Handbook Chapter 5: *Extended Environmental-Economic Accounts*

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Outline

1. Background – Extended GVC-model based Environmental-Economic Accounts

   > Drivers and policy perspective

   > Conceptual framework

   > Application of the framework

2. Proposed table of content of chapter 5

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Drivers and policy perspective

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Sustainable Development Goals (SDGs)

End Poverty

Sustainable Agriculture

Healthy Lives

Equitable Education

Gender Equality

Water

Energy

Sustainable Growth

Innovation & Infrastructure

Inequality

Sustainable Cities

SCP

Climate Change

Oceans

Ecosystems

Peace and Governance

Partnership

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Policy programmes feeding SDGs

|	
Sustainable consumption and production (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*
Green economy	*"one that results in **improved human well-being** and social equity, while significantly **reducing environmental risks and ecological scarcities**"*
Resource efficicency	*using the Earth's limited resources in a sustainable manner while minimizing impacts on the environment. It allows us to create more with less and to **deliver greater value** with **less input***

Driver and policy perspective
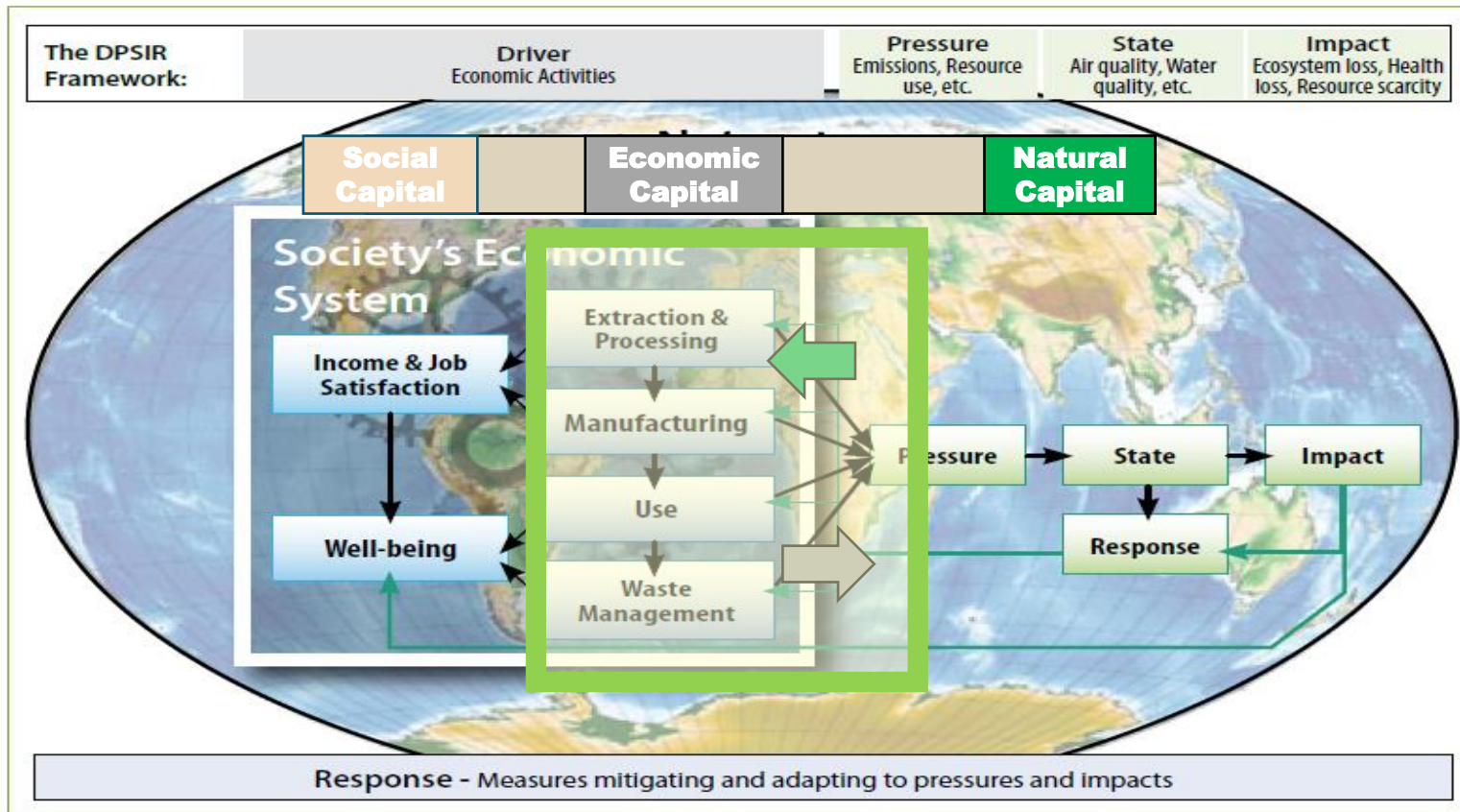
Driver and policy perspective

