Towards "UNSD" global environmental MR EE IO tables supporting the UN SDGs

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UNCEEA meeting, 25-27 June 2014, New York

Outline

1. Key international sustainability policies

2. Data needs: detailed MR EE IO essential

3. How UNCEEA can build upon the experiences of the science community

4. Collaborative data and data processing environments: The ‘SEEA Lab’

5. Outlook

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KEY INTERNATIONAL SUSTAINABILITY POLICIES

Policy programs feeding into the UN Sustainable Development Goals

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

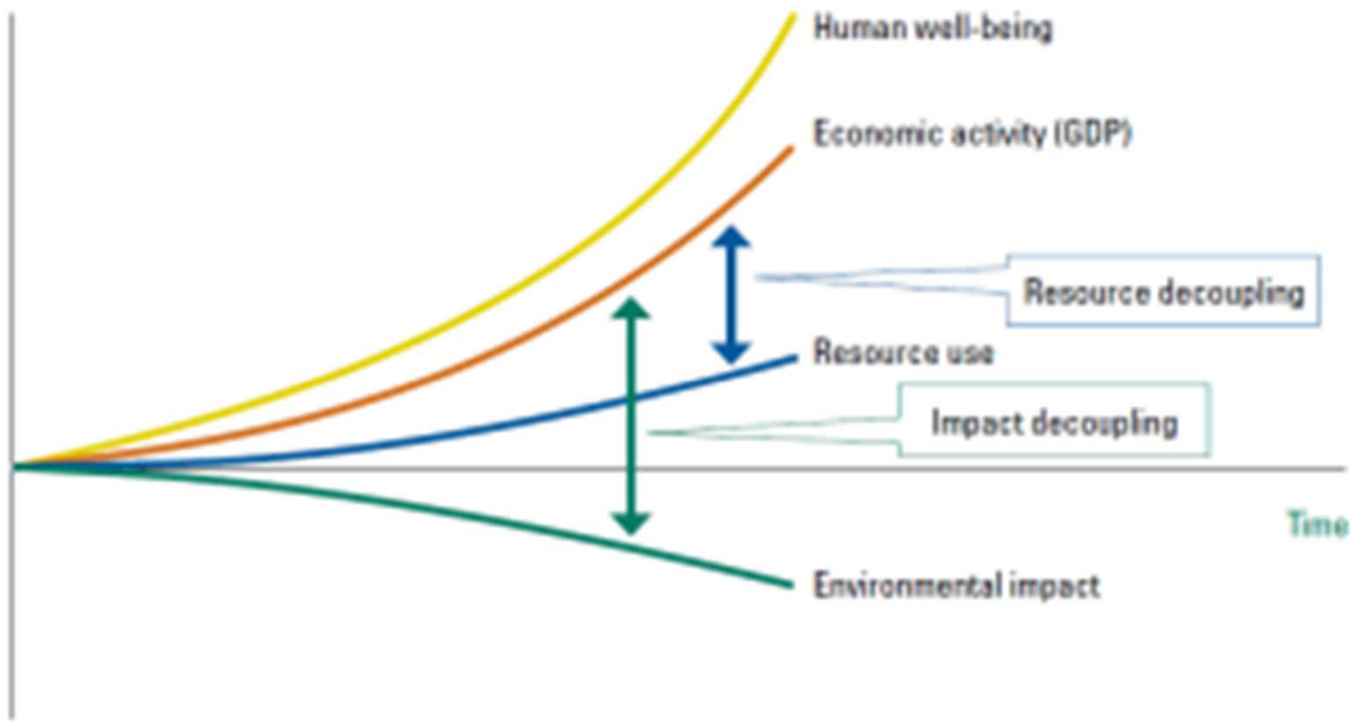
*“one that results in **improved human well-being** and social equity, while significantly **reducing environmental risks and ecological scarcities**”*

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***

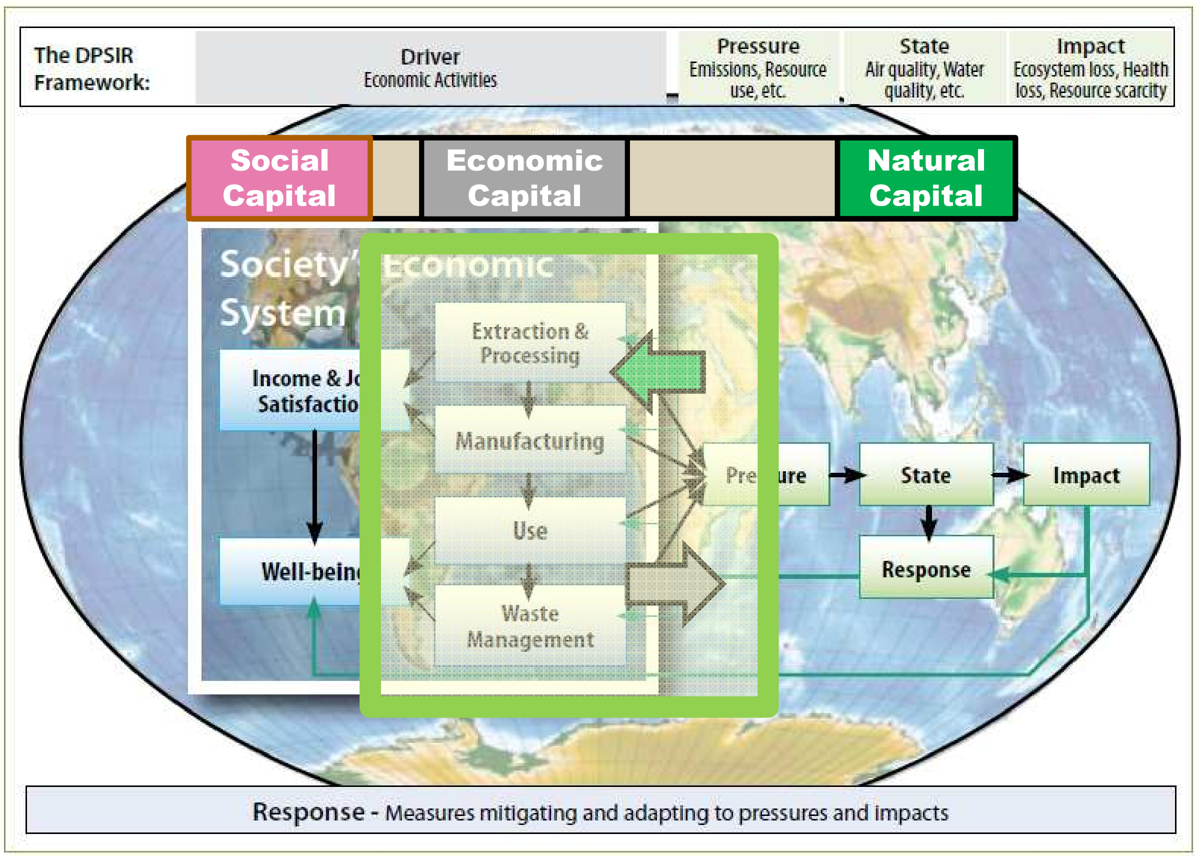
SCP, Resource Efficiency, Green Economy…

All aim at improved human well-being decoupled from resource use and emissions



Avoid indicator overload: use SEEA for data organisation

- •Natural system and Socio-economic system
- •Driver-Pressure-State-Impact-Response chain
- •Natural-Economic-Social capital stocks
- •Global SUT/IOT for economic/material flows and pressures



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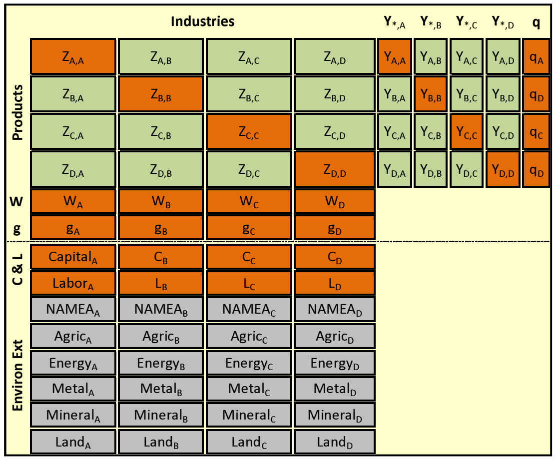
USEFULNESS OF MR EE IO

Detailed Multi-Regional EE SUT / IOT = core

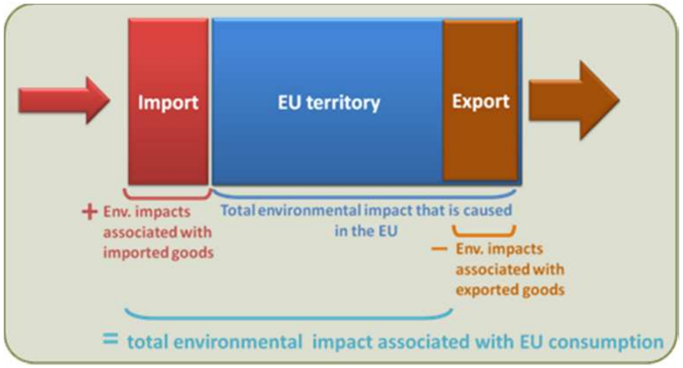
- Global SUT/IOT linked via trade
  - Country SUT/IOT (red)
  - Import/export trade matrices (green)
  - Exensions: emissions, energy, materials, land water (grey)



- Detail in environmentally relevant sectors (agri, energy, resources)

- One consistent dataset for territorial and consumption based assessments

  .



