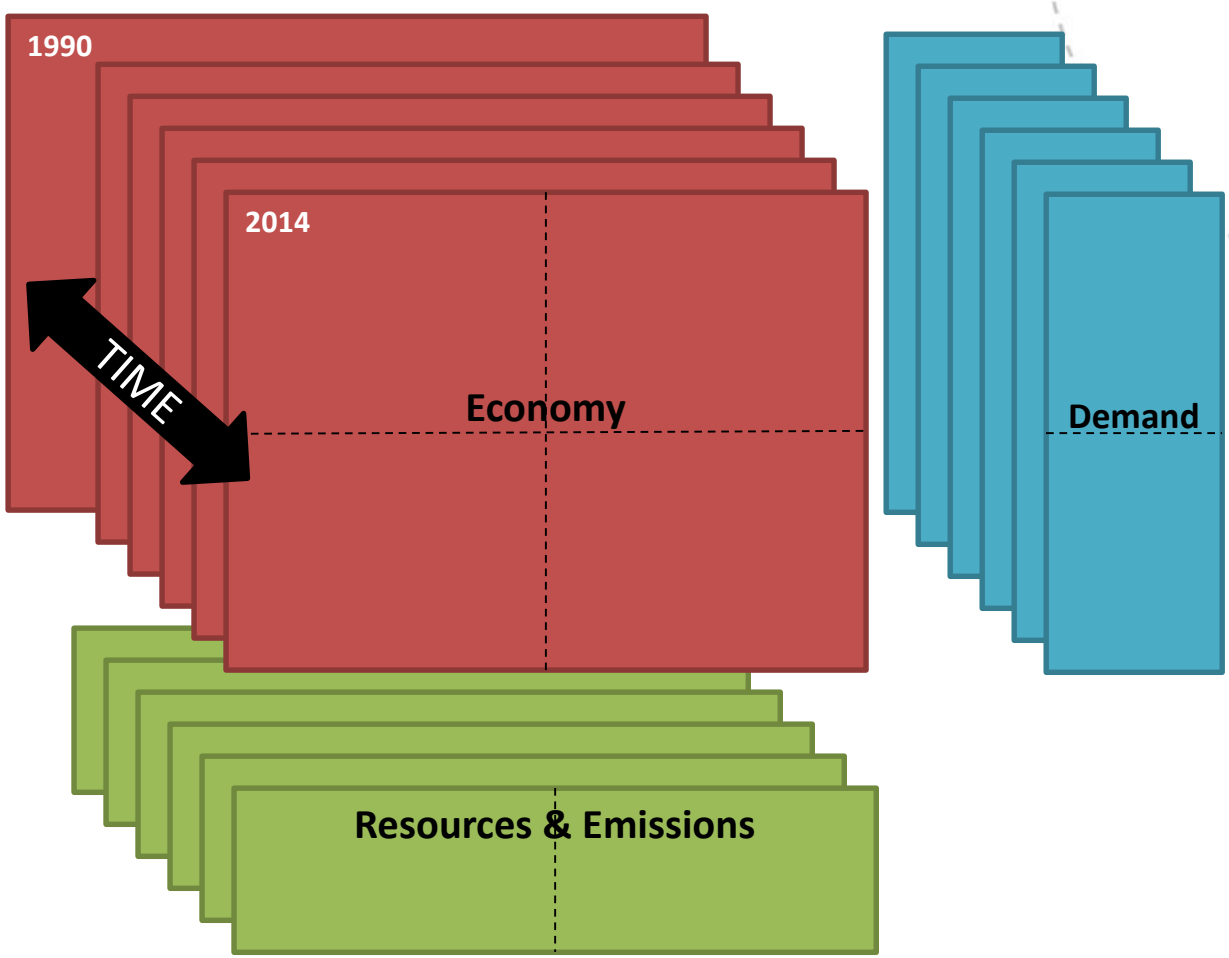
Modelling approaches in DESIRE

Resource Efficiency and Footprint indicators for decoupling

Prepared by Richard Wood (NTNU) for the WRF, 13 October 2015

Presented by Arnold Tukker (TNO, UL-CML)

Simple frameworks



Snapshots of history with multi-regional input-output analysis

System properties (1)

- Economic
  - Supply and Use system
  - Pricing layers – explicit identification of margin and taxes
- Environment
  - Material extraction
  - Energy & greenhouse emissions
    - Emission coefficients by product by use by region
  - Water regionalisation
  - Biodiversity/Metals/Waste

