Greenhouse gas emission statistics - carbon footprints

Statistics Explained

This article is about carbon dioxide (CO2) emissions classified by final use of products in the EU-27 , also known as 'carbon footprints'. Eurostat uses a modelling approach to compile these estimates , based on economic information and air emissions accounts (AEA) . Carbon footprints are one particular analytical application of AEA.

Eurostat also records and publishes the AEA, which include a range of greenhouse gas (GHG) emissions. AEA are suited for integrated environmental-economic analyses such as the 'footprints' presented here or for calculating emission intensities. As a third set of greenhouse gas emissions statistics, Eurostat disseminates GHG emissions classified by technical processes. These are recorded in so-called GHG emission inventories and form the official data for international climate policies.

Eurostat estimates that the total carbon footprint of EU-27 was equal to 6.7 tonnes of CO2 per person in 2019. The EU-27 emitted 0.26 tonnes CO2per person more to produce exports in goods and services, than it avoided by importing goods and services. Services, that accounted for 25 % of the total carbon footprint, only accounted for 7 % of the direct CO2emissions (transport, construction and real estate services are accounted for separately). The majority of the emissions originate from EU production activities.

Carbon dioxide emissions associated with EU consumption

The right-hand bar of Figure 1 shows the carbon dioxide (CO2) emissions due to final use of products within the EU-27 economy. The EU-27 final use of products encompasses consumption by private households and governments as well as the use of products for gross fixed capital formation , or in other words investments, such as buildings, plants and machinery, motor vehicles, and infrastructure. The estimate includes CO2emitted to produce the final product, including emissions from intermediate inputs and CO2emissions avoided due to importing intermediate and final products. The estimate of avoided CO2emissions can be interpreted as an approximation of the CO2emitted abroad to produce the imported products by the EU-27. As the point of reference is the final product, it gives a consumption perspective of CO2emissions and is also referred to as consumption-based accounting. This type of estimate is also known as a 'carbon footprint'. Eurostat's carbon footprint of the EU-27 measures how much CO2would have been emitted due to EU-27's demand for products, if all imported products were produced within the EU-27 using an EU-27 average production technology.

The EU-27's total carbon footprint was equal to 6.7 tonnes CO2per person in 2019. It consists of about 1.6 tonnes of CO2per person directly emitted by private households from burning fossil fuels (for example for heating dwellings and fuelling private vehicles) and 5.1 tonnes/person emitted indirectly along the production chains of final products which were either consumed or invested in within the EU-27. A majority of the latter — 4.1 tonnes/person — stemmed from domestic production activities actually located in the EU-27. A smaller part, equal to 1.0 tonnes/person, is estimated to have been avoided by importing intermediate and final products into the EU-27, eventually for EU-27 final use.
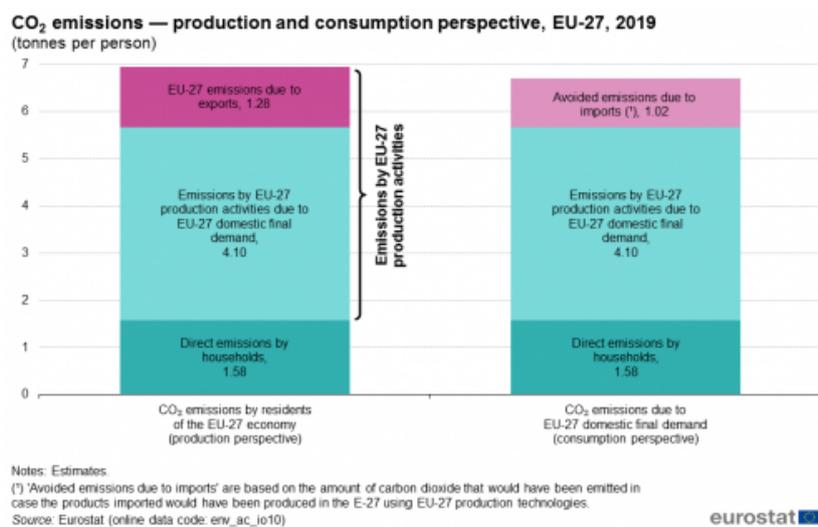
Figure 1: CO2 emissions — production and consumption perspective, EU-27, 2019 (tonnes per person) Source: Eurostat (env_ac_io10)

Eurostat's carbon footprint estimate is based on the 'domestic-technology-assumption'. This assumption is used to approximate the emissions embodied in imported products by assuming that the imported products are produced with production technologies similar to those employed within the EU-27. By importing various goods and services from the rest of the world, the EU-27 can be seen to have 'avoided' 1.0 tonnes of CO_2emissions per person that would otherwise have been emitted by its own production activities. However, average production technologies in the EU-27 may not match very closely the production technologies used outside the EU-27 to produce products that are imported by the EU-27. To estimate emissions embodied in EU-27 imports based on the production technologies used abroad, a global model and accompanying dataset that include all inter-industry trade flows are needed. Although several research projects have produced global datasets, a regularly produced, standardised dataset is currently not available. Eurostat is developing such a dataset in the FIGARO project , but due to the scope and complexity, it will take several years before the development has advanced enough to use the dataset in carbon footprint modelling.

