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Footprint type indicators at country level

Eurostat – Unit E2

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1 Introduction

Eurostat estimates and disseminates footprint type indicators for the aggregated EU economy. Eurostat also promotes that countries produce their own national footprint estimates, and for this purpose, Eurostat provides compilation tools and methodologies. In the context of the European Green Deal, there is increased demand for environmental footprints information, also at country level.

This paper provides a brief overview on this work and presents Eurostat's plans towards footprint-type indicators at country level.

The working group is invited to:

- **report about the relevance of footprint-type indicators in their national context, e.g. examples of national policy demand for footprint-type indicators;**
- **inform the group if they intend to estimate footprint-type indicators at country level;**
- **comment on Eurostat's ideas related to footprint-type indicators at country level (chapter 4).**

2 Problem description – background – state of the art

2.1 Definition of footprint-type indicators

This paper defines footprint-type indicators as aggregates derived from consumption-based environmental accounts. The latter estimate environmental characteristics – occurring in both, the reporting geographical entity and abroad – that are associated with the production of goods and services delivered to final demand¹ of the economy of the reporting geographical entity.

2.2 Eurostat's current work related to footprint-type indicators

This section presents a summary of Eurostat's current work related to footprint-type indicators in the domains of air emissions, energy, materials, and land use (see also Annex 1 for an overview table).

2.2.1 Air emissions (carbon) footprints and domestic energy footprint

Eurostat estimates and disseminates consumption-based accounts for air emissions since 2013; for energy since 2020.

¹ Final demand of goods and services is a macro-economic metric defined in national accounts and includes final consumption expenditures by households, governments, and NPISH (P3), gross capital formation (P5), and exports (P6).

Eurostat employs the standard Leontief-type input-output modelling for estimating EU wide footprint-type indicators for emissions to air and net domestic energy use. The standard Leontief-approach assumes domestic production technologies for imported goods and services to EU. Beside others, this approach estimates the air emissions and energy use ‘avoided’ in the EU production system due to imports of goods and services.

Eurostat produces these estimates using an Excel-tool which is available on Eurostat’s website (<https://ec.europa.eu/eurostat/web/environment/methodology> , section ‘IO modelling and tools’). This tool applies standard Leontief matrix algebra employing the so-called domestic technology assumption (DTA). This assumption is used to approximate the emissions/energy embodied in imported products by assuming that the imported products are produced with production technologies similar to those employed within the domestic economy. In other words, the model estimates emissions/energy ‘avoided’ through the import of goods and services.

The data inputs to this Excel-model are publicly available European statistics, namely:

- ESA supply and use tables at basic prices (with a breakdown by 64 NACE production activities, 64 CPA product groupings, and categories of final demand);
- air emissions accounts (with a breakdown by 64 NACE production activities, and 13 pollutants and greenhouse gases);
- physical energy flow accounts (indicator: ‘net domestic energy use’ with a breakdown by 64 NACE production activities).

Eurostat does not collect footprint-type indicators for air emission nor energy from Member States. Nevertheless Eurostat encourages Member States to produce estimates e.g. using the Excel-tool mentioned above.

2.2.2 *Material footprints*

EU level: the EU RME model

Since 2, Eurostat has been producing and publishing demand-based material flow accounts and derived ‘material footprint’ indicators for the aggregated EU economy. Eurostat employs Leontief type modelling based on an extended input-output model designed for material flows. This EU RME model undertakes a specific IOT-based calculation which is denoted as ADTA-IO model (adapted domestic technology assumption input output model, see documentation of EU RME model²). At its core, this EU RME model has a hybrid (physical-monetary) input-output table with 182 products³. Adjustments have been made to adjust for the DTA, e.g. the energy-mix in the exporting country is taken into account. The tool and the documentation are available on the Eurostat’s website⁴.

² <https://ec.europa.eu/eurostat/documents/1798247/6874172/Documentation+of+the+EU+RME+model/>

³ The granularity of the standard ESA supply and use tables (NACE A*64) is insufficient for modelling material flows.

⁴ <https://ec.europa.eu/eurostat/web/environment/methodology>, section ‘IO modelling and tools’

The model calculation provides detailed annual results on product flows in raw material equivalents (RME) in a breakdown by the following dimensions:

- categories of final demand and imports,
- 182 product groups,
- 51 raw material categories (without aggregates).

Eurostat publishes RMC, plus RME estimates of imports and exports, plus results broken down by 64 product groupings and categories of final demand and imports.

Country RME tool and voluntary reporting of country level 'material footprints'

In addition to the EU estimates, Eurostat collects footprint-type material flow indicators from national statistical institutes on a voluntary basis via the annual EW-MFA questionnaire⁵ (Table I). Thirteen countries have reported so far. Eurostat publishes both, EU and country data⁶.