Forward modelling

Household/consumption modelling

System properties (2)

- Multi-regional framework
  - 43 countries + 5 «other» regions
- Backcasting to 1990
- Nowcasting to 2016
- Economic + Physical layering
  - Material balances -> waste & recycling estimation
  - «native units» multi-layer/mixed unit modelling
  - stocks

Input-output balances

- Economic balances – basic price, purchaser price, income and expenditure approaches.
- Physical balances - Input- and output flows for a generic activity. The output of ‘materials for treatment’ is the calculated balancing item from which waste accounts are derived.

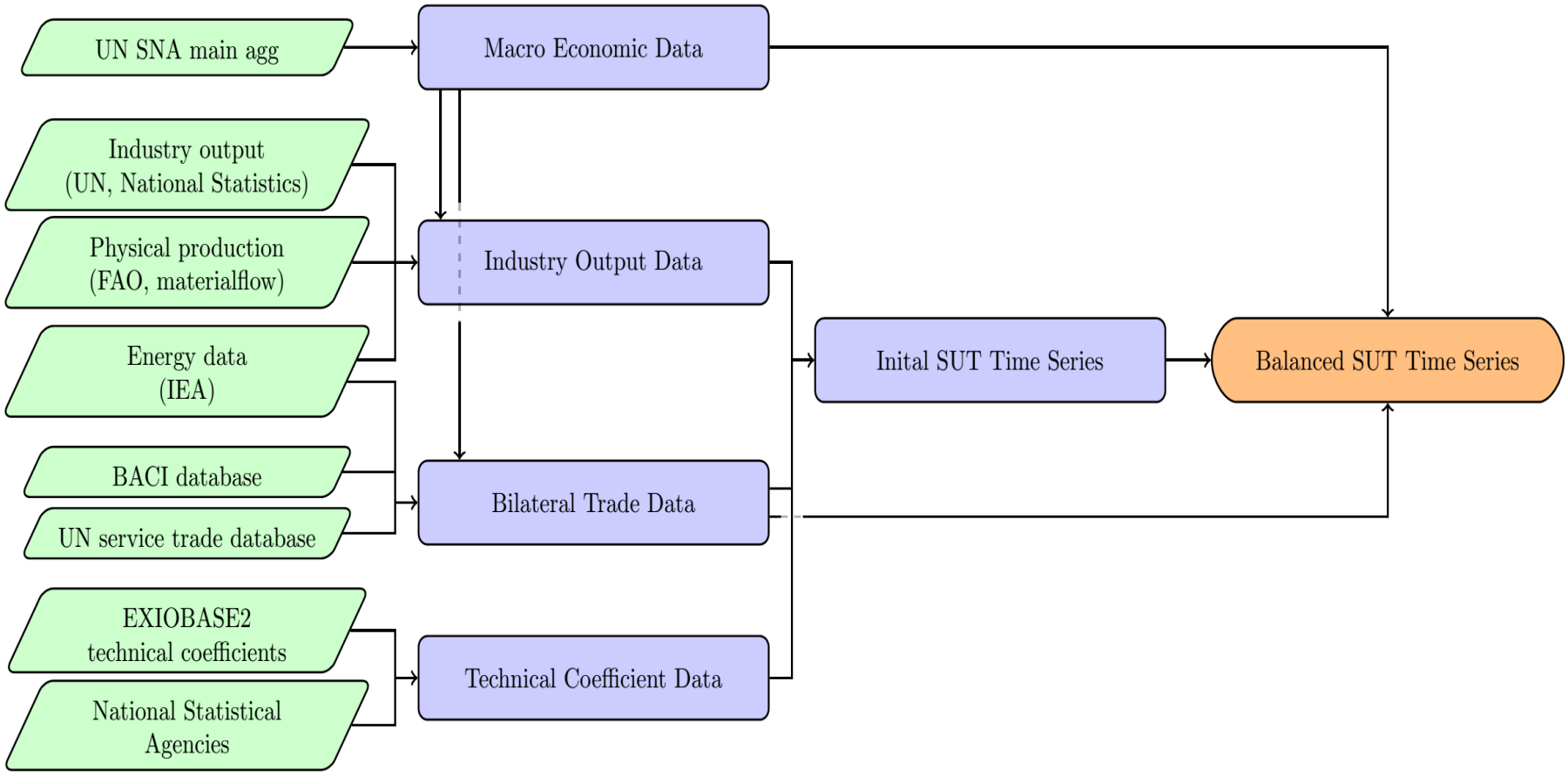
Building EXIOBASE 3 in short

- Start with trade
  - COMTRADE / BACI
