Sensitivity of carbon footprint calculations:

Bridging the gap between academia and statistics

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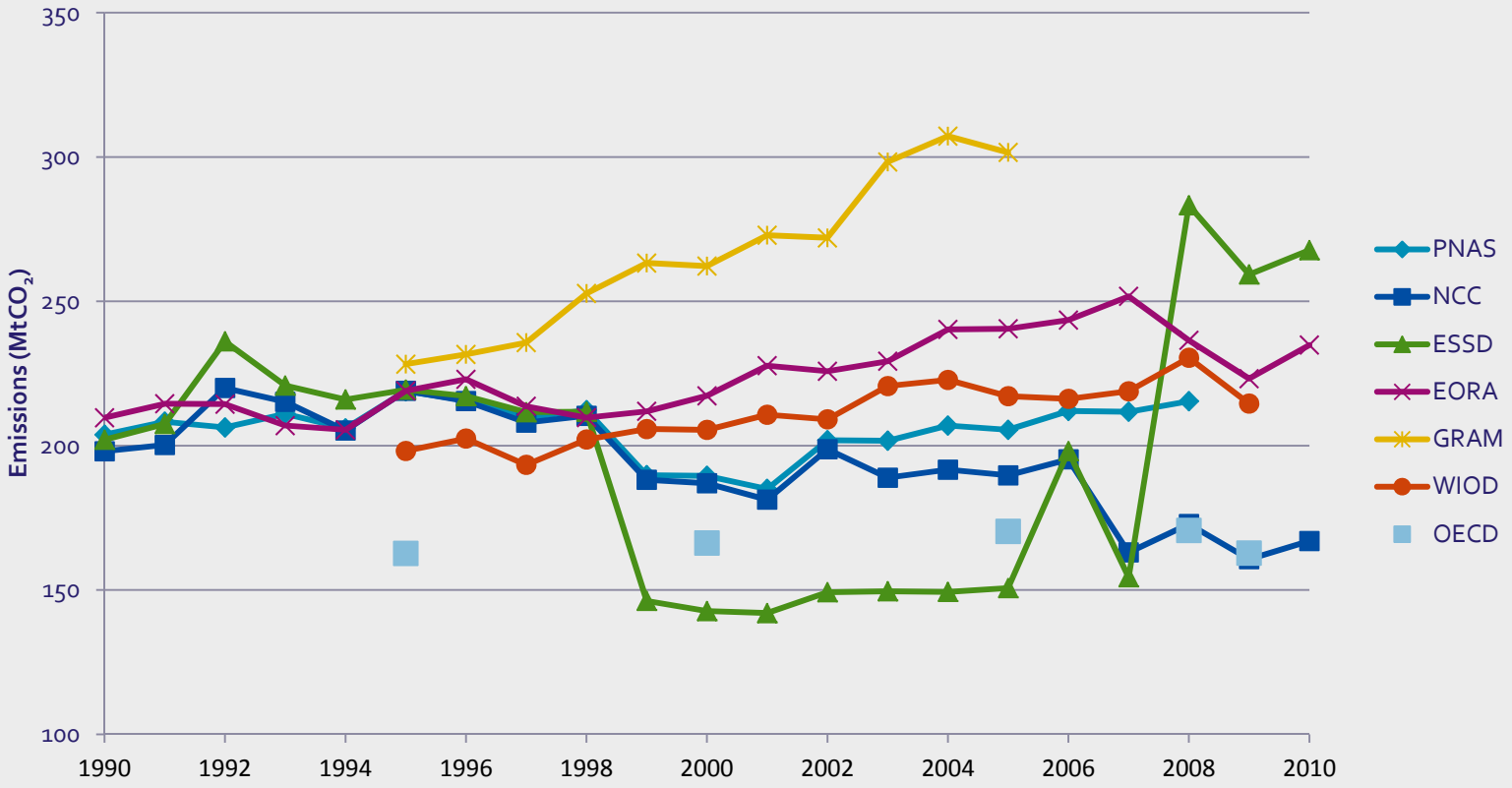
Statistics Netherlands