MR EE IO work from the scientific community (1)

1. EXIOBASE consortium (TNO, CML, NTNU, WU)

- Eurostat Data Centre Projects

- Some 15 Million Euro EU FP7 funding (EXIOPOL, CREEA, DESIRE, CARBON CAP)
  - 160 sectors/ 200 product groups per country
  - 43 countries + 5 Rest of Continents (8000 sectors, 10.000 products)
  - Time series based on UN main aggregates developed in DESIRE
  - 40 emissions, 80 resources, land, water, added value and employment
  - …linked to various impact indicators (e.g. GWP)

- Work on improved assessment methods (e.g. spatially explicit water and land use impacts, advanced biodiversity impact indicators)

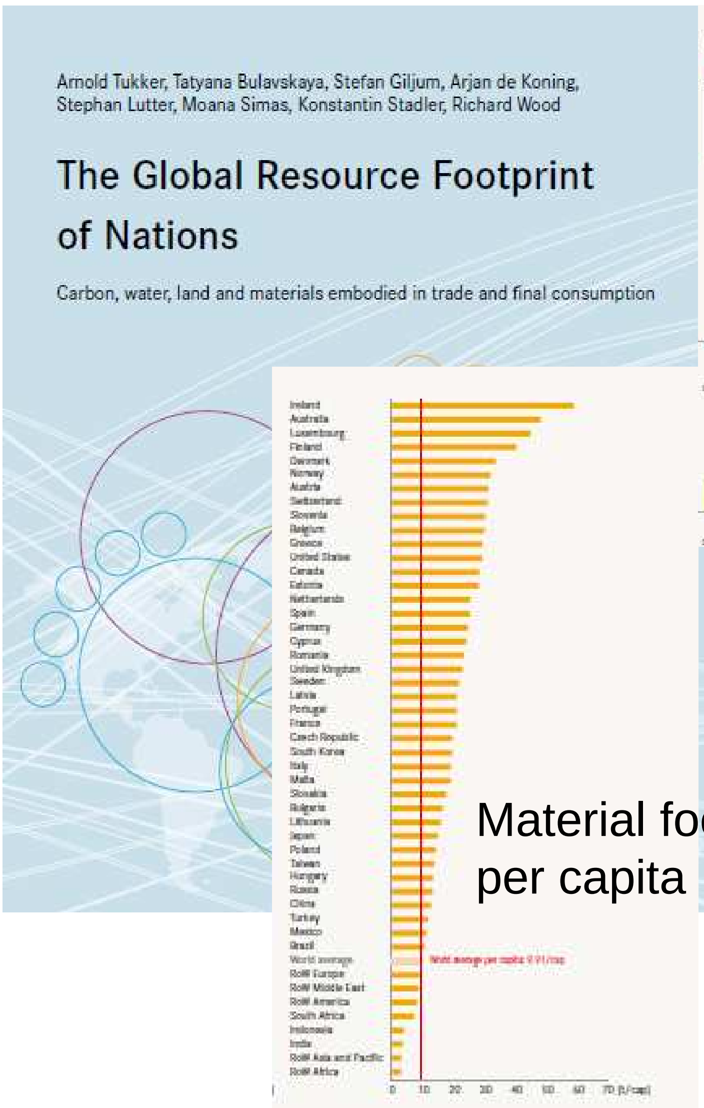
MR EE IO work from the scientific community

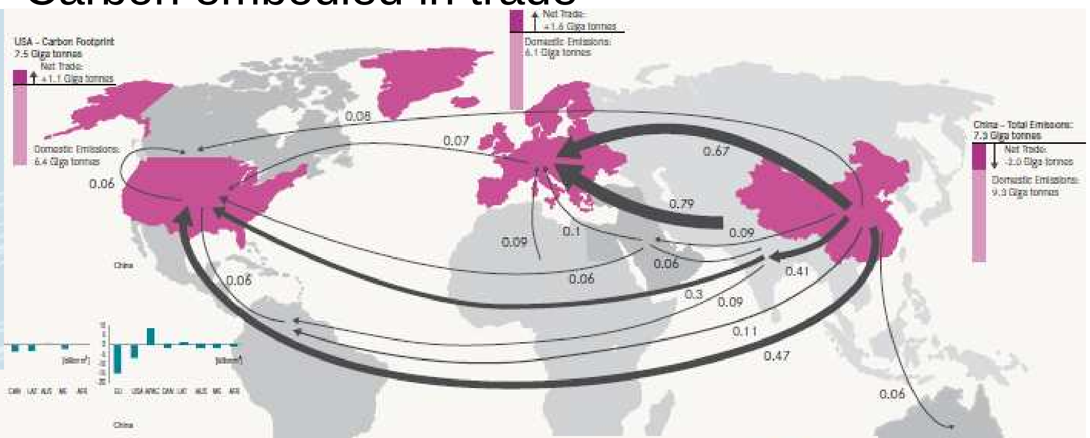
2. The University of Sydney
    - Developed the Eora database
        - 187 individual countries
        - Heterogeneous data classification: Countries are represented in their native classification. Total number of sectors ~15,000
        - Continuous time series for the years 1990-2011
        - Large set of environmental indicators for each year (GHG, land, water, employment, biodiversity threats, …)
    - Currently developing a collaborative data processing network (the Industrial Ecology Virtual Laboratory).

3. Others: economic focus, lack of detail in environmental sectors
    - WIOD -> TIVA (RU Groningen, OECD)
    - GTAP (Purdue)
    - GRAM (GwS)

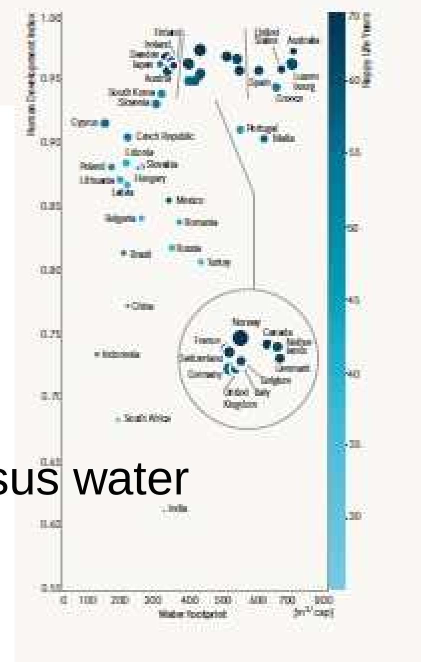
Some illustrative results

Carbon embodied in trade





Material footprint per capita



HDI versus water footprint

Many NSIs already do (MR) EE IO or similar work

1. UK: carbon footprint project (DEFRA)
2. Sweden: impacts driven by Swedish consumption (funding of Swedish EPA)
3. EUROSTAT: material footprint / RMC project
4. Netherlands: linking Dutch EE IO with WIOD, other
5. Canada: calculations of carbon footprints
6. …etc
7. **A (semi-)official global MR EE IO would have helped such work highly!**

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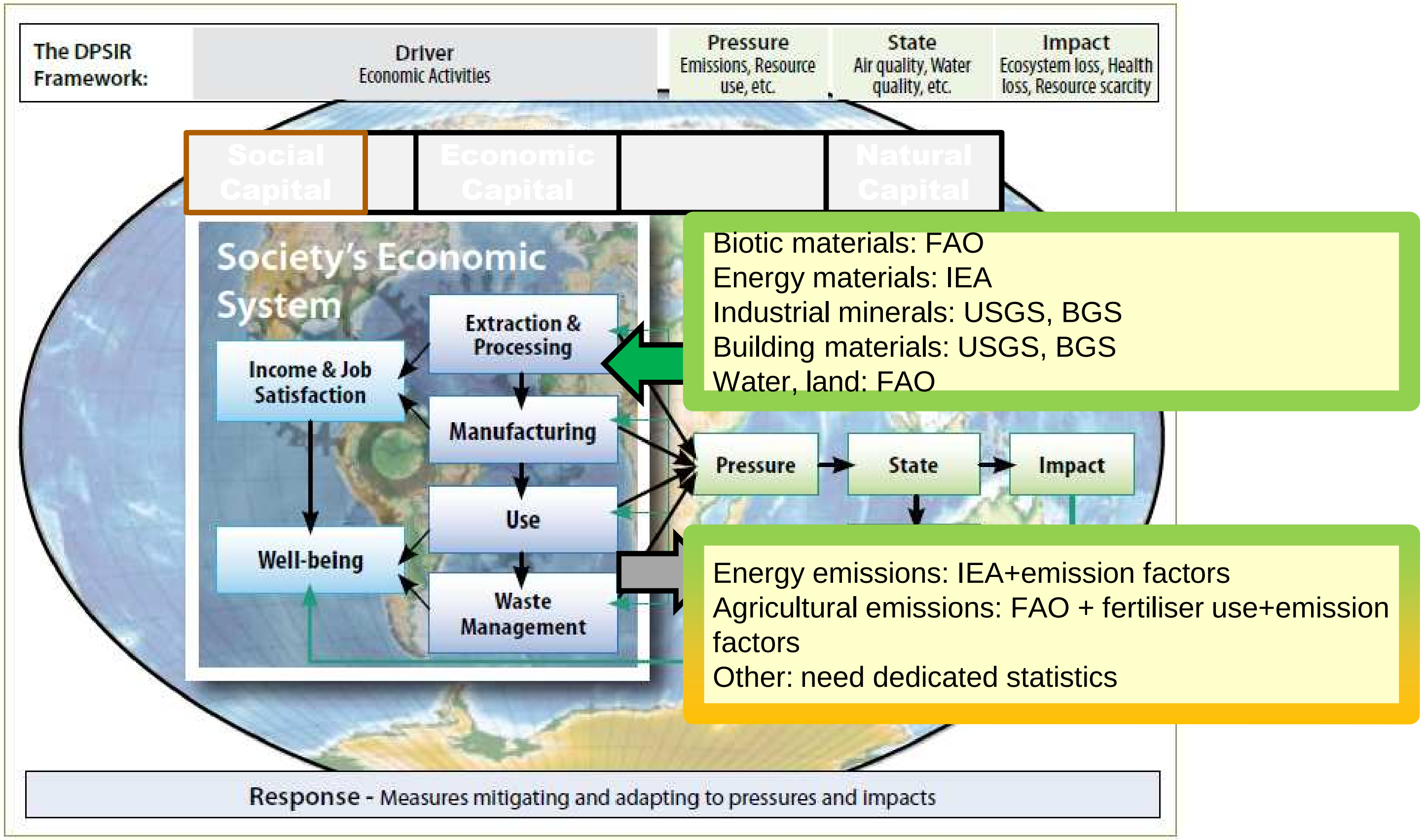
FEASIBILITY BUILDING (MR) EE IOs GIVEN DATA NEEDS

