Climate change - driving forces

Statistics Explained

Based on data available in October 2025.
Planned article update: October 2026.

Highlights

At EU level, all main source sectors, except transport, have reduced their greenhouse gas emissions compared with 1990.

While transport-related greenhouse gas emissions in 2023 exceeded the values of 1990, they remained below pre-COVID-19 levels.

Improved energy efficiency and changes in fuel mix are important drivers for reducing greenhouse gas emissions in the EU.

GHG emissions resulting from human activities cause anthropogenic climate change. The EU is an ambitious contributor to the global efforts to fight climate change and reduce GHG emissions and is committed to being climate neutral by 2050.

This article analyses major driving forces behind long-term trends of greenhouse gas (GHG) emissions in the European Union (EU) based on statistics available from Eurostat .

GHG emissions in the EU have decreased by 35% between 1990 and 2023 (the most recent reference year for which data officially reported to UNFCCC are available). Year 2020 had seen a special decline due to the COVID-19 pandemic. In 2021, GHG emissions increases back to the level of the long-term trend. In 2023 GHG emissions reached a level below the one recorded during the COVID-19 pandemic. The main driving forces behind the long-term fall in total GHG emissions are improvements in energy efficiency and in the energy mix.

General overview

This statistical article is organised in the same order as the reporting on the main source sectors in the GHG emission inventories . First an overall picture is given, followed by sections presenting the GHG emissions of each specific source sector together with the developments for the underlying drivers. The aim is to help the reader understand which factors influence the development of GHG emissions.

The European statistical system (ESS) collects official statistics, some of which are used to estimate GHG emissions that are reported in GHG emission inventories. While national statistical institutes are usually not directly responsible for compiling GHG emission inventory data, they often support the compilation by providing auxiliary input data.

In the EU, GHG emission inventories of Member States are collected by the European Environment Agency (EEA) on behalf of the Directorate-General for Climate Action of the European Commission , to produce the EU GHG emission inventory. Eurostat provides energy statistics to the EEA for the validation of the GHG emission inventories. Eurostat produces a range of statistics that provide a solid basis for analysing the driving forces behind GHG emissions and their patterns over time. Values on international aviation and navigation are modelled by the

Joint Research Centre of the European Commission (JRC).

Total emissions, main breakdowns by source and general drivers

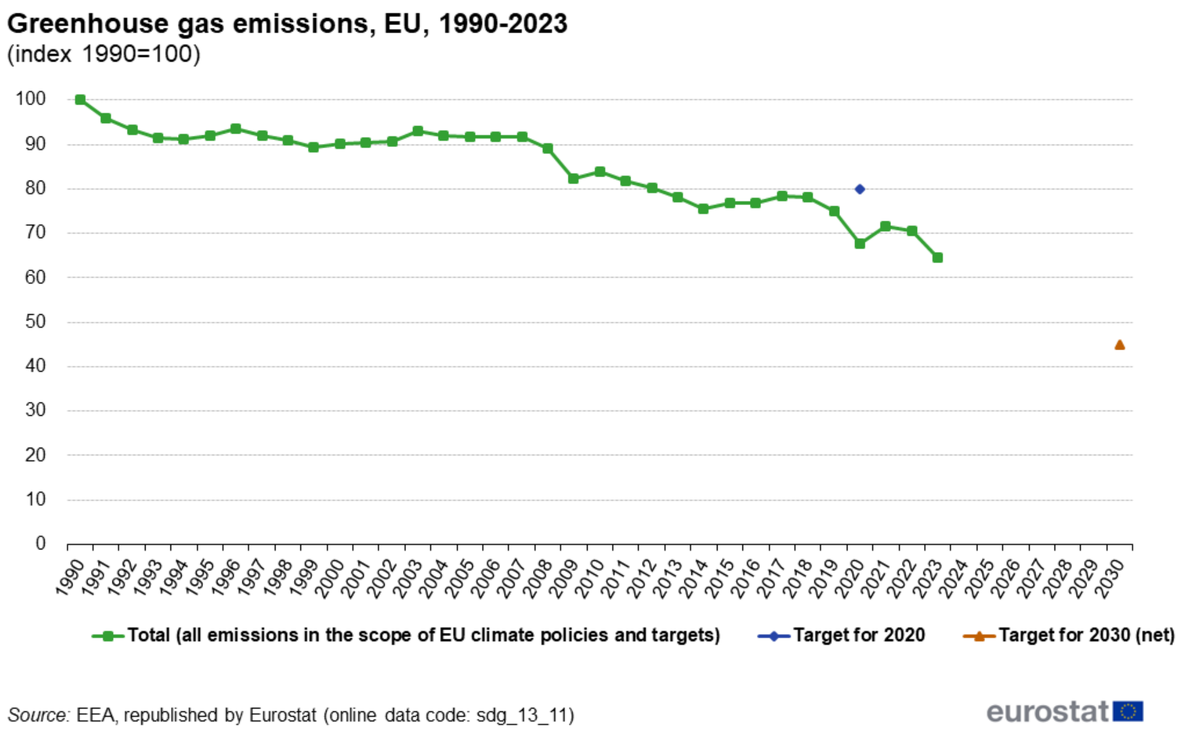


Figure 1: Greenhouse gas emissions, EU, 1990-2023 Source: EEA, JRC, republished by Eurostat (sdg_13_11)

Figure 1 shows that overall, the EU's GHG emissions have followed a downward trend over the last three decades; in 2023 - the most recent year for which figures officially reported to the UNFCCC are available – total GHG emissions in the scope of EU climate policies and targets (i.e. including LULUCF - Land use, land use change and forestry, including international aviation and navigation, while excluding the other memo items of the UNFCCC reporting; see Figure 1) decreased by 35% as compared to the 1990 levels. Due to the COVID-19 pandemic, emissions declined sharply in 2020, after which they increased to the level of the long-term pre-pandemic trend in 2021. In 2023, a similar important decline to what had been observed in 2020 was recorded again. The target proposed for 2030, a reduction of GHG emissions by 55% compared with 1990 levels is for net GHG emissions, i.e. taking into account net removals in LULUCF.

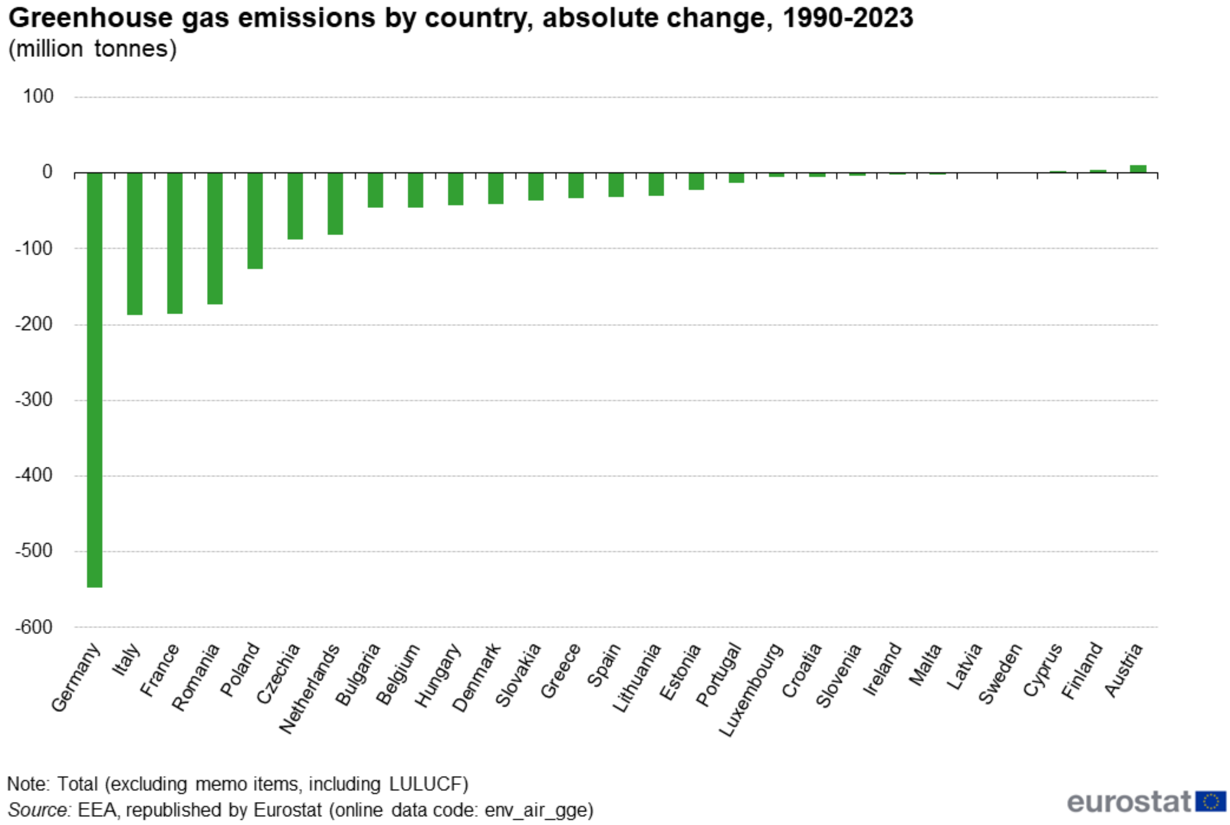


Figure 2: Greenhouse gas emissions by country, absolute change, 1990-2023 Source: EEA, republished by Eurostat (env_air_gge)

Figure 2 shows the absolute 1990-2023 change in GHG emissions by country. These absolute changes add up to the EU total reduction of 1.73 billion tonnes of CO2-equivalent. Note that the ranking would change to a large extent if the relative changes or changes in emissions per capita were compared. The rest of this Statistics Explained article will focus on the aggregate for the EU. More information for individual EU countries can be retrieved from GHG inventory dataset in Eurostat's database.