Carbon footprint estimates-Netherlands



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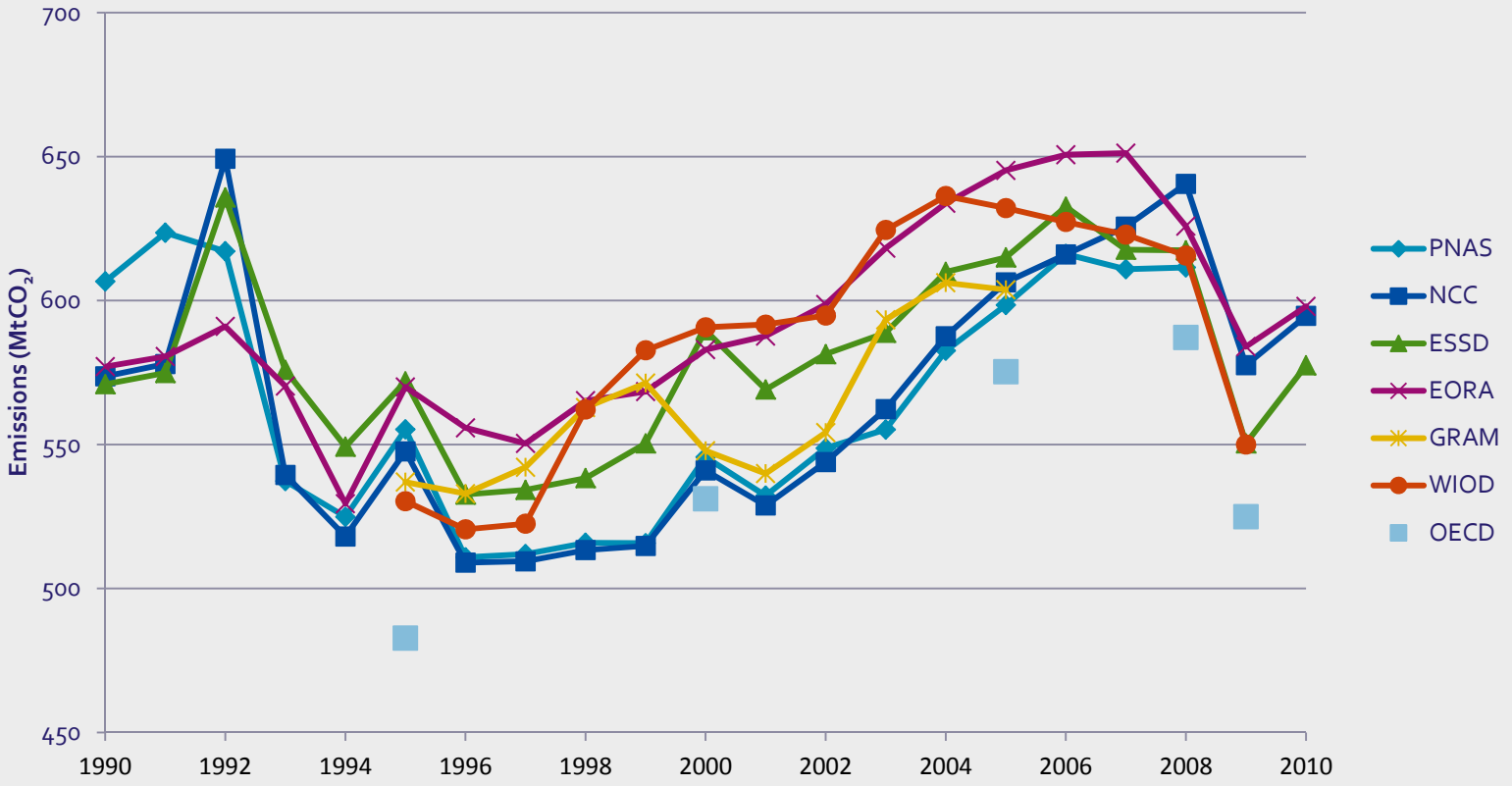
Annual growth rates – Netherlands

