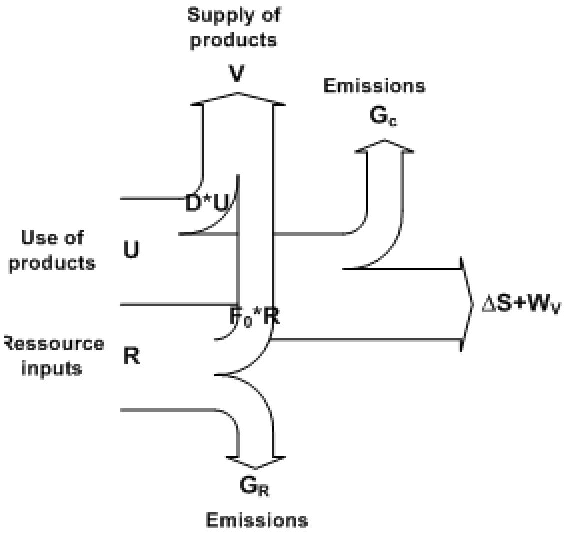
- Country SUT, global MR EE SUT and global MR EE IOT
  - 43 countries linked via trade, 5 Rest of Continents
  - 160 sectors and product groups per country
  - 40 emissions, 80 resources, land and water per sector
  - Global physical SUT
  - Years: 2000 and 2007
- See Economic Systems Research, 1st issue 2013 for comparison with WIOD, EORA, GTAP

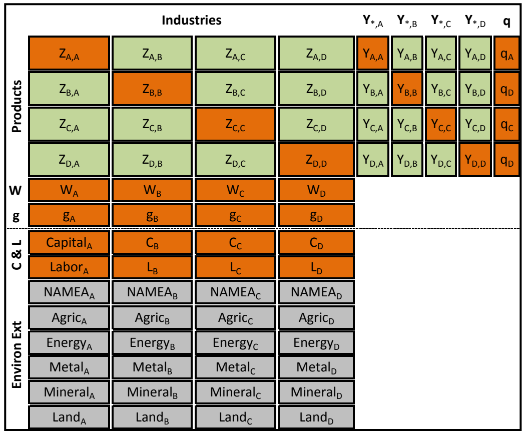


TNO innovation for life

CREEA WP4: Global P-SUT = MFA/Waste accounts

- For each ‘cell’ in the SUT, we create a physical input-output balance
  - U = material inputs, next to primary resource
  - S, emissions = material outputs
  - Remainder is “waste”..with properties related to U!
- We then add all wastes by type to +/- 20 categories….and distribute them over re-use, landfill, incineration and compare to waste statistics
- Problematic issue is waste from stocks/durable goods; no stock data
- We estimate physical flows using physical data where available and prices