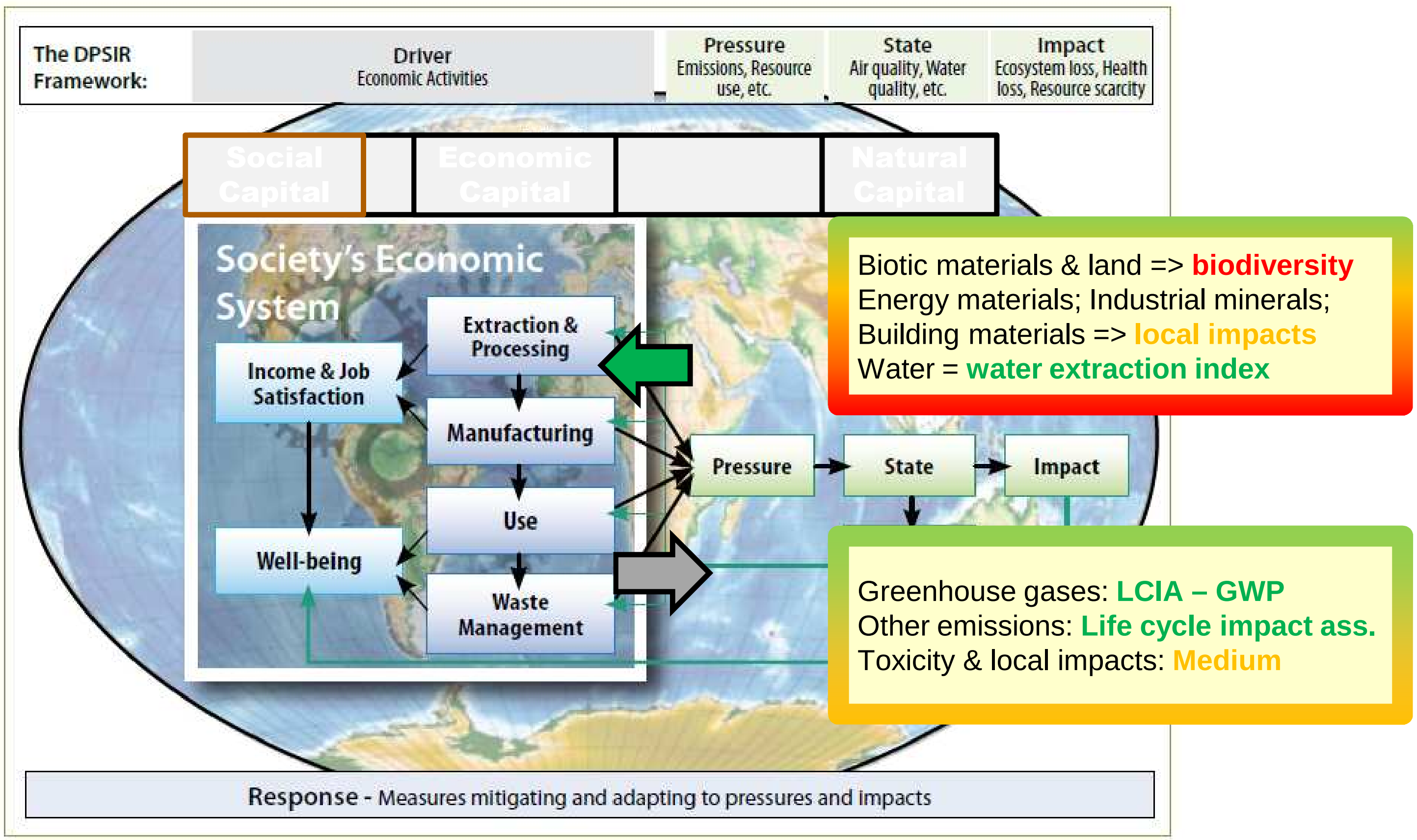
Typical data situation: pressures

Pressures broken down by industry: resource extraction good , emissions: good to medium



Typical data situation: impacts

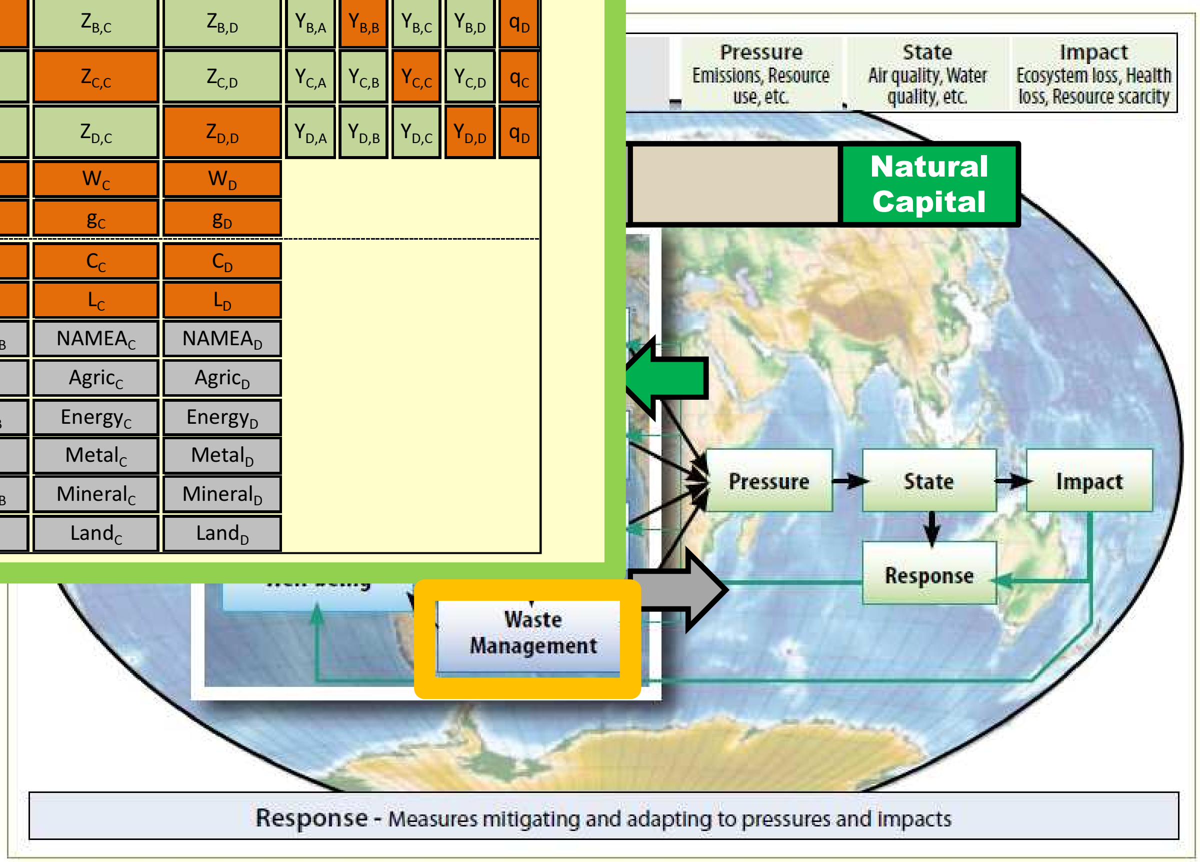
Impact indicators: emissions good (global warming) to medium (toxic impacts); resources good (water) to bad (biodiversity)



Typical data situation: economic system

Economic data: SUT/IOT: good – often not detailed (waste: medium)

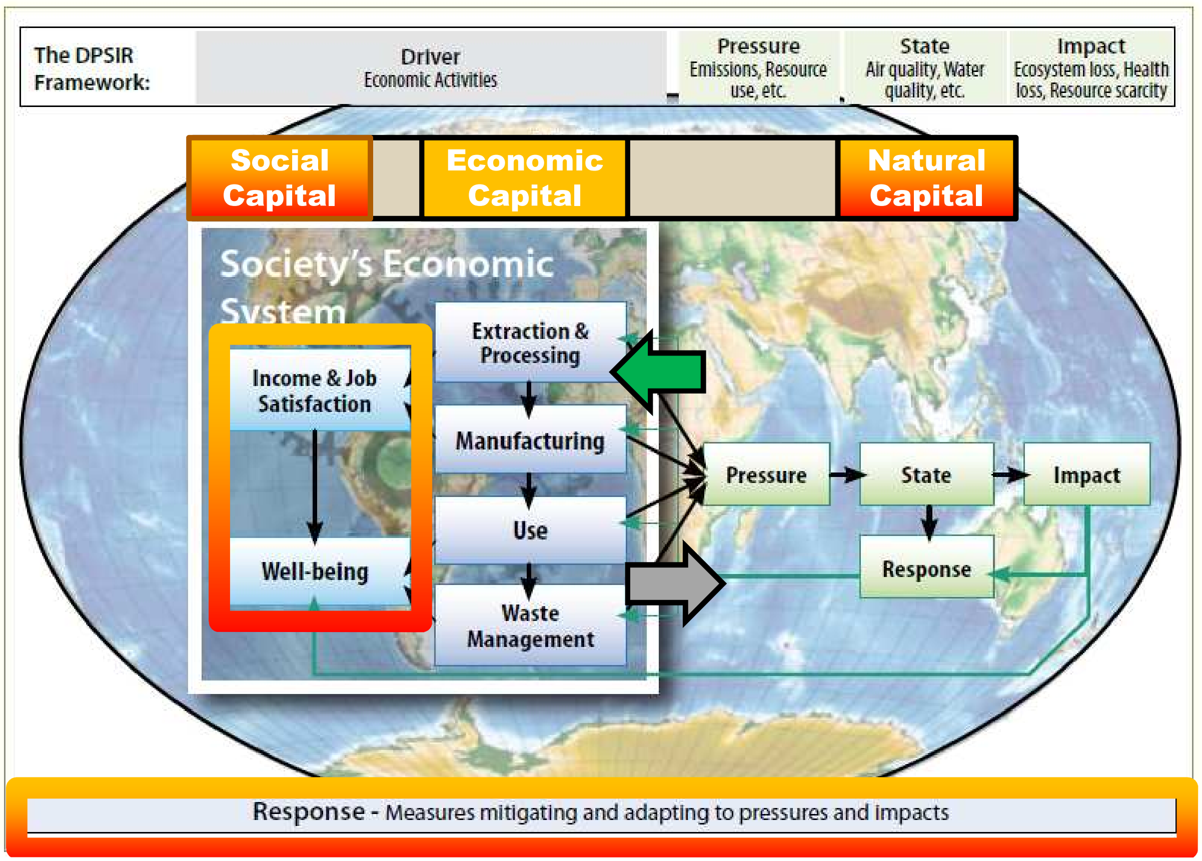
		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$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