  - Trade in SUT
  - Optimize to a ‘trade cubicle’ with harmonized trade and right transport and insurance margins
- Impose trade on national SUT/IOT
- Disaggregate using additional information
  - Structural business statistics
  - PRODCOM for products
  - IEA, FAOSTAT for products
- Create time series

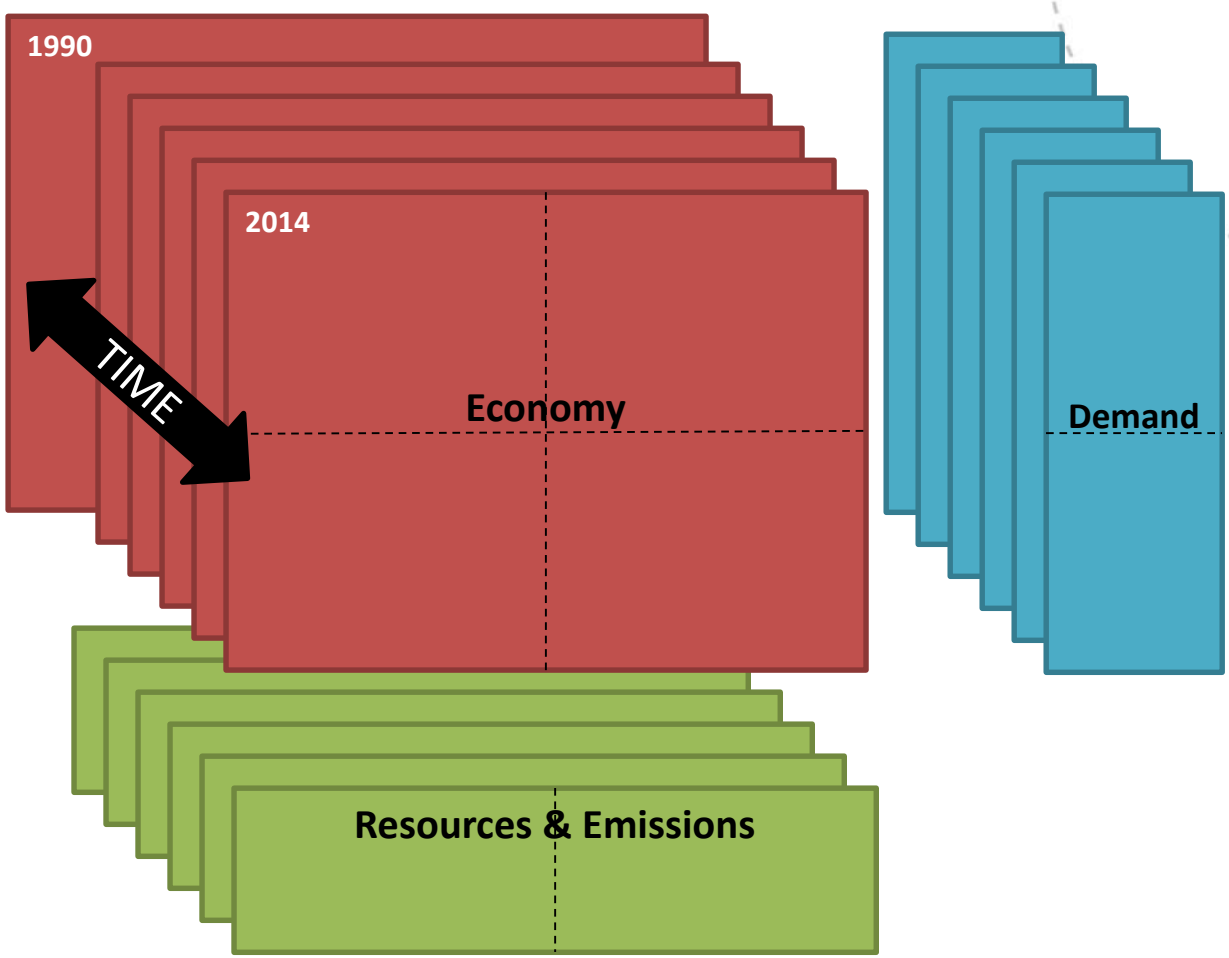
Building EXIOBASE 3 in short

- This leads to a global MR SUT/IOT
- Add extensions
  - Emissons: activity levels (IEA energy flows used by sector) * emission factors
  - Resources: IRP resource database
  - Land: FAOSTAT
  - Water: FAO and others
  - Labor: ILO

Compilation steps (blue) and main data sources (green) for the compilation of the monetary SUT time series.