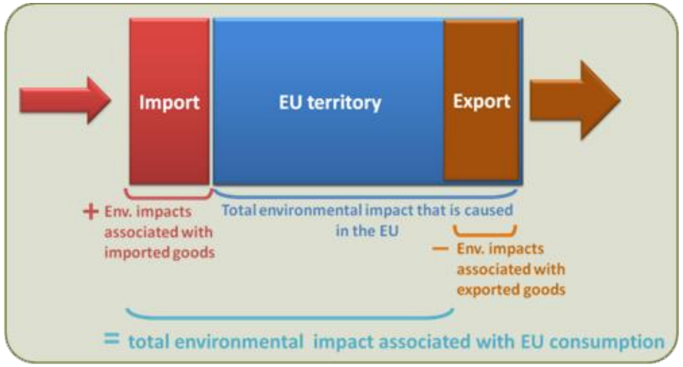




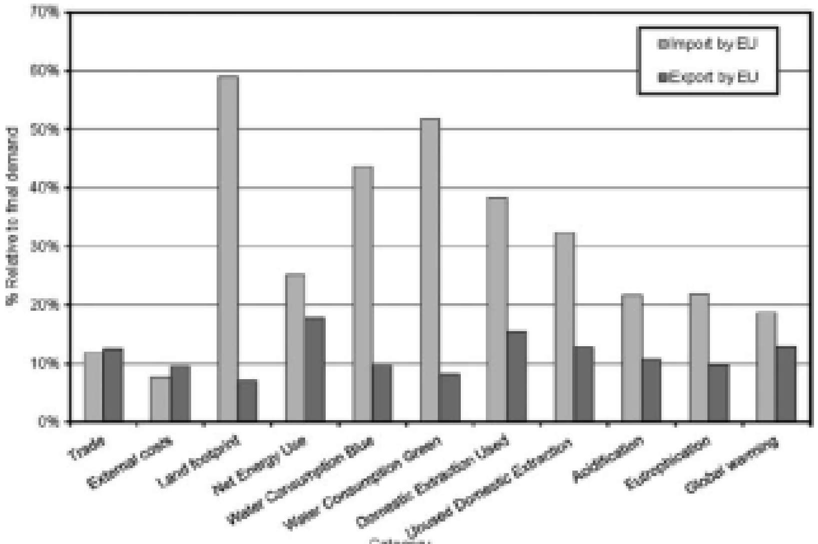
CREEA Results

Example 1: Impacts of EU27 consumption

1. Consumption & production perspective



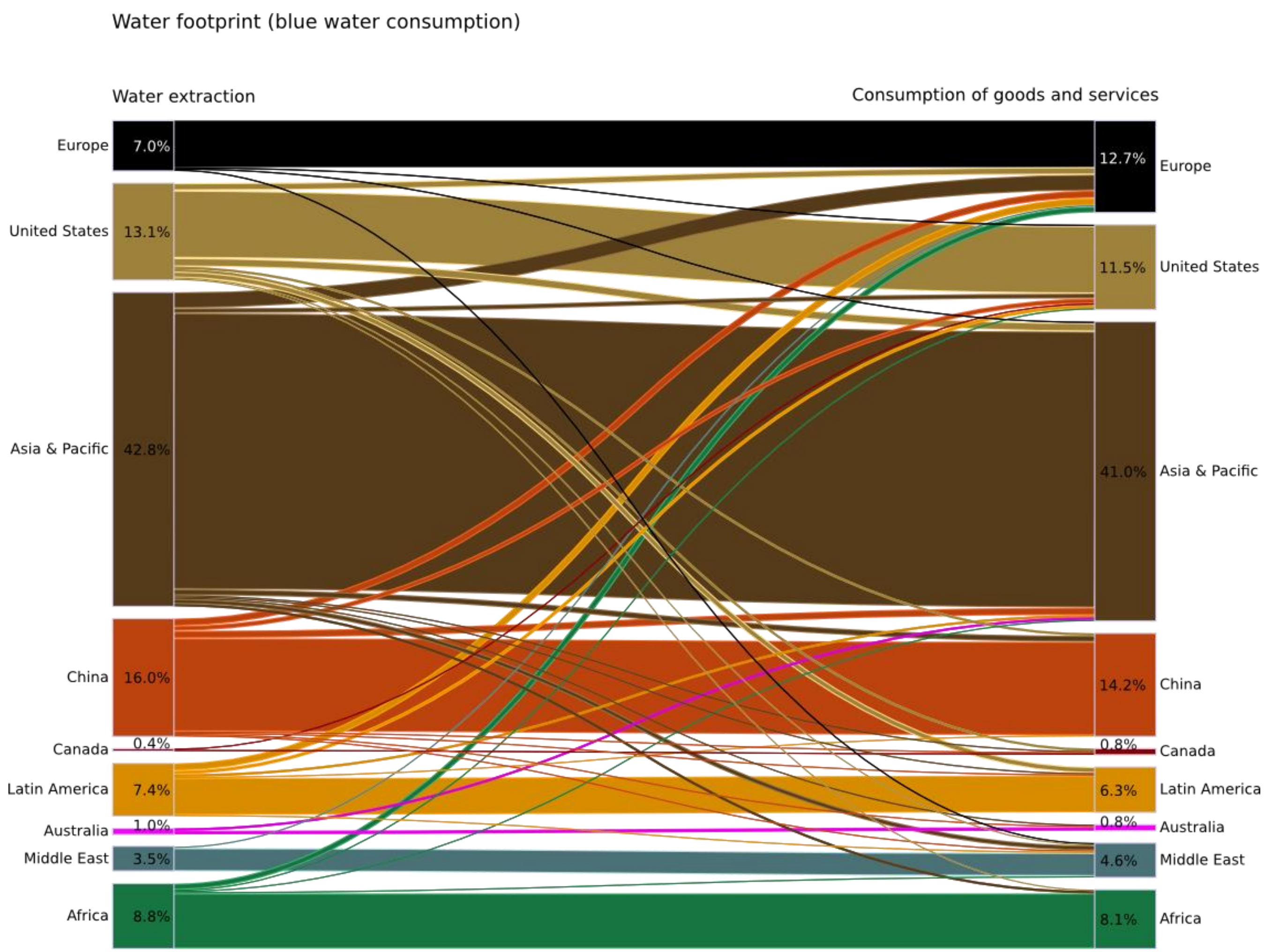
2. Example: % impacts of EU27 consumption abroad. Water, land, materials >30%