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

- This facilitates insight into the drivers of the environmental pressures and the indirect effects (footprints) of various economic activities
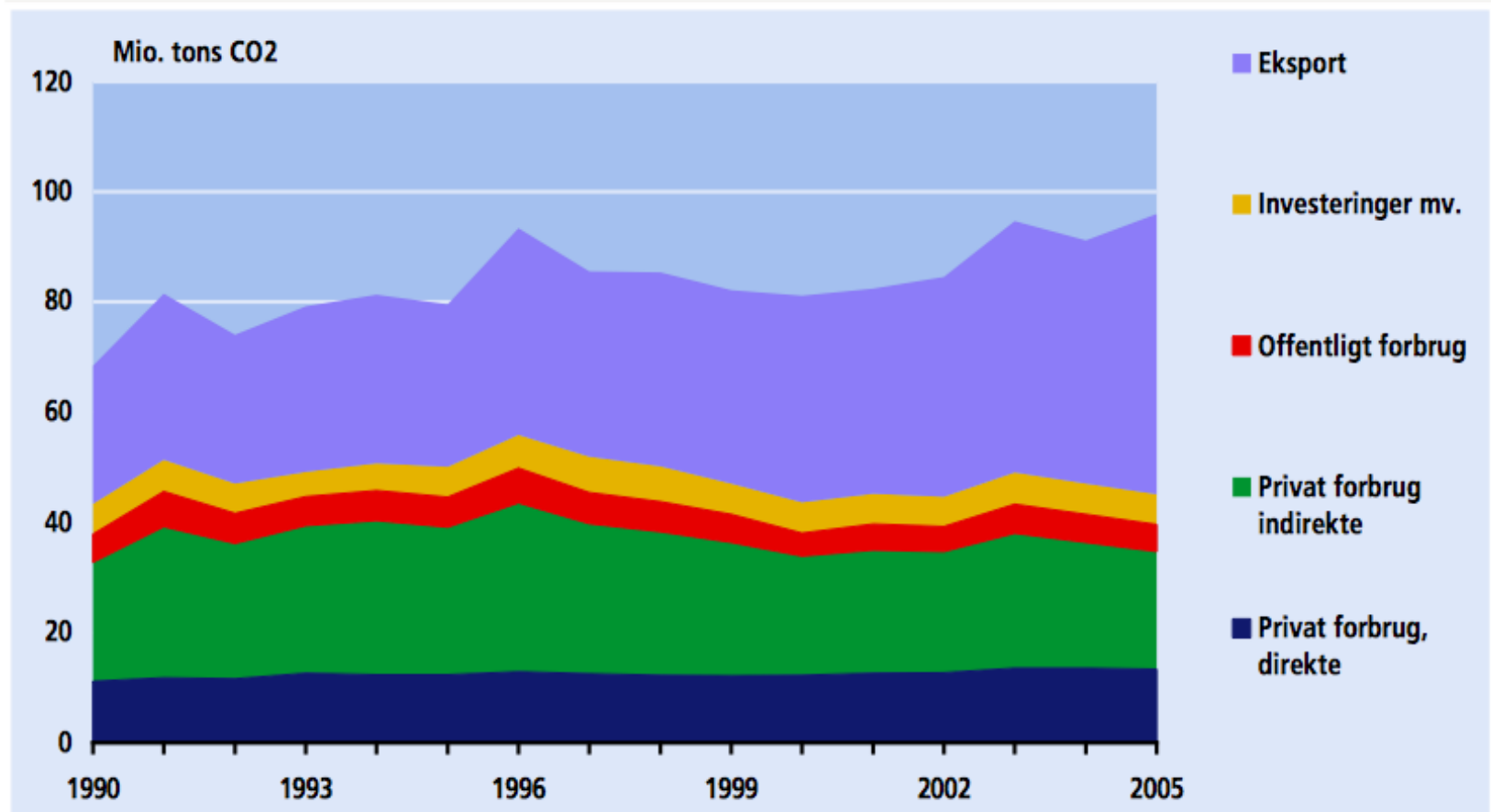

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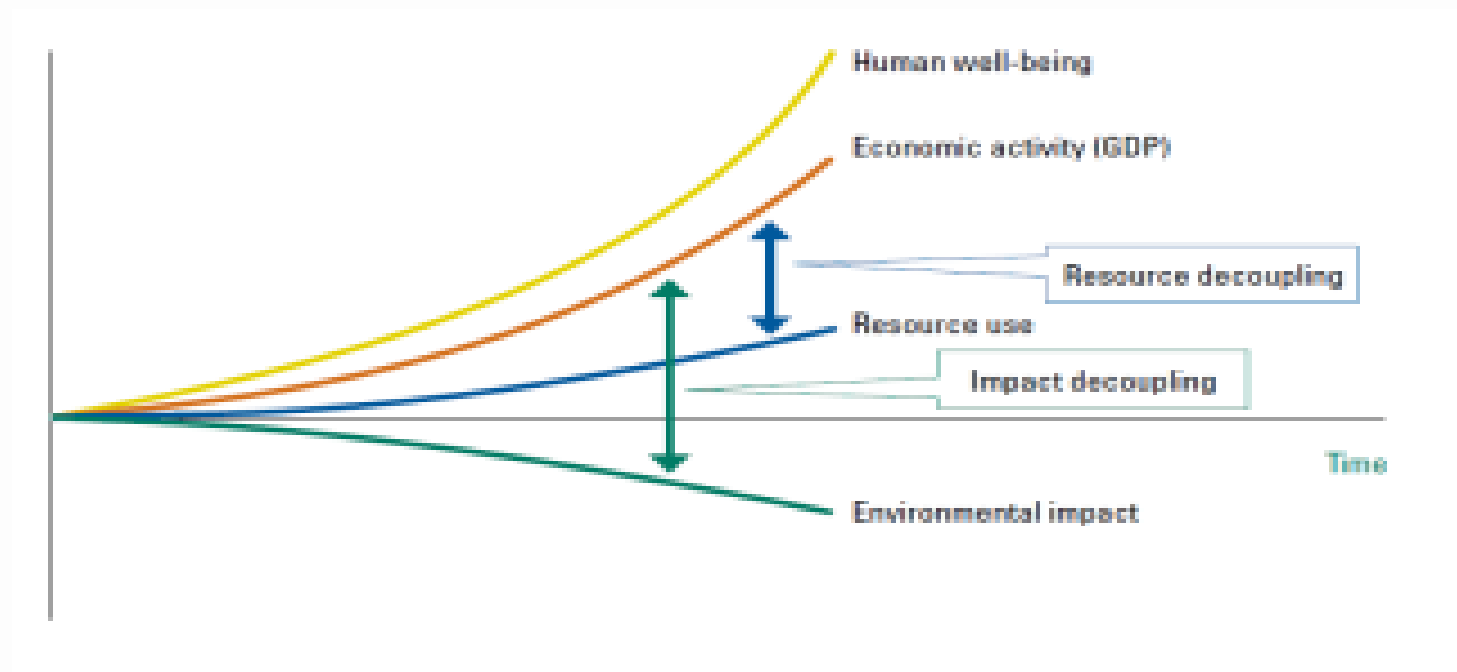
Example: What are the air emissions throughout the economy resulting from private consumption, exports, etc.?
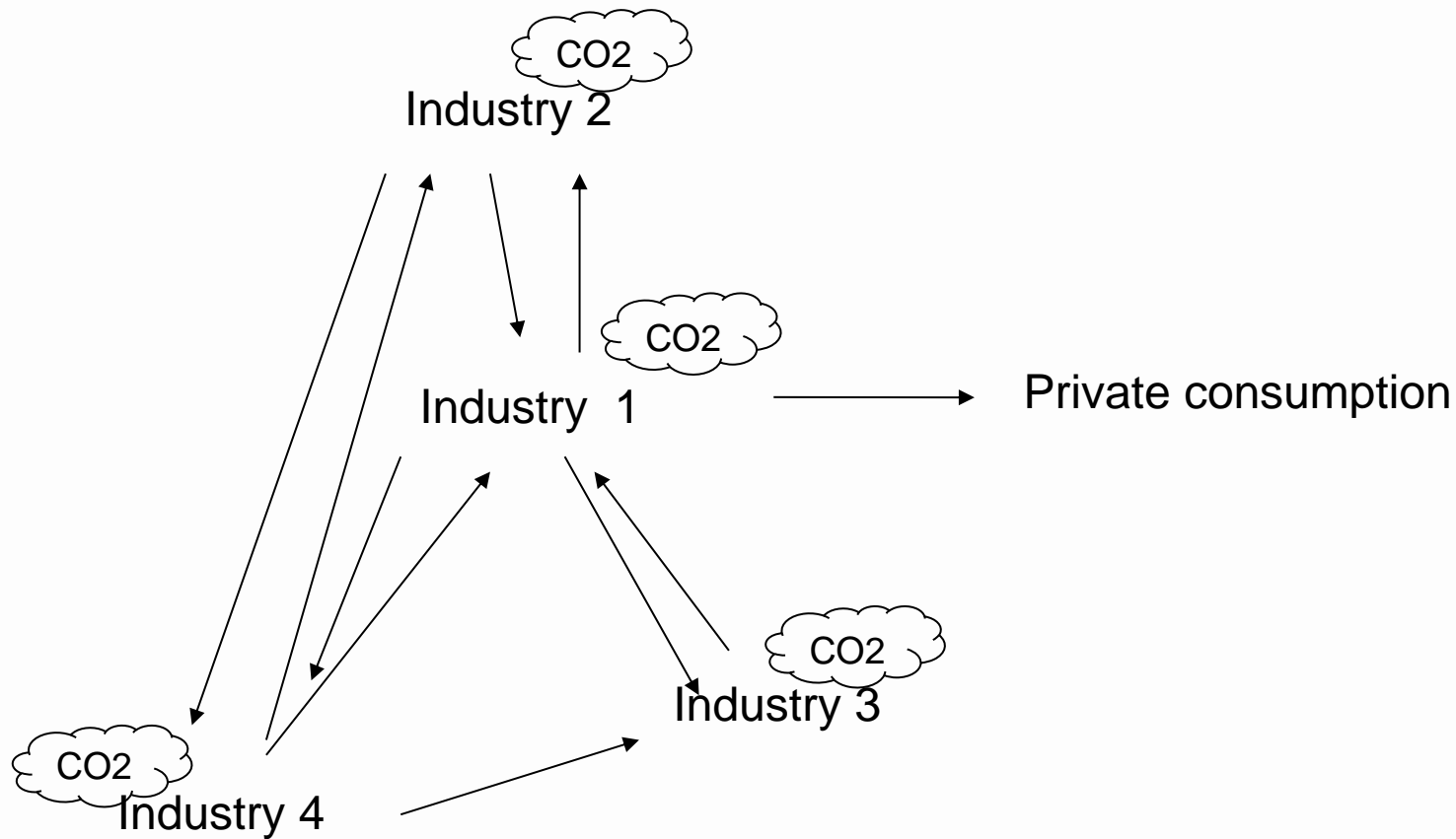
Using the environmental-extended input-output modelling gives the answer:

DANISH CO2 EMISSION BY CAUSING ECONOMIC ACTIVITIES

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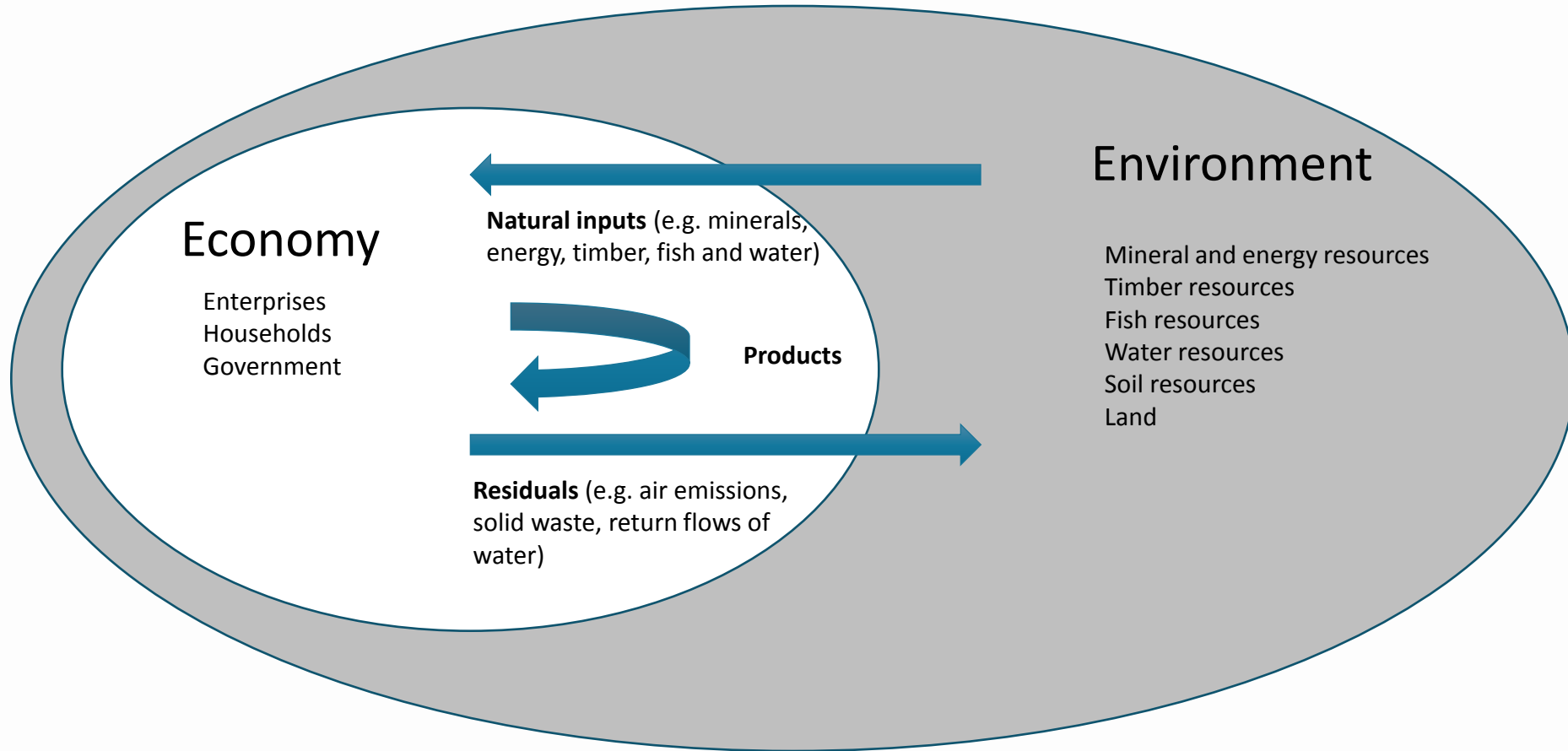# Conceptual framework