Typical data situation: responses & capital stocks

Responses: **medium** to **bad**

Economic/”produced” capital: **medium**; Social/”intangible” and Natural capital: **medium** to **bad**; limited insights in **safe thresholds**



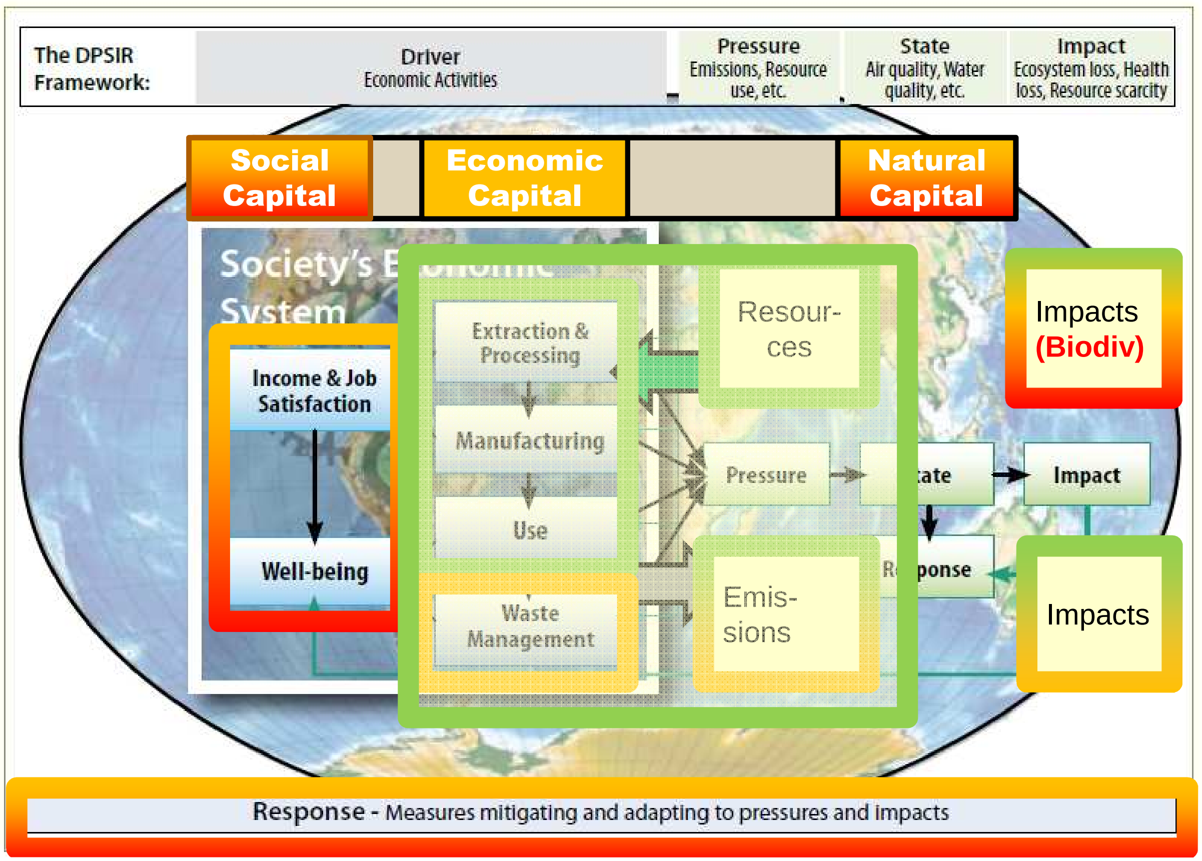
Summary

Good: economic system; resource & emission pressures, some impacts

Medium: Some emission pressures, some impacts, economic capital, waste

Bad: part of social capital, natural capital, responses, biodiversity impacts

Global MR EE IO hence feasible



Global MR EE IO TOOLS DEVELOPED BY USYDNEY

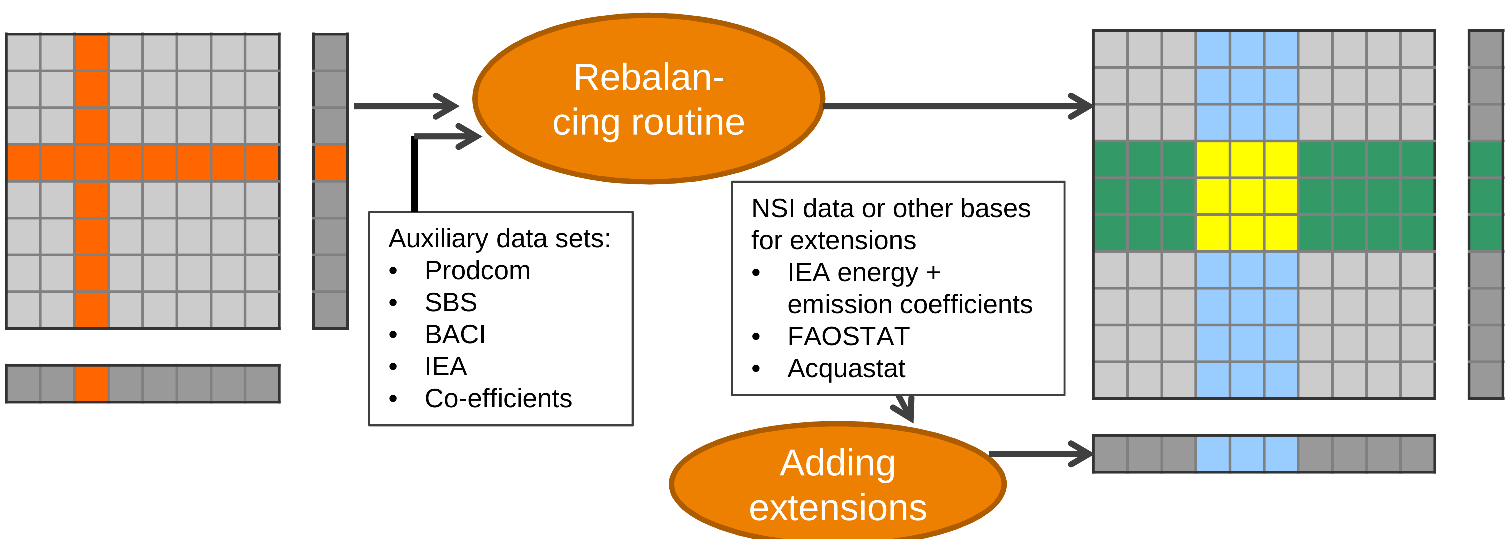
AND THE EXIOBASE CONSORTIUM

EXIOBASE: SUT harmonization routine ('red' to 'yellow')

1. Auxiliary data
    - Product statistics to split up rows (e.g. ProdCom)
    - Industry statistics to split up columns (e.g. Structural Business Statistics)
    - COMTRADE/BACI, IEA to split imports and exports
    - Co-efficients from various sources (AgriSams, similar country, etc.)