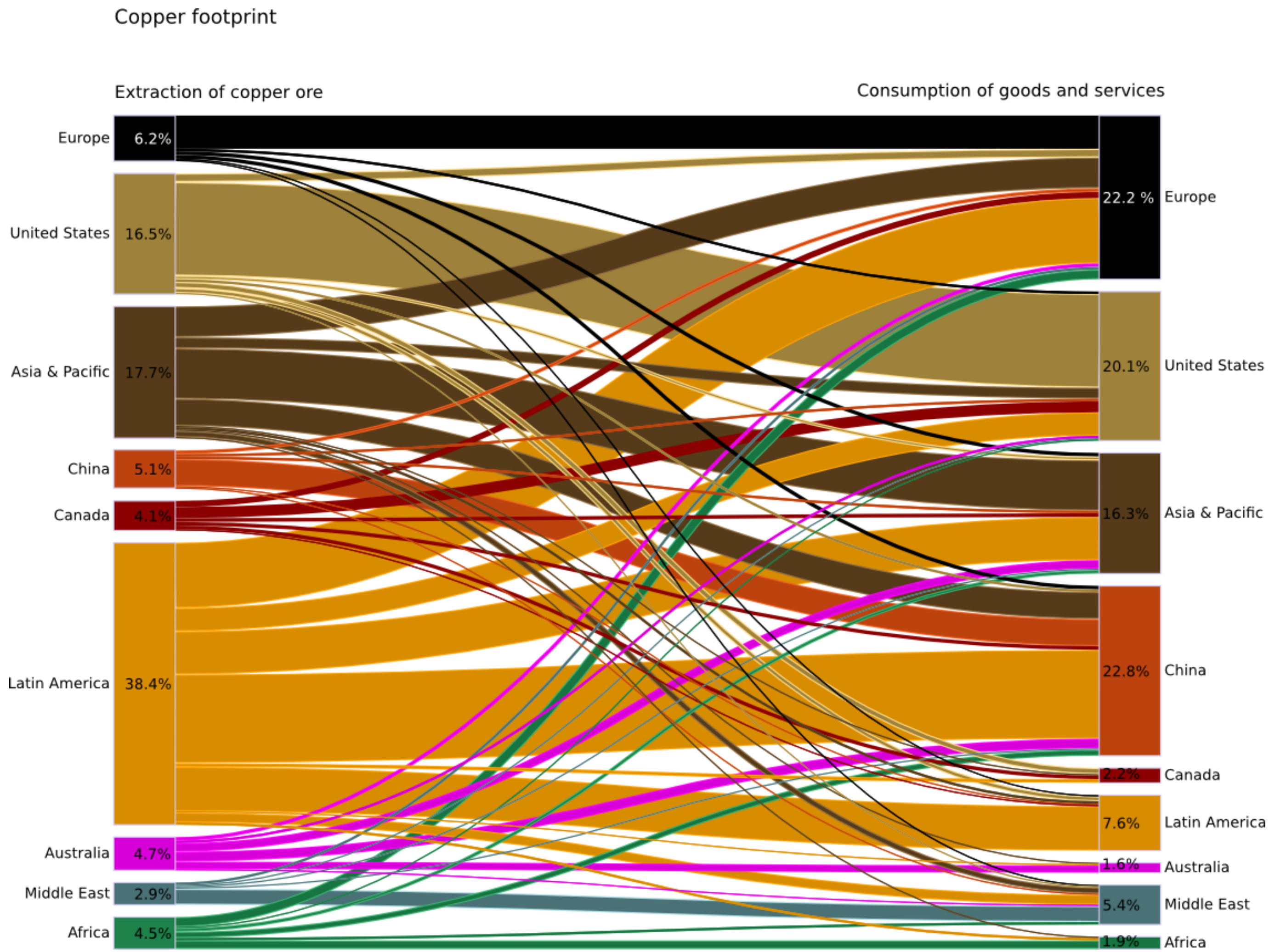
Note: Trade taken relative to Europe's final demand (which is given the small difference between exports and imports close to GDP). The global warming excludes emissions from land use change.