The greenhouse gas emissions reported in Figure 1 are all due to human activities. Therefore, one may think that more people would cause more GHG emissions. In addition, most of these human activities are economic activities, for example to produce and consume goods and services. Hence, one may also expect that more economic activity would produce more GHG emissions. As a result, an informative way to assess trends in GHG emissions is to examine them against a unit of population (per capita) or unit of economic activity. The most general indicator for economic activity is gross domestic product (GDP) .

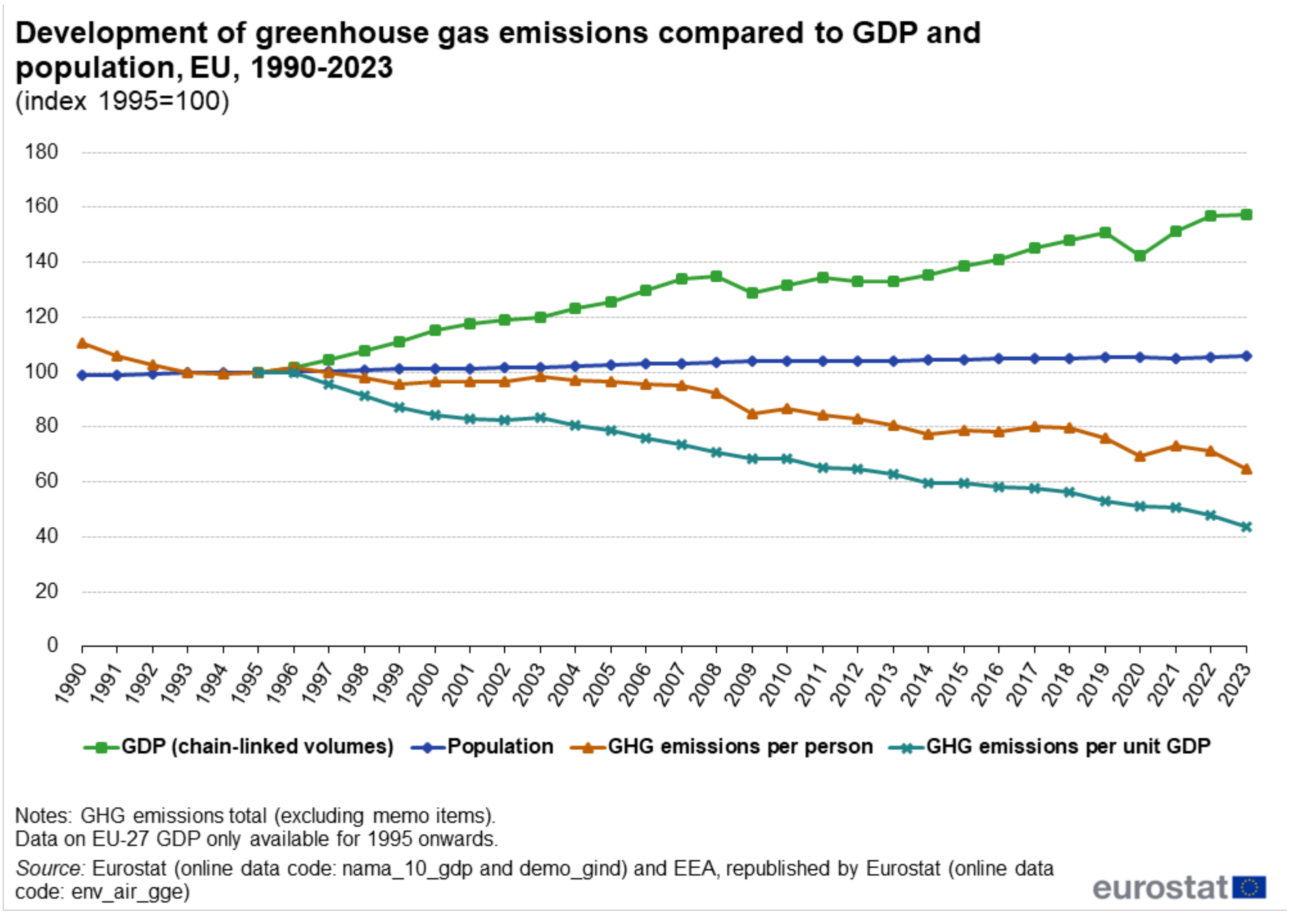


Figure 3: Development of greenhouse gas emissions compared with GDP and population, EU, 1990-2023
Source: Eurostat (nama_10_gdp) (demo_gind) and EEA, republished by Eurostat (env_air_gge)

Figure 3 shows an upward trend for GDP (except for year 2020, due to the COVID-19 pandemic) and a less distinctive, but also upward trend for population. Over the last decades, the average annual growth rates for GDP and population are 1.7% and 0.2%, respectively. The GHG emissions per person in the EU have been declining, on average by -1.5% annually.

This implies that there must have been changes in how these human activities were carried out, so that even with almost continuous economic growth and increasing population, greenhouse gas emissions are being reduced.

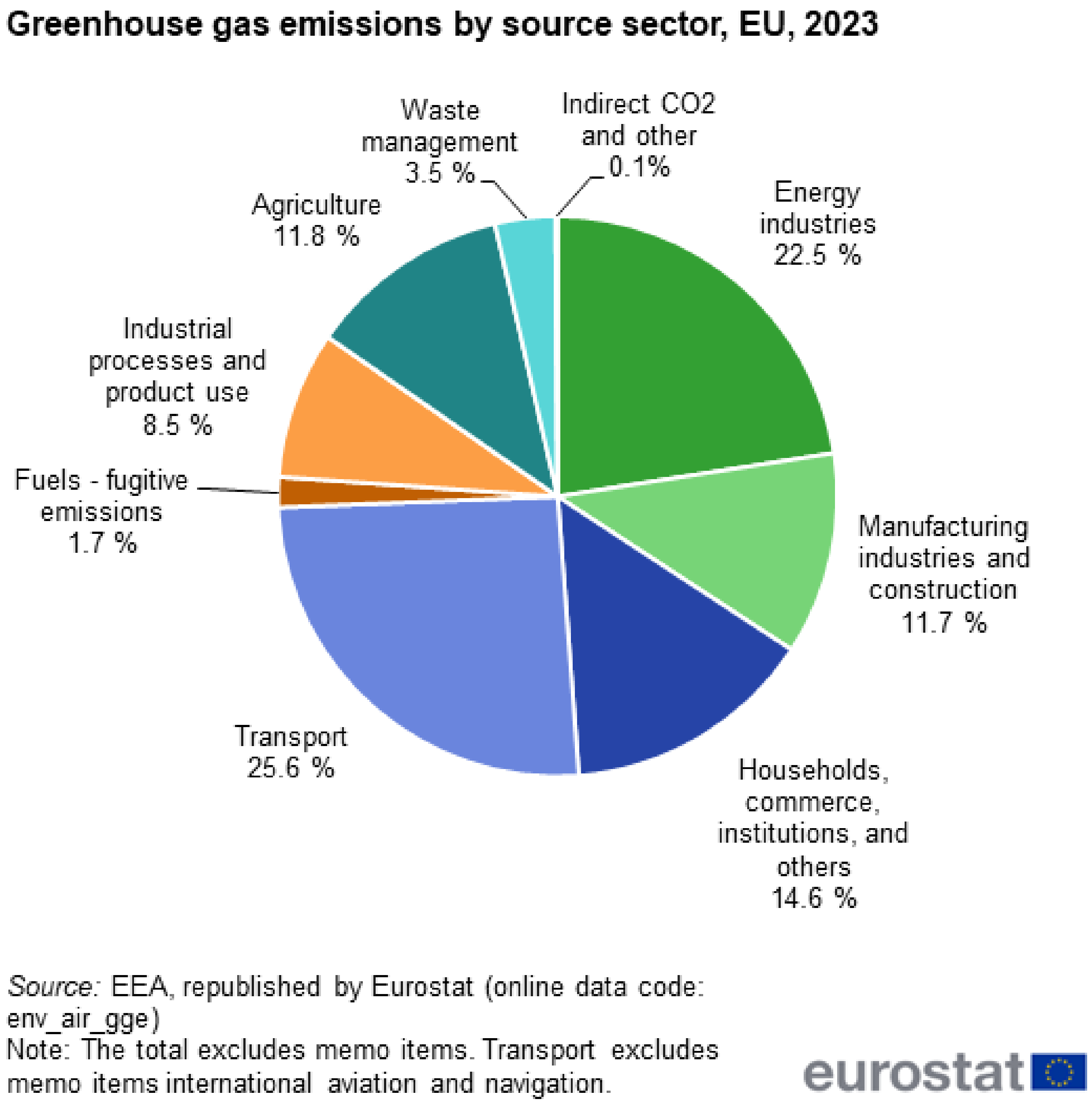


Figure 4: Greenhouse gas emissions by source sector, EU, 2023 Source: EEA, republished by Eurostat (env_air_gge)

To understand better the driving forces behind the reduction in GHG emissions, we need to look in more detail at the sources of these GHG emissions and the underlying human activities. Figure 4 shows the GHG emissions broken down by source sectors as reported in UNFCCC GHG emission inventories .