Simple frameworks



Snapshots of history with multi-regional input-output analysis

Comparison of the characteristics of EXIOBASE 2 and EXIOBASE 3. *) Historic time series for up to 2012, the rest of the years has been now-casted.

	EXIOBASE 2	EXIOBASE 3
Baseyear(s)	2007	1995 – 2016 *)
Products	200	200
Industries	163	163
Countries	43 (27 EU member plus 16 major economies)	44 (28 EU member plus 16 major economies)
Rest of the world regions	5 (Europe, Asia, Africa, America, Middle East)	5 (Europe, Asia, Africa, America, Middle East)
Water accounts	172 (Water blue and green per source, including final demand)	172 (Water blue and green per source, including final demand)
Material accounts	48 (Used extractions) 48 (Unused extractions)	189 (Energy products, including final demand) 222 (Used extractions) 222 (Unused extractions)
Land accounts	15	13 (Including build up land for final demand)
Social accounts	6	14 (Employment per skill level and gender; vulnerable employment)
Emissions	26 (from combustion including final demand) 11 (non-combustion) 3 (HFC, PFC, SF6)	26 (from combustion including final demand) 11 (non-combustion) 3 (HFC, PFC, SF6)

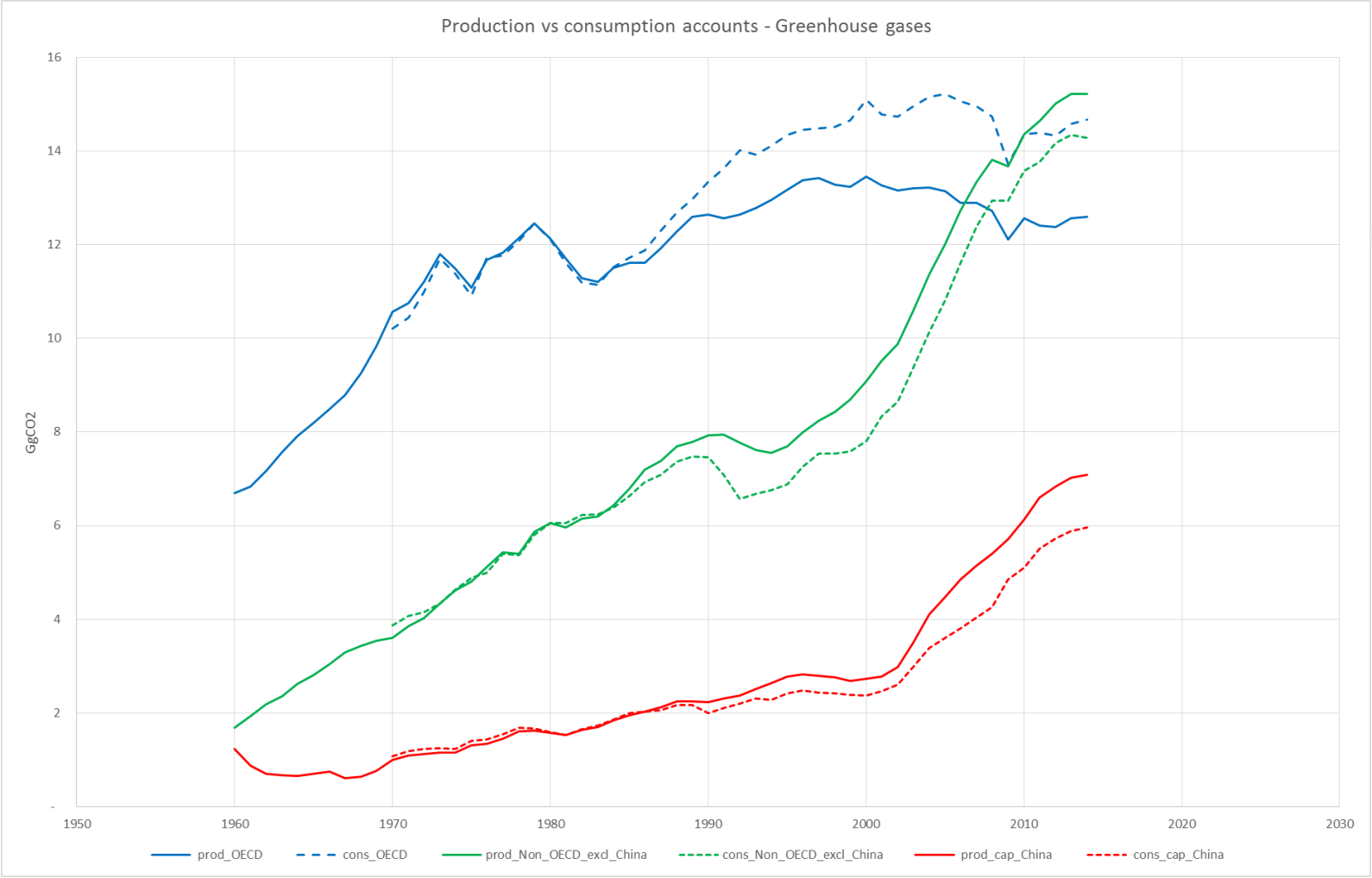
Topic	Indicator name	Definition/Unit
Energy	Energy dependency	import/total use (%)
	Primary energy intensity	ktoe/euro
	Energy use (TPES, GIEC) by fuel	tons of oil eq.
Materials	Material productivity	€ per kg DMC
		€ per kg RMC € per kg TMC
	Import dependence	Imports/DMC (%)
	DMI, DMC	tonnes
	RMI, RMC	tonnes
	TMR, TMC	tonnes
	PTB, RTB	tonnes
Water	Water productivity	€ per m^3
	Water abstraction	m^3
	Water consumption	m^3
	Water footprint	m^3
Land	Land productivity	€ per ha
	Artificial land / built-up area	hectares
	Land Footprint / Actual Land Demand	hectares
Carbon	CO_2 emission intensity	kg of CO_2 per €
	GHG emissions intensity	kg of CO_2 equivalent per €
	CO_2 emissions	tonnes of CO_2
	GHG emissions	tonnes of CO_2 equivalents
	Carbon Footprint	tonnes of CO_2 equivalents
Waste and emissions	Air emission intensity	Kg emission per €
	Waste intensity	Kg waste per €
	Recycling rates	%
	Total recycling amounts	tonnes
	Total waste generation	tonnes
	Emissions from landfills	tonnes
	Emissions of air pollutants	tonnes