Source: EU FP6 EXIOPOL project, TNO et al.

Example 2: Water footprint of consumption versus extraction



Example 3: Copper footprint of consumption versus extraction



This conference

This conference

- CREEA and Environmental accounting
- Input output analysis and building CREEA
- Case results
  - Water
  - Materials
  - Forestry
  - Physical SUT
- Key note
- Interactive session
- Panel discussion
- Concluding remarks

CREEA: the next steps

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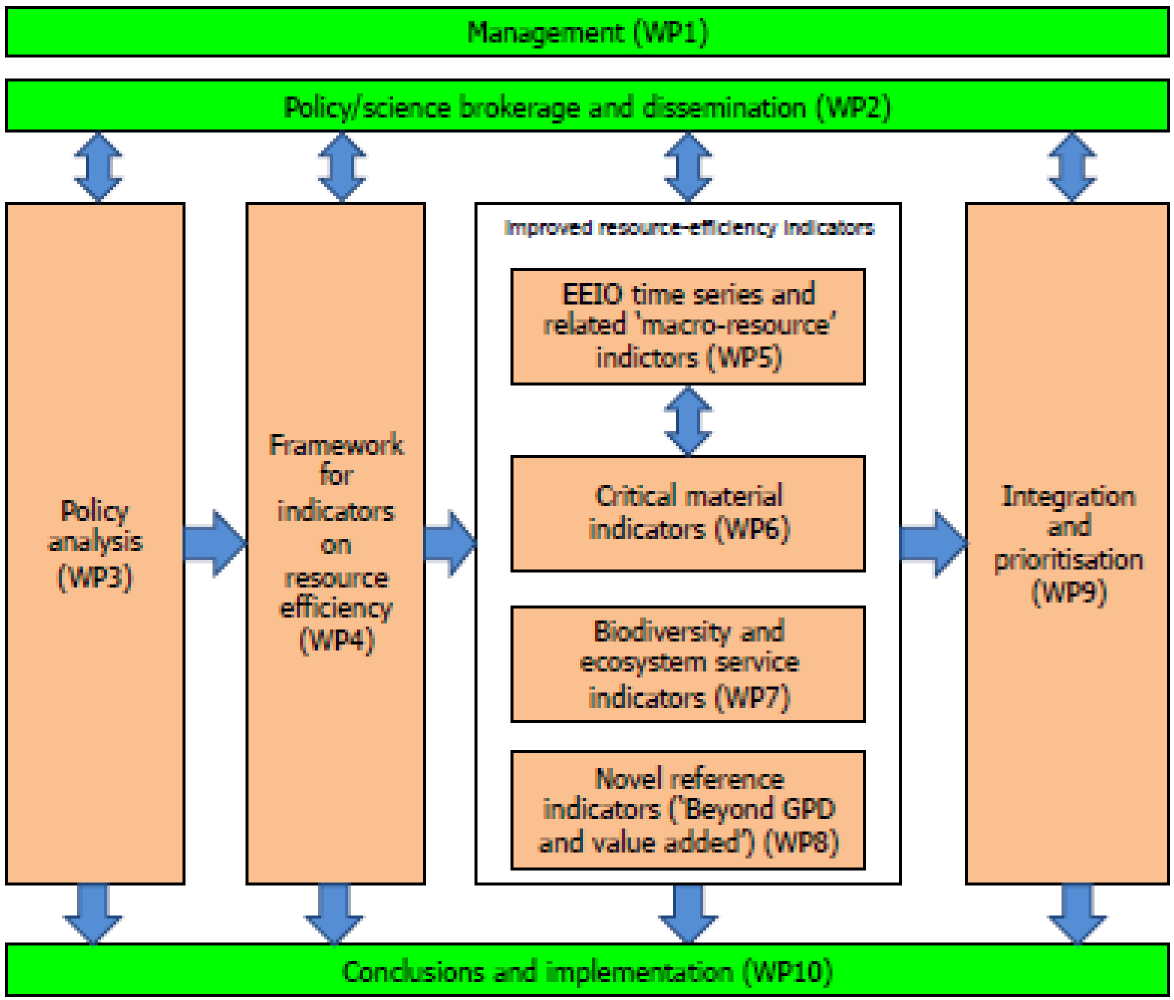
EXIOPOL & CREEA part of a string of projects