As shown in Figure 4, about three-quarters of the GHG emissions are due to fuel combustion. This includes fuel combustion to generate electricity and heat (energy industries), to manufacture goods and to construct buildings and infrastructure (manufacturing industries and construction), to heat buildings and water (households, commerce etc.), and to move freight and persons (transport). The remaining share of total GHG emissions, about one quarter, is due to other activities that mostly do not involve fuel combustion. These include industrial processes and product uses, agricultural activities, and waste management.

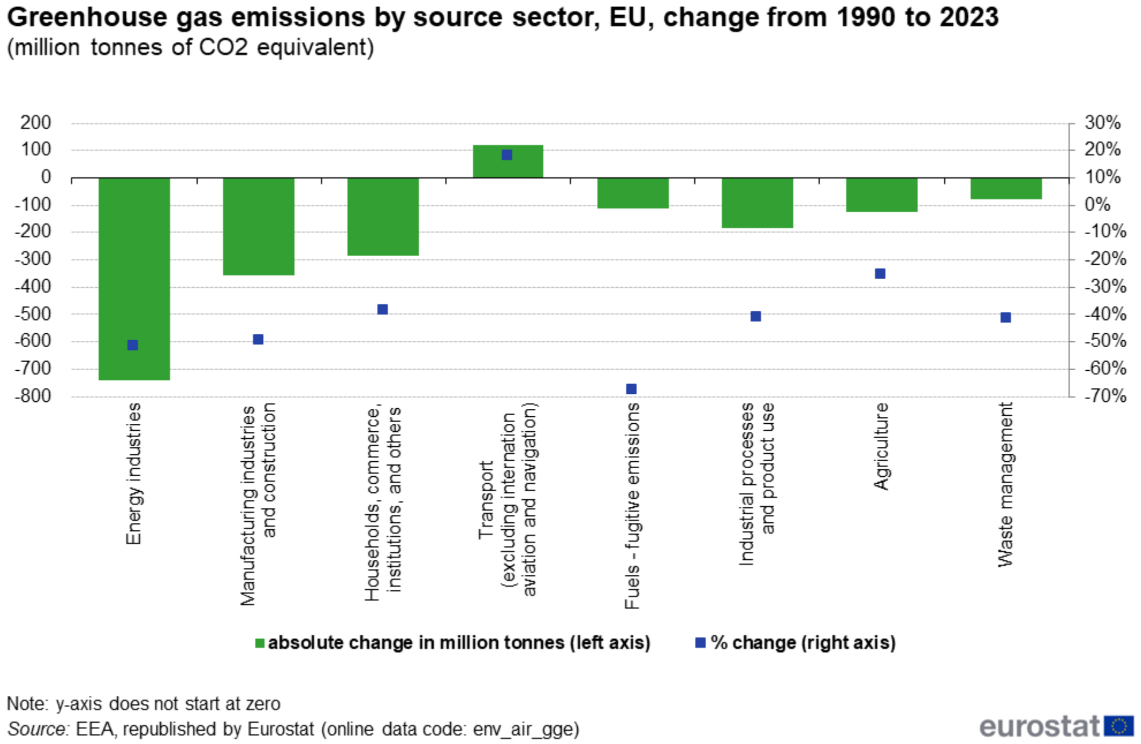


Figure 5. Greenhouse gas emissions by source sector, EU, change from 1990 to 2023 Source: EEA, republished by Eurostat (env_air_gge)

Overall, GHG emissions have been declining, and this holds for most source sectors (see Figure 5). However, there is one exception; GHG emissions from fuel combustion in transport have increased, compared with 1990. The largest absolute decrease in emissions occurred in the fuel combustion of the energy sector, which was mainly linked to the generation of electricity and heat. An impressive reduction in both absolute and relative terms can be seen for fuel combustion in manufacturing industries and construction. The remainder of this article looks at the source sectors in more detail and explains what is behind these changes.

Fuel combustion

In 2023, GHG emissions from fuel combustion stood at 2 310 million tonnes; which was 1 263 million tonnes, or 35% less than in 1990. Please note that these figures exclude international aviation and navigation. Other means of transport are included.

Fuel combustion is broken down into 4 sub-sectors, 3 of which are presented in Figure 6. Transport, the fourth sub-sector of fuel combustion is discussed further below.

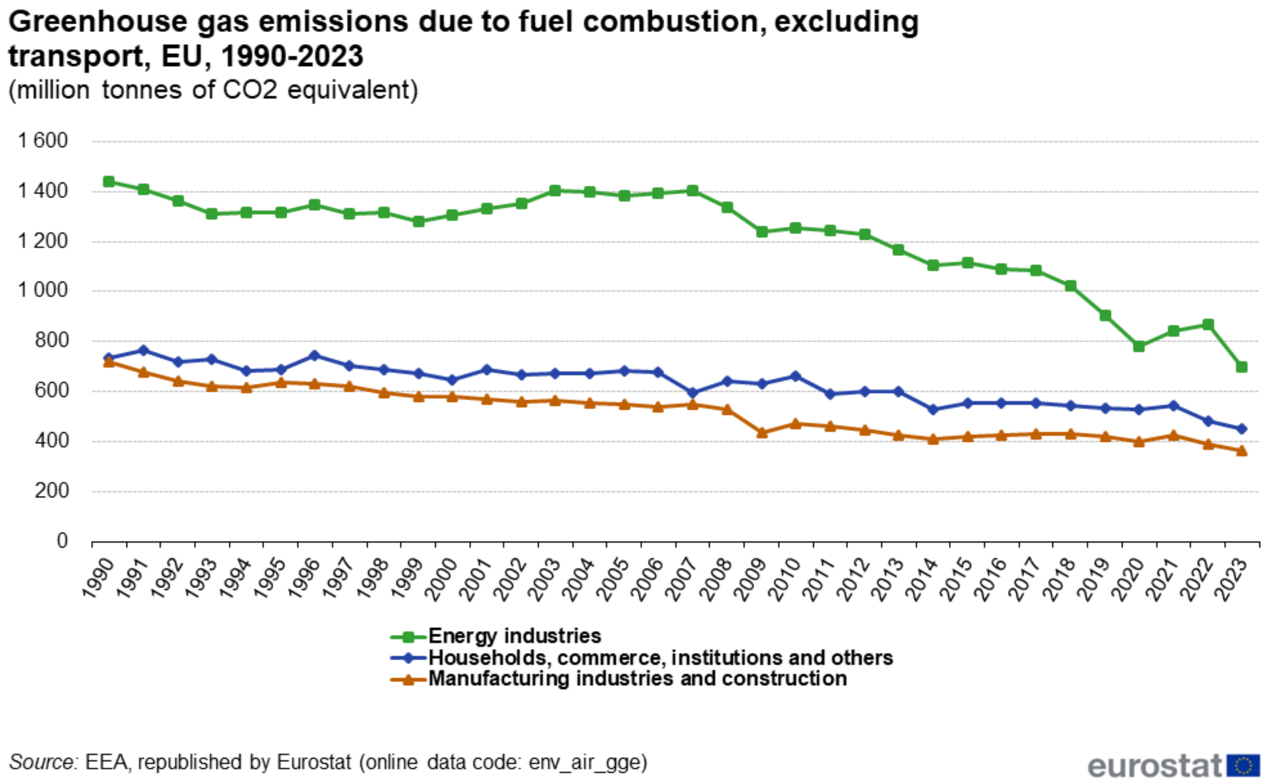


Figure 6: Greenhouse gas emissions due to fuel combustion, excluding transport, EU, 1990-2023 Source: EEA, republished by Eurostat (env_air_gge)

Energy industries

Total GHG emissions of fuel combustion by the energy industries (public electricity and heat production, petroleum refining, and manufacturing of solid fuels) have fallen strongly from 1990 to 2023 by 742 million tonnes of CO2-equivalent or 51% (Figure 5). This development in GHG emissions by 51% in the energy sector is the largest relative decrease among all fuel combustion source sectors and the amounts of GHG emissions reported in 2023 (700 million tonnes) is even lower than the value reported during the COVID-19 pandemic in 2020 (778 million tonnes). At the same time, the production of electricity and heat has increased by 9%. The driving force behind this positive development is the change in fuel mix in the energy sector. Emission-intensive solid and liquid fossil fuels have been replaced by renewable energy sources and natural gas. The latter does not produce as many emissions as the combustion of solid and liquid fossil fuels.