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Conceptual framework

1. Physical supply and use table with environmental extension in the System of Environmental Economic Accounting (SEEA)

2. Environmental-extended input-output tables (EE-IOT)

    - Single region input-out tables with environmental extension

    - Multi-regional input-output tables with environmental extension

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The System of Environmental Economic Accounting (SEEA)

- An internationally agreed statistical framework to measure the environment and its interactions with economy

- The **SEEA Central Framework** was adopted as an international statistical standard by the UN Statistical Commission in 2012

- The **SEEA Experimental Ecosystem Accounts** complement the Central Framework and represent international efforts toward coherent ecosystem accounting

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Physical Flows in the SEEA

Economy

Enterprises
Households
Government

Natural inputs (e.g. minerals, energy, timber, fish and water)

Products

Residuals (e.g. air emissions, solid waste, return flows of water)

Environment

Mineral and energy resources
Timber resources
Fish resources
Water resources
Soil resources
Land

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Physical supply and use table with environmental extension

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environment	Total supply of natural inputs
Products	Output			Imports		Total supply of products
Residuals	Residuals generated by industry	Residuals generated by final household consumption	Residuals from scrapping and demolition of produced assets			Total supply of residuals
Use table						
Natural inputs	Extraction of natural inputs					Total use of natural inputs
Products	Intermediate consumption	Household final consumption	Gross capital formation	Exports		Total use of products
Residuals	Collection and treatment of waste and other residuals		Accumulation of waste in controlled landfill sites		Residual flows direct to environment	Total use of residuals

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Column: Environment

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environment	Total supply of natural inputs
Products	Output			Imports		Total supply of products
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Record
- Flows from the environment (natural input flows)
- Flows to the environment (residual flows)

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Columns: Industries and households

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environ-ment	Total supply of natural inputs
Products	Output			Imports		Total supply of products
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Record

- Use of natural inputs, the production and intermediate consumption of products,

- Generation of residuals by all enterprise and households in the economy

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Column: Accumulation

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environ-ment	Total supply of natural inputs
Products	Output			Imports		Total supply of products
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Residuals	Collec-tion and treatment of waste and other residuals		Accumula-tion of waste in controlled landfill sites		Residual flows direct to environ-ment	Total use of residuals

Record:
- reductions in the physical stock of produced assets through scrapping and demolition
- Emissions from controlled landfill sites
- Gross capital formation
- Accumulation of materials in controlled landfill sites

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Column: Rest of the word

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environment	Total supply of natural inputs
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Record:

- Imports and exports of products and flows of residuals
- Exclude transboundary flows (e.g. polluted water flowing into other country) – they are considered flows within the environment.

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Environmental extended input output tables (EE-IOT)

- Integrated datasets that combine information from standard monetary input-output table (IOT) and information on environmental flows

- Compilation of the EE-IOT consists of two parts
  i.   Standard input output table in monetary terms
  ii. Environmental data by industries taken from the physical supply and use table.
  iii. Import/export trade matrices (for MRIO)

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A single region EE-IOT

	Industries	Sub-total	Final demand					Total demand (basic prices)
			Final consumption		Gross capital formation		Exports, free on board price	
Industries	Industry by industry transactions in basic prices		By house-holds, non-profit institutions serving households (NPISH), Government		Gross fixed capital formation and changes in inventories		Intra- and extra EU	
Subtotal (1)	Total intermediate consumption by industry		Total final demand by type					Total demand
Tax less subsidies (2)	Net tax on production							
Total (1)+(2)	Total intermediate consumption in purchasers' prices							
Compensation of employees Other net taxes on production Consumption of fixed capital Operating surplus, net	Components of value added by industry							
Subtotal (3)	Value added							
Total (1)(2)(3)	Output by industry at basic prices							
Imports	Imports (cost, insurance and feight price)							
Total supply	Supply in basic prices							

Natural input (e.g. natural resources: land, fossil fuels, minerals, etc.)	Resource use per type and industry		Resource use per consumption activity					Total
Residual (e.g. emission) SEEA	Emission per type and industry		Emission, per consumption activity					Total

A single region EE-IOT

- standard IOT in monetary terms

Data in monetary terms

		Industries			Final demand			Total output
		1	...	j	Final consumption	Gross capital formation	Exports	
Industries	1							
	...	Z			C	f	e	$q+m$
	j							
Value added		v						
Total inputs		q			c_{tot}	f_{tot}	e_{tot}	

Data in physical (non-monetary) terms

Natural inputs / residuals		r				r_{tot}

- Environmental information from PSUTs

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A single region input-output table with environmental data

- From the IOT and the environmental intensity obtained from the PSUTs, information on the environmental flow corresponding to a certain final use can be estimated

Example: Water consumption by industries by final demand that caused them – Denmark 2015

Water consumption by industries 2005.						
	Total	Private consumptio	Government consumptio	Investment, buildings	Investment others	Export
Agriculture	160.368	33.345	1.863	231	-137	122.165
Horticulture, orchards etc.	7.926	3.217	240	46	11	4.272
Agricultural services; landsc	912	150	284	115	3	345
Forestry	74	19	8	3	1	26
Fishing	38.776	2.132	312	43	47	36.227
Extr. of crude petroleum, r	2	0	0	0	0	2
Extr. of gravel, clay, stone a	3.254	590	313	842	33	1.373
Production etc. of meat an	36.292	10.012	609	78	124	25.153
Processing etc. of fish and f	8.071	1.582	55	7	13	6.328
Processing etc. of fruit and	4.355	356	55	8	9	3.939
Mfr. of vegetable and anim	1.169	516	36	4	5	601