1. Goal: building the most ambitious macro-database for economic global relations, emissions and resource use, and foresight model
2. Role of each project (some 15 Mio Euro in total)
    - EXIOPOL: first detailed global Input Output model with resources & emissions
    - CREEA: expands EXIOPOL with energy & resource flows in society
    - DESIRE: builds time series of the IO database, that can calibrate our model; adds biodiversity impact indicators;
    - CARBON-CAP: uncertainty analysis and application on carbon policies
    - BrainPool / Beyound GDP: Provides alternative reference to GPD for resource efficiency assessments
    - EMINIMM: case studies on diffusion of technologies; leading to better estimates of technical change in our model
    - POLFREE: sophisticated modelling of policy scenarios for resource efficiency
    - TNO funding: first detailed related CGE model, EXIOMOD
    - COMPLEX: adds agent-based modelling and an Integrated Assessment Suite

.

DESIRE: comprehensive indicators for resource efficiency

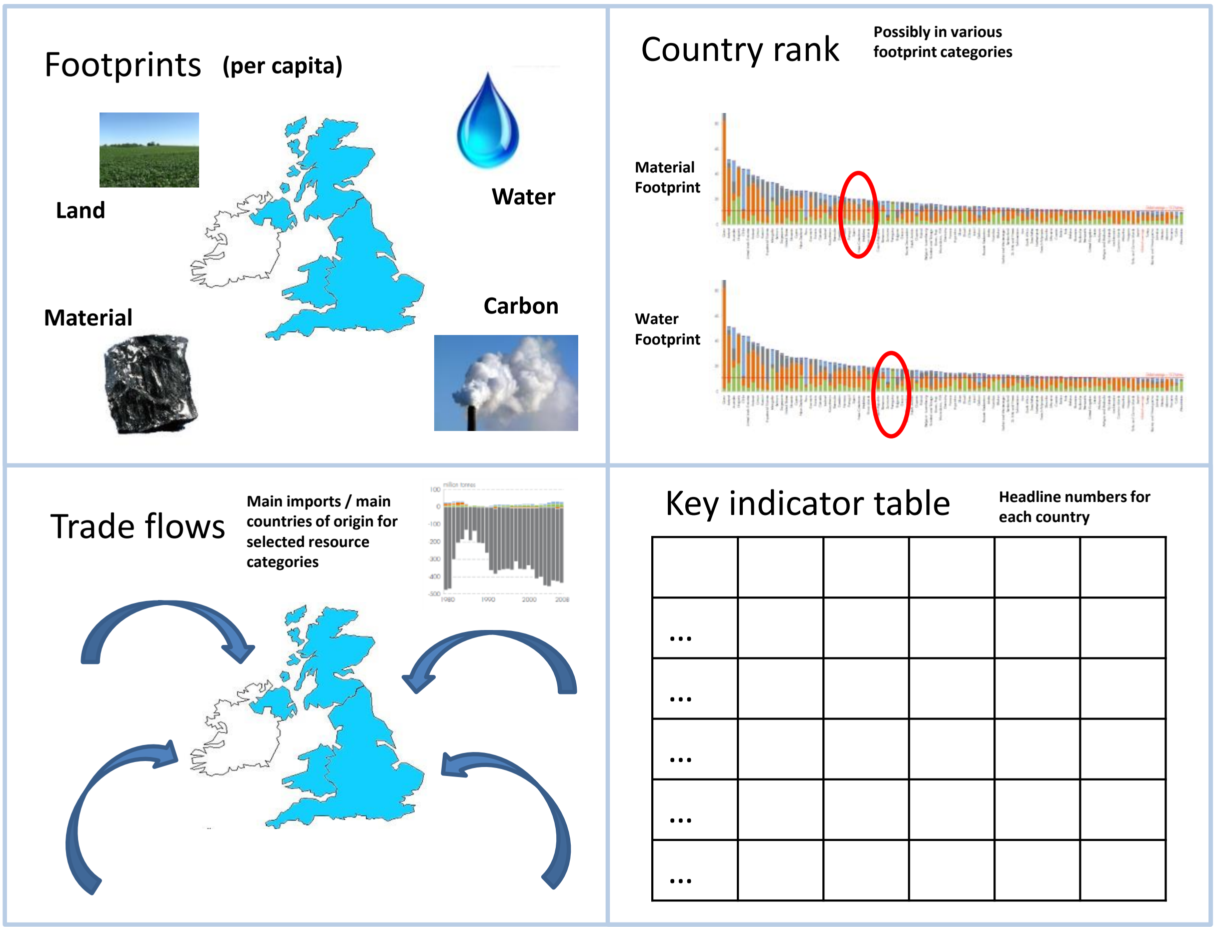
Also critical materials. biodiversitv and bevound GDP