Carbon footprint estimates-Italy



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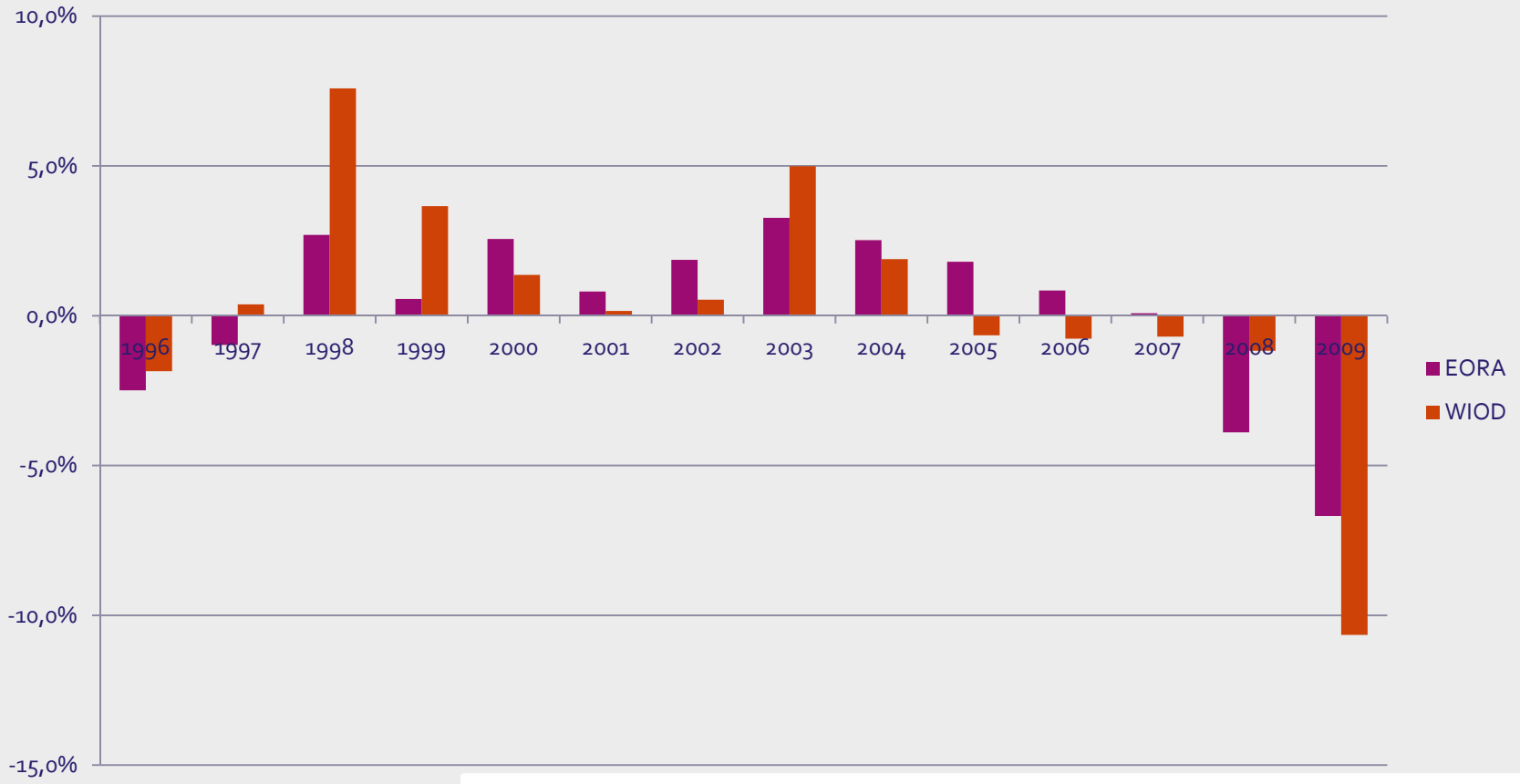
Annual growth rates – Italy



Problem: Sensitivity of footprints

- Solution: Reconciling academic and statistical work on footprints
- Joint work of Rutger Hoekstra, Daan Zult, Bram Edens, Oscar Lemmers, Harry Wilting (PBL), Ronghao Wu (intern) and Aksshat Goel (intern)