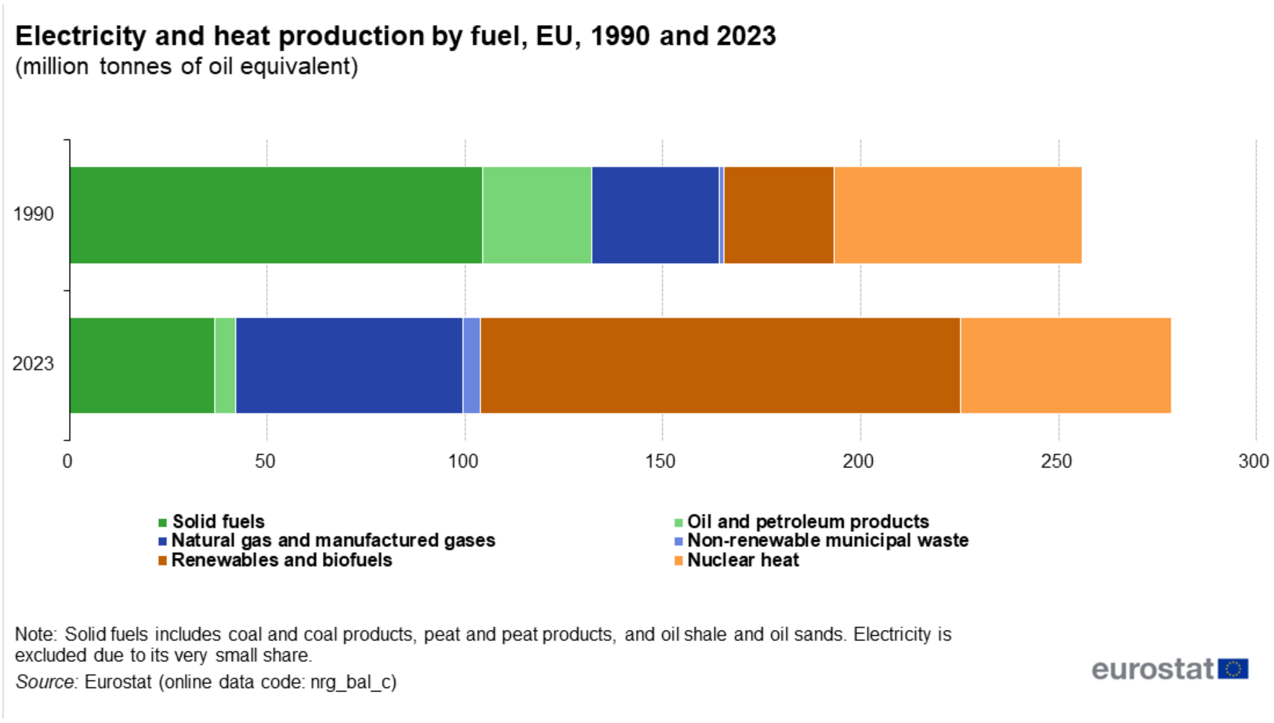


Figure 7: Electricity and heat production by fuel, EU, 1990 and 2023 Source: Eurostat (nrg_bal_c)

Of the GHG emissions from fuel combustion by energy industries, 82% is due to public electricity and heat production. Figure 7 compares the production of electricity and heat in 1990 with 2023 by type of fuel. The most remarkable finding is the increase by 9% of the total production of electricity and heat, from 256 to 279 million tonnes of oil equivalent (MTOE). However, the energy sources that have contributed most to this increase in absolute terms are renewable ones showing an increase of 94 MTOE, and gas of 25 MTOE.

Figure 7 also shows that the use of solid fuels and crude oil and petroleum products both decreased significantly from 1990 to 2023. These are both fuel types with high emission coefficients; in other words, fuel types that emit relatively large amounts of GHG when they are combusted.

Renewables can also replace fossil fuels indirectly by substituting electricity generated from fossil fuels with electricity generated from renewable energy sources. Examples are electric cars and electric cooking and heating, which do not combust fuels on the spot. Hence, electricity from renewable sources has a large potential to reduce GHG emissions from fuel combustion.

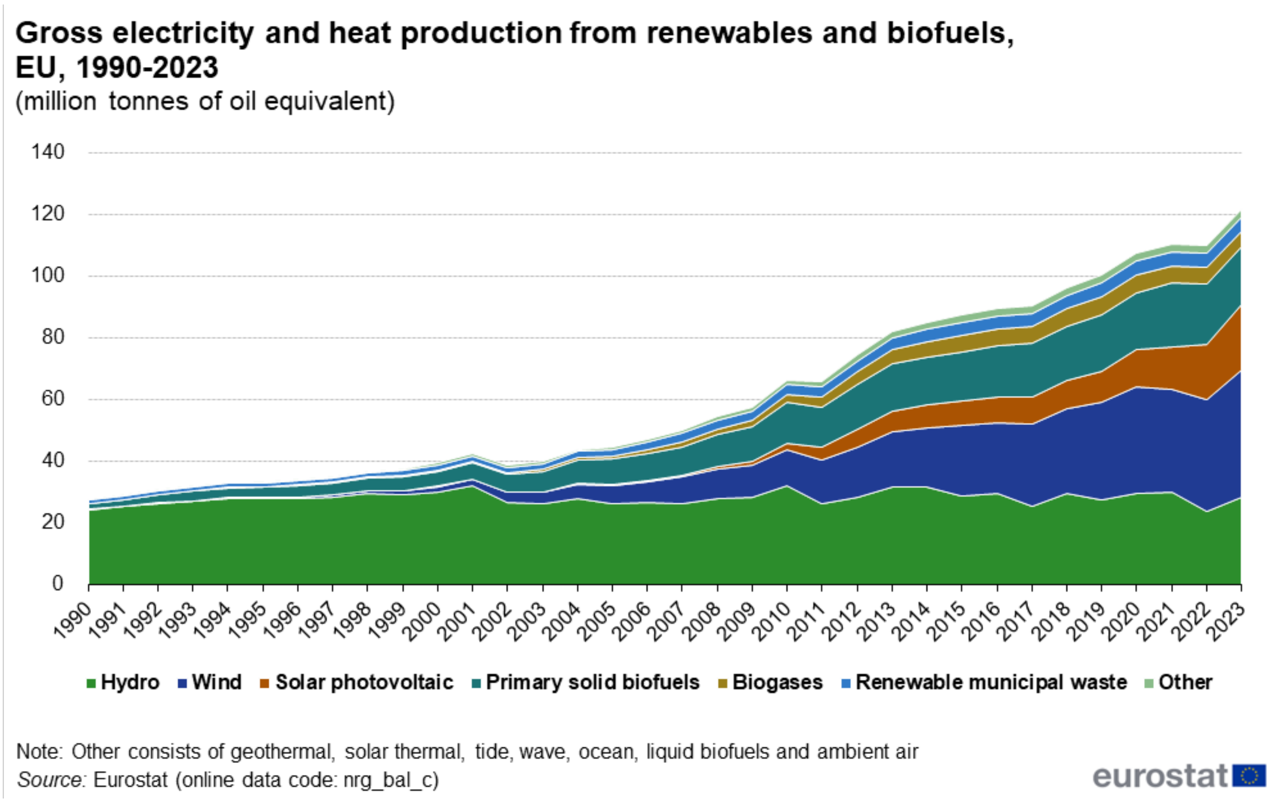


Figure 8: Gross electricity generation from renewable energy, EU, 1990-2023 Source: Eurostat (nrg_bal_c)

Figure 8 shows the relative contribution of renewables to the increase in electricity generated from this source in 1990-2023. From the first years of the millennium, electricity generated from renewable sources more than tripled. While hydro-electric power was almost completely responsible for all renewable electricity generated in 1990 with 88%, it generated only 23% of electricity in the EU in 2023. Wind power has clearly seen the largest overall increase with 34% of renewable energy generated by this source in 2023, followed by solar photovoltaic power accounting for 17% in 2023.

Manufacturing industries and construction

Fuel combustion in manufacturing industries and construction is the source sector with the second largest reduction in GHG emissions between 1990 and 2023 by 358 million tonnes of CO2-equivalent (Figure 5) representing a 50% decrease. This drop in emissions is driven by an increase in energy efficiency, in other words producing more output with less energy, and a change in the fuel mix. Figure 6 illustrates that this has been a steady path over the years, with small interruptions

linked to the economic recession (2009) and the COVID-19 pandemic and the post-pandemic recovery (2020 - 2021).