Carbon dioxide emissions associated with EU production

CO_2emissions may also be analysed from a production perspective, in other words, emissions generated by the EU-27 economy. In 2019, these amounted in total to 7.0 tonnes CO_2per person (see left-hand bar of Figure 1). CO_2emitted in the EU-27 was made up of 1.6 tonnes/person direct emissions by private households (for example for heating and private transport) and 5.4 tonnes/person coming from domestic production activities, in other words from EU production activities. The majority of the latter relate to the production of goods and services for the EU domestic final use (4.1 tonnes/person). A smaller part of the EU production emissions is due to the production of goods and services that are exported outside the EU (1.3 tonnes/person). See the Statistics Explained article ' Greenhouse gas emission statistics - air emissions accounts ' for more information about air emissions from the production perspective.

Note that, due to the modelling assumptions, among which the domestic technology assumption, Eurostat's carbon footprint estimate is more uncertain than the production-based emissions reported in the air emission accounts.

Net emission balance due to trade

Figure 1 shows that the difference between the consumption perspective and the production perspective, when looking at national footprint of all products together, is equal to the difference between the emissions due to exports and the avoided emissions due to imports.

Figure 2 has a closer look at the CO_2emissions related to trade flows. The figure shows the development

over time of the emissions to produce exports, the avoided emissions due to imports and the difference between the two, which is the net emission balance due to trade. The balance shows the amount of CO2emissions that the EU-27 would stop emitting in case it would not trade, all else kept equal. No trade means no exports, so the EU-27 would not emit the CO2emissions to produce these exports, which are equal to 1.28 tonnes CO2per person in 2019. In addition, without trade, the EU-27 would have to produce the goods and services it imports itself, so it would emit 1.02 tonnes CO2per person extra. Together, the 1.28 tonnes per person emitted extra due to exports and the avoided 1.02 tonnes per person due to imports, result in a balance of 0.26 tonnes CO2per person extra that the EU-27 emits because it trades goods and services.
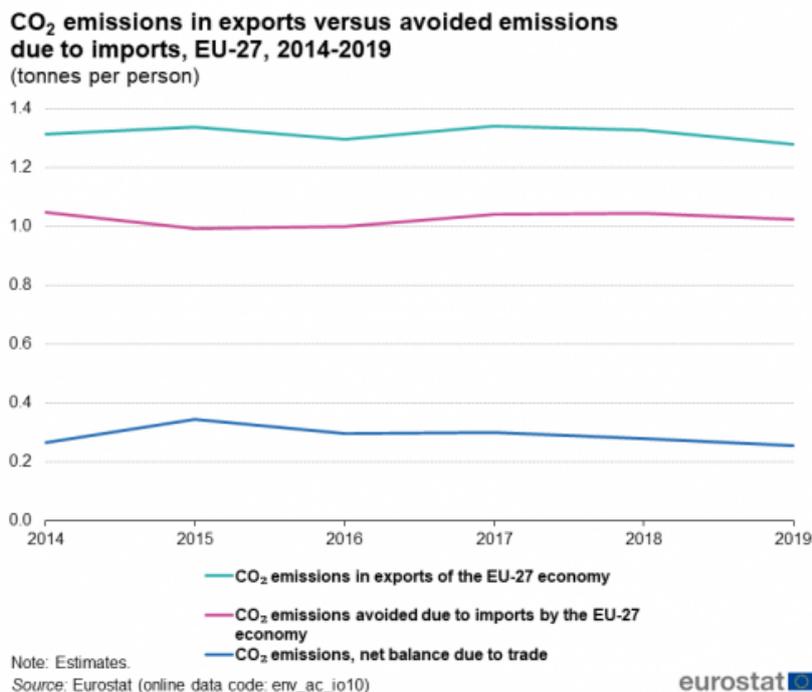

CO₂ emissions in exports versus avoided emissions due to imports, EU-27, 2014-2019
(tonnes per person)

Note: Estimates.
Source: Eurostat (online data code: env_ac_io10)

Figure 2: CO2 emissions in exports versus avoided emissions due to imports, EU-27, 2014-2019 (tonnes per person) Source: Eurostat (env_ac_io10)

Products with largest contribution to the carbon footprint

Figure 3 shows the carbon footprint by broad product group. The size of each box represents the relative size of the CO2footprint for that product group.

