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Greenhouse gas emission statistics - emission inventories

Data from June 2019
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Highlights

Greenhouse gas emissions in the EU down by 22 % between 1990 and 2017.

Greenhouse gas emissions in the EU - highest in Germany (21 %), lowest in Malta (0.1 %) in 2017.

Greenhouse gas emission trends, EU-28, 1990 - 2017 (Index 1990=100)

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- *Note: Greenhouse gas emissions (including international aviation, indirect CO2 and excluding LULUCF)*
- *Source: European Environment Agency (online data code: env_air_gge)*

This article is about emissions of greenhouse gases (GHG emissions) classified by technical processes. These are recorded in GHG emission inventories submitted to the United Nations Framework Convention on Climate Change (UNFCCC) and form the official data for international climate policies.

In addition, Eurostat disseminates GHG emissions classified by emitting economic activities. Those are recorded in air emissions accounts (AEA). Furthermore, Eurostat estimates and disseminates so-called 'footprints' which are GHG emissions classified by products that are finally demanded by households or government, or that are invested in or exported.

Full article

Trends in greenhouse gas emissions

Trends in greenhouse gas emissions

The trends in emissions of all greenhouse gases are covered in this article: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and natrium trifluoride (NF_3) in all sectors of the inventories, including international aviation, including indirect CO_2 emissions and excluding emissions or removals from land use, land use change and forestry (LULUCF), in line with the EU international headline target of 20 % reduction of GHG emissions by 2020.

The driving forces behind GHG (e.g. increased energy use, etc.) are not discussed here, nor are the impacts of climate change on human activities. For an analysis of the driving forces behind emissions, based on Eurostat statistics, see the article Climate change - driving forces.

In 2017, greenhouse gas emissions in the EU-28 were down by 22 % compared with 1990 levels, representing an absolute reduction of 1 240 million tonnes of CO_2-equivalents, putting the EU on track to surpass its 2020 target, which is to reduce GHG emissions by 20 % by 2020 and by 40 % by 2030 compared with 1990.

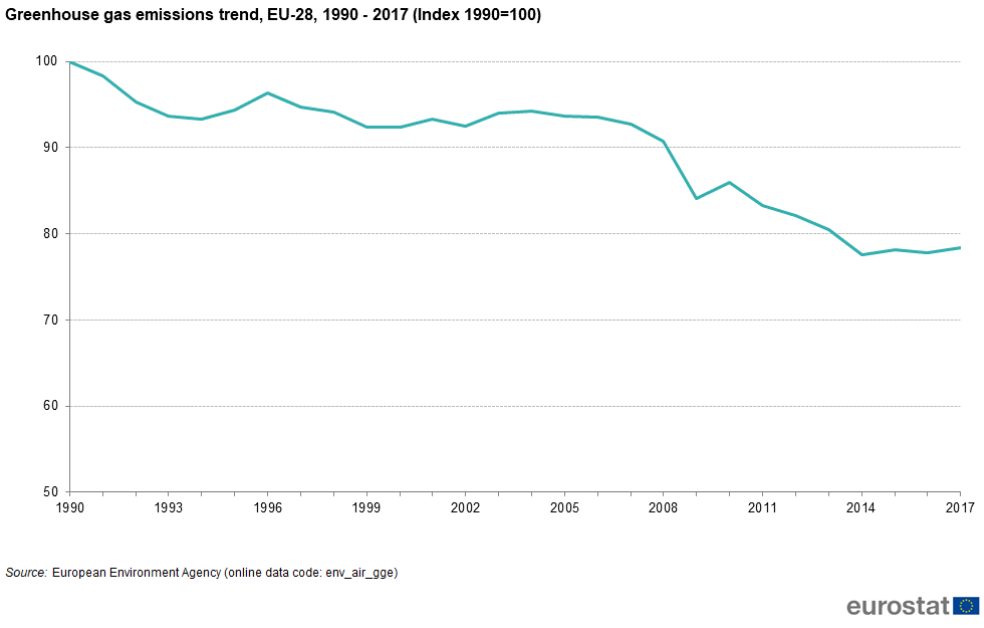

Figure 1: Total greenhouse gas emissions (including international aviation and indirect CO2, excluding LULUCF) trend, EU-28, 1990–2017

(Index 1990 = 100)