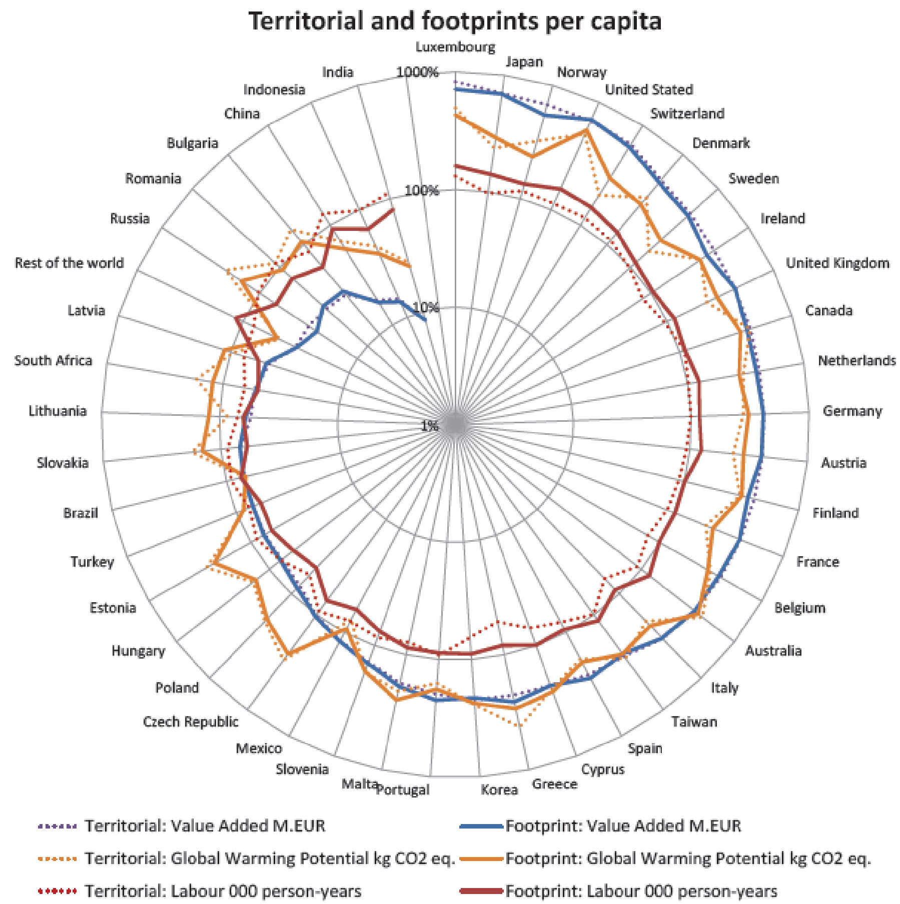
In production: booklet ‘The carbon, water, land and material footprint of nations