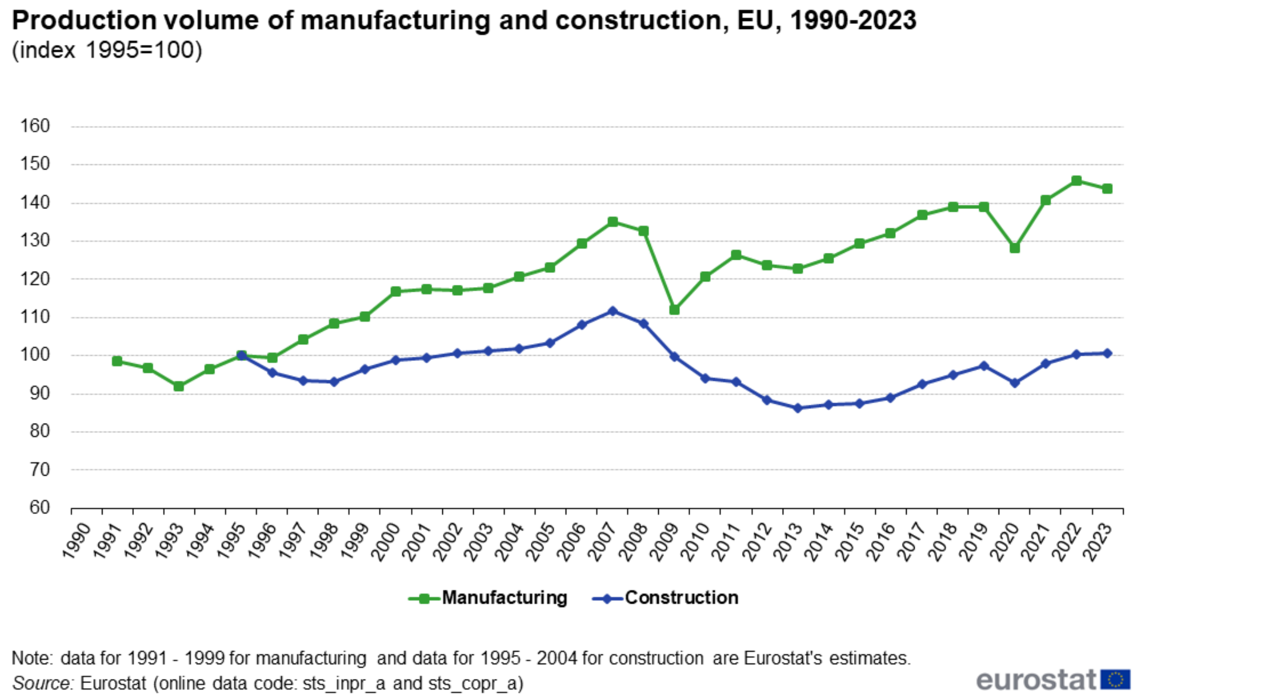


Figure 9: Production volume of manufacturing and construction, EU, 1990-2023 Source: Eurostat (sts_inpr_a) (sts_copr_a)

This is in contrast to the production volume by manufacturing, which has increased over these years as shown in Figure 9. Manufacturing output has increased most years, with large drops only in 2009 as a result of the recession and recently due to the COVID-19 pandemic. Construction output shows a different path: the decrease in construction output lasted up to 2013 when it has started slowly increasing until 2019 before dropping again due to COVID-19. Still, just prior to the economic recession, construction output was around 10% higher than in the nineties, without having a visible impact on the GHG emissions for these years. While years 2021-2022 showed an increase in manufacturing and construction volume, the trajectory has dropped in 2022-2023 for both sectors (see Figure 6).

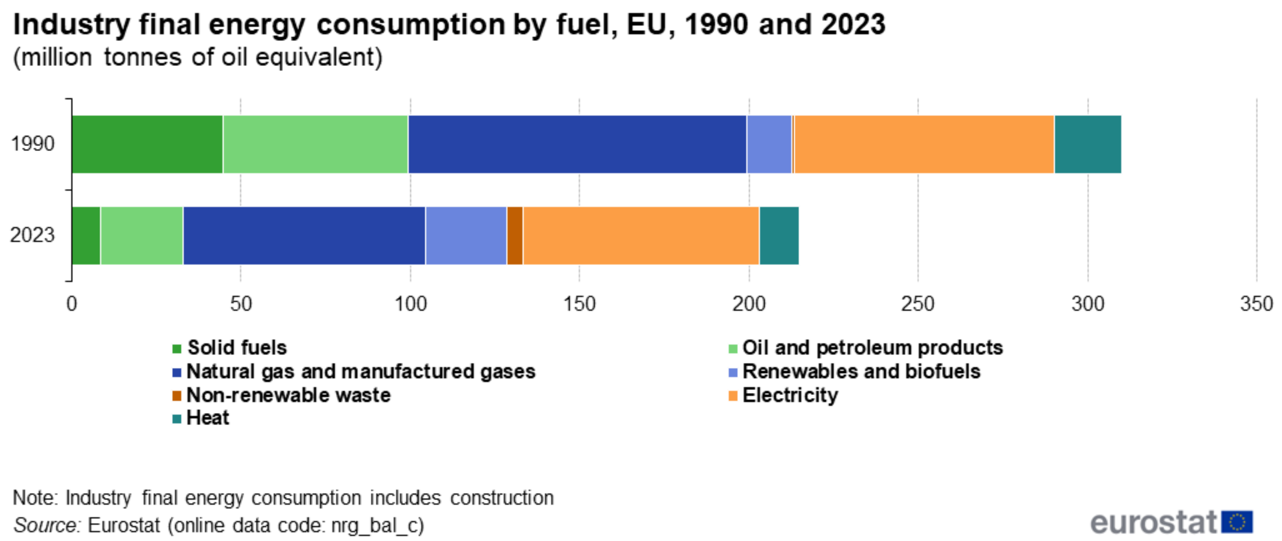


Figure 10: Industry final energy consumption by fuel, EU, 1990 and 2023 Source: Eurostat (nrg_bal_c)

Although production output has increased in these industries in 1995-2023, the GHG emissions have fallen and hence the GHG intensity of the activities has been reduced. The industries' final energy consumption composition in Figure 10 shows the two underlying drivers for the reduction in GHG emissions: energy efficiency and a change in the fuel mix. Energy efficiency has increased, because more is produced with less energy; from 1990 to 2023 the total final energy consumption by industry has fallen by 31%. In addition, the fuel mix has changed: the consumption of solid fuels and total petroleum products has been reduced by 81% and 55% respectively, whereas the use of renewable energy, including biofuels has increased by 85%. This implies less greenhouse gas emissions from fuel combustion per unit of final energy consumption by industries.

Households, commerce, institutions and others

GHG emissions from fuel combustion by households, commerce, institutions and others arise mainly in connection to space heating and warm water. They contributed with a drop of 284 million tonnes of CO2-equivalent to the overall reductions of GHG emissions in 1990-2023 (see Figure 5) mainly due to a change in the fuel mix used, as shown in Figure 11.

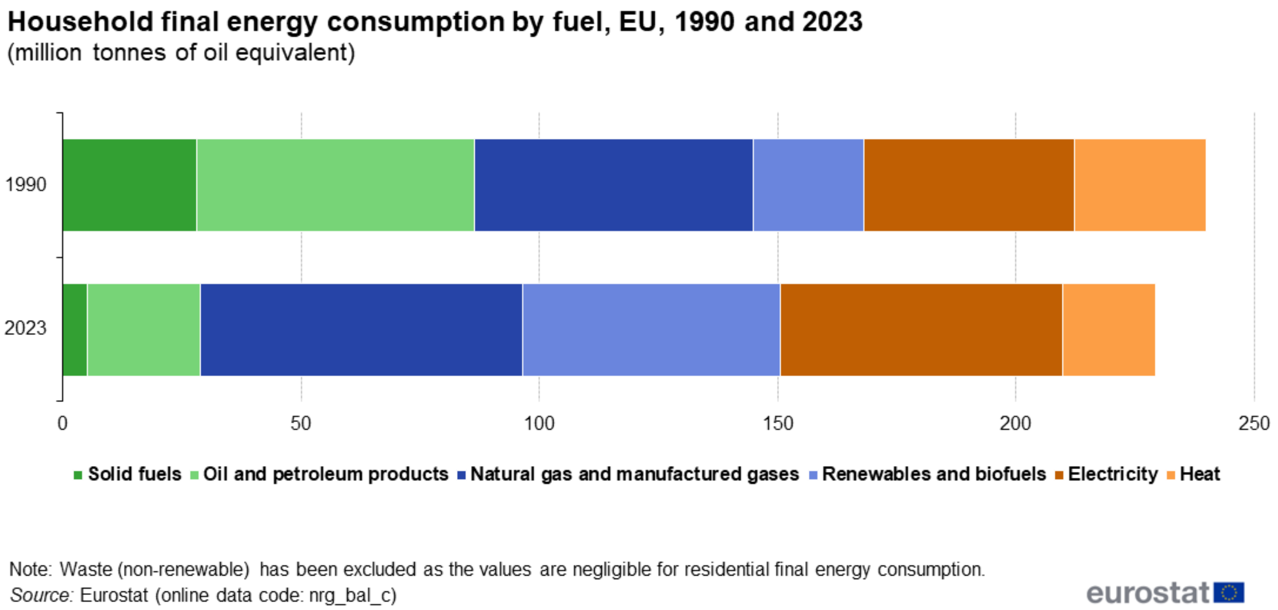


Figure 11: Household final energy consumption by fuel, EU, 1990-2023 Source: Eurostat (nrg_bal_c)

The relative drop in GHG emissions of 39% from 1990 to 2023 (Figure 5) follows from a relatively stable downward trend (Figure 6). Fuel combustion-born GHG emissions can be related to final energy consumption in households and commerce. Figure 11 shows associated changes in the final energy consumption of households between 1990 and 2023. Final energy consumption by households decreased by 4% over this time period and the use of solid fuels and petroleum products decreased by 81% and 59%, respectively. Households now use substantially more renewables including biofuels (increase by 134%), natural gas (increase by 15%) and electrical energy (increase by 34%).

Transport-related emissions, including emissions from international aviation and international navigation

The transport sector is the only fuel combustion sub-sector, which shows an increase in GHG emissions over the last decades. Between 1990 and 2023, transport-related GHG emissions (including international aviation and navigation) increased by 25%, or 210 million tonnes of CO2-equivalent (Figure 12). In 2020, GHG emissions from transport dropped by more than 200 million tonnes CO2-equivalent due to the COVID-19 pandemic. By 2022, these emissions have returned back to pre-pandemic levels. A minor decrease is shown between 2022 and 2023.