Source: Eurostat (env_air_gge), European Environment Agency

Figure 1 shows that there was a general downward trend to emissions during the 1990–1999 period (aside from a relative peak in 1996, when a cold winter led to an increase in heating requirements). From 1999 to 2006 the evolution of greenhouse gas emissions within the EU-28 remained relatively unchanged, although it started falling at a modest pace through to 2008. The year 2009 saw a sharp drop in emissions as a consequence of the global financial and economic crisis and the resulting reduced industrial activity. Emissions increased in 2010 and decreased again from 2011 onward. In 2015, GHG emissions slightly increased compared to 2014. In 2016 the decreasing tendency returned. Emissions increased by 0.7 % (30 million tonnes of CO_2-equivalents) between 2016 and 2017.

Across EU Member States in 2017, greenhouse gas emissions were the highest in Germany (21 % of the EU-28 total or 936 million tonnes of CO_2-equivalents), followed by the United Kingdom and France. The biggest decreases compared to 1990 were reported for Lithuania, Latvia, Romania and Estonia (– 57 %, – 56 %, – 54 % and – 48 % respectively). On the other side of the spectrum, the biggest increases compared to 1990 were reported for Cyprus (+ 56 %), Portugal (+ 23 %) and Spain (+ 22 %). (See Table 1 and Figure 2).

Total greenhouse gas emissions by country (incl international aviation, indirect CO2 and excl LULUCF), 1990 - 2017
(Million tonnes of CO2 equivalents)

	1990	1995	2000	2005	2010	2015	2017	Share in EU-28*
EU-28	5 722.9	5 397.8	5 287.2	5 362.0	4 917.5	4 470.3	4 483.1	100.0%
Belgium	149.7	157.6	154.5	148.9	137.1	121.6	119.4	2.7%
Bulgaria	102.6	75.5	59.8	64.5	61.1	62.2	62.1	1.4%
Czechia	199.8	158.7	151.1	149.5	141.7	129.5	130.5	2.9%
Denmark	72.1	80.1	73.2	68.8	65.5	50.8	50.8	1.1%
Germany	1 263.2	1 138.1	1 064.7	1 016.5	967.0	931.8	936.0	20.9%
Estonia	40.5	20.3	17.4	19.3	21.3	18.3	21.1	0.5%
Ireland	56.5	60.3	70.3	72.0	63.4	61.7	63.8	1.4%
Greece	105.6	111.8	128.9	138.9	121.0	98.2	98.9	2.2%
Spain	293.3	335.3	397.1	452.6	370.1	351.8	357.3	8.0%
France	556.6	553.8	567.0	570.7	528.0	477.3	482.0	10.8%
Croatia	32.4	23.2	26.1	30.3	28.4	24.6	25.5	0.6%
Italy	522.1	538.3	562.1	589.2	514.7	443.7	439.0	9.8%
Cyprus	6.4	7.9	9.2	10.2	10.3	9.1	10.0	0.2%
Latvia	26.5	13.0	10.6	11.6	12.7	11.6	11.8	0.3%
Lithuania	48.6	22.5	19.6	23.0	20.9	20.5	20.7	0.5%
Luxembourg	13.1	10.7	10.6	14.3	13.4	11.6	11.9	0.3%
Hungary	94.2	75.9	73.9	76.2	65.7	61.3	64.5	1.4%
Malta	2.3	3.0	3.1	3.2	3.2	2.5	2.6	0.1%
Netherlands	226.4	239.3	229.8	225.8	224.1	207.5	205.8	4.6%
Austria	79.6	80.9	82.1	94.5	86.8	81.0	84.5	1.9%
Poland	475.0	445.7	396.3	404.3	413.1	392.3	416.3	9.3%
Portugal	60.8	70.8	84.3	88.1	71.7	71.1	74.6	1.7%
Romania	248.9	187.8	143.6	151.7	124.4	117.2	114.8	2.6%
Slovenia	18.7	18.8	19.1	20.6	19.7	16.9	17.5	0.4%
Slovakia	73.4	53.3	49.2	51.3	46.4	41.8	43.5	1.0%
Finland	72.3	72.8	71.3	71.2	77.4	57.2	57.5	1.3%
Sweden	72.7	74.7	70.4	68.6	66.4	55.7	55.5	1.2%
United Kingdom	809.9	767.6	741.9	726.2	642.1	541.5	505.4	11.3%
Iceland	3.8	3.7	4.4	4.4	5.2	5.4	5.9	0.1%
Lichtenstein	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.0%
Norway	51.9	51.8	55.7	56.3	56.8	56.1	54.4	1.2%
Switzerland	56.7	56.1	57.2	58.3	58.5	52.9	52.6	1.2%
Turkey	219.8	248.4	300.5	340.6	404.6	483.4	537.4	12.0%