2. Rebalancing routine via minimum entropy between 'first guess' and balanced tables

3. Estimating valuation layers and extensions afterwards

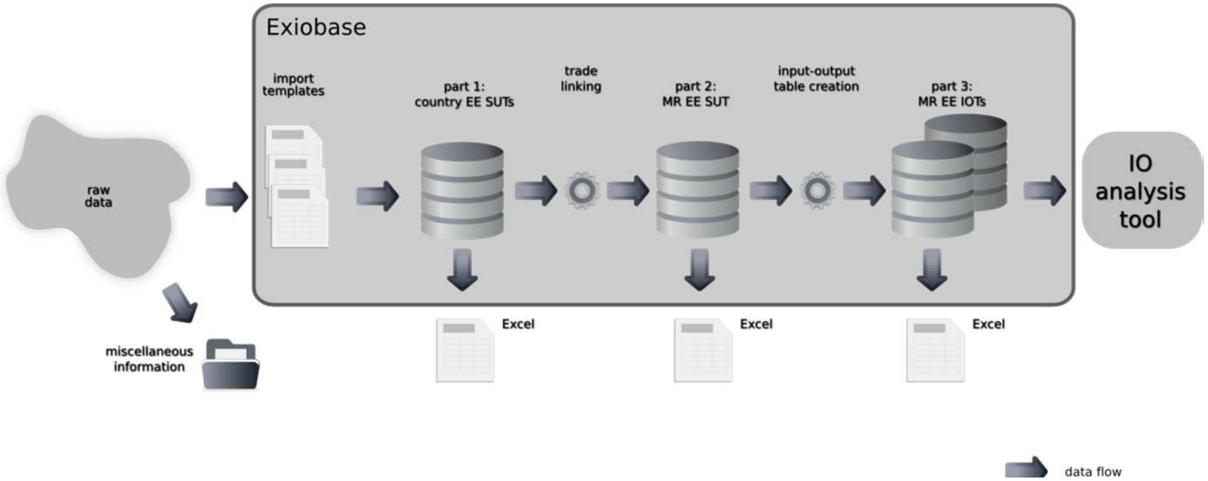


EXIOBASE: link country SUT via trade and creation of IOT

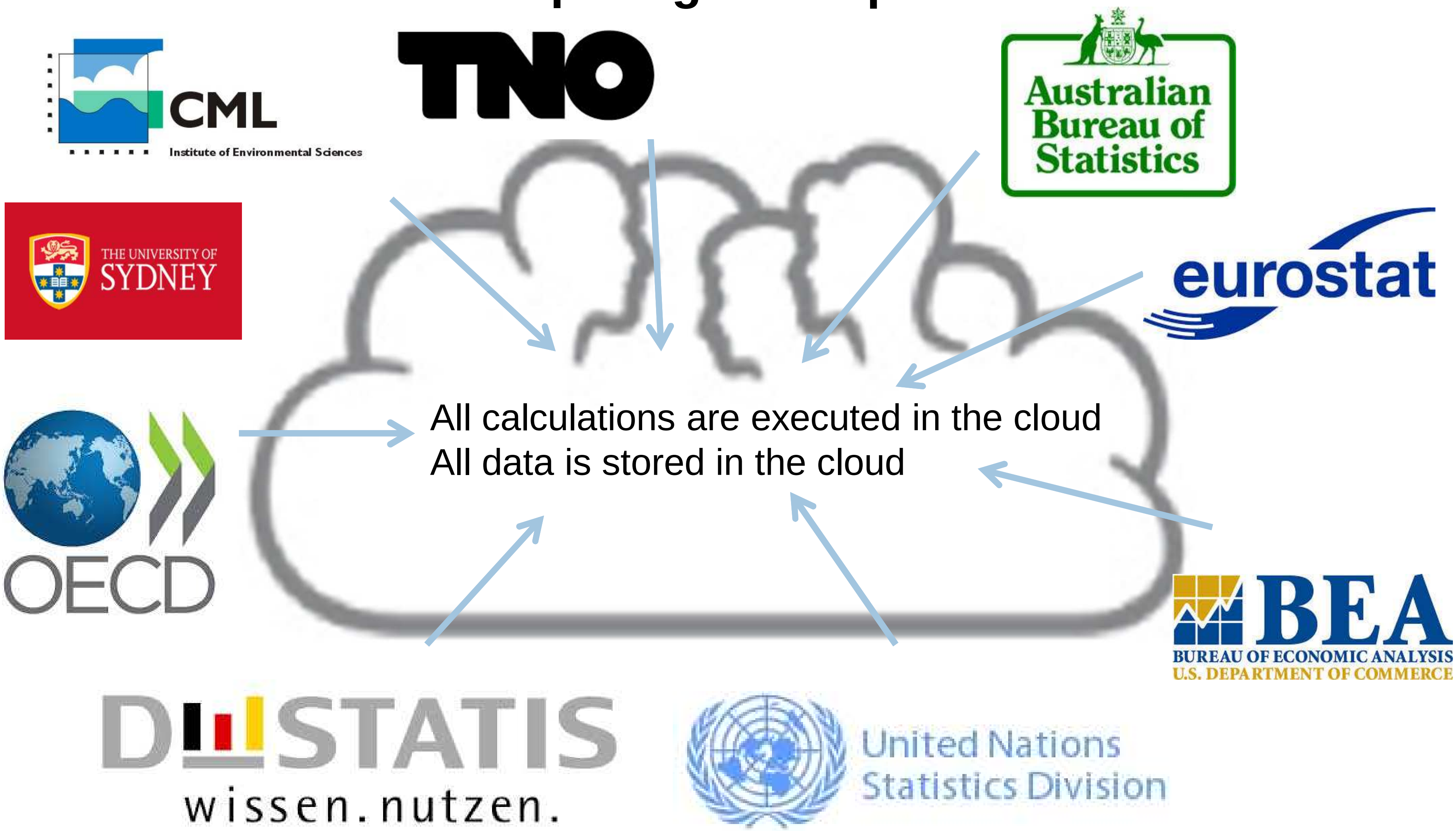
1. Trade linking
   •Construct trade shares from COMTRADE/BACI, others
   •Split Import use up via trade shares and confront with Export
   •Rebalance

2. SUT to IOT: automated calculation using Eurostat Model B

3. All fully automated and done in minutes – main difference with Usydney: the system is not in the cloud and has no interface for 3rd parties



UN-SEEALab inspired by Australian IELab: Cloud Computing Concepts



UN-SEEALab based on the following principles

- All data storage and computation tasks are realised within the the cloud. A software framework manages all activity on the cloud.

- Each participant and can upload new source data independently to the UN-SEEALab framework on the Cloud

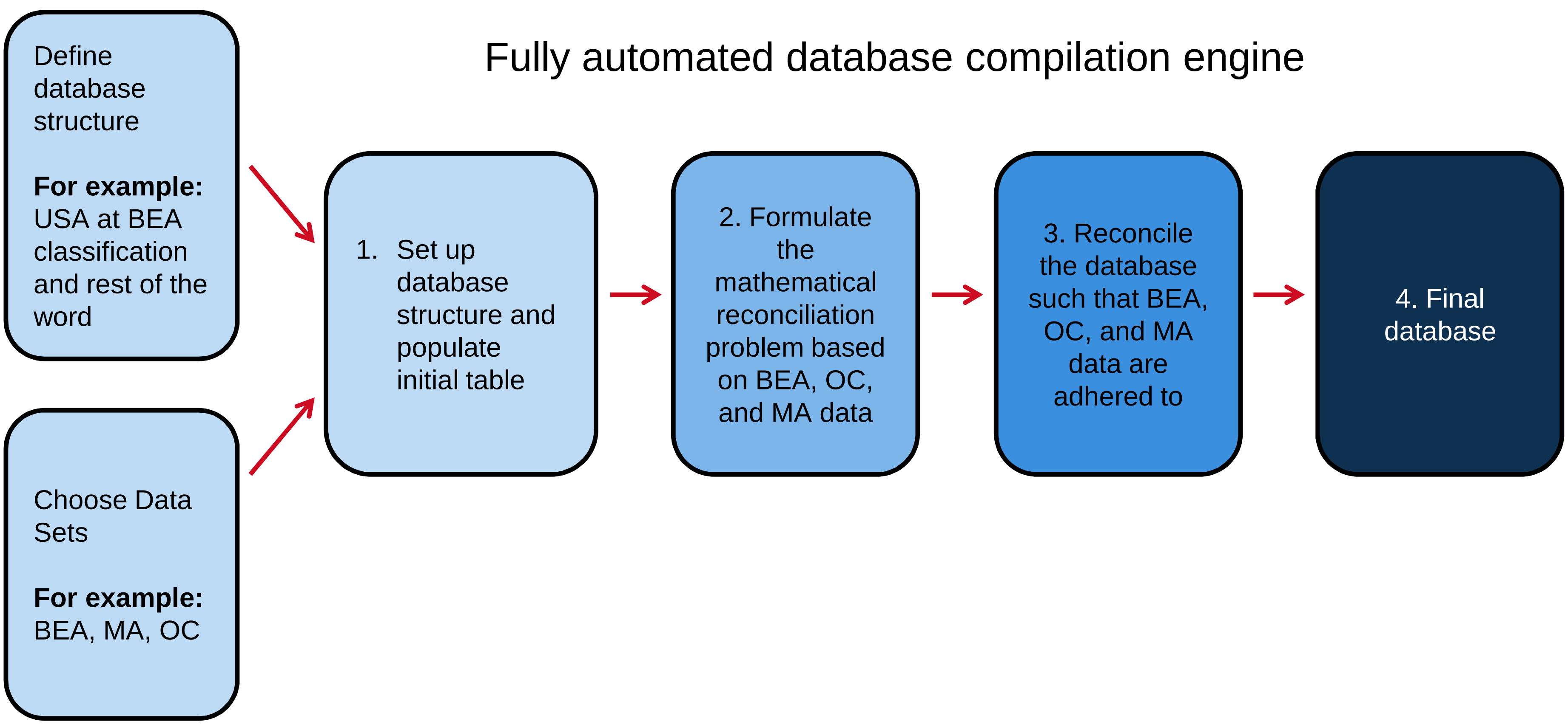
- Within the UN-SEEALab framework, databases of arbitrary structure, arbitrary size, and based on any selection of source data sets can be generated at a mouse-click.

- Database compilation engine is highly automated.

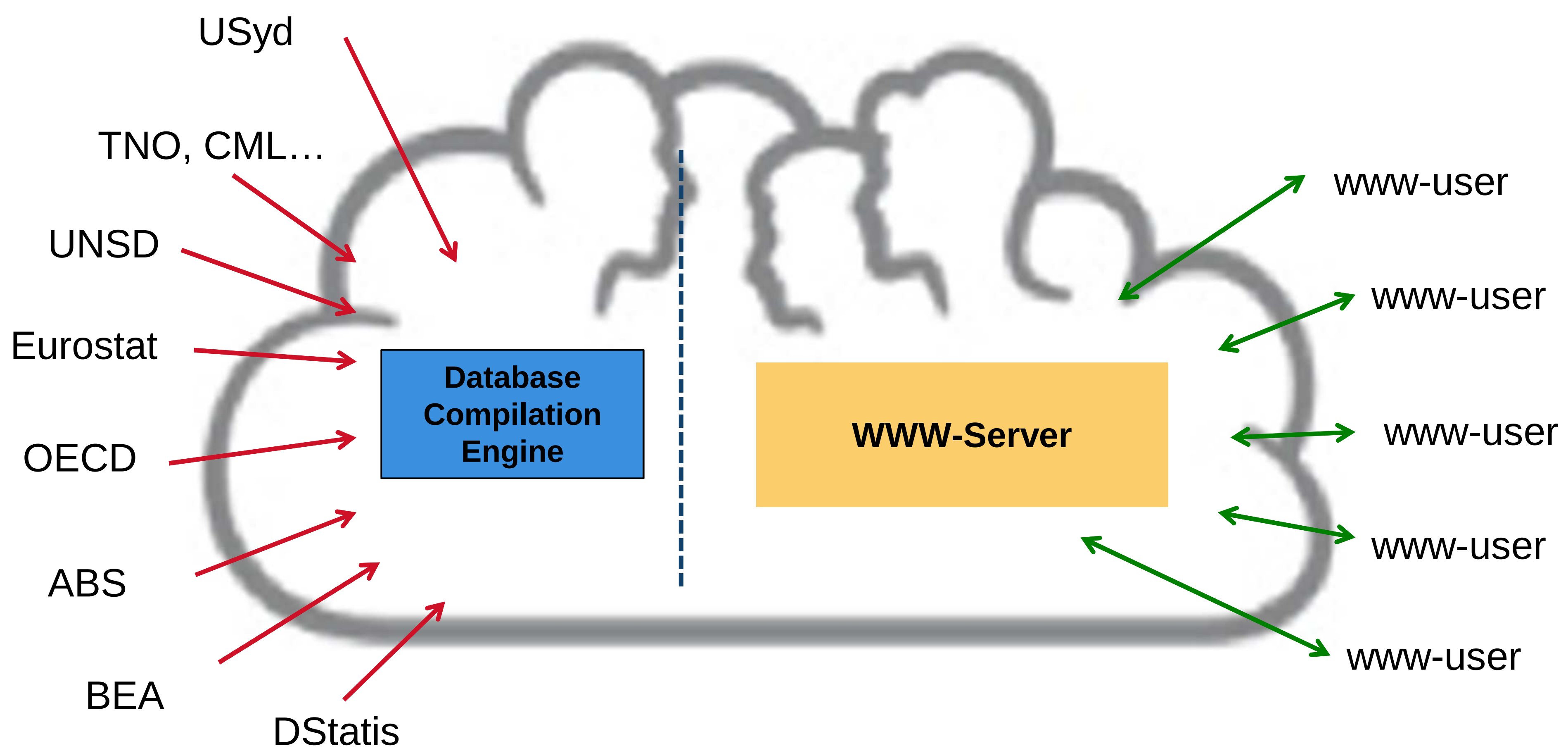
- The entire framework can be accessed from any computer in the world (including www-access).