Country factsheets for 43 countries

Country fact sheet: **United Kingdom**



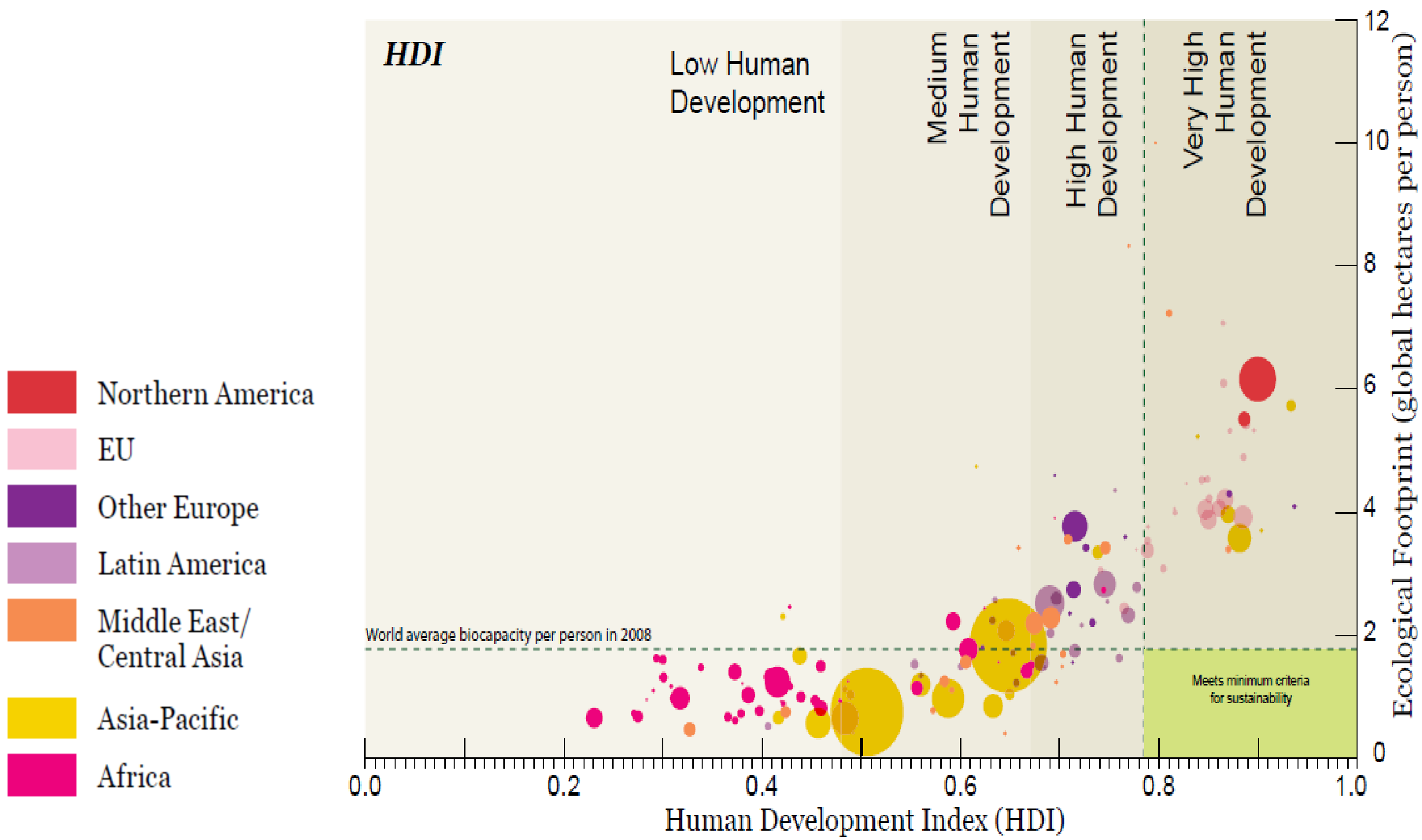
Thematic analyses (Example: territorial impacts and footprints per capita comparative to world average (GWP, labor, value added)



