Producing footprint-type indicators for SDG monitoring

7th Expert Meeting on Statistics for Sustainable Development Goals - Session 5: Expanding the SDGs monitoring with non-traditional data sources

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Stephan MOLL – Eurostat E2

Overview

1. Footprint-type indicators produced by Eurostat – overview & example

2. ... their use in Eurostat's SDG monitoring

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1 production of footprint type indicators

- Domains ('footprints' of ...):

  - Air emissions: greenhouse gases, air pollutants

  - Materials extraction

  - Energy: net domestic energy use

  - Land use

  - Economic: value added

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Fundamentals

- Consumption-based accounts

- …& derived footprint-type indicator

- Conceptual basis:

    - System of national accounts (SNA)

    - System of environmental-economic accounts(SEEA)

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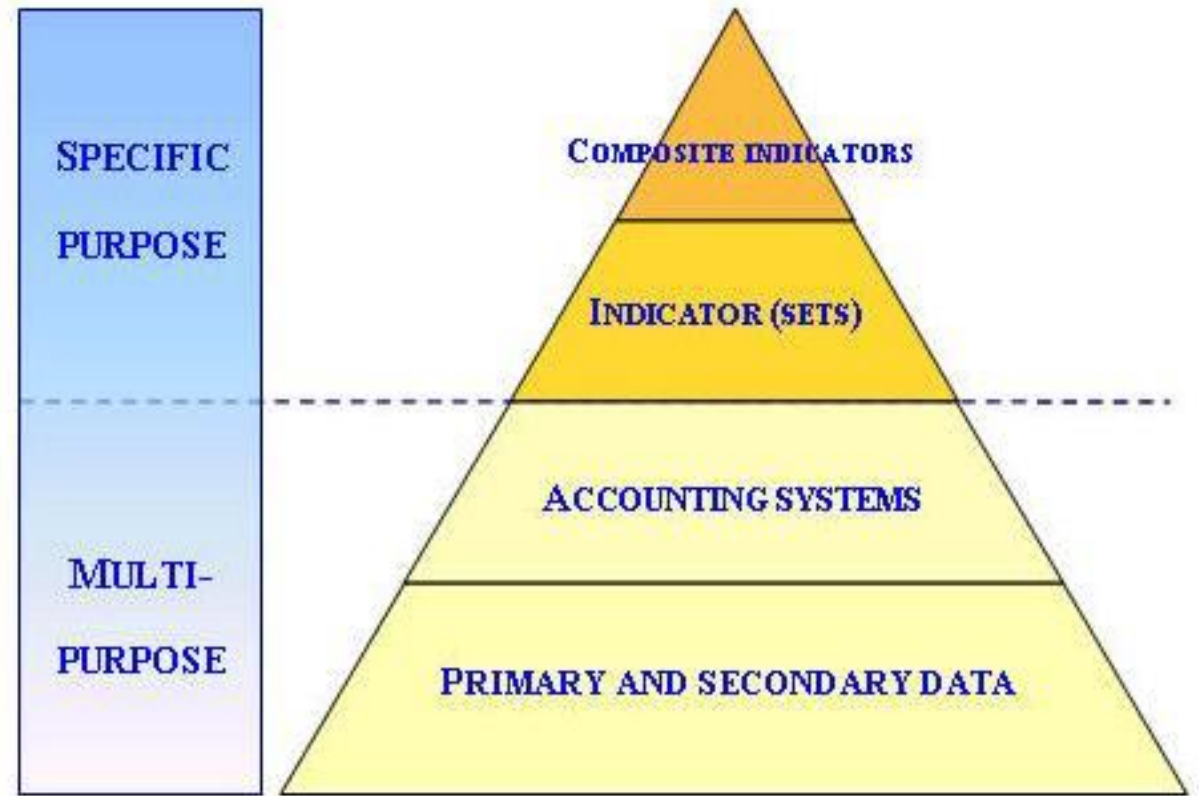
Definition: footprint type indicators

- Certain phenomena associated with 'production'

- ...are re-attributed to 'consumption'

- Definition of 'consumption':

  - final demand in a inter-country IOT =

    - final consumption expenditure (P3)

    - gross fixed capital formation (P5)

- plus: direct phenomena exerted by private households

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Methods

- Input-output modelling

  - Single region model

  - Multi-regional (inter-country) model   data requirements – global !