- Hoekstra, R. B. Edens, D. Zult, R. Wu and H. Wilting, 2013. *Environmental footprints: A methodological and empirical overview from the perspective of official statistics.* Paper for the FP7 funded project "European Framework for Measuring Progress" (e-Frame), March 11th 2012.
- Hoekstra, R., Zult, D., Edens, B., Lemmers, O., Wilting , H. and R. Wu, 2013. *Producing carbon footprints that are consistent to the Dutch National and environmental accounts.* Paper for the 21st International Input-Output Conference, July 9 – 12th 2013, Kitakyushu, Japan and the Workshop on the Wealth of Nations in a Globalising World, July 18-19th 2013, University of Groningen, The Netherlands

Introduction

1. Overviews
   - Academic work (including databases)
   - Statistical work
2. Empirical comparisons
3. Solution
   - Single country national accounts consistent (SNAC) carbon footprint
4. Threats

Overview: Academic work

- 1990's
  - Ecological Footprints
  - Attributing environmental pressure to consumption
- Later
  - Water, Material, Land and Carbon footprints
- Increasing use of input-output methodology
  - Environmental applications 1960's
  - Input-output model
  - Multiregional input-output (MRIO) database
- Literature: Three research questions
  - Footprints
  - Consumption vs production based
  - Carbon leakage

Overview: MRIO

		Country A	Country B	Country A	Country B	Output
		Industries	Industries	Domestic final demand	Domestic final demand	
Country A	Industries	Z_{AA}	Z_{AB}	c_{AA}	c_{AB}	q_A
Country B	Industries	Z_{BA}	Z_{BB}	c_{BA}	c_{BB}	q_B
	Value added	v_A	V_B			
	Total input	q_A	q_B			
	GHG emissions	r_A	r_B			

Overview: MRIO databases

	GTAP	EXIOPOL/ CREEA	WIOD	EORA	OECD-WTO	
					Previous	New
Institute	Purdue University	EXIOPOL: FP6 project lead by FEEM CREEA: FP7 project lead by TNO	FP7 project led by the University of Groningen	University of Sydney	OECD	OECD
Years	1997, 2001, 2004, 2007 (years are not comparable)	2000 (EXIOPOL) 2007 (CREEA)	1995-2009	1990-2009	1995, 2000	2005, 2008 and 2009
Prices of previous year	-	-	1995-2006	-	-	-
Countries/ Regions	66-129 (depends on year)	43	35	187	41	40
Industries	57	130	37	100-500	17	18
Environmental data	Greenhouse gases (CO_2, NO_2, CH_4) Energy use Land use (split agro-ecological zone)	Emissions (56) Materials (96) Land use (15) Water use (14)	Energy use / several energy carriers Water consumption Land use Emissions of greenhouse gases Air pollutants Resource use/extraction Generation and treatment of various types of waste	Greenhouse gases Air pollution Water use Ecological Footprint	CO_2	None