Production or Consumption approach; Absolute or Productivity metric

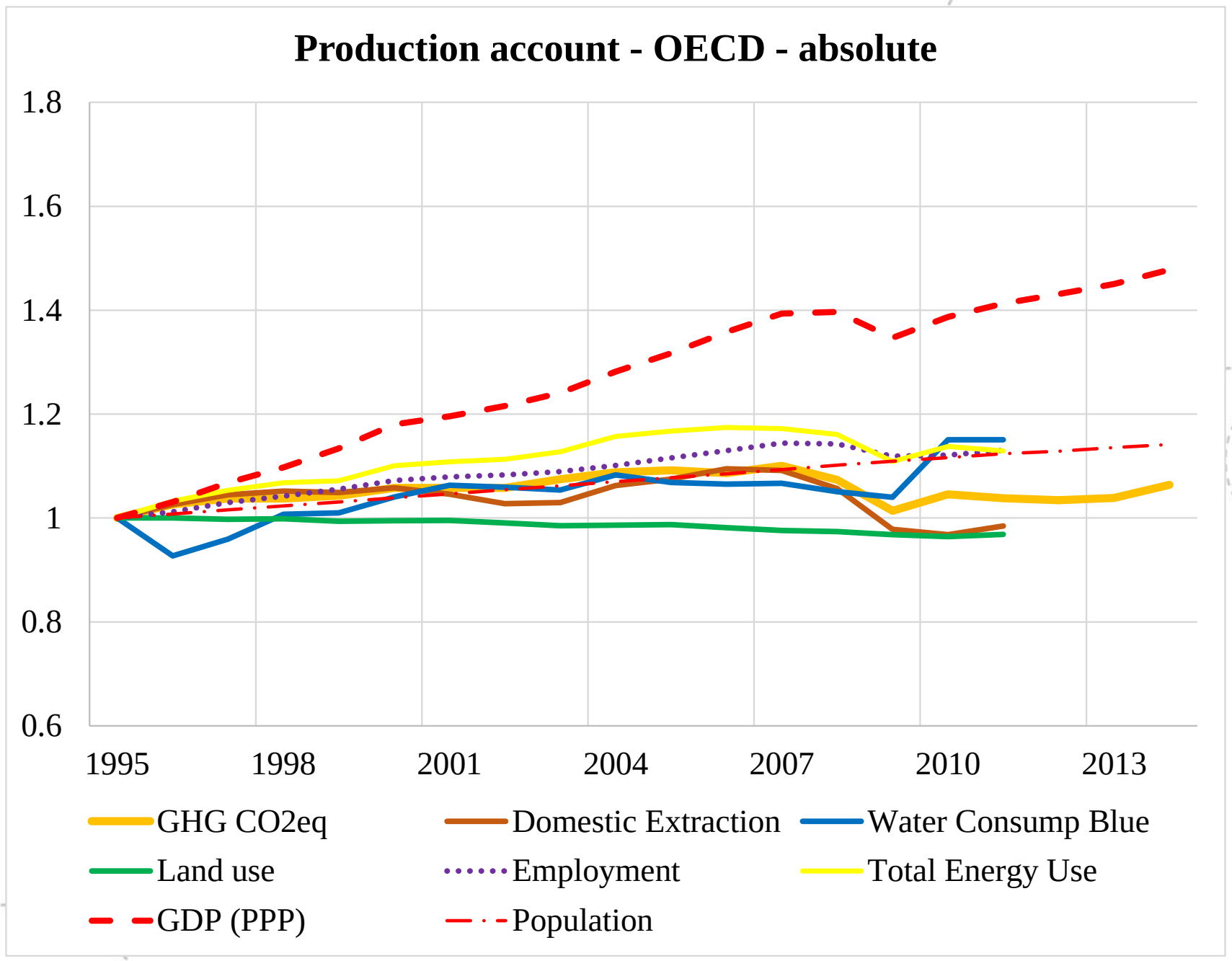
Alternate approach/metric