- Coefficient approach (incl. life-cycle inventory based)

- Composite methods (combinations)

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Eurostat's method mix:

- Input-output modelling

  - Single region IO model

  - Multi-regional (inter-country) IO model

- Coefficient approach (incl. life-cycle inventory based)

- Composite methods (combinations)

Air emissions, energy use

CO_2 emissions, gross value added

Land use

Materials extraction

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Example = carbon footprints

- Multi-regional IO model (FIGARO)

- huge analytical potential !

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Data requirements

- Inter country input-output table (IC IO) representing the global economy.

  - => provided by FIGARO:

  - 46 geographical entities; 64 production activities
    (46x64 x 46x64 = 2 944 x 2 944 = 8 667 1360)

- CO_2-emission vector

  - => provided by Eurostat E.2:

  - 46 geographical entities; 64 production activities + 1 households
    (1 x 46 x (64+1) = 2 990)

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Model

Leontief-type model: $$\mathbf{B}^* = \hat{\mathbf{g}} \cdot \mathbf{L} \cdot \mathbf{Y}$$

with

$\mathbf{B}^*$ Matrix of the re-attributed environmental pressure variable to final demand by category of final demand and production activity of origin

$\hat{\mathbf{g}}$ diagonalised vector of CO2-emission coefficients

$\mathbf{L}$ Leontief matrix

$\mathbf{Y}$ Final demand matrix, products by categories of final demand

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Data structure of modelling results

- Resulting matrix $\mathbf{B}^*$ has the shape of a final demand matrix. Multi-country set-up (one single year):

  - vertical – rows (2 944):
    - production activity of origin of pressure (64)
    - geographical entity of origin of pressure (46)

  - horizontal – columns (230):
    - categories of final demand (5)
    - geographical entity of final demand (46)

  - plus households' direct emissions (1x46)

- => 687 700 data points

Data structure of modelling results

- Multi-dimensional data cube, i.e. csv.flatfile with a record for each of the 687 700 data points, for each of the 11 years = 7 564 700 records

1.	time_period	reference year
2.	ref_area	country of origin of CO_2
3.	industry	production activity of origin
4.	counterpart_area	country of final demand
5.	sto	category of final demand
6.	obs_value	observation value (modelling result)
7.	decimals	
8.	unit_measure	tonnes
9.	unit_mult	3 (i.e. thousand of tonnes)

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Data structure of modelling results

time_period	ref_area	industry	counterpart_area	sto	obs_value	decimals	unit_measure	unit_mult
2010	IN	A01	BE	P3_S13	2.719	3	TN	3
2010	IN	A02	BE	P3_S13	0.568	3	TN	3
2010	IN	A03	BE	P3_S13	0.072	3	TN	3
2010	IN	B	BE	P3_S13	5.051	3	TN	3
2010	IN	C10T12	BE	P3_S13	0.241	3	TN	3
2010	IN	C13T15	BE	P3_S13	0.869	3	TN	3
2010	IN	C16	BE	P3_S13	0.129	3	TN	3
2010	IN	C17	BE	P3_S13	1.385	3	TN	3
2010	IN	C18	BE	P3_S13	0.158	3	TN	3
2010	IN	C19	BE	P3_S13	7.306	3	TN	3
2010	IN	C20	BE	P3_S13	15.503	3	TN	3
2010	IN	C21	BE	P3_S13	0.334	3	TN	3
2010	IN	C22	BE	P3_S13	0.078	3	TN	3
2010	IN	C23	BE	P3_S13	13.79	3	TN	3
2010	IN	C24	BE	P3_S13	49.916	3	TN	3
2010	IN	C25	BE	P3_S13	0.255	3	TN	3
2010	IN	C26	BE	P3_S13	0.014	3	TN	3
2010	IN	C27	BE	P3_S13	0.032	3	TN	3
2010	IN	C28	BE	P3_S13	0.057	3	TN	3
2010	IN	C29	BE	P3_S13	0.008	3	TN	3
2010	IN	C30	BE	P3_S13	0.002	3	TN	3
2010	IN	C31_32	BE	P3_S13	0.444	3	TN	3
2010	IN	C33	BE	P3_S13	0.017	3	TN	3

