15 Carbon footprint

Indicator type **Core indicator** *Published*

Versioning

First publication	9/19/2019	Latest update	8/27/2021

Area and sub-area

Area and sub-area	Emissions	Consumption

Presentation

Tier	2
Indicator definition and description	Carbon footprints represent the amount of CO2 (or CO2-equivalent) emissions that are associated with domestic final use (where domestic final use consists of consumption and gross capital formation) and that are directly emitted by households. A carbon footprint includes both emissions by residents and emissions elsewhere that are due to domestic final use or directly emitted by households, and excludes emissions by residents that are due to final use elsewhere (i.e. emissions embodied in exports).
Unit of measure	kg CO2 (equivalents) / capita
Coverage	Consumption and investment
Spatial aggregation	National economy
Reference period	Calendar year
Update frequency	Annual
Base period	

Disaggregation (operational indicators)

Disaggregation (operational indicators)	Comments
Gender, age groups and disabilities	
Income group	
Spatial	

Other related -indicators (e.g.contextual, proxy, other core indicators)

ID	Subindicator	Type
88	Carbon footprint by product	Contextual indicator

Relevance

Policy context and rationale	General context: Sustainable production and consumption. Carbon footprints play a large role in the public debate about climate change as they can be seen as a measure of the consumer behaviour. Related SDG target 12.c: Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities
Related SDG indicator (SDG I.)	Not applicable

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Relation w SDG-I.

Related Sendai Framework I.	Not applicable

Policy references

Document title	Link
Transforming our world: the 2030 Agenda for Sustainable Development (General Assembly of the United Nations, 2015)	https://sustainabledevelopment.un.org/post2015/transformingourworld

Methodology

Methodology for indicator calculation

The carbon footprint indicator is derived from air emission accounts in combination with environmental-economic modelling also referred to as environmentally-extended input-output modelling. For details see the methodology references.

For national level indicators, input-output (IO) modelling relies on the availability of economy-wide economic and environmental datasets. The IO model connects production-side air emissions by economic activity (air emission accounts) to final demand for consumption and investment using economic data representing inter-sectoral linkages. A national carbon footprint indicator can be obtained from the IO model as well as more detailed consumption-based air emission accounts (e.g. footprints broken down by broad product groups or final demand category, such as household or investment expenditure. IO tables and air emission accounts are compiled based on international standards (System of National Accounts/European System of Accounts and System of Environmental-Economic Accounting respectively).

The concept of a footprint indictor is that it captures all impacts related to the environmental pressure, natural resource or economic resource of interest and associates it with a final product / product group. This includes impacts or pressures along the production chain and across countries. The more accurately these international and inter-sectoral links are captured, the more accurate the resulting footprint estimate of the actual impact/pressure at the global level will be. Hence, ideally an international dataset is used as input to the IO modelling that includes all international trade in some detail. National Statistical Offices generally do not produce international datasets and therefor often fall back on an IO modelling set-up that requires less data, but more assumptions. Estimates derived with different IO modelling set-ups result may differ quite significantly.

The metadata sheet of the material footprint included in the SDG indictor set (SDG indicator 8.4.1/12.2.1), specifies that an IO model was used to compile the international dataset with material footprint estimates. More specifically, a multi-regional input-output (MRIO) modelling framework based on an international dataset was used. Databases with the required input for global MRIO modelling have been set-up by the OECD and by various research consortiums (one of them has been used to produce the SDG indicator 8-4-1 estimates, commissioned by the International Resource Panel of UN Environment).

In a broad sense, there is consensus on the ideal IO modelling methodology to estimate the total impact or environmental pressure across the world, but not an explicit international agreement on what an acceptable IO modelling set-up would be in different scenarios. For some NSIs it may be acceptable to use estimates sourced from an international database in a national SDG indicator set, while others may want to rely on in-house source data only.

An alternative methodological approach for carbon footprint estimation is life cycle assessment (LCA). This approach has a product-level focus. There is an international standard for the carbon

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	footprint of products; ISO 14067 “Product Carbon Footprint”. Researchers have used this approach to calculate national carbon footprints bottom-up, i.e. by aggregating / extrapolating results to a national total. A mix of IO modelling and LCA can also be used, which is also known as a hybrid approach.

Methodology references

Document title	Link
Quo Vadis MRIO? Methodological, data and institutional requirements for multi-region input–output analysis (Thomas Wiedmannabc, Harry C. Wilting, Manfred Lenzen, Stephan Lutter, VivekaPalm, 2011)	https://www.sciencedirect.com/science/article/pii/S0921800911002606
Metadata of SDG indicator 8.4.1 (12.2.1): Material Footprint, material footprint per capita, and material footprint per GDP (United Nations Environment Programme (UNEP), 2018)	https://unstats.un.org/sdgs/metadata/files/Metadata-08-04-01.pdf
Creating consolidated and aggregated EU27 Supply, Use and Input-Output Tables, adding environmental extensions (air emissions), and conducting Leontief-type modelling to approximate carbon and other 'footprints' of EU27 consumption for 2000 to 2006 (Eurostat, 2011)	https://ec.europa.eu/eurostat/documents/1798247/6191529/eeSUIOT-TechDoc-final-060411.pdf/96a44595-c00d-4e05-914f-396ec27687b9
Estimating CO2 Emissions Embodied in Final Demand and Trade using the OECD ICIO 2015 (OECD, 2016)	https://www.oecd-ilibrary.org/science-and-technology/estimating-co2-emissions-embodied-in-final-demand-and-trade-using-the-oecd-icio-2015_5jlrcm216xkl-en
Input-Output Analysis Foundations and Extensions (Miller and Blair, 2009)	https://www.cambridge.org/ch/academic/subjects/economics/econometrics-statistics-and-mathematical-economics/input-output-analysis-foundations-and-extensions-2nd-edition?format=HB&isbn=9780521517133
Creating consolidated and aggregated EU27 Supply, Use and InputOutput Tables, adding environmental extensions (air emissions), and conducting Leontief-type modelling to approximate carbon and other 'footprints' of EU27 consumption for 2000 to 2006 (Eurostat, 2011)	https://ec.europa.eu/eurostat/documents/1798247/6191529/eeSUIOT-TechDoc-final-060411.pdf/96a44595-c00d-4e05-914f-396ec27687b9
System of Environmental Economic Accounting Applications and Extensions (United Nations, European Commission, Food and Agriculture Organization of the United Nations, OECD, World Bank, 2017)	https://seea.un.org/applications-extensions

Classification syst.	Standard product or economic activities classifications, e.g. CPA 2008 and ISIC Rev. 4

Data sources

Main source	Official statistics: SEEA and/or SNA
Explanation	Air emission accounts and supply and use or input-output tables plus the required additional modelling

SEEA Accounts that can serve as data sources

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SEEA Account	Comments
Air emission accounts	

UN-FDES 3.1.1: Emissions of greenhouse gases

International databases containing this indicator

OECD Carbon dioxide emissions embodied in international trade	http://www.oecd.org/sti/ind/carbondioxideemissionsembodiedininternationaltrade.htm
Eurostat Emission Greenhouse Gases And Air pollutants	https://ec.europa.eu/eurostat/web/products-datasets/-/env_ac_io10
Eora Global Supply Chain Database: Carbon footprint of natio	https://worldmrio.com/footprints/carbon/
EXIOBASE	https://www.exiobase.eu

Comments

Comments: The global footprint network uses a different definition and methodology. Even with the methodology described here implementation may differ (multi-regional/country modelling vs. using a domestic technology assumption)