Building a Time Series of Environmental Accounts for a Word Input-Output Database

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Outline

- Environmental Accounts (EA) in WIOD
- Construction of energy accounts
- Construction of air emission accounts
- Construction of other satellite accounts
- Stylised facts
WIOD database

- World Input-Output Database
  - National supply/use and I/O tables
  - International supply/use and world I/O tables
  - Socio-economic satellite accounts
  - Environmental satellite accounts

- Publicly released on 16th April 2012 at the WIOD launch event in Brussels
WIOD EA in brief

- Indicators covered
  - Energy
  - Air emissions
  - Materials extraction
  - Land use
  - Water use

- Geographical coverage: full world coverage
  - EU27 countries
  - 13 major non-EU countries
  - Rest of the world (1 region)

- Time coverage: full time series 1995-2009

- Sectoral coverage
  - 35 WIOD industries (based on NACE Rev. 1.1, 2002)
  - Final consumption (households)
### Definition of WIOD EA

![Diagram showing the WIOD EA framework](image)

(Moll et al., 2008)

- **SUT framework**
- **Environmental satellites**

The matrix represents the WIOD EA framework with:
- Products: `I`, `V`, `U`, `Y`, `q`
- Industries: `q^T`, `x^T`, `x`, `w`
Content of WIOD EA

• Core indicators
  – Energy accounts (in TJ)
    ➢ Gross energy use (by 36 sectors and 27 energy entries)
    ➢ Emission relevant energy use (by 36 sectors and 27 energy entries)
  – Air emission accounts (in t / 1000 t)
    ➢ CO2 emissions (by 36 sectors and 27 energy entries)
    ➢ Non-CO2 emissions (by 36 sectors): NOx, SOx, NMVOC, CO, CH4, N2O, NH3

• Additional indicators
  – Materials extraction accounts (in 1000 t)
    ➢ Used materials (by 2 sectors and 12 materials types)
    ➢ Unused extraction (by 2 sectors and 12 materials types)
  – Land use accounts (in 1000 ha)
    ➢ Agriculture and forest land use (by 4 land types)
  – Water use accounts (in 1000 m³)
    ➢ Use of water (by 36 sectors and 3 water types)
Overview of energy accounts

- NAMEA energy: fully compliant with SNA

- Includes physical energy flows (in TJ) but excludes energy assets, energy and environmental taxes/subsidies, permits, licenses

- Energy uses for 26 energy commodities and losses covering:
  - Coal and coal derivatives
  - Oil and gas
  - Electricity and heat
  - Refinery products
  - Renewables and waste
  - Losses
Structure of energy accounts

1995-2009

36 sectors
- Industries
- Households

26 fuels and losses
- Coal
- Oil and gas
- Electricity and heat
- Refinery products
- Renewables
- Waste
- Losses
Basic principles for energy accounts

- Gross vs. net energy concept

\[
\text{Gross: } \text{Domestic production + Imports} - \text{Exports} + \text{Inventory changes} = \text{Intermediate consumption + Final uses}
\]

\[
\text{Net: } \text{Direct extraction + Imports} - \text{Exports} + \text{Inventory changes} = \text{Conversion losses + Final uses}
\]

- WIOD methodology based on **gross energy** concept:
  - Double counting, but
  - Fully consistent with input records in the USE table
  - Information kept on the energy mix
  - More suitable for modelling applications with integrated economy-environment analysis (e.g. fuel substitution)
Data sources for energy accounts

- Official NAMEA energy (AUT, DEU, DNK, NLD, AUS, CAN)
- IEA energy balances and energy prices
- WIOD data (SUTs, sectoral gross output deflators, employment data)
- Transport data (aviation and marine bunkering from EXIOPOL, car fleet from ODYSSEE)
- Tourism data (tourism terms of trade statistics from OECD-Eurostat)
Main issues for energy accounts

- Mismatch between IEA balances and SNA classifications (sectors and energy commodities)
  → WIOD USE tables and assumptions (on energy prices and USE table shares)

- Discordant conceptual definition of sectors (Heat and electricity autoproduction, Road transport)
  → Reassignment combining WIOD SUTs, additional info and assumptions

- Territorial vs. Residence principle (transport)
  - Road transport → Correction with tourism statistics
  - Air and maritime transport → Correction with WIOD SUTs and EXIOPOL data