CO2 emissions emitted by metal manufacturing (NACE C24) in India caused by the final consumption expenditure of general government (P3 S13) in Belgium

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Results: EU versus the rest of the world

2020 [Gt]	serving EU's consumption		serving consumption in the non-EU rest of the world		Total produced	
produced in EU	2.3	7%	0.5	2%	2.8	8%
produced in the non-EU rest of the world	0.9	3%	30.7	89%	31.7	92%
Total consumed	3.2	9%	31.2	91%	34.4	100%

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2010

2010 [Gt]	serving EU's consumption		serving consumption in the non-EU rest of the world		Total produced	
produced in EU	3.1	*9%*	0.6	*2%*	3.6	*11%*
produced in the non-EU rest of the world	1.2	*4%*	28.9	*86%*	30.2	*89%*
Total consumed	4.3	*13%*	29.5	*87%*	33.8	*100%*

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2015

2015 [Gt]	serving EU's consumption		serving consumption in the non-EU rest of the world		Total produced	
produced in EU	2.7	*7%*	0.6	*2%*	3.3	*9%*
produced in the non-EU rest of the world	1.0	*3%*	31.6	*88%*	32.6	*91%*
Total consumed	3.7	*10%*	32.2	*90%*	35.9	*100%*

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2019

2019 [Gt]	serving EU's consumption		serving consumption in the non-EU rest of the world		Total produced	
produced in EU	2.6	*7%*	0.6	*2%*	3.2	*8%*
produced in the non-EU rest of the world	1.1	*3%*	33.3	*89%*	34.4	*92%*
Total consumed	3.7	*10%*	33.9	*90%*	37.6	*100%*

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2020

2020 [Gt]	serving EU's consumption		serving consumption in the non-EU rest of the world		Total produced	
produced in EU	2.3	7%	0.5	2%	2.8	8%
produced in the non-EU rest of the world	0.9	3%	30.7	89%	31.7	92%
Total consumed	3.2	9%	31.2	91%	34.4	100%

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EU's CO2 emissions decreasing