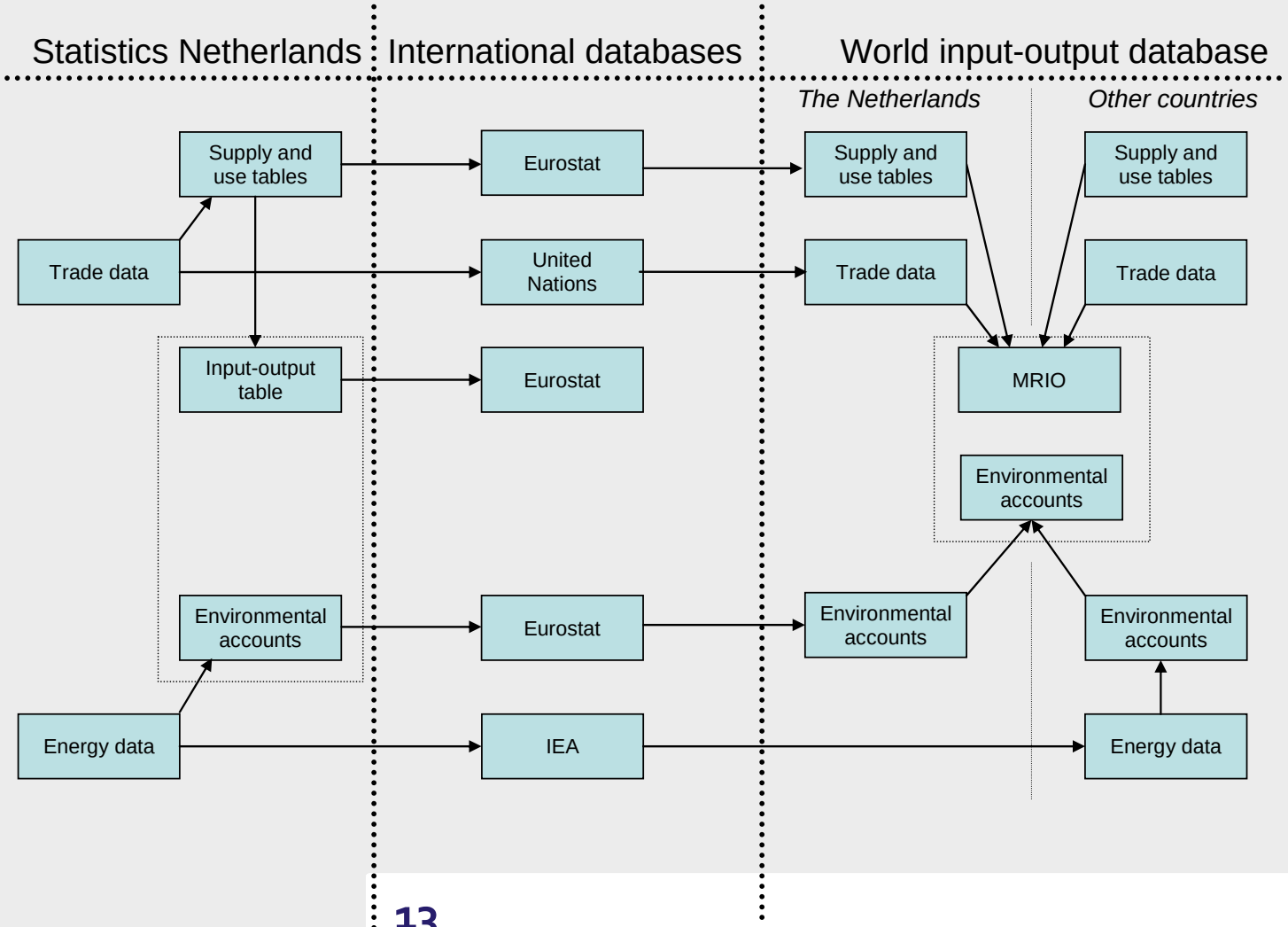
Aim of MRIO footprints

- Aim of MRIO
  - Information about global developments
  - No claim to be 100% correct at national level
- MRIOs are trying to converge
  - But do not look at link to statistics

Overview: Statistical work

NSI/Other	Institute	Country	Type	Time series or most recent year	Environmental issue
National Statistical Institutes	Australian Bureau of Statistics	Australia	SRIO	2007/2008	GHG
	Statistics Canada	Canada	MRIO	2002 and 2006	GHG
	Statistics Denmark	Denmark	Partial	2005	CO_2
	INSEE	France	Partial	2005	CO_2
	DESTATIS	Germany	Partial	2007	CO_2
	Statistics Netherlands	Netherlands	Partial	2009	GHG (4)
	Statistics Sweden	Sweden	SRIO	1993-2008	Energy; materials; air emissions
Other government agencies	PBL	Netherlands	Partial and MRIO	2001	GHG (3) and land
	DEFRA	United Kingdom	MRIO	1990-2009	CO_2 and GHG
International institutes	OECD	OECD countries	MRIO		
	Eurostat	EU27	SRIO	2000-2007	8 pressures

Empirical difference: MRIO construction



Empirical difference: WIOD vs. CBS data

WIOD aggregates (dollars, tens of billions, rounded)