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A multi-regional input-output table (2 countries) with environmental data

		Country A	Country B	Country A		Country B		Output
		Industries	Industries	Final demand		Final demand		
				Final consumption	Gross capital formation	Final consumption	Gross capital formation	
Country A	Industries	Z_{AA}	Z_{AB}	c_{AA}	f_{AA}	c_{AB}	f_{AB}	q_A
Country B	Industries	Z_{BA}	Z_{BB}	c_{BA}	f_{BA}	c_{BB}	f_{BB}	q_B
	Value added	v_A	V_B					
	Total input	q_A	q_B					

	Natural inputs/residuals	r_A	r_B					

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Detailed multi-regional EE-IOT

- Global SUT/IOT linked via trade
  - Country SUT/IOT (red)
  - Import/export trade matrices (green)
  - Environmental physical flows such as emissions, energy, materials, land, water (grey)

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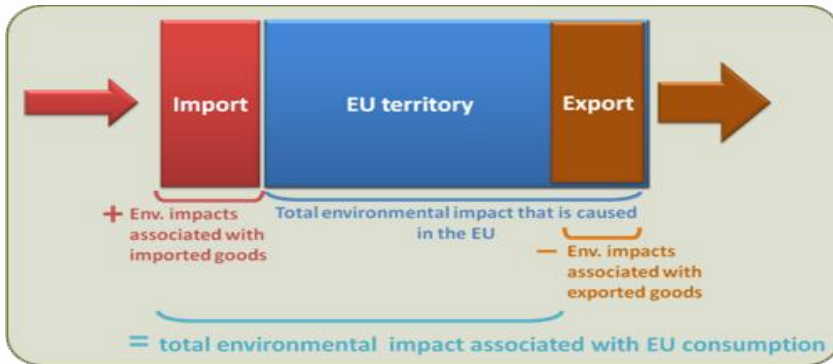
	Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products	$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
	$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
	$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$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

Suggested data organisation

1. Measure environmental state & relevant thresholds

2. Measure responses

3. Get detailed stock-flow data of the economic system and its environmental flow in an EE IO format following SEEA – which includes

4. Gives one related dataset allowing for calculating pressures and impacts, from a consumption and territorial perspective

Applications

Extended analysis

- Multiplier analysis

- Attribution of environmental pressures to final demand
  - Footprint calculations
  - Production verse consumption perspective
  - Global shifts in environmental pressures

- Resource use and environmental efficiency indicators

- Decoupling analysis

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Example: CO2 embodied in Danish exports and imports

	CO2 balance for Danish foreign trade
	1000 tonnes CO_2
Emissions embodied in exports	20,368
Emissions embodied in imports	26,795
Surplus on CO_2 balance	-6,427

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Diagram 3: CO_2 emissions and embodied CO_2 in Germany 2007

mn tonnes

1,487

imports
528

embodied CO_2-emissions

CO_2-emis-sions on national territory[1] 959

domestic production
755

private households
204

supply side

1,487

exports
600

domestic consumption
684

204

demand side

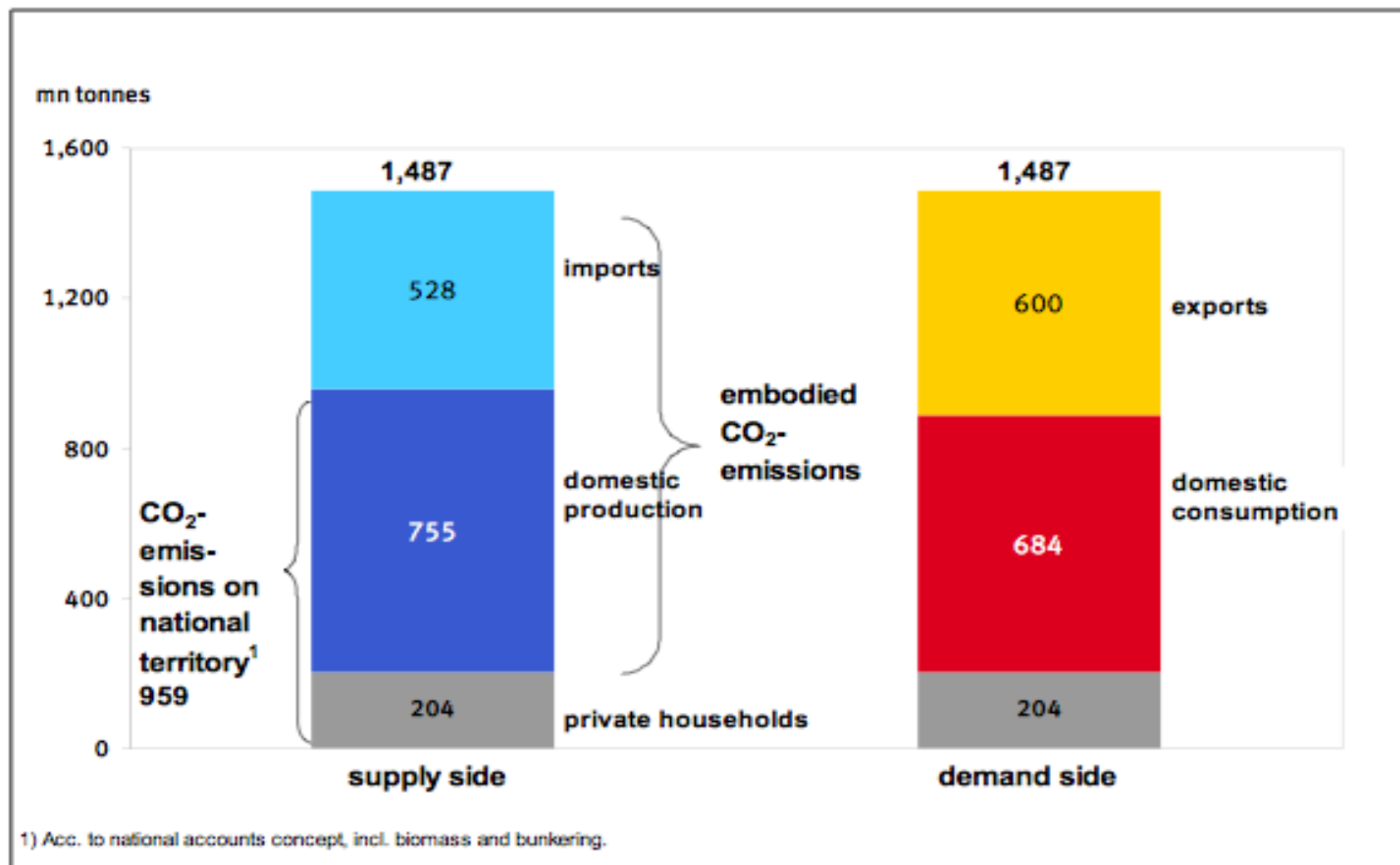1) Acc. to national accounts concept, incl. biomass and bunkering.