*Share in EU-28 total in year 2017

Source: European Environment Agency (online data code: env_air_gge)

eurostat

Table 1: Total greenhouse gas emissions (including international aviation and indirect CO2, excluding LULUCF), by country, 1990–2017

(million tonnes of CO_2-equivalents)

Source: Eurostat (env_air_gge), European Environment Agency

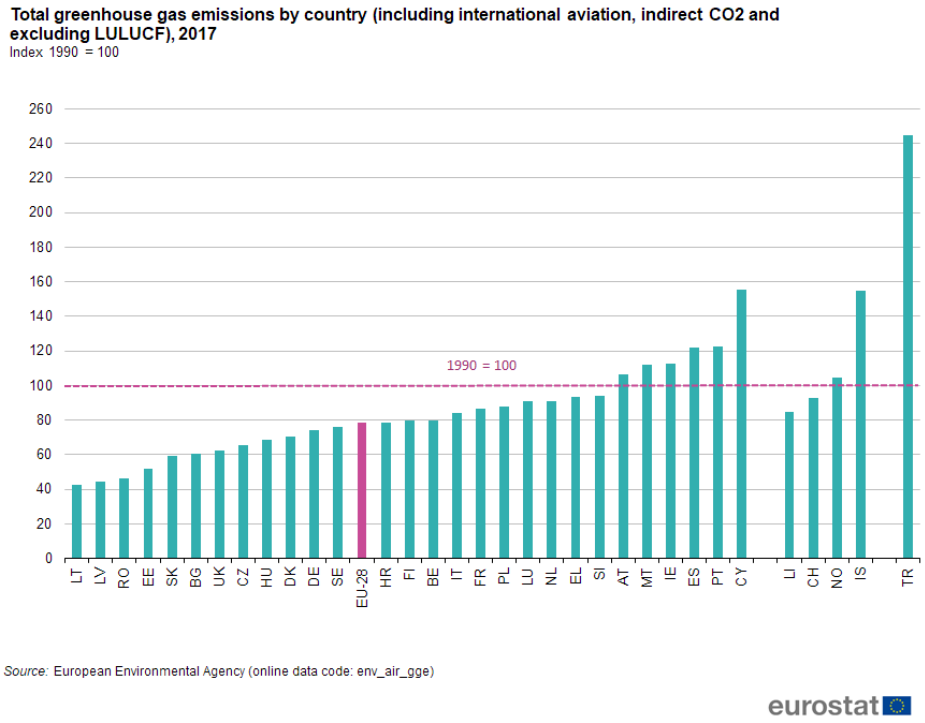

Figure 2: Total greenhouse gas emissions (including international aviation and indirect CO2, excluding LULUCF), by country, 2017

(Index 1990 = 100)

Source: Eurostat (env_air_gge), European Environment Agency

Figure 3 shows the EU-28 greenhouse gas emissions broken down by main source sectors. 'Fuel combustion and fugitive emissions from fuels (without transport)' was responsible for 54 % of EU-28 greenhouse gas emissions in 2017. In 1990 this source sector was even more dominant at 62 %. Fuel combustion for transport (including international aviation) was the second largest source sector with 25 % in 2017; it has increased its contribution significantly since 1990 (15 %). Greenhouse gas emissions from agriculture contributed with 10 % to EU-28 total greenhouse gas emissions. Industrial processes and product use contributed another 8 %. Management of waste contributed with 3 %.