EU's CO2 emissions

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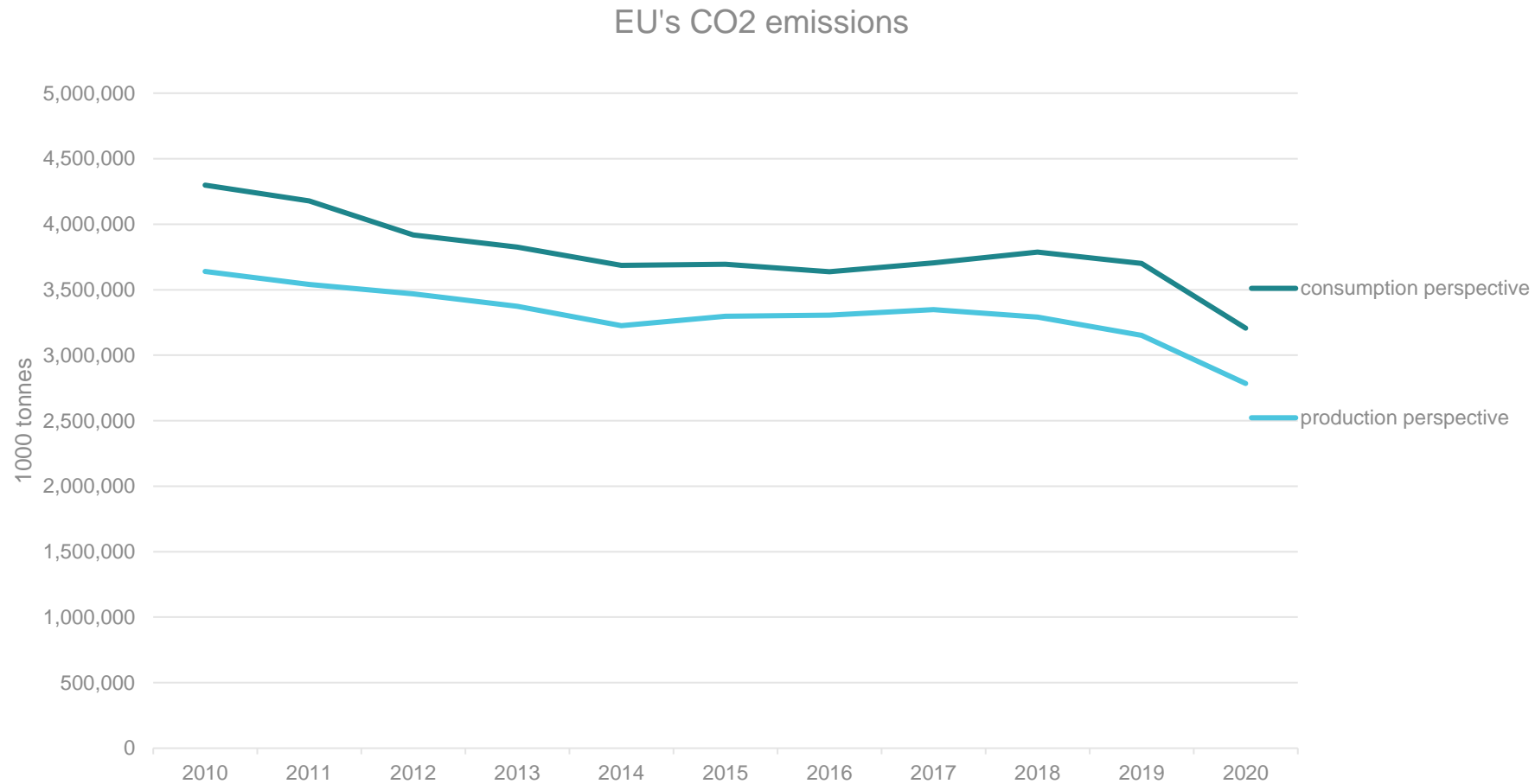
EU's consumption-based emissions by origin

CO2 emissions serving EU's consumption by origin

	2010		2015		2019		2020	
	Gt	**%**	**Gt**	**%**	**Gt**	**%**	**Gt**	**%**
European Union	3.057	71%	2.672	72%	2.556	69%	2.258	70%
Argentina	0.006	0%	0.003	0%	0.004	0%	0.004	0%
Australia	0.008	0%	0.006	0%	0.008	0%	0.007	0%
Brazil	0.012	0%	0.012	0%	0.011	0%	0.010	0%
Canada	0.021	0%	0.017	0%	0.026	1%	0.026	1%
Switzerland	0.006	0%	0.004	0%	0.005	0%	0.004	0%
China	0.300	7%	0.251	7%	0.253	7%	0.211	7%
United Kingdom	0.033	1%	0.024	1%	0.025	1%	0.020	1%
Indonesia	0.012	0%	0.009	0%	0.010	0%	0.008	0%
India	0.041	1%	0.039	1%	0.049	1%	0.037	1%
Japan	0.022	1%	0.017	0%	0.017	0%	0.014	0%
South Korea	0.024	1%	0.018	1%	0.019	1%	0.017	1%
Mexico	0.010	0%	0.011	0%	0.013	0%	0.012	0%
Norway	0.013	0%	0.013	0%	0.012	0%	0.010	0%
Russia	0.181	4%	0.153	4%	0.163	4%	0.112	4%
Saudi Arabia	0.016	0%	0.021	1%	0.015	0%	0.011	0%
Turkey	0.021	0%	0.023	1%	0.033	1%	0.038	1%
United States of America	0.092	2%	0.075	2%	0.084	2%	0.070	2%
South Africa	0.029	1%	0.019	1%	0.024	1%	0.019	1%
Rest of the World (non-G20 & no	0.395	9%	0.307	8%	0.375	10%	0.319	10%
Total	**4.298**	100%	**3.694**	100%	**3.700**	100%	**3.207**	100%