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Diagram 8: CO$_2$ emissions of exports by type of goods 2007 (percentage)

Legend:
- Products of agriculture, food
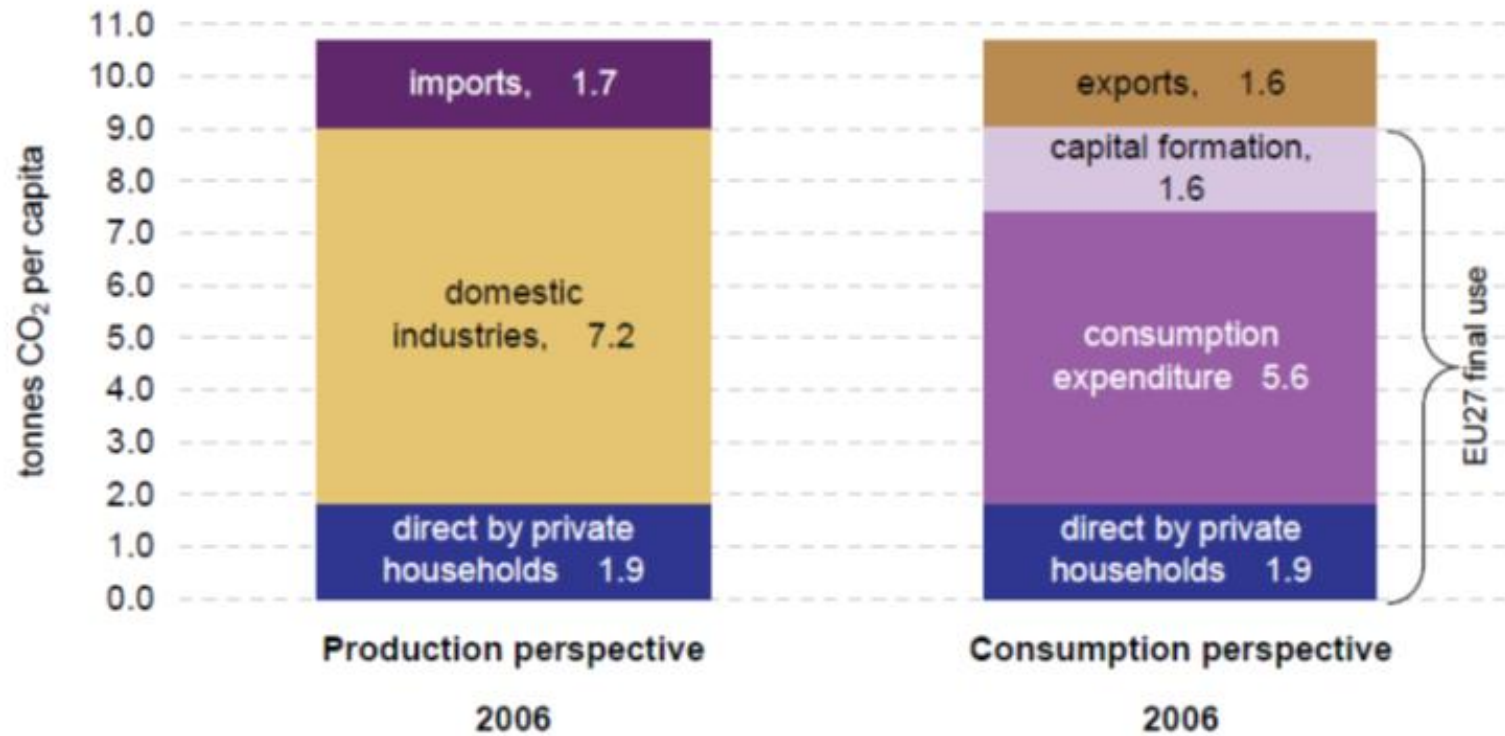- Pulp, paper
- Chemicals, plastics
- Iron, steel, non-fer.prod.
- Machinery
- Motor vehicles
- Other goods
- Energy carrier
- Transport services
- Other services

Values shown on chart: 3.1, 3.3, 16.5, 17.3, 8.5, 13.5, 21.8, 8.2, 4.0, 3.9

Center: total 600 mn tonnes

1) Excl. re-exports.