The broad product group classified here as 'Materials & manufactured products' represents 23 % of the total CO2emissions due to domestic final demand for products. Both of the groups 'Utilities' and 'Construction and real estate' represent 12 % of the CO2emissions. Transport accounts for 6 %. The group 'Other services' represents with 25 % a slightly larger share as the tangible products of the group 'Materials & manufactured products'. Whereas services generally emit relatively little CO2directly (7 %, source: air emission accounts), the CO2footprints of the services product groups clearly show that the demand for some of these services is also an important driver of CO2emissions, due to the indirect CO2that is emitted to supply these services.

Note that, in Figure 3, the reported CO2emissions for these broad product groups cover the CO2emissions due to domestic demand for products, which is 76 % of the total EU-27 carbon footprint. The other 24 % consists of direct emissions by households, which amounts to 1 578 kg of CO2emissions per person.

CO₂ footprints, by product group, EU-27, 2019 (kg per person)

Figure 3: CO2 footprints by product group, EU-27, 2019 (kg per person) Source: Eurostat (env_ac_io10)

Table 1 shows which products have the largest carbon footprints (CO2 emissions due to EU-27 demand for final products). With 0.726 tonnes/person or 726 kg/person the final use of the product group electricity, gas, steam and air conditioning has the biggest carbon footprint. Next ranks the final use of constructions and construction works with 632 kg/person while the final use of food products, beverages and tobacco products ranks third with a carbon footprint of 362 kg/person.

CO2 emissions due to final use of products, by type of final use and origin, EU-27, 2019

CPA product	Final consumption expenditure		Gross capital formation		Domestic final use, total	
	domestic emissions	imported emissions (¹)	domestic emissions	imported emissions (¹)	Global emissions	
	kg per person					%
Electricity, gas, steam and air conditioning	712	38	-23	-1	726	10.8
Constructions and construction works	25	5	507	94	632	9.4
Food, beverages and tobacco products	275	75	10	3	362	5.4
Retail trade services, except of motor vehicles and motorcycles	163	23	11	2	200	3.0
Accommodation and food services	167	29	0	0	196	2.9
Public administration and defence services; compulsory social security services	166	25	1	0	192	2.9
Coke and refined petroleum products	106	86	0	0	192	2.9
Land transport services and transport services via pipelines	150	15	5	1	171	2.6
Motor vehicles, trailers and semi-trailers	57	28	59	28	171	2.6
Real estate services	139	22	4	1	166	2.5
Human health services	134	28	0	0	162	2.4
Wholesale trade services, except of motor vehicles and motorcycles	104	22	30	6	162	2.4
Air transport services	107	31	0	0	139	2.1
Scientific research and development services	10	3	66	38	116	1.7
Products of agriculture, hunting and related services	75	23	6	2	106	1.6
Machinery and equipment n.e.c.	2	1	59	34	97	1.4
Education services	83	10	0	0	93	1.4
Residential care services; social work services without accommodation	65	9	0	0	74	1.1
Textiles, wearing apparel, leather and related products	28	37	1	5	72	1.1
Other products	622	201	169	103	1 095	16
Total	3 193	710	905	315	5 123	76.4
Direct emissions by private households	1 578	0	0	0	1 578	23.6
All CPA products (CPA = Statistical Classification of Products by Activity) plus direct emissions by private households	4 771	710	905	315	6 701	100.0

Note: Estimates.
(¹) Imported emissions are estimated as 'avoided emissions due to imports'; the amount of CO₂ that would have been emitted in case the imported product would have been produced in the EU-27.
Source: Eurostat (online data code: env_ac_io10)

eurostat

Table 1: CO2 emissions due to final use of products, by type of final use and origin, EU-27, 2019 Source: Eurostat (env_ac_io10)