Requires physical dimensions of product flows

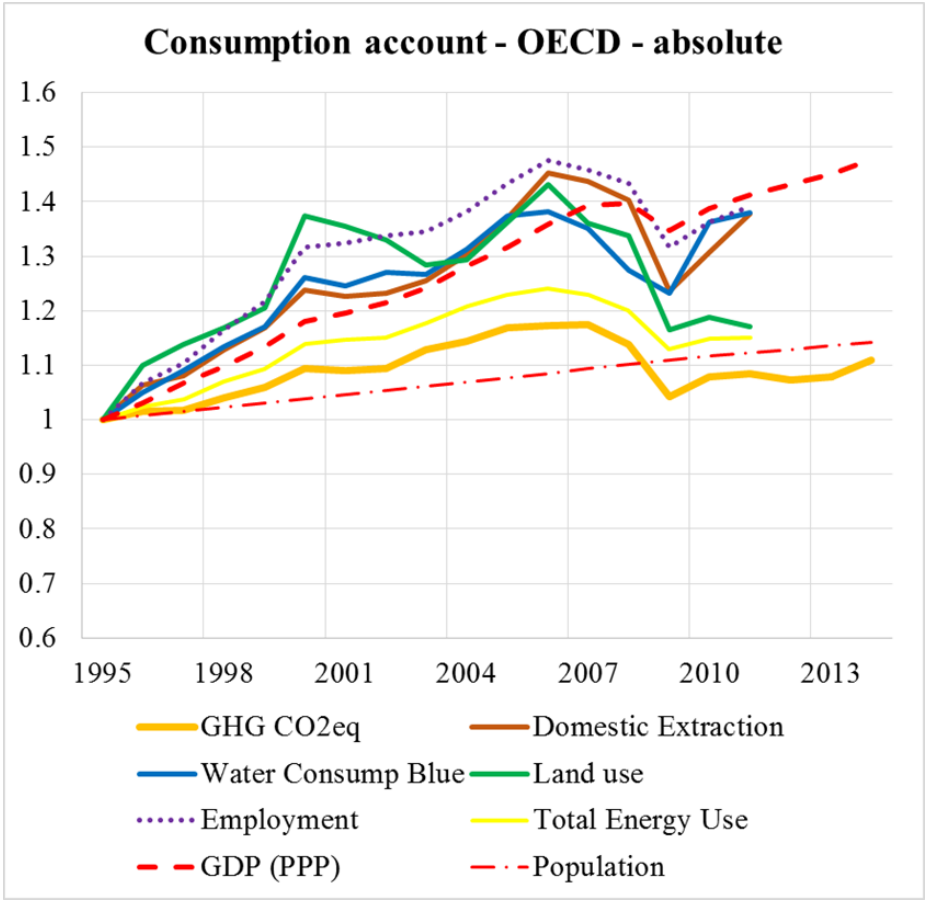
Decoupling – production vs consumption?