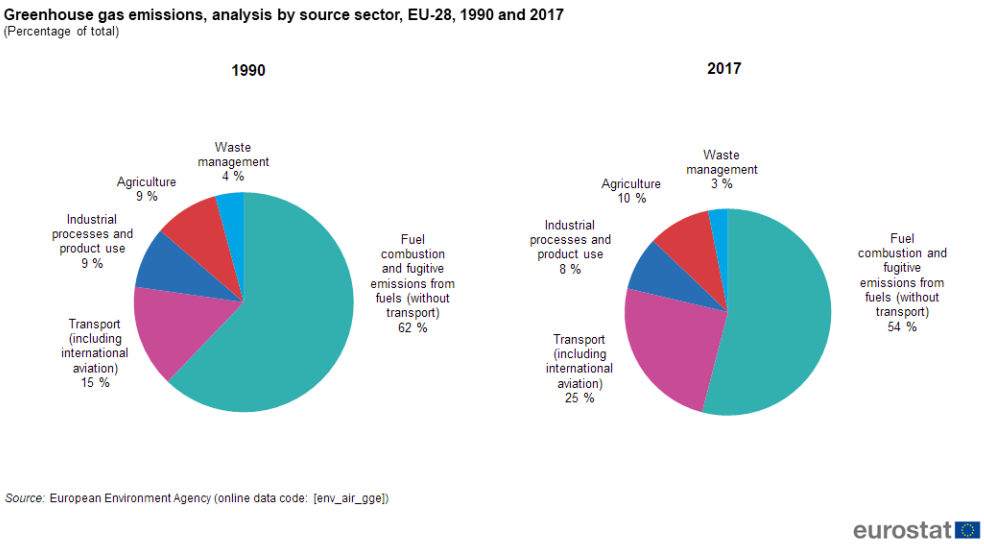

Figure 3: Greenhouse gas emissions, by source sector, EU-28, 1990 and 2017

(percentage of total)

Source: Eurostat (env_air_gge), European Environment Agency

Source data for tables and graphs

- GHG statistics: tables and figures 2019

Data sources

Data in this article is based on the data reported in annual greenhouse gas inventories from the European Union (EU) to the United Nations under the United Nations Framework Convention on Climate Change (UNFCCC). Under the inventories, international aviation is reported as a memo item, while LULUCF is one of the six inventory sectors (see below). For a further understanding of the EU targets and commitments, see Context.

Each greenhouse gas has a different capacity to cause global warming, depending on its radiative properties, molecular weight and the length of time it remains in the atmosphere. The global warming potential (GWP) of each gas is defined in relation to a given weight of carbon dioxide for a set time period (for the purpose of the Kyoto Protocol a period of 100 years). GWPs are used to convert emissions of greenhouse gases to a relative measure (known as carbon dioxide equivalents: CO_2-equivalents). The weighting factors currently used are the following: carbon dioxide = 1, methane = 25,

nitrous oxide = 298, and sulphur hexafluoride = 22 800; hydrofluorocarbons and perfluorocarbons comprise a large number of different gases that have different GWPs.

The European Environment Agency (EEA) compiles an annual greenhouse gas inventory report on behalf of the EU. Estimates of greenhouse gas emissions are produced for a number of sources which are delineated in sectors primarily according to the technological source of emissions, as devised by the Intergovernmental Panel on Climate Change (IPCC). The five main emission source sectors include:

- energy (fuel combustion and fugitive emissions from fuels) — which also includes transport;
- industrial processes and product use;
- agriculture;
- land use, land use change and forestry (LULUCF); and
- waste management.

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	link
2. GHG emissions classified by technical processes	GHG emission inventories by UN	official international reporting framework for international climate policies	env_air_gge	this article

		(UNFCCC, EU MMR)		
3. 'footprints' = GHG emissions classified by final use of products	Modelling results published by Eurostat	one particular analytical application of AEA	env_ac_io10	link

Emissions accounts versus emission inventories

The main differences between air emissions accounts (AEA) and GHG emission inventories are:

Air emissions accounts – greenhouse gases (residence principle)	Greenhouse gas emission inventories (territory principle)
Emissions are assigned to the country where the economic operator causing the emission is resident.	Emissions are assigned to the country where the emission takes place
Emissions are classified by economic activity, following the NACE classification of the system of national accounts.	Emissions are assigned to processes classified according to their technical nature (e.g. combustion in power plants, solvent use).
Emissions from international navigation and aviation are assigned to the countries where the operator of the ship/aircraft is resident, regardless of where the emission takes place.	Emissions from international navigation and aviation are assigned to the countries where the associated fuel is bunkered, irrespective of the operator's place of residence.

Note: National and EU totals differ between the two approaches, as different boundaries apply. GHG inventories include international aviation and maritime transport (international bunker fuels) as memorandum items, which means that they are excluded from national totals reported. However, they are included in air emissions accounts totals. Therefore, total emissions reported in GHG inventory databases can differ significantly from the total reported in air emissions accounts for countries with a large international aircraft and/or shipping fleet. AEA reconciles totals with emission inventories through so-called 'bridging items'.