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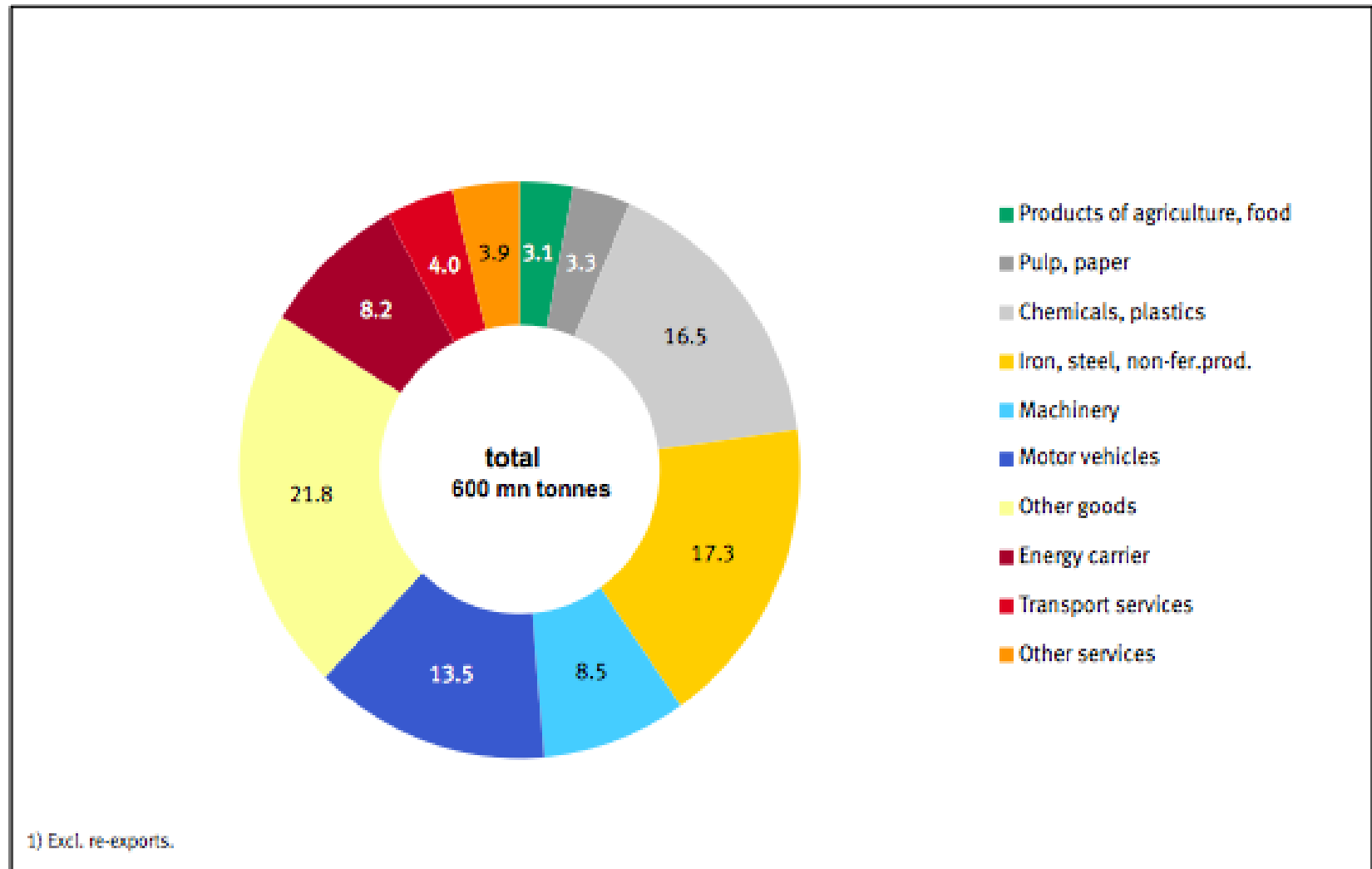
Diagram 10: CO$_2$ emissions of private households and embodied CO$_2$ of consumer goods 2007 (percentage)

- Products — 10.7%
- Food — 7.8%
- Gasoline (direct consumption) — 16.0%
- Lodging (direct fuel conumption) — 17.3%
- Transport — 10.6%
- Lodging (electricity etc) — 20.1%
- Services — 17.5%

direct emissions

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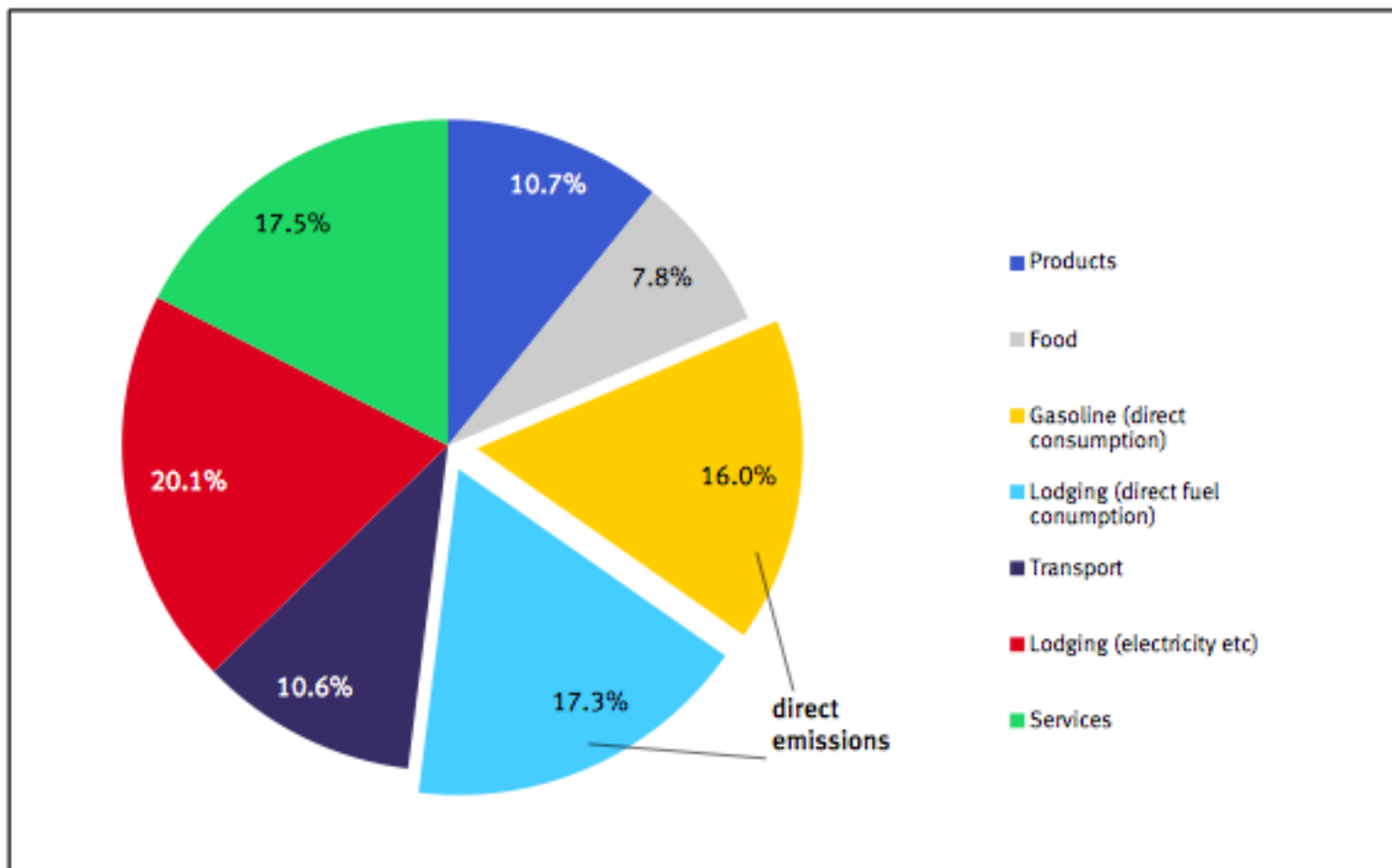
Example : Carbon emissions in Europe