	Industries	FD (domestic)	Exports	Output
Industries	500	590	430	1520
Imports	250	110	150	510
Value added	710	0	0	710
Taxes less subsidies	50	40	0	90
International trade margin	10	10	0	10
Total input	1520	740	580	2840

Statistics Netherlands aggregates (dollars, tens of billions, rounded)

	Industries	FD (domestic)	Exports	Output
Industries	570	620	340	1530
Imports	220	80	180	480
Value added	710	0	0	710
Taxes less subsidies	20	70	0	90
International trade margin	0	0	0	0
Total input	1530	760	520	2810

Differences

	Industries	FD (domestic)	Exports	Output
Industries	14%	5%	-22%	0%
Imports	-13%	-29%	26%	-5%
Value added	0%			0%
Taxes less subsidies	-53%	57%		-1%
International trade margin				
Total input	0%	2%	-10%	-1%

Empirical differences: Reasons

1. Differences between official statistics
   - Imports/exports
2. Differences between official statistics between countries
   - Trade asymmetries
3. Official statistics vs. international databases
   - Confidential data
   - Trade in goods data
   - Conceptual difference in margins
   - Aggregation level (SUT and Environmental accounts)
4. Assumption in the compilation of the WIOD database
   - Resolving asymmetries
   - Conversion of the SUT to IOT
   - International transport margins