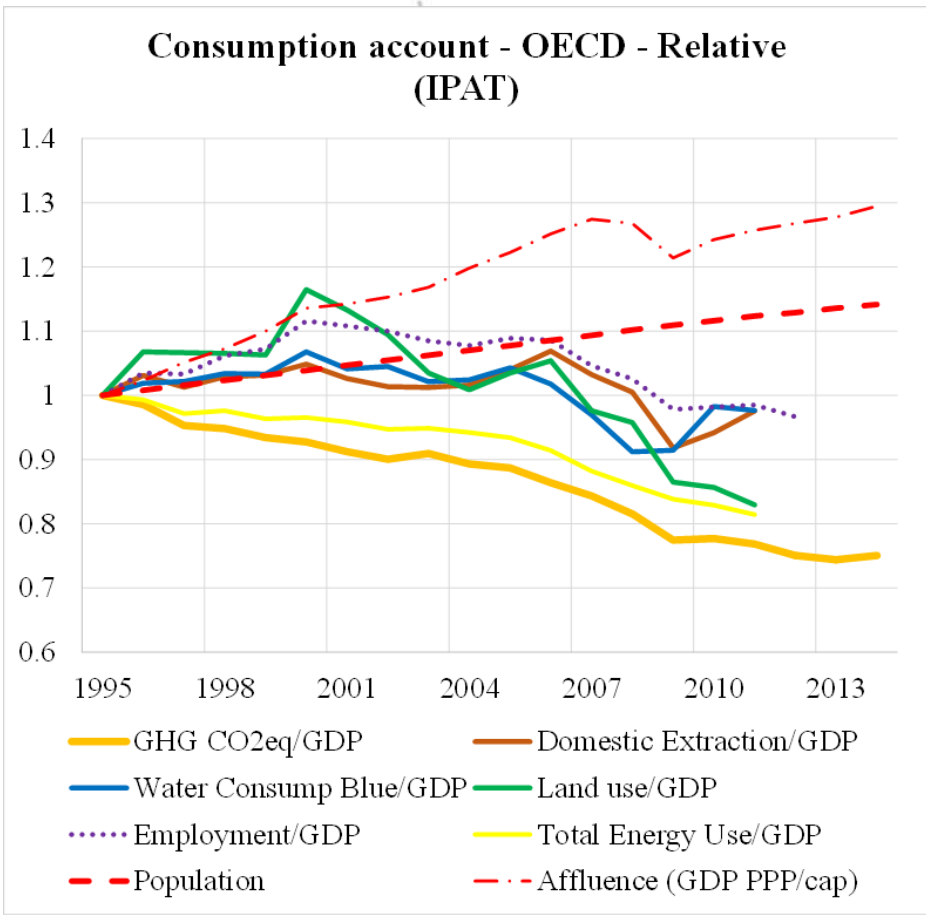


Source: own calculations – multi-MRIO-model mean

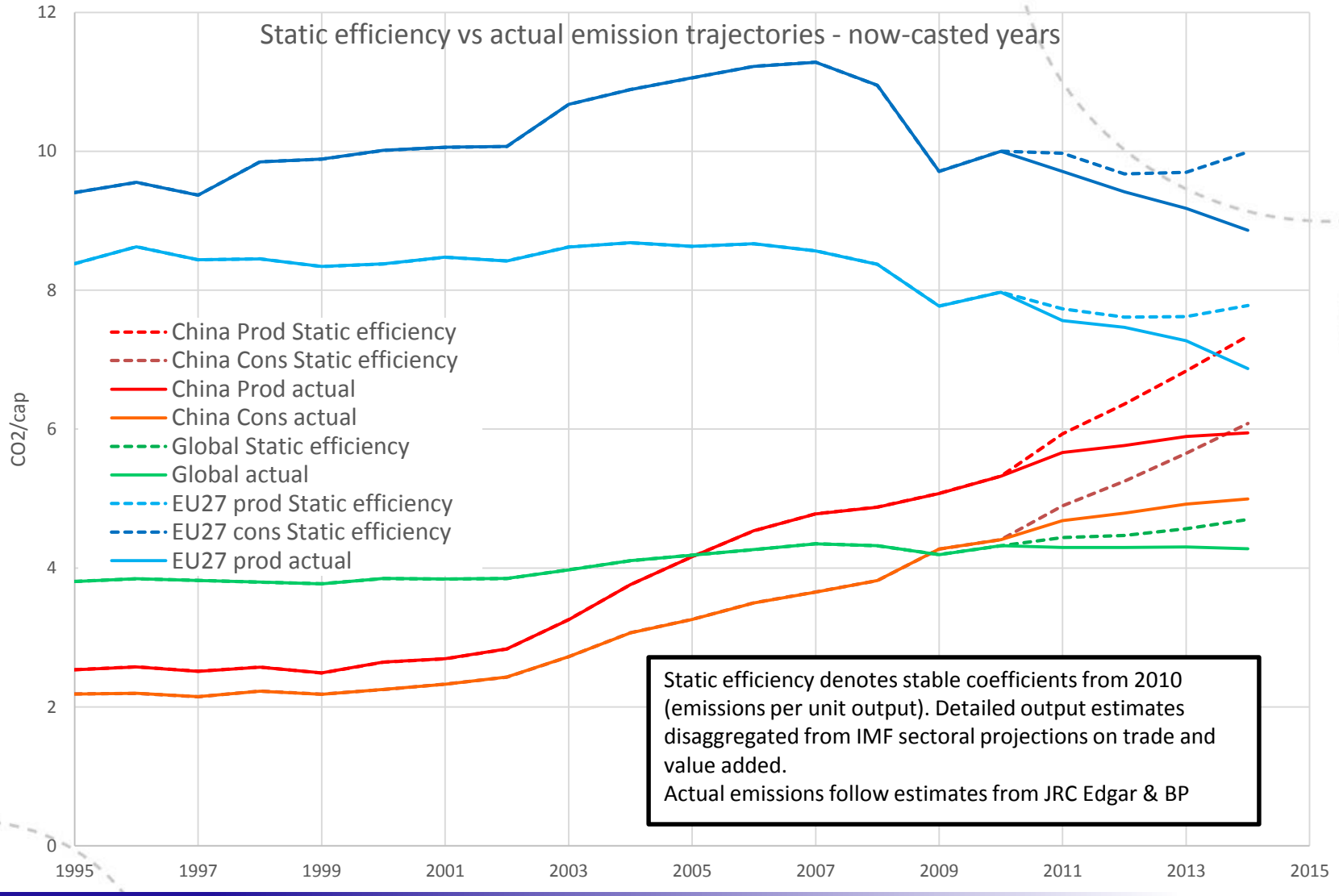

Production account - OECD - absolute
1.8
1.6
1.4
1.2
1
0.8
0.6
1995
1998
2001
2004
2007
2010
2013
GHG CO2eq
Domestic Extraction
Water Consump Blue
Land use
Employment
Total Energy Use
GDP (PPP)
Population

Decoupling – production vs consumption?





Now-casting


Static efficiency vs actual emission trajectories - now-casted years
CO2/cap
12
10
8
6
4
2
0
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
China Prod Static efficiency
China Cons Static efficiency
China Prod actual
China Cons actual
Global Static efficiency
Global actual
EU27 prod Static efficiency
EU27 cons Static efficiency
EU27 prod actual
Static efficiency denotes stable coefficients from 2010 (emissions per unit output). Detailed output estimates disaggregated from IMF sectoral projections on trade and value added.
Actual emissions follow estimates from JRC Edgar & BP

Conclusions

- Building a detailed MR EE IO is possible
- Gives interesting information on many indicators
- Now-casting still a problem

Thanks for your attention!