From: Wood & Steen Olsen, 2013

Example: Quality of life versus footprints

Human Development versus ecological footprint by country



Source: new economics foundation


Potential collaboration with the statistical world

1. Countries build own EE SUT/IOT but face pollution embodied in trade
   - A joint WG of NSIs and researchers could link and harmonize such initiatives, compare OECD WG on Material Flow Analysis
   - DESIRE can offer some funds to support this,,,,
   - ,,,would there be interest? What would be a good host ? (e.g. UNCEAA, London Group, UNEP SETAC LCI, OECD….)
2. Support to countries with less data seems feasible too
   - EXIOPOL, EORA had to develop many gap filling routines
   - Crude but usable EE SUT probably can be estimated with FAOSTAT, IEA and macro-economic data


Conclusion

- UN SEEA 2013 suggests SUT/IOT as the way to organise economic and environmental data in a consistent framework
- EXIOPOL, CREEA show the power of having such a consistent dataset
- Main problem is harmonization across data suppliers
  - SUT (NSIs): please provide valuation layers
  - Energy & Physical data (e.g. IEA, FAO): use standard product & industry classifications
  - Emission data (e.g. UNFCCC, CLRTAP): idem
  - Trade (UN COMTRADE): solve mirror statistics puzzle
- EXIOBASE available for (a not for profit) f(r)ee at www.exiobase.eu


THANKS FOR YOUR ATTENTION!


Example 6: 'Hot spot' analysis – 80% of impacts due to

Food (meat and dairy)

Mobility

Housing (heating and cooling) and Electrical appliances

COICOP	Study	Dall et al.	Kok et al.	Labouze et al.	Nemry et al.	Nijdam and Wilting	CEDA EU25
	Indicator	Energy	Energy	GWP	GWP	GWP	GWP
	Main approach	Bottom-up	Hybrid	Bottom-up	Bottom-up	IO	IO
CP01-02	Food	26,2%	13,0%	7,0%NA	3,6%NA	22,1%	31,0%
CP03	Clothing	1,3%	2,2%	3,3%	1,3%	6,5%	2,4%
CP04-05	Housing	40,8%	54,3%	58,8%	53,5%	33,4%	23,6%
CP06	Health		1,8%		0,3%	0,3%	1,6%
CP07	Transport	19,5%	18,3%	29,6%	32,9%	17,3%	18,5%
CP08	Communication			0,0%	2,9%	0,0%	2,1%
CP09	Recreation	7,2%	8,1%	0,0%		15,1%	6,0%
CP10	Education		1,8%			0,7%	0,5%
CP11	Restaurants					2,8%	9,1%
CP12	Miscellaneous	5,1%	0,4%	1,3%	5,4%	1,8%	5,2%
	TOTAL	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Source: EIPRO study, TNO, CML, VITO and DTU for DG JRC IPTS

CREEA WP3, water accounts

- Physical Water SUT for a test country (Netherlands)
- Valuation methods with regard to water extraction
- Water quality accounts with regard to chemical and thermal pollution
- Dataset for EXIOBASE: water use by 160 sectors for 43 countries

CREEA WP5: Forest accounts

- TASK 5.1: Revising the proposed SEEA 2012 methodology for forests
- TASK 5.2: Developing procedures for integrating national forest data into the proposed SEEA 2012 framework
- TASK 5.3: testing the methodology by data gathering for selected countries
- Each task corresponds to a deliverable in the project
- Rather stand alone deliverable

CREEA WP6: Kyoto accounts

- Mapping IEA energy database on MR SUT and emission calculation
  - IEA format -> SUT
  - Territorial to residence
  - IEA product classification now harmonized with EXIOBASE 2.0; IEA industries need correspondence with more detailed EXIOBASE
  - Allocation: mix of physical and economic coefficients (latter assuming price homogeneity of Use)
  - UNFCCC emission factors give emissions
  - Other emissions similar approach
- Land use cover change: tested for Annex 1, not certain for others
- Experimental inclusion of Emission trading schemes
- Experimental analysis of response measures (e.g. taxation)

CREEA WP7: Integrating into EXIOBASE 2.0

- A global MR SUT with extensions for 2007
  - 160 sector and 180 products by country
  - Trade linked
  - Not only monetary MR SUT, but also energy MR SUT (probably good, IEA based) and material MR SUT (somewhat problematic)
  - 43 countries and 5 ‘rest of continents’
  - 80 resources, 40 emissions
  - Nice tool to analyse resource-efficiency at sector, country and global scale including geographical trade offs