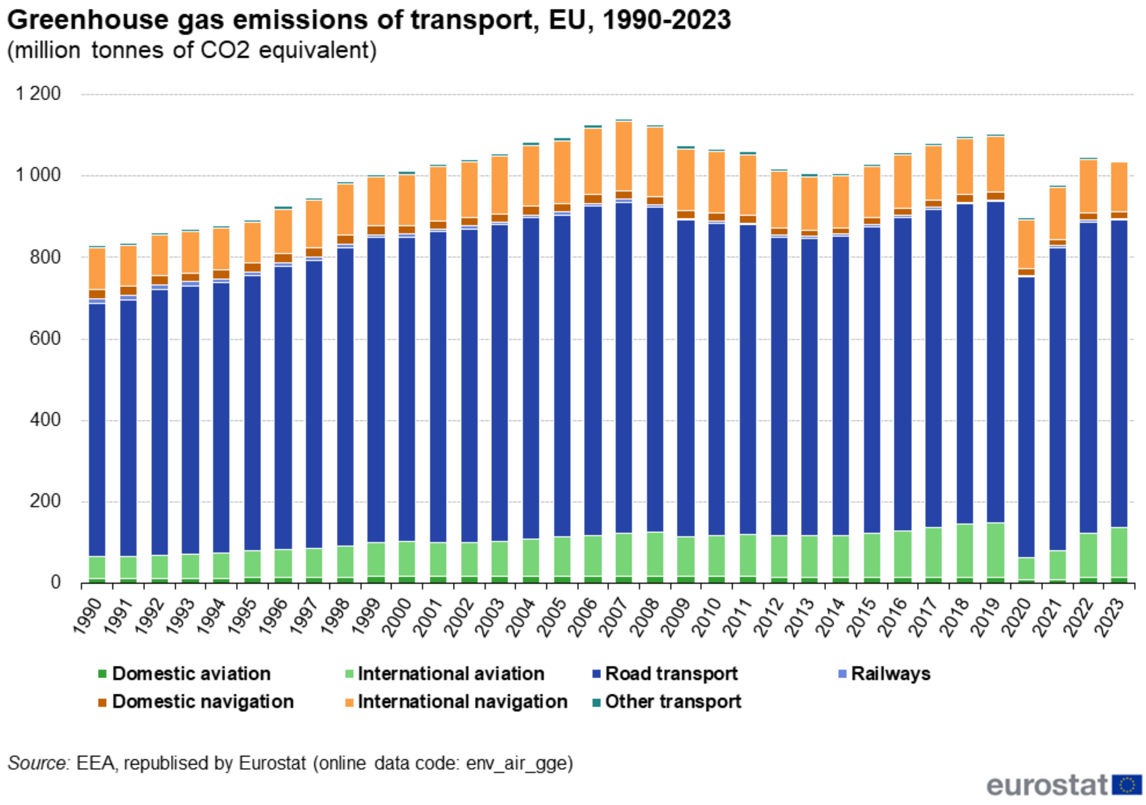


Figure 12: Greenhouse gas emissions of transport, EU, 1990-2023 Source: EEA, republished by Eurostat (env_air_gge)

Figure 12 presents the development of GHG emissions by the transport sector over time in more detail. Road transport is the largest contributor accounting for approximately three quarters of transport-related GHG emissions and its share has remained relatively stable (71-77%) throughout 1990-2023. International aviation, which is currently the second most important contributor to the GHG emissions of transport, accounted for only 7% of transport-related GHG emissions in 1990, but this has increased to 12% already in 2018, then dropped due to the COVID-19 related restrictions, and has reached the same level of 12% again in 2023. The relative contribution of international navigation, currently representing 12% of the GHG emissions of transport, has remained relatively stable (12-15%) in 1990-2023.

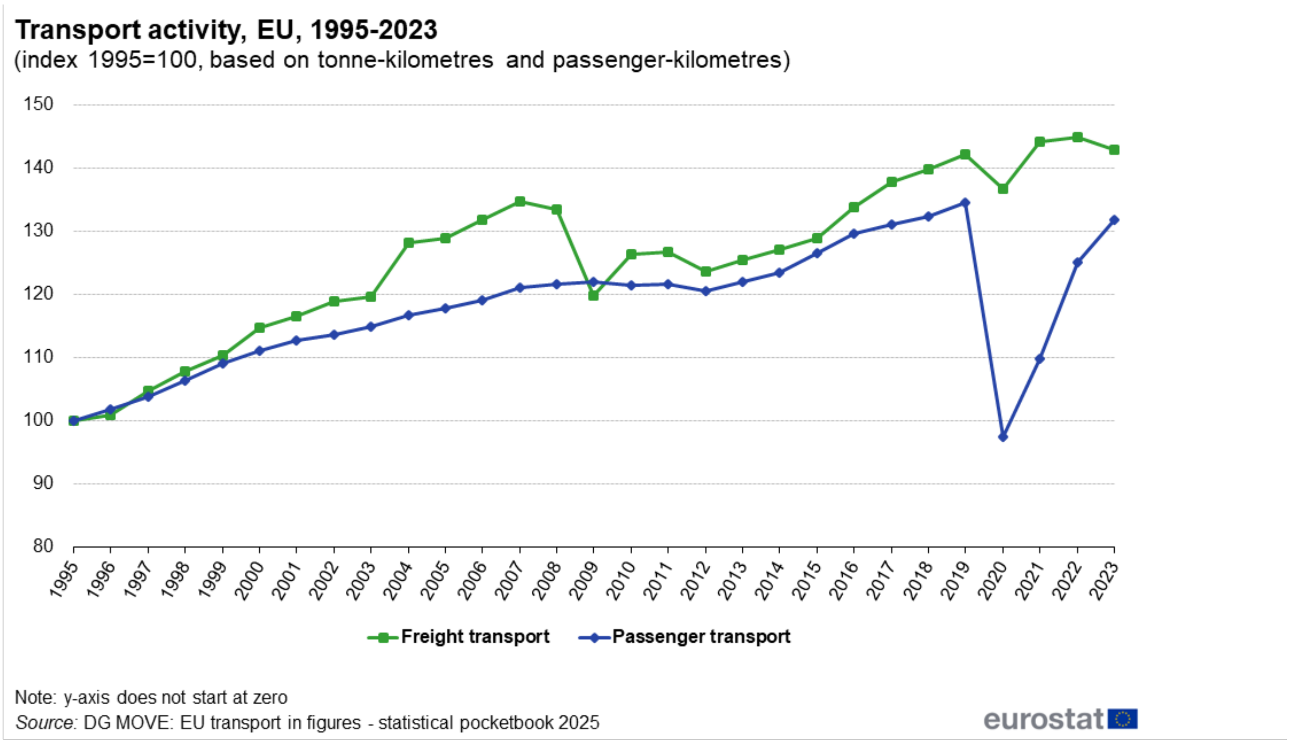


Figure 13: Transport activity, EU, 1995-2023 Source: DG MOVE Statistical Pocketbook 2025

The development in GHG emissions correlates closely with overall transport activity, also referred to as transport performance or transport volume, measured in tonne-kilometres and passenger-kilometres , see Figure 13. Passenger transport has increased during most of the years until 2019, showing a steep decrease in 2020 due to the COVID-19 pandemic and a recovery almost to pre-pandemic levels in 2023. Freight transport shows the impact of the economic recession in 2009 and of the COVID-19 pandemic in 2020, a complete recovery and an exceedance of pre-pandemic levels in 2021-2022, followed by a small decline in 2023. Transport performance statistics confirm that road transport is the most significant mode of transport: 81% of passenger transport performance and 53% of freight transport performance was accounted for by road transport in 2023, if considering all types of transport modes (inland, air and maritime transport).

The energy consumption in transport has increased in line with the increase in transport activity. Almost all fuel used in transport consists of petroleum products and there has only been a marginal shift towards renewables, so there has not been a significant favourable shift in the fuel mix as seen for the other sectors.[1].

To conclude this section on GHG emission from fuel combustion, energy mix changes seem to be the driving force behind the reduction of emissions in most fuel combustion sub-sectors. The following sections describe the GHG emissions by source sectors other than fuel combustion.

Industrial processes and product use

The source sector 'industrial processes and product use' is responsible for 8.5% of total GHG emissions (see Figure 4). It has seen an absolute reduction in GHG emissions of equal 186 million tonnes of CO2-equivalent in 2023 compared with 1990, representing a decrease of 41% (see Figure 5). This source sector represents a wide range of production processes and economic activities across different industries (see examples in Table 1). It excludes GHG emissions from fuel combustion, covered in the sections above.