- Inconsistencies between IEA data and WIOD SUTs, e.g.
  - Breaks/gaps in IEA time series → Supplementary own estimations (case by case)
  - No records in WIOD SUTs → Proxy variable (case by case)

- Alignment with official NAMEA energy
  → Calibration of WIOD time series at sector and energy commodity levels
Overview of air emission accounts

- NAMEA air: fully compliant with SNA

- Emission flows (in t or 1000 t) of 8 pollutants related to:
  - Global warming (CO2, CH4, N2O)
  - Acidification (SO2, NOX, NH3)
  - Tropospheric ozone formation (NOX, NMVOC, CO, CH4)

- CO2 emissions from 26 fuels and non-energy related emissions covering:
  - Coal and coal derivatives
  - Oil and gas
  - Electricity and heat
  - Refinery products
  - Renewables and waste
  - Non-energy related

Same as in energy accounts
Structure of air emission accounts

1995-2009

36 sectors
- Industries
- Households

8 pollutants
- CO2
- CH4
- N2O
- SO2
- NOX
- NH3
- NMVOC
- CO

Country X
Basic principles for air emission accounts

- Energy-first vs. inventory-first approach (Eurostat, 2009)
  - *Energy-first*: starts from energy data re-arranged into energy accounts and applies emission factors (with taking into account non-energy related emissions) to derive air emissions
  - *Inventory-first*: starts from national emission inventories, adjusts for residence principle and allocates the process-oriented emissions to economic activities to derive air emissions

- Methodology for WIOD
  - **NAMEA-air like** data were given priority when available
  - **Energy-first** approach when most emissions linked to fuel combustion: CO2, NOx, SOx, NMVOC and CO
  - **Inventory-first** approach when most emissions not linked to energy use: N2O, CH4 and NH3
Data sources for air emission accounts

- Eurostat NAMEA air (EU27)
- UNFCCC emission inventories
- EDGAR emission inventories
- IPCC emission factors
- WIOD data (SUTs, employment data)
Main issues for air emission accounts

- **Energy-first approach**
  - Non-energy related CO2 emissions (non-reporting countries)
    → Based on average ratio (energy vs. non-energy)
  - Non-CO2 emission factors (non-EU countries)
    → Calibrated coefficients based on EU sectoral emission factors

- **Inventory-first approach**
  - Mismatch between inventory and SNA classifications
    → Same strategy as for energy accounts (WIOD USE tables and assumptions)
  - Territory principle
    → Application of scaling factors
  - Missing year (2009)
    → Extrapolation from 2008
Overview of other satellite accounts

- Other extensions fully compliant with SNA

- 12 types of materials extraction (in 1000 t) covering:
  - Biomass
  - Fossil fuels
  - Metals and other minerals

- 4 types of land use (in 1000 ha) covering:
  - Agriculture areas
  - Forestry areas

- 3 types of water use (in 1000 m³)
  - Blue water
  - Green water
  - Grey water
Data sources for other satellite accounts

- Eurostat material flow accounts
- SERI/Wuppertal Institute material flow data
- FAOSTAT agricultural and forestry land use and agricultural production
- Mekonnen and Hoekstra (2010 & 2011) on water use
- EXIOPOL data on water use
- IEA data on hydropower
- WIOD data (sectoral gross output)
- Population data
Main issues for other satellite accounts

- Material flows unavailable for some countries/years
  → Combine Eurostat/SERI data with WIOD socio-economic accounts

- Forestry areas (economic activity) not available
  → Combine FAO data with WIOD material flow accounts

- No NAMEA water like data available
  → Combine water intensities with some FAO, IEA, EXIOPOL and population data
Stylised facts

Worldwide CO2-equivalent GHG emissions

In GtCO2e

In shares (%)
Stylised facts

GHG emission intensity of gross value added in EU27, 2008 (tCO2e/1000€)

- LUX: least emission intensive (high value added in services)
- Other least emission intensive: SWE and FRA (low emission electricity production)
- EU12 more emission intensive
- DNK: emission intensive due to predominance of maritime sector
Stylised facts

National NOx emission intensity of energy use (t/TJ)
EU27 SOx emission intensity of energy use for SOx intensive sectors (t/TJ)
Conclusions

• Use of official and (publicly) available information

• Reconciliation of heterogeneous data with a transparent methodology

• Construction of environmental satellite accounts based on SNA conventions

• High potential for modelling and policy analysis (energy and air emissions)
Thank you