UN-SEEALab: Data processing concepts

User Input



UN-SEEALab: global access



HOW THE STATISTICAL COMMUNITY CAN BENEFIT

OF WORK FROM SCIENTIFIC COMMUNITY

Limitations of current work

1. Current MR EE IO projects are done by scientists

2. Participation and input of NSIs is limited
   - Scientists do not use all available data (e.g. valuation layers in some EU countries)
   - NSIs do not comment on detailing, harmonization and trade linking

3. Problem areas
   - NSIs (still) have own interpretations of classifications, etc.
   - Inconsistencies between FAO, IEA and NSI IO & emission data
   - Imports and Exports in national SUTs inconsistent at global level -> ‘trade with aliens’
     - 0.2% of all trade in EXIOBASE
     - >100% of trade of specific products
   - NSIs are bound to confidentiality issues

How UNCEEA could move forward using this

1. Goal: ‘more official’ Global MR EE IO.

2. Collaboration of: UN SD, interested NSIs, team of EXIOBASE & ISA scientists
   - UN SD provide: platform, supervision, harmonized COMTRADE
   - NSIs provide
     - Their best available EE SUT/IOT & auxiliary data
     - Cross-checks on the harmonization & detailing, or do this themselves
   - EXIOBASE team and ISA team provide
     - Harmonization and detailing tools
     - A ‘virtual laboratory’ platform for collaboration with others
     - Insights in ‘thorny issues’

Possible financing & organisation

1. Typical budget EU / ISA projects: 1.5-3 Mio, more modest starts possible

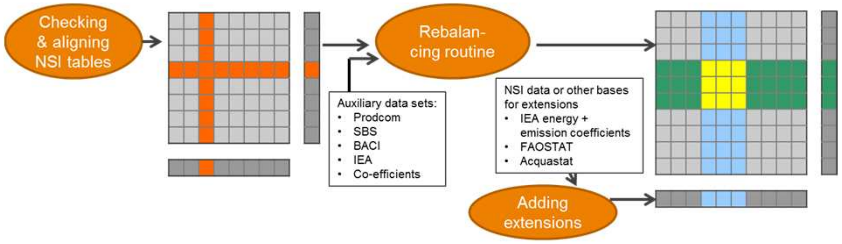
2. Already available resources
   - Ongoing EU projects (DESIRE: running till 2016)
   - Submitted EU projects (Climate ACTT: CML, USydney, UN DESA)
   - 2015 EU H2020 proposal on Climate-food-water nexus
     - *=> in all these submissions NSI or UN SD input welcome!!!*
   - Infrastructure from EXIOBASE, EORA and the Virtual Lab projects
   - University of Sydney has just launched a “Global Virtual Laboratory” project funded by the Australian Research Council (until 2017).

3. Additional sources to consider
   - Large programs (e.g. EuropeAid / Switch Asia an SwitchMed)
   - Contributions of countries / NSIs (e.g. 50k x 40 countries = 2 Mio)
   - Secondments
   - PhD stipend programs available in many countries (would provide a considerable workforce)

Possible financing & organisation

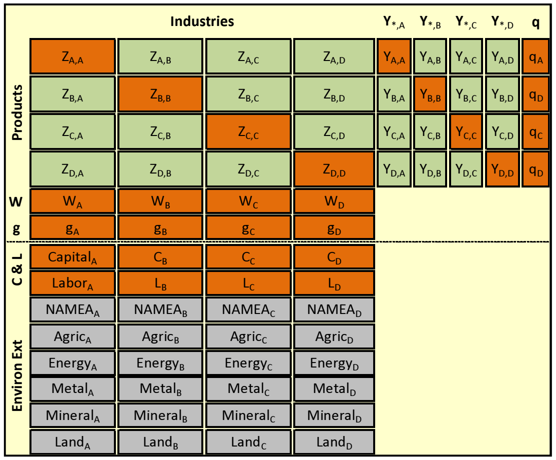
Country level

- NSI-researcher interaction – can be added to existing projects
  - EU FP7 DESIRE
  - CLIMATE ACTT
- Capacity via PhD stipends
- Using a virtual lab



Global level & integration

- UNCEEA steering group
- UN SD providing trade data
- Using Usydney or EXIOBASE tools for integration



Actions we could discuss now

- Who is interested in working now already with us in existing projects and applications?

- Could we form a UNCEEA WG pursuing this idea (UNSD, NSIs)?

- Ideas about the goal (how ‘official’, homogeneous GMRIO or not, how to link to individual NSI EE IO)

- Who is interested to explore the following funding routes with us?
  - UNCEEA endorsed proposals to PhD stipend organisations (CSC, DIKTI, NUFFIC, EC Marie Curie,…)
  - Seconded staff to support a central UNCEEA secretariat
  - Major funding programs (e.g. Europe Aid)
  - Direct lobby for support funding of UNSD

Thanks for your attention!

Leftover slides

Example 2: 80% of impacts of consumption caused by

Food (meat and dairy)

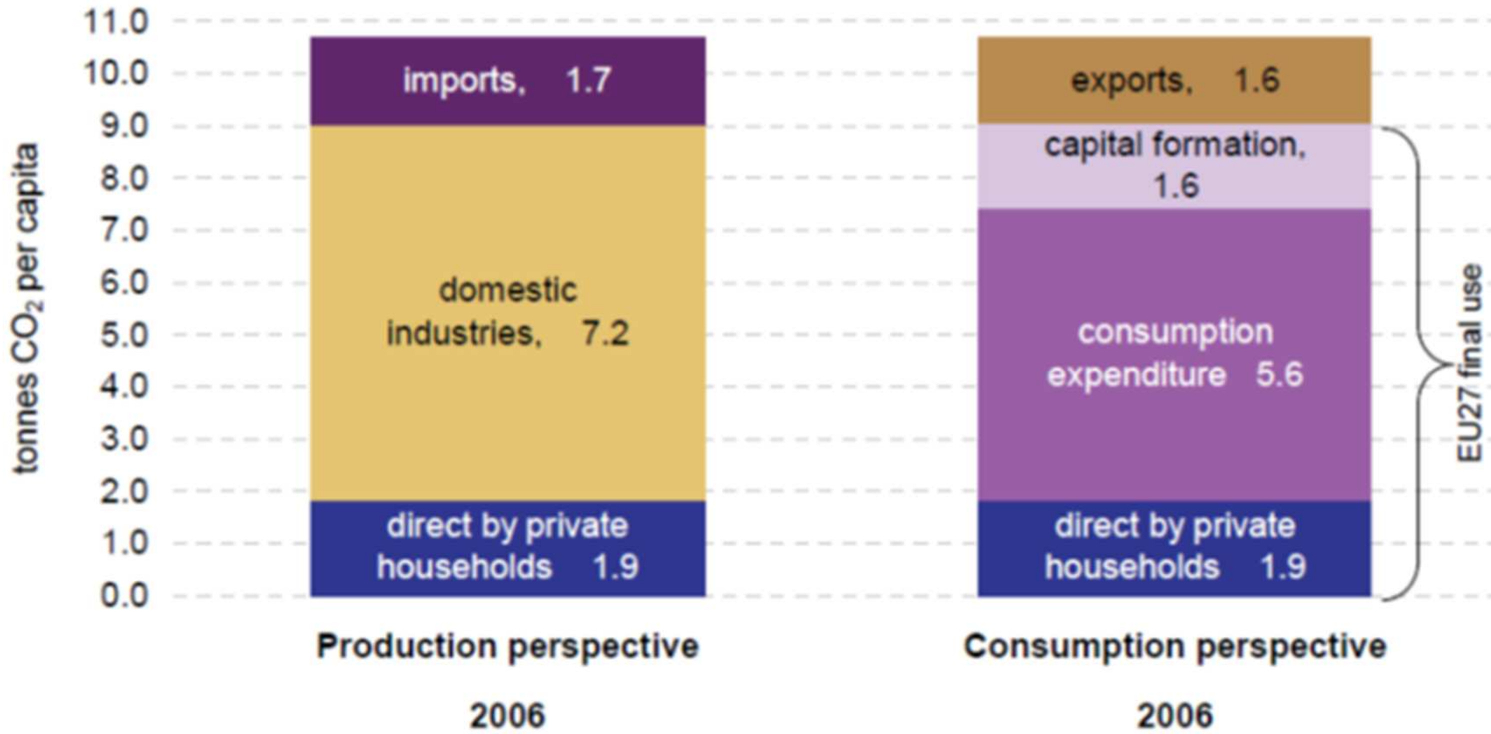
Mobility

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

Example 3: Carbon emissions in Europe

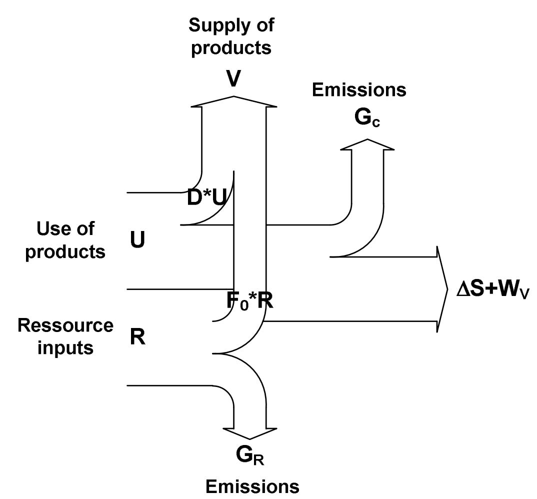


Source: Eurostat EE SUT/IOT project, DG JRC IPTS, TNO, CML, NTNU, RUG

Example 4: Resource-efficiency by sector

- Advanced method
- Estimates not only economic, but also physical relations in an Input-Output table
- Per sector
  - Input intermediate products + resources
  - Output of manufactured products
  - Output of waste and emissions