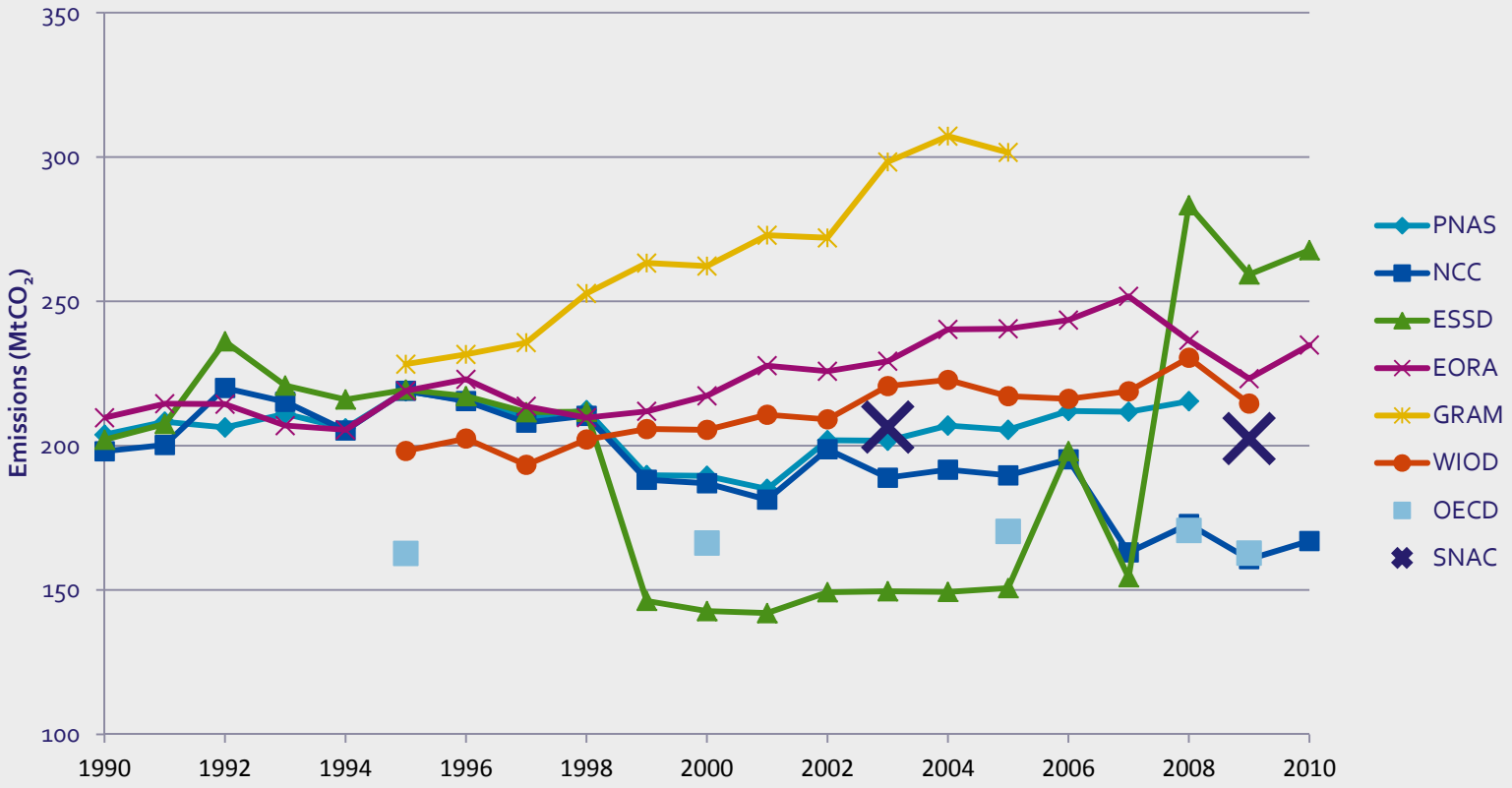
Solution: the SNAC-footprint

– Produce a footprint, based on MRIO, that is consistent to official statistics of the Netherlands
  - Single-country National Accounts consistent (SNAC)
  - "Adjust WIOD to be consistent to Dutch NA data"

Four main improvements

1. Trade data
   - Trade in goods: Bilateral trade data (re-exports and domestic trade) from micro data
   - Trade in services: Trade in services (confidential)
2. National Accounts
   - Conceptual differences margins/services
   - Expand from 35 industries to 135
   - Expand from 59 goods and services to 221
3. Environmental accounts
   - Expand from 35 to 71 industries (CO_2 only)
4. Balancing using the WIOD procedure but keeping the Dutch data fixed

SNAC footprint vs. other estimates



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SNAC-footprint vs. other estimates (2009)

	SNAC	WIOD		EORA		NCC		ESSD	
	MtCO2	MtCO2	%	MtCO2	%	MtCO2	%	MtCO2	%
Total footprint	202	210	4%	223	10%	161	-20%	259	28%
Domestic indirect	80	71	-11%						
Domestic direct	40	39	-3%						
Total domestic	120	109	-9%						
Total foreign	83	101	22%						

Results for top 10 countries/regions

	SNAC	WIOD	Difference
Row	20938	21624	-686
CHN	16002	21109	-5107
DEU	8084	8987	-903
RUS	6926	8220	-1294
USA	4714	6060	-1345
BEL	3318	4299	-982
GBR	3023	4278	-1254
IND	2508	3541	-1032
POL	1703	2423	-720

Sensitivity analysis –Aggregation and emissions data

	SNAC-footprint	Aggregation		CO_2 data		Original WIOD	
No. industries (IO calculations)	71	35		35		35	
CO_2 data	SNAC	SNAC		WIOD		WIOD	
Total Footprint	**198**	**205**	**3%**	**207**	**5%**	**210**	**6%**
Domestic indirect emissions	77	84	8%	86	11%	71	-8%
Domestic direct emissions	38	38	0%	38	0%	39	0%
Total Domestic	**116**	**122**	**5%**	**125**	**8%**	**109**	**-6%**
Total Foreign	**82**	**83**	**1%**	**83**	**1%**	**101**	**23%**

Threats

1. SNA conceptual revision
2. Product and industry classifications
3. Differences SNA and SEEA

Conclusions

1. Sensitivity of carbon footprints are large for some countries
   - Most for small open economies
2. MRIOs are produced for global questions, a SNAC-footprint is more relevant for national policy makers
3. MRIO producers could quite easily make a footprint for individual countries using "SNAC-philosophy"
4. Cooperation
   - Statistical offices should work together on footprints
   - MRIO developers should work together with Statistical offices
5. SNAC-approach can also be applied to other globalization indicators: e.g. trade in value added
6. Threats Statistical revisions

E-Frame final conference

- February 10-11th 2014
- Amsterdam
- Invitation only
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