Since several years, Eurostat offers an Excel-tool for countries to produce the RME estimates. This is the so-called 'Country RME tool' (see also section 3.2) which is based on Eurostat's EU RME model. The tool has two main input data: (1) country specific imports and exports, usually extracted from Eurostat's database for international trade in goods (COMEXT), and product-specific RME-coefficients obtained from the EU RME model. The latter reflect the EU average and are multiplied with the imports and exports of the respective country. Countries may or may not use this tool for the estimates they report on a voluntary basis via the EW-MFA questionnaire. Countries are encouraged to adjust the coefficients in the tool to their national circumstances. For further details, please see [Handbook for Country RME tool](#).

2.2.3 Land footprints

In 2020, Eurostat and the European Joint Research Centre (JRC) started a joint project on land footprints. The objective is that JRC develops an estimation method for Eurostat to regularly produce footprint-type indicators for agricultural and forestry land use for the aggregated EU. The basic idea is to develop product- and geo-specific land-use-coefficients that are multiplied with the amounts of imported and exported biomass-based goods. First pilot results are expected by the end of 2021. The results will be disseminated once the quality is satisfactory and the production procedures are in place.

2.3 Demand for footprint-type indicators at country level

In the context of the Sustainable Development Goals and the European Green Deal there is increasing EU and international demand for footprint-type indicators at country level. The rationale is that the EU has a small share of global production, in particular production of goods which require more natural resources than services, and instead it has a higher share of

⁵ <https://ec.europa.eu/eurostat/documents/1798247/6191533/Economy-wide+material+flow+accounts+%28EW-MFA%29+questionnaire>

⁶ <https://ec.europa.eu/eurostat/web/environment/material-flows-and-resource-productivity>

global consumption. Therefore, the EU demand is inducing pressure in natural resources elsewhere in the world, and this situation does not show in production-based statistics. Some examples of initiatives are:

- There is one UN SDG indicator 12.2.1 about material footprints (<https://sdg.data.gov/12-2-1/>). UNEP is the custodian agency.
- The Circular Economy Action Plan, section 8 ‘monitoring progress’ states that ‘Indicators on resource use, including consumption and material footprints to account for material consumption and environmental impacts associated to our production and consumption patterns will also be further developed and will be linked to monitoring and assessing the progress towards decoupling economic growth from resource use and its impacts in the EU and beyond’⁷. DG ENV regularly requests for material footprints at country level and has expressed the aspirations to add footprint-type indicators to the European Semester. Indicators on material footprints are candidates for inclusion in the Commission circular economy monitoring framework (see separate document for agenda item 20).
- The European Parliament is calling for 2030 targets for material footprints.⁸
- The 2021 edition of the Eurostat EU SDG monitoring report will include a new chapter on spillover effects, which will be approached with footprints measures.
- The Commission Joint Research Centre (JRC) also produces footprint measures and develops methodologies based on life-cycle analysis. Those methodologies and data will likely have a stronger role for EU policymaking, e.g. for businesses to substantiate claims that their products are ‘greener’ and want to advertise them as such.

For monitoring progress on those initiatives, only EU aggregated data are not enough. Data at Member State level are necessary too. The National Statistical Offices of some Member States show interest in producing footprint-type indicators; e.g. Germany, Netherlands, and Italy for the case of material footprints; France for carbon footprints.

3 Options to estimate footprint-type indicators at country level

The [SEEA applications and extensions](#) (see chapter III) presents an overview of methods to establish consumption-based environmental accounts and derived footprint-type indicators. Eurostat considers environmentally extended multi-regional input-output (EE-MRIO) modelling as an appropriate method.

⁷ https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en

⁸ <https://www.europarl.europa.eu/news/en/press-room/20210122IPR96214/meps-call-for-binding-2030-targets-for-materials-use-and-consumption-footprint>

3.1 Towards a single global EE-MRIO data set authorised by international statistical organisations:

Yet, the international community of statistical organisations has not established an authoritative global EE-MRIO database. For the time being, there are several global EE-MRIO data sets available – provided by the academic research community. These data sets vary in scope (country and time coverage) and granularity of production activities and products. The academic EE-MRIO data sets reveal modelling results with significant differences that make it difficult to assess the data quality of derived footprint-type indicators. Therefore, Eurostat decided rather not to use them.

Instead, OECD, Eurostat and the European Joint Research Centre are joining efforts towards an authoritative global EE-MRIO dataset that may be considered official statistics. Still, this will need some years to become operational.