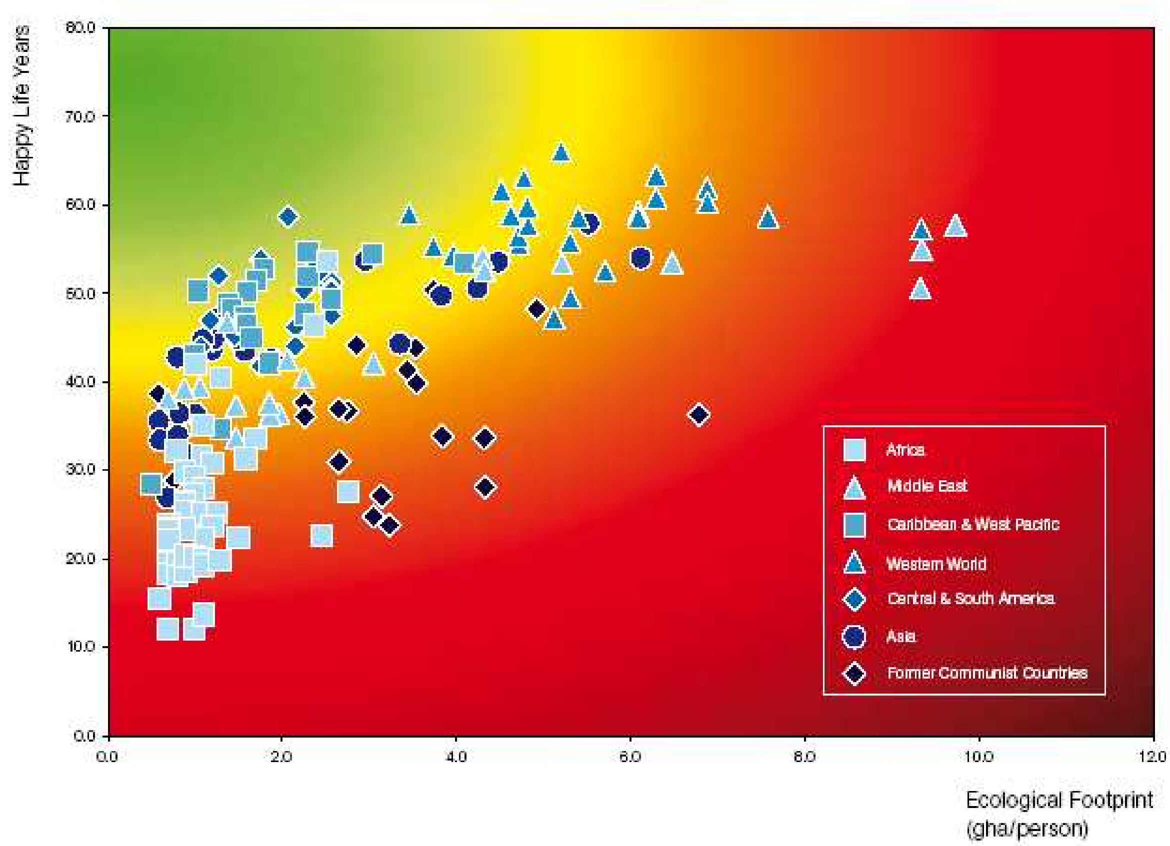
		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$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



Source: EU FP7 CREEA project, TNO, 2-0 LCA, CML, NTNU, SERI, others

Example 5: Quality of life versus impacts

Happy life years versus ecological footprint by country



Source: new economics foundation

Example 6: Redundancy of indicators revisited

Despite the many indicator systems, the consumption perspective and impact indicators often are forgotten

	Pressures		Impacts	
	EU27 territory	Consum-ption	EU27 territory	Consum-ption
Material Use	Domestic material use **Domestic Material Consumption**	Global material demand **Raw Material Consumption**	***Territorial part of* Life-Cycle Resource Indicator** *(Env. weighted Material Consumption)*	**Life-Cycle Resource Indicator** *(Env. weighted Material Consumption)*
	7	2	0	0
Energy Use & Climate Change	Domestic energy use **Gross Inland Energy Cons.**	Global energy demand **Energy Footprint**	Domestic GHG emissions **Territorial GHG Emissions**	Global GHG emissions **Carbon Footprint**
	4	0	12	4
Water use	Domestic water use **Water abstraction**	Global water demand **Water Footprint**	Domestic water exploit. **Water Exploitation Index**	Global water exploit. **Global Water Consumption Index**
	4	2	2	0
Land Use	Domestic land use **Domestic Land Demand**	Global land demand **Actual Land Demand (Footprint)**	Domestic LU intensity **Human Appropriation of Net Primary Production**	Global LU intensity ***eHANPP, LEAC and other indicators on ecosystem quality***
	2	3	0	0

Source: EU FP7 DESIRE project, TNO et al.

Conclusions and recommendations

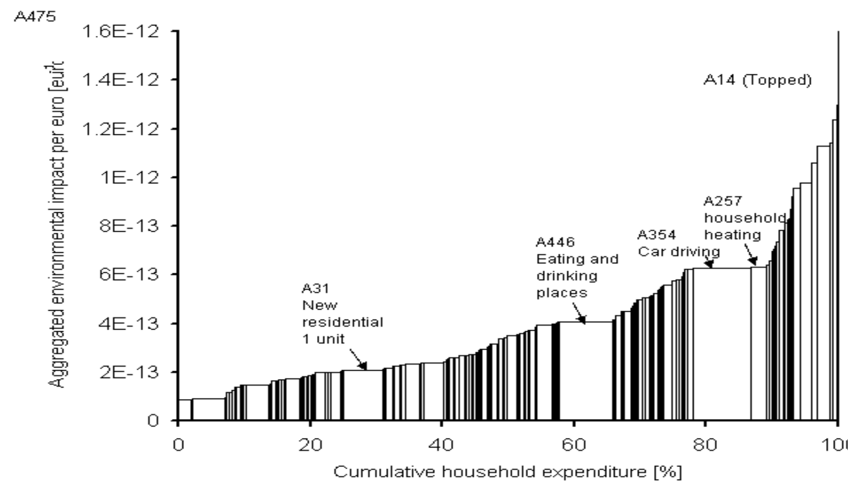
1. Use an agreed **coherent concept**
2. Work where possible with **existing data & indicator compilers**
3. Use **UN SEEA**, existing **economic accounts** and **pressure databases** in combination with **existing impact assessment methods**
4. Use an EE IO framework: ensures that with territorial accounts you can calculate **consumption-based accounts**
5. Complement total pressure and impact indicators with **efficiency indicators** for key sectors

6. Data gaps: likely on **social capital**, **natural capital/state**, **responses**
7. Improve scientific basis for **impact indicators (e.g. biodiversity)**
8. Improve insights in **thresholds related to natural and social capital**

Slides with additional examples

What you can calculate with EE SUT and IOT

- EU EIPRO (480 sector EE IOT)
  - Priority setting of products
  - Proved that food, mobility and housing were prio’s
- EU Diet change
  - Change to healthy diets by changing demand vector
  - Showed rebounds by linking EE IOT to the CAPRI model



Tukker (ed., 2006), Journal Industrial Ecology 10: 3

	Aggregated environmental impacts (%)			
	Scenario 0: Status quo	Scenario 1: Recommendations	Scenario 2: Recommendations including red meat reduction	Scenario 3: Mediterranean
Sub-scenario ‘All’				
Food	27	27	25	25
Non-food	73	73	73	73
Total	100	100	98	98
Sub-scenario ‘All + first order’				
Food	27	27	25	25
Non-food	73	73	74	73
Total	100	100	99	98
Sub-scenario ‘All + first and second orders’	100	100	99	99

Tukker et al., 2011, Ecological Economics (in press)