Figure 4 shows for the same products the development of their carbon footprint over time. This figure shows that the general trend is not directly shaped by the products with the largest share in total carbon footprint. Emissions from the product group electricity, gas, steam and air conditioning have been falling for the past three years after the maximum in 2016. Emissions from constructions and construction works have been rather stable over the past years. Emissions from the product group food products, beverages and tobacco products have been slightly falling in recent years.
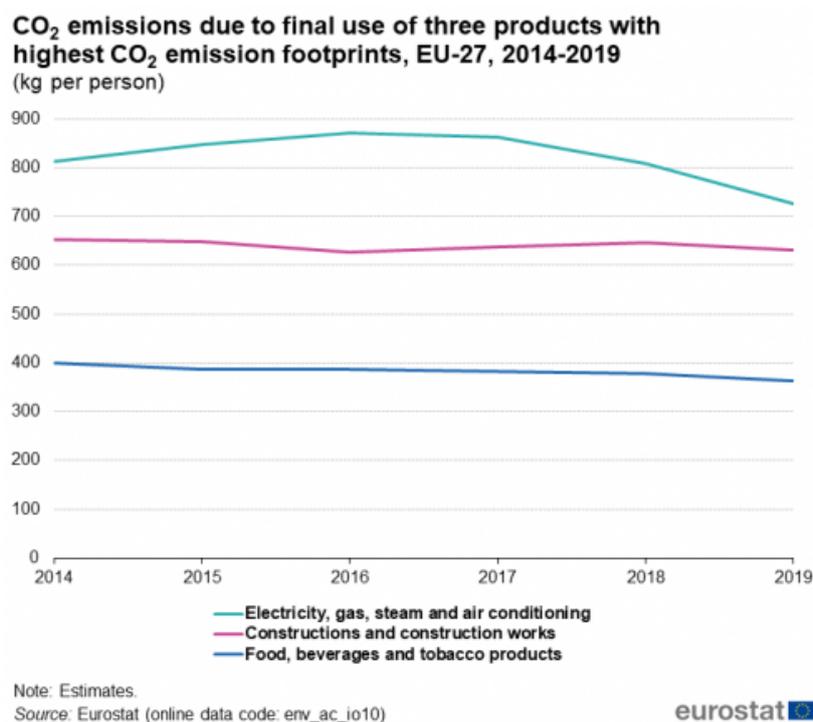
Figure 4: CO2 emissions due to final use of three products with highest CO2 emission footprints, EU-27, 2014-2019 (kg per person) Source: Eurostat (env_ac_io10)

Source data for tables and graphs

- Greenhouse gas emission statistics - carbon footprints : tables and figures

Data sources

Two main Eurostat data sources feed into the modelling to compile the estimates presented above.

The CO2emissions from a production perspective come from air emissions accounts which are part of Eurostat's environmental accounts programme. Air emissions accounts record the emissions of greenhouse gases and air pollutants by a detailed breakdown of economic activities, namely 64 industries and various activities of private households.

The carbon footprint estimates are based on single-region environmentally extended input–output modelling. The modelling is based on the aforementioned air emissions accounts which are integrated with ESA supply and use tables . Please note that the subdivision into domestic and exported emissions shown on the left-hand side of Figure 1 — the production perspective — is also a result of this modelling. The model is implemented as Excel tool and available via Environment – methodology .

The modelling results are published in the dataset 'Emissions of greenhouse gases and air pollutants from final use of CPA08 products - input-output analysis, ESA 2010 (env_ac_io10). This dataset contains estimates not only for CO2emissions, but for all greenhouse gas emissions, as well as several air pollutants.

Estimates for the most recent year in the dataset are estimated based on national accounts data for the year before and early estimates of air emissions accounts.

Three perspectives of greenhouse gas emission statistics

Eurostat presents three perspectives of greenhouse gas (GHG) emissions statistics:

Perspective	Statistical framework	Purpose	Related data set	Related SE article
1. GHG emissions classified by economic activities	Air Emissions Accounts (AEA) by Eurostat	tailored for integrated environmental-economic analyses	env_air_aa	Greenhouse gas emission statistics - air emissions accounts
2. GHG emissions classified by technical processes	GHG emission inventories by UN	official international reporting framework for international climate policies: *The United Nations Framework Convention on Climate Change* (UNFCCC) and *the European Union Greenhouse gas Monitoring Mechanism Regulation* (EU MMR)	env_air_gge	Greenhouse gas emission statistics - emission inventories
3. 'footprints' = GHG emissions classified by final use of products	Modelling results published by Eurostat	one particular analytical application of AEA	env_ac_io10	this article

Context

Supply and use tables portray production and consumption activities of national economies in a detailed manner. They form the basis for so-called input–output models and analyses. Both the tables and the models constitute powerful tools for addressing a range of policy areas. The focus of these models is generally made through an analysis of long-term structural changes within economies, for example, by studying value added shares, trade shares, or accumulated value added along certain production chains.

By adding environmental information (for example, air emissions or the use of energy) to these input–output models, it is possible to extend their analytical scope. Environmentally extended input–output analyses are of particular relevance for policy areas such as sustainable production and consumption , the sustainable use of natural resources , and resource productivity .

Other articles

- Greenhouse gas emission statistics - air emissions accounts
- Greenhouse gas emission statistics - emission inventories
- Supply and use tables - input-output analysis

Publications

- Energy, transport and environment indicators — 2019 edition

Database

- Air emissions accounts (env_air_aa) , see:

Emissions of greenhouse gases and air pollutants from final use of CPA08 products - input-output analysis, ESA 2010 (env_ac_io10)

- ESA Supply, use and input-output tables

Dedicated section

- Air Emissions Accounts
- ESA Supply Use and Input-Output tables

Methodology

- Technical documentation eeSUIOT project
- Environmental accounts methodology
- Eurostat manual for air emissions accounts
- Supply, use, and input-output tables methodology
- Eurostat Manual of Supply, Use and Input-Output Tables

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