3.2 Interim solution: Eurostat's tools

Interim solutions are needed if the policy demand for footprint-type indicators at country level is to be met in the short term. Since several years, Eurostat provides two tools (implemented in Excel) that are supposed to assist national statistical institutes in estimating demand-based environmental accounts and footprint-type indicators at country level. These tools are described above in section 2.2.

4 Eurostat's plans to estimate footprint type indicators at country level

4.1 Material footprints

The demand for 'material footprints' seems in particular high and in the draft ESEA action plan (see document ENV/EA-MESA/WG/2021/14 related to agenda item 14) Eurostat commits to produce and disseminate estimates for material footprints at country level in the short term.

Eurostat intends to make these estimates for those Member States who – so far – have not reported 'material footprints' via the annual EW-MFA questionnaire.

At this stage, Eurostat intends to use the Country RME tool for this exercise. If resources allow, Eurostat will perform these estimates still in 2021. They will be flagged as Eurostat estimates. They would be used in the Commission circular economy monitoring framework should it be agreed that the indicator 'material footprints (RMC)' is added to the monitoring framework. These estimates can be replaced starting from 2022 with better estimates produced by the Member States and reported in the EW-MFA questionnaire.

4.2 Carbon footprints

In a joint pilot project (FIGARO) Eurostat and Joint Research Centre are currently compiling a global EE-MRIO data set for the reference period 2010-2019. It will include data for more than 40 countries and a rest-of-the-world block trade linked input-output tables and CO₂-

emissions. The EE-MRIO data set will be used for Leontief-type modelling and provide amongst others carbon footprint estimates for European countries. The modelling results will be subject to further quality assurances, e.g. benchmarked with the currently already published carbon footprints for the aggregated EU economy.

5 Conclusions

There is an increasing EU and international demand for footprint-type indicators.

For the aggregated EU economy, Eurostat already produces and publishes footprint estimates for air emissions, energy and materials.

Eurostat offers two tools that can be used to estimate consumption-based accounts and derived footprint-type indicators at country level. Both tools employ transparent methodology and use European statistics as input.

Some national statistical institutes report already estimates of material footprints to Eurostat. In the short term, Eurostat intends to produce and publish material footprints at country level (see draft ESEA action plan).

In a pilot project, Eurostat is testing the possibility to produce carbon footprints based on a global data set (multi-regional input-output data extended by environmental variables).

Annex 1: Overview on Eurostat's work related to footprint-type indicators (April 2021)

	Air emissions	Materials 1	Materials 2	Energy	Land
Data set name	Emissions of greenhouse gases and air pollutants from final use of CPA08 products - input-output analysis, ESA 2010	Material flow accounts in raw material equivalents - modelling estimates	Material flow accounts in raw material equivalents by final uses of products - modelling estimates	Energy used for the provision of goods and services (domestic energy footprint) - input-output analysis	Not available yet; administrative arrangement with JRC (Jan 2020 – Dec 2021); Regular production planned for 2022
Data set code	env_ac_io10	env_ac_rme	env_ac_rmeffd	env_ac_pefafp	to be developed
'Statistics Explained' article	Greenhouse gas emission statistics – carbon footprints	Material flow accounts statistics – material footprints		Energy use by businesses and households - statistics	-
'Footprints' variables ...	Emissions to air (CO ₂ , N ₂ O, CH ₄ , HFC, PFC, SF ₆ +NF ₃ , NO _x , SO _x , NH ₃ , NMVOC, CO, PM ₁₀ , PM _{2.5})	Materials extracted (ca. 50 material classes)	Materials extracted (ca. 50 material classes)	Domestic energy use (of EU residents)	Crop land, grassland, forest land
.. assigned to (granularity of results)	Final use of 64 CPA products; by category of final use (households, government, investments, exports); by origin (domestic, rest of the world)	Indicators: RMC, RMI, RME of imports and exports	Final use of 64* CPA products; by category of final use (households, government, investments, exports) * available 182 (not published)	Final use of 64 CPA products; by category of final use (households, government, investments, exports)	Apparent consumption of all biomass based products in EU
Geographical resolution	EU27; EU28	EU27; EU28; 9 countries	EU27; EU28	EU27; EU28	EU27
Time: annual	2008 – T-2y	2000 – T-2y	2008 – T-2y	2014 – T-2y	to be developed
Model type	Single Region Input-Output (64 x 64); 'domestic technology assumption'	Single Region Hybrid Input-Output (182 x 182) amended by information on technology in rest of the world		Single Region Input-Output (64 x 64); 'domestic technology assumption'	apparent consumption of commodities from agricultural and forestry statistics is multiplied by technical coefficients