Context

The term climate covers meteorological phenomena over a lengthy period of time, for example, trends in temperature, storm activity or rainfall. Climate change results from natural phenomena and has occurred periodically throughout history) — sometimes with catastrophic effects, such as the extinction of various species during the different ice ages. Over the past two decades a growing body of scientific evidence has been established that suggests that the most recent changes in the earth's climate have been substantially influenced by human activity, so-called anthropogenic effects.

Solar energy (heat from the sun), arrives in the earth's atmosphere as short wavelength radiation. Some of this is reflected by the earth's surface (especially from snow and ice covered areas) and atmosphere; however, the vast majority is absorbed, warming the planet. As the earth's surface gains heat, it starts to emit long wavelength, infra-red radiation back into the atmosphere. Despite their relative scarcity (less than 0.1 % of the total atmosphere, which consists mostly of nitrogen and oxygen), greenhouse gases are vital to life on earth because of their ability to act like a blanket, trapping some of this infra-red radiation and preventing it from escaping back into space; without this process the temperature on the earth's surface would be a lot colder. This layer of greenhouse gases has become thicker as a result of human activity and this process would appear to be disturbing the natural balance between incoming and outgoing radiative energy.

Substantial amounts of human-induced greenhouse gas emissions have come from the increased use of fossil fuels burned to power new machines, generate electricity and propel transport vehicles. The amount of emissions has accelerated in the last 200 years, reflecting increases in the world's population, economic development, and increased production and consumption in a globalized economy.

To prevent the most severe impacts of climate change, the international community has agreed that global warming should be kept below 2ºC compared with the temperature in pre-industrial times. That means a temperature increase of no more than 1.2°C above today's level. To stay within this ceiling, the scientific evidence shows that the world must stop the growth in global greenhouse gas emissions by 2020 at the latest, reduce them by at least half of 1990 levels by the middle of this century and continue cutting them thereafter.

EU leaders have committed to transforming Europe into a highly energy-efficient, low carbon economy. The EU has set itself objectives for reducing its greenhouse gas emissions progressively up to 2050.

For 2020, the EU has committed to cutting its emissions to 20 % below 1990 levels. This commitment is one of the headline targets of the Europe 2020 growth strategy, known as the Climate and Energy package. The headline target for a 20 % GHG emissions reduction by 2020 includes international aviation but excludes LULUCF. The core policies that contribute to reaching this target are the EU Emissions Trading System, covering major polluters in energy and industry, including aviation, and responsible for roughly 45 % of all emissions, and the Effort-Sharing Decision, covering the remaining emissions (agriculture, waste, buildings, etc.), under national binding targets for each EU Member State.

The EU internal 20 % target is also the basis for its international commitments under the Kyoto Protocol's second commitment period (2013–20). The Kyoto Protocol's scope does not include international aviation but allows for the use of carbon sinks (from LULUCF) and emissions trading for reaching compliance. In addition, the EU has offered to increase its emissions reduction to 30 % by 2020 if other major emitters commit to undertake their fair share of a global emissions reduction effort.

Looking beyond 2020, in its climate and energy policy framework for 2030, the European Union sets itself a target of reducing emissions to 40 % below 1990 levels by 2030.

For 2050, EU leaders have endorsed the objective of reducing Europe's greenhouse gas emissions by 80 % compared to 1990 levels as part of efforts by developed countries as a group to reduce their emissions by a similar degree. The European Commission has published a roadmap for building the low-carbon European economy that this will require.

Major EU initiatives to reduce greenhouse gas emissions include:

- developing and implementing the EU Emissions Trading System, with the ultimate aim of building an international carbon trading market, including aviation;
- monitoring the implementation of Member States' emission reduction targets in the sectors outside the EU ETS ('Effort Sharing Decision');
- implementing the legislation to raise the share of energy consumption produced by renewable energy sources, such as wind, solar and biomass, to 20 % by 2020;

- a target to increase Europe's energy efficiency by 20 % by 2020 by improving the energy efficiency of buildings and of a wide array of equipment and household appliances;
- binding targets to reduce CO_2 emissions from new cars and vans; and
- supporting the development of carbon capture and storage (CCS) technologies to trap and store CO_2 emitted by power stations and other major industrial installations.