[1] For an in-depth analysis of developments in the environmental performance of transport in the EU see the Transport and Environment Report 2022

Greenhouse gas emissions from industrial processes and product use - selected source sectors, EU, 1990 and 2023

(million tonnes of CO_2 equivalent)

		1990	2023	% share in total 1990	% share in total 2023	change 1990-2023 million tonnes	change 1990-2023 %
CRF2	Industrial processes and product use	450	265	100	100	-186	-41
CRF2A	Mineral industry	134	88	30	34	-46	-34
CRF2A1	Cement production	95	61	21	23	-34	-36
CRF2B	Chemical industry	162	47	36	17	-114	-71
CRF2B2	Nitric acid production	41	2	9	1	-39	-96
CRF2C	Metal industry	134	59	30	23	-75	-56
CRF2C1	Iron and steel production	104	55	23	21	-49	-48
CRF2F	Product uses as substitutes for ozone depleting substances	0	57	0	21	57	928 888
CRF2F1	Refrigeration and air conditioning	0	51	0	19	51	1 102 797

Note: included sub-sectors have a rounded share in the total equal or larger than 10% in either 1990 or 2023

Source: EEA, republished by Eurostat (online data code: env_air_gge)

eurostat

Table 1: Greenhouse gas emissions from industrial processes and product use - selected sectors, EU, 1990 and 2023 Source: EEA, republished by Eurostat (env_air_gge)

To understand what drives the reduction in GHG emissions, it is useful to have a more detailed look at the sub-sectors with the largest contributions. Table 1 shows a selected subset of the industrial processes and product use source sector. All production processes that traditionally had a large share in the total GHG emissions, namely mineral (cement, lime, glass), chemical and metal manufacturing, have reduced their GHG emissions sizably.

To complete the overview, an opposite trend is seen for sub-sector 'product uses as substitutes for ozone depleting substances' which mainly relates to the emissions of fluorinated gases (F-gases). Within this sub-sector, 'refrigeration and air conditioning' has by far the largest absolute increase with 51 million tonnes of CO2-equivalent in 1990-2023. The demand for refrigeration and air conditioning is likely to increase in the future, so the GHG intensity of this source sector will need to be reduced (see the section on GHG intensities of economic activities below).

Agricultural emissions

Out of the total GHG emissions in 2023, 11.8% were emitted by the agricultural source sector (see Figure 4). Over the period of 1990 to 2023, the source sector reduced its emissions by 125 million tonnes of CO2-equivalent, which corresponds to a reduction of 25% (see Figure 5). Figure 14 shows the GHG emissions in 1990 and 2023 for different agricultural activities.

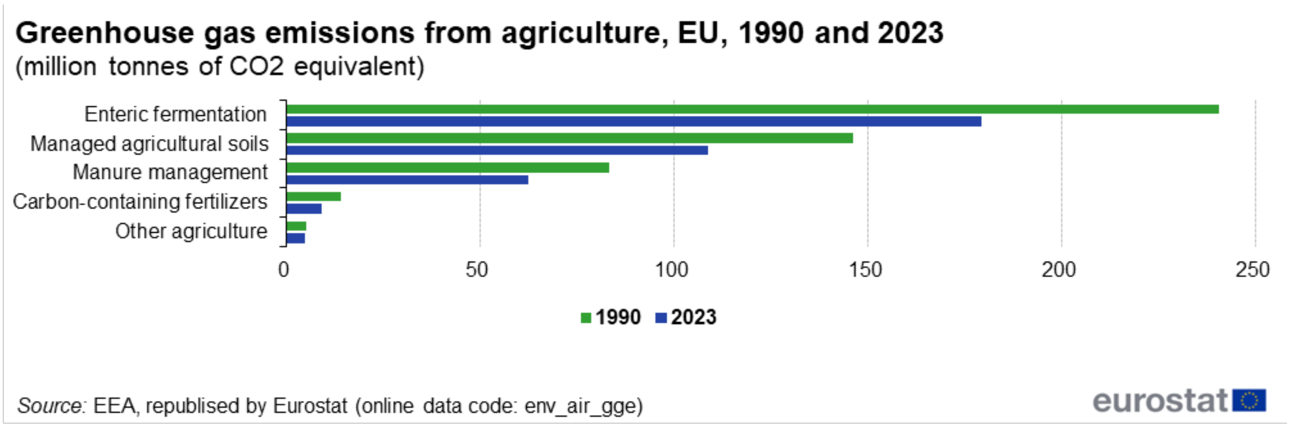


Figure 14: Greenhouse gas emissions from agriculture, EU, 1990 and 2023 Source: EEA, republished by Eurostat (env_air_gge)

Emissions from enteric fermentation, which comprises the digestive processes of animals and results in the emissions of methane, were reduced by 61 million tonnes of CO2-equivalent or 25% of the 1990 GHG emissions in 2023. The largest share of the GHG emissions due to enteric fermentation, 86%, are from the digestive system of cattle. These emissions fell by 25% since 1990, but the decrease in GHG emissions primarily took place during the first decade; between 2001 to 2023, emissions have been reduced by only 9%, whereas there was a 12% drop in the head count of bovine animals, which includes cattle, buffaloes and oxen (Figure 15). Note, data on bovine animals for the EU are not available for the years before 2001.

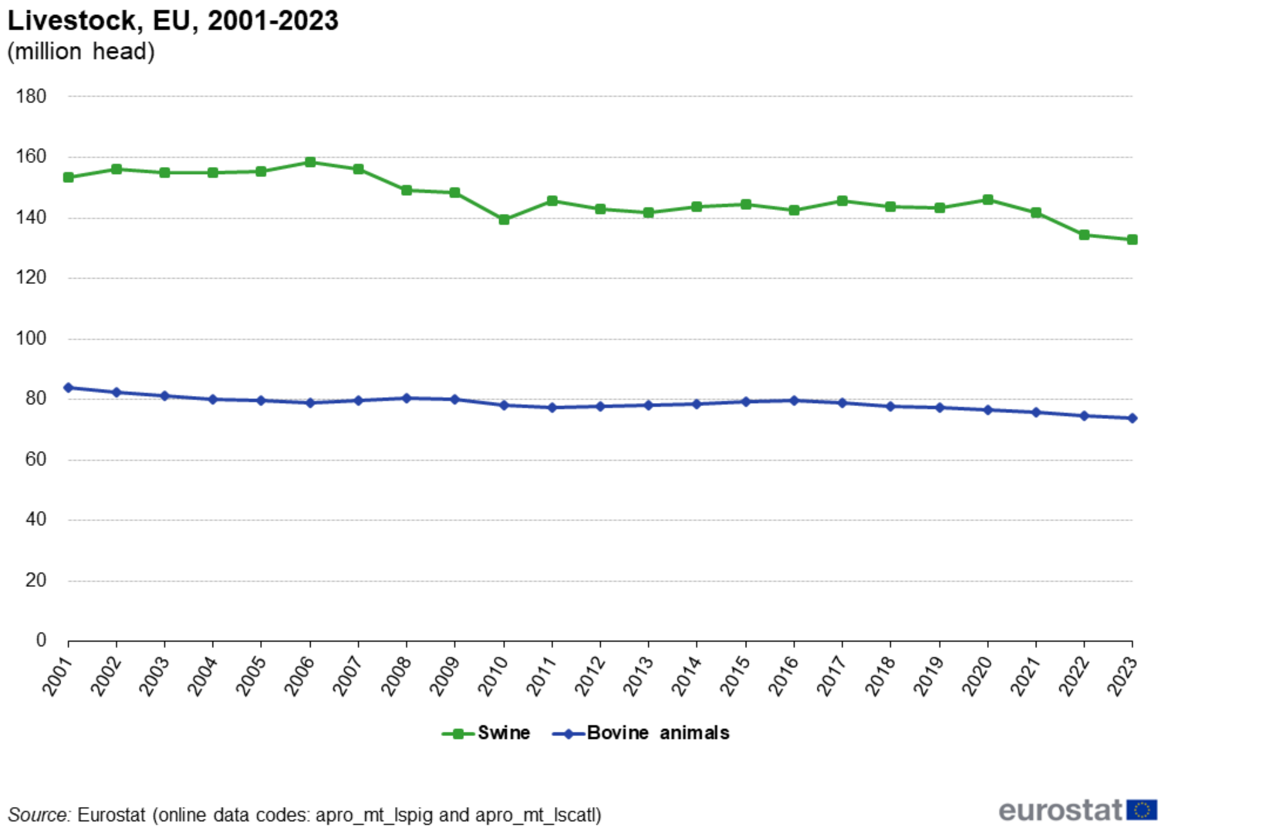


Figure 15: Livestock, EU, 2001-2023 Source: Eurostat (apro_mt_lspig) (apro_mt_lscatl)

Not all digestive systems produce as much methane as the digestive system of cattle. For example, the head count of swine in the EU is almost twice the head count of bovine animals, as shown in Figure 15. Still, the enteric fermentation of swine results in only 2%, of total GHG emissions of enteric fermentation.

Emissions from manure management fell by 21 million tonnes of CO2-equivalent or 25% in 1990-2023 (see Figure 14). GHG emissions from manure management are either estimated based on livestock statistics or manure management system usage data. They include methane emissions (two-thirds on average) and nitrous oxide emissions (one-third on average).

Emissions from waste

Emissions from waste have fallen mainly due to a reduction in GHG emissions from solid waste disposal, which is a direct consequence of a decrease in landfilling ; i.e. the deposition of waste into or onto land. Decomposition of the organic fraction of waste in absence of or at low levels of oxygen leads to methane emissions. Such conditions are typical for landfills. In 2023, waste management accounted for 3.5% of total GHG emissions (see Figure 4). GHG emissions from waste management have been reduced by 76 million tonnes of CO2-equivalent, or 41% between

1990 and 2023.