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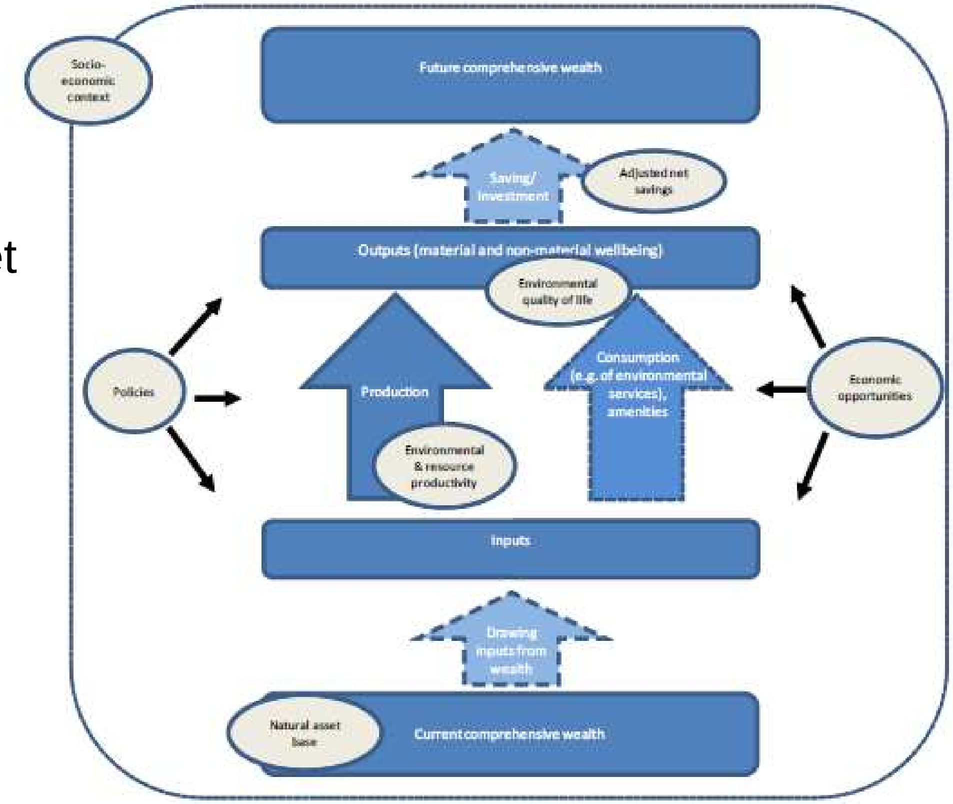
10 januari 2011
M Bouman
TNO Nieuwe huisstijl

Based on a string of EU funded projects next to EEA and Eurostat work

1. Goal: building the most ambitious macro-database and dynamic model for
   - Economic interactions in and between countries (MR IO Table)
   - At a > 130 sector and product level
   - Including detailed emission and resource extraction data
2. Role of each project (total 15 Mio Euro, with TNO, CML, NTNU, SERI, others)
   - EXIOPOL: first version of the database, TNO government money: first version of a dynamic CGE model (EXIOMOD)
   - CREEA: 2nd base year; water extraction by river basin; using IEA and other information to create the worlds first physical and energy MR IO linked to economic data
   - DESIRE: builds MR EE IO time series; adds biodiversity indicators; rigorous assessment of resource indicators; identification of ‘minimum useful set’
   - CARBON-CAP: consumption based emission analysis for climate policy
   - EMINIMM: quantifies diffusion of eco-innovation, to be fed into our model
   - POLFREE: aligns EXIOMOD with an environmental model; sophisticated evaluation of resource efficiency scenarios for Europe
   - DG ENV: visible scenario-analysis with the EXIOMOD model

To avoid indicator proliferation, we need a concept

1. Is in part logic thinking
2. Is in part alignment
3. Example: Green growth knowledge platform
   - Inputs: the natural asset base
   - Production: intensity/productivity
   - Outputs: material and non-material wellbeing



Note: White ovals represent indicator categories.

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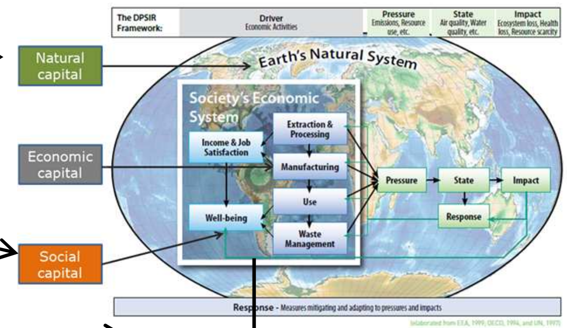
Suggested data organisation

1. Measure natural capital stock / Environmental state & relevant thresholds
2. Measure well-being and social capital stock
3. Measure responses
4. Get detailed stock-flow data of the economic system and its material flows and emissions; f.i. in an EE IO format following UN SEEA – which includes
    - Drivers
    - Capital stock
5. Gives one related dataset allowing for calculating pressures and impacts, from a consumption and territorial perspective



		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		$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
		$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
		$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
		$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
		$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
		$Land_A$	$Land_B$	$Land_C$	$Land_D$					

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Some examples

1. Natural capital & thresholds

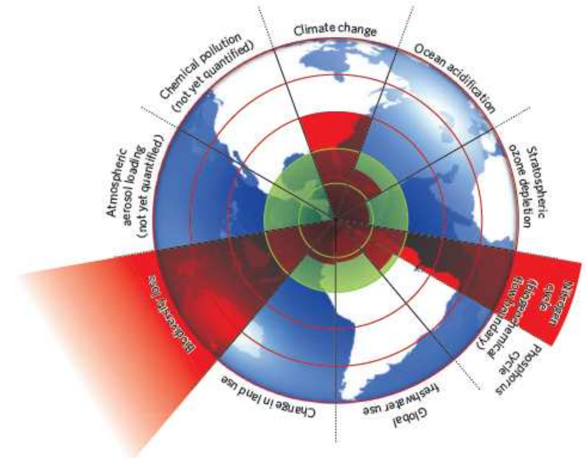
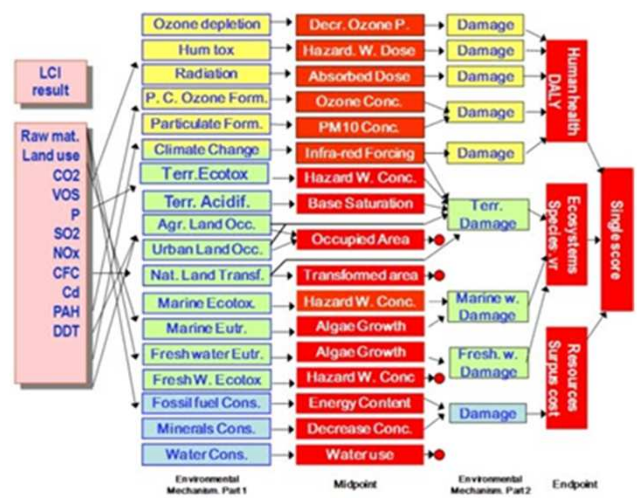


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

2. Well being and social capital (-)

3. Responses (-)

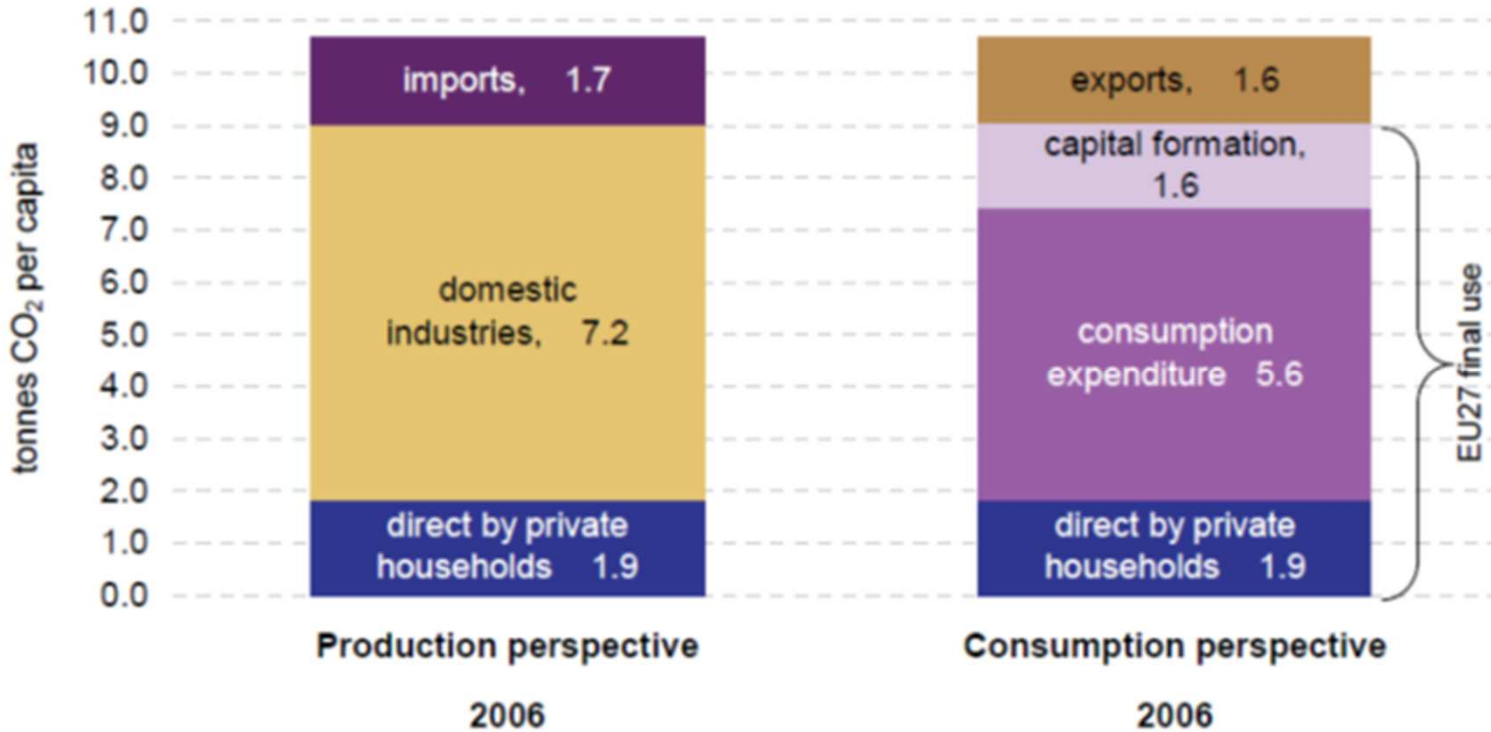
4. Stock-flow data in economy and related pressures and impacts



How to select the 'best' indicator set

- Use the RACER concept
  - relevant,
  - acceptable,
  - credible,
  - easy and
  - robust'
- Use the Policy Cycle Concept – do the indicators help in all steps?
- Use correlation analysis to understand which headline indicators have most saying power

Example 2: Carbon emissions of EU (Eurostat)



Source: Eurostat EE SUT/IOT project, DG JRC IPTS, TNO, CML, NTNU, RUG

Review of indicator systems – a few too many?

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