Example: footprint analysis

Carbon embodied in trade

Material footprint per capita

HDI versus water footprint

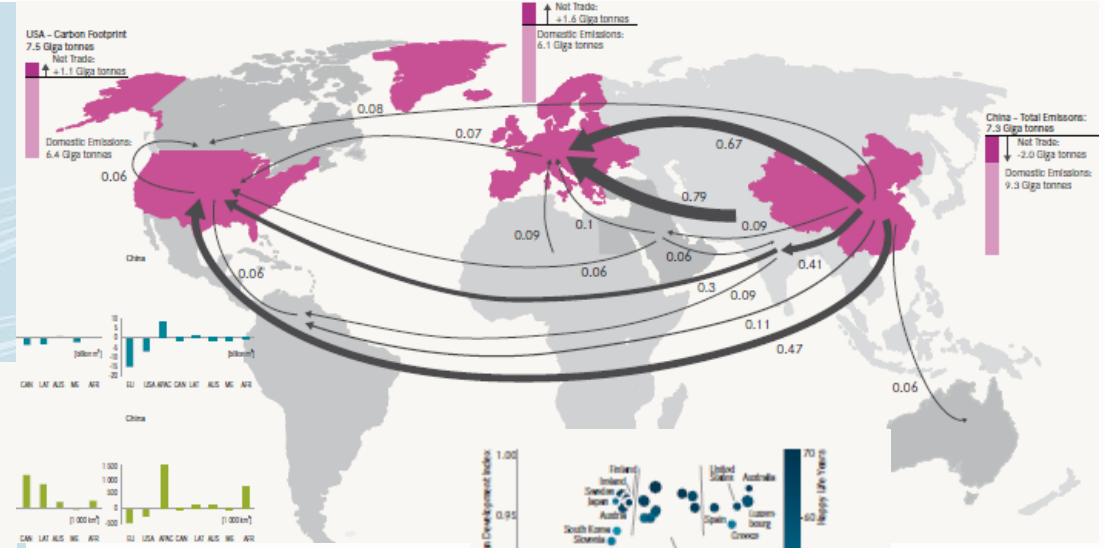The Global Resource Footprint of Nations

Arnold Tukker, Tatyana Bulavskaya, Stefan Giljum, Arjan de Koning, Stephan Lutter, Moana Simas, Konstantin Stadler, Richard Wood
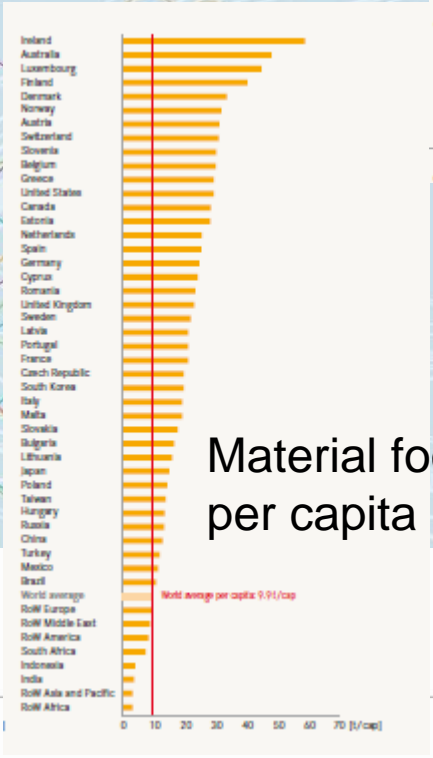
Carbon, water, land and materials embodied in trade and final consumption

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Proposed table of content

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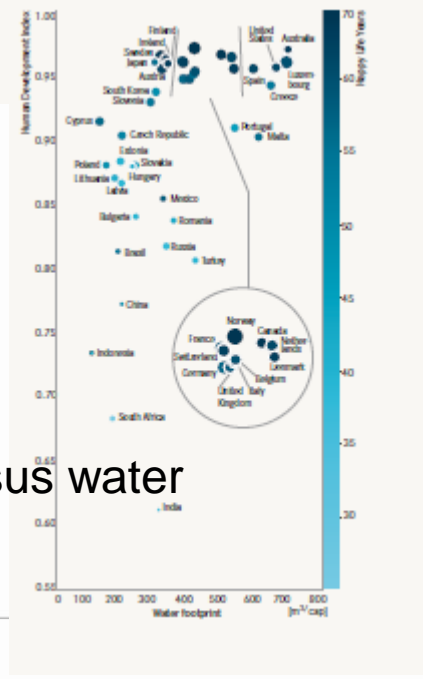
Proposed table of content

1. Drivers and policy perspective

   ➢ The drivers for the environmentally extended IO and SUT tables of the national environmental-economic account (EEA)

   ➢ Global multi-regional environmental-extended IO and SUT, including the need for a global value chain approach

2. Conceptual framework

   ➢ The framework of the national EEA

   ➢ the framework of the GVC industry specific EEA

   ➢ the framework of multi-regional environmental-extended IO and SUT

3. The applications

   ➢ Describing the types of extended analyses offered by the national and global environmental-economic accounting framework by including the environmentally related extensions.

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Discussion questions

1. Currently the scope of this chapter will focus on the conceptual framework. Should the following topic be covered in the chapter?

   - Institutional arrangement

   - Data source

   - Compilation issue

   - Policy application s

   - Others?

2. An unavoidable consequence of the production of multi-regional environmental-extended IO table is that it will not be consistent to the single regional environmental-extended IO table produced by the national statistical offices due to the following issues

   - Single regional environmental-extended IO table only use data from that country

   - Balancing – in multi-regional environmental-extended IO table needs to be struck on a global scale, not on national scale

   - Conflicting data sources

   - Existence of trade asymmetrics

   What is the recommended approach in dealing with these issues?

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THANK YOU

seea@un.org

http://unstats.un.org/unsd/envaccounting