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EU's production-based emissions by destination

EU's CO2 emissions serving consumption by destination

	2010		2015		2019		2020	
	Gt	**%**	**Gt**	**%**	**Gt**	**%**	**Gt**	**%**
European Union	3.057	84%	2.672	81%	2.556	81%	2.258	81%
Argentina	0.004	0%	0.004	0%	0.003	0%	0.003	0%
Australia	0.012	0%	0.011	0%	0.010	0%	0.009	0%
Brazil	0.018	1%	0.017	1%	0.016	1%	0.011	0%
Canada	0.013	0%	0.014	0%	0.014	0%	0.012	0%
Switzerland	0.028	1%	0.026	1%	0.024	1%	0.024	1%
China	0.054	1%	0.078	2%	0.085	3%	0.084	3%
United Kingdom	0.049	1%	0.036	1%	0.033	1%	0.024	1%
Indonesia	0.006	0%	0.006	0%	0.006	0%	0.005	0%
India	0.020	1%	0.019	1%	0.020	1%	0.016	1%
Japan	0.024	1%	0.023	1%	0.022	1%	0.019	1%
South Korea	0.012	0%	0.013	0%	0.013	0%	0.009	0%
Mexico	0.010	0%	0.012	0%	0.011	0%	0.009	0%
Norway	0.012	0%	0.009	0%	0.011	0%	0.009	0%
Russia	0.032	1%	0.022	1%	0.022	1%	0.019	1%
Saudi Arabia	0.012	0%	0.018	1%	0.013	0%	0.010	0%
Turkey	0.024	1%	0.024	1%	0.018	1%	0.013	0%
United States of America	0.099	3%	0.118	4%	0.109	3%	0.092	3%
South Africa	0.007	0%	0.006	0%	0.006	0%	0.004	0%
Rest of the World (non-G20 & no	0.146	4%	0.168	5%	0.160	5%	0.154	6%
Total	**3.641**	100%	**3.297**	100%	**3.151**	100%	**2.783**	100%

Results - narratives

- EU's consumption-based CO_2 emissions are bigger than production-based

- EU's carbon footprint in the world

  - has been decreasing from 4.3 (2010) to 3.2 (2020) billion tonnes

  - shares in global CO_2 emissions decreased from 13% to 9%

- EU's 'self-sufficiency' rather stable (ca. 70%)

- Important 'trading partners':

  - Rest of the World and China: asymmetry is getting less

  - Russia: asymmetry stable   US: stable balance

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2 Footprint-type indicators & SDG monitoring

- Eurostat's monitoring report:

2 Footprint-type indicators & SDG monitoring

- SDG 12 – Responsible consumption and production

- Special chapter: spillover effects

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Table 12.1: Indicators measuring progress towards SDG 12, EU

Indicator	Long-term trend (past 15 years)	Short-term trend (past 5 years)
Decoupling environmental impacts from economic growth		
Consumption of hazardous chemicals	↗ (green)	↘ (red)
Material footprint	↗ (green)	↓ (red)
◎ Average CO_2 emissions from new passenger cars	↗ (green) (¹)	↘ (red)
Energy productivity (*)	↑ (green)	↑ (green)
Green economy		
Gross value added in the environmental goods and services sector	↑ (green)	↑ (green)
Waste generation and management		
Circular material use rate	↑ (green)	↑ (green)
Generation of waste excluding major mineral wastes	↘ (red) (²)	↓ (red) (³)

(*) Multi-purpose indicator.
(¹) Past 13-year period.
(²) Past 14-year period.
(³) Past 4-year period.

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Special chapter: spillover effects

- Carbon footprints

- Land use footprints

- Material footprints

- Economic spillover effects (value added footprints)

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Thank you

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