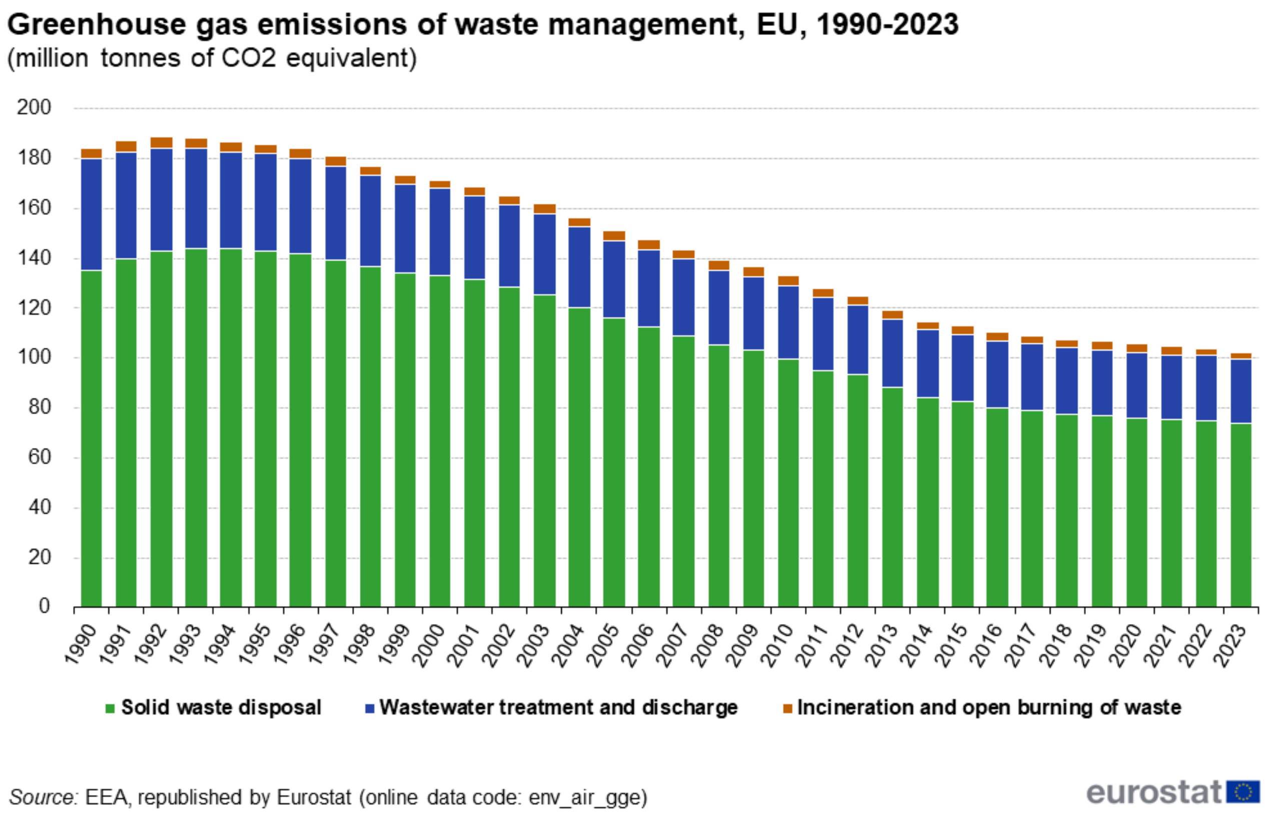


Figure 16: Greenhouse gas emissions of waste management, EU, 1990-2023 Source: EEA, republished by Eurostat (env_air_gge)

Figure 16 shows that waste management emissions of GHG remained relatively stable in the first half of the 1990s. Since the second half of the 1990s, GHG emissions started to decrease and have continued to do so in a very stable way until the first half of the 2010s, after which the decrease has slowed down. In absolute terms, the decrease was largest for solid waste disposal with 61 million tonnes CO2-equivalent or 45% in 1990-2023. Waste water treatment reduced its GHG emissions by 42% (19 million tonnes of CO2-equivalent). Figure 17 shows statistics from municipal waste treatment that give more background on the apparently steady fall of GHG emissions from waste management.

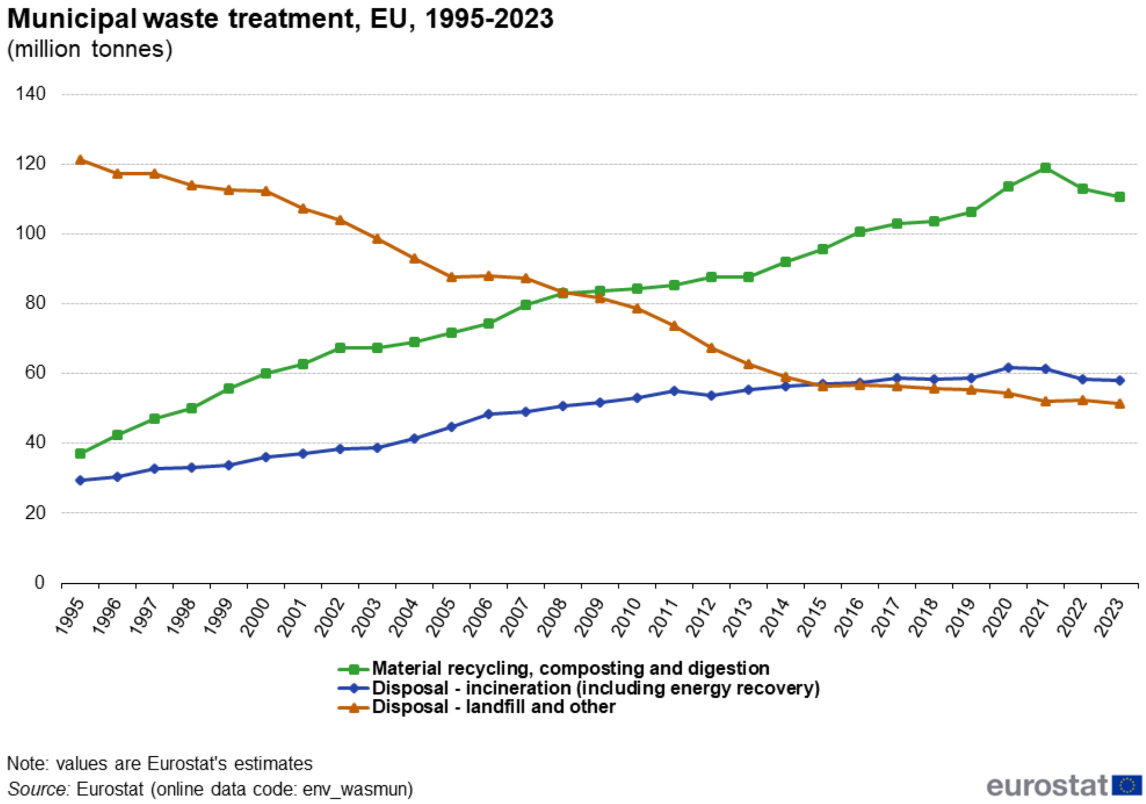


Figure 17: Municipal waste treatment, EU, 1995-2023 Source: Eurostat (env_wasmun)

Waste landfilling was reduced by 58% in 1995-2023. There are two main reasons for this reduction. First, the recycling and composting of solid waste is now 3 times its 1995 value. Given that 1) our economy is growing and needs materials to produce goods and services, 2) material resources are not unlimited and 3) the use of primary materials needs to be reduced, recycling has become more and more important. Second, total incineration with energy recovery has increased. This seems counterfactual to the fact that reported GHG emissions from incineration have decreased. However, GHG emissions from incineration with energy recovery are not recorded in the waste source sector of the GHG emission inventories (discussed here), but in the energy source sector (discussed above). In addition, carbon dioxide emissions from burning biomass are only included as a memo item in the GHG emission inventories and are not included in the total value of GHG emissions reported. Figure 7 shows that waste used as a fuel to produce electricity and heat has quadrupled over 1990-2023.

The strong reduction in landfilling as a treatment of waste is a combined result of the Waste Framework Directive (Directive 2008/98/EC) and the Landfill Directive (Council Directive 1999/31/EC). The Waste Framework Directive sets out a waste hierarchy in waste prevention and management with waste disposal (landfilling) being the last on the list. The objective of the Landfill Directive is to prevent or reduce, as far as possible, the negative effects on the environment and risks to human health from the landfilling of waste. The New Circular Economy Action Plan helps accelerate EU's shift to a resource-efficient, low-waste and climate-neutral economy.

Land use, land use change and forestry (LULUCF) is an overall sink of emissions

In addition to the sources of GHG emissions represented in Figure 4 and Figure 5, GHG emission inventories also include a source sector that is, overall, a sink of GHG emissions. This means that the GHG emissions for this source sector are recorded as negative numbers, because they represent a removal of GHG from the atmosphere. This source sector is called land use, land use change and forestry, abbreviated as LULUCF. Depending on the context and purpose, emissions from LULUCF are either included in, or excluded from, reported total GHG emissions (therefore Figure 1 shows two totals). On average, taking LULUCF into account reduces total GHG emissions by 6-7%.

Previously, LULUCF was excluded from the EU climate target (e.g. the 20% reduction target by 2020). The revised Regulation on land use, land use change and forestry fully integrated the LULUCF sector's emissions and removals into the proposed 2030 EU greenhouse gas reduction target of -55% by 2050 (Article 4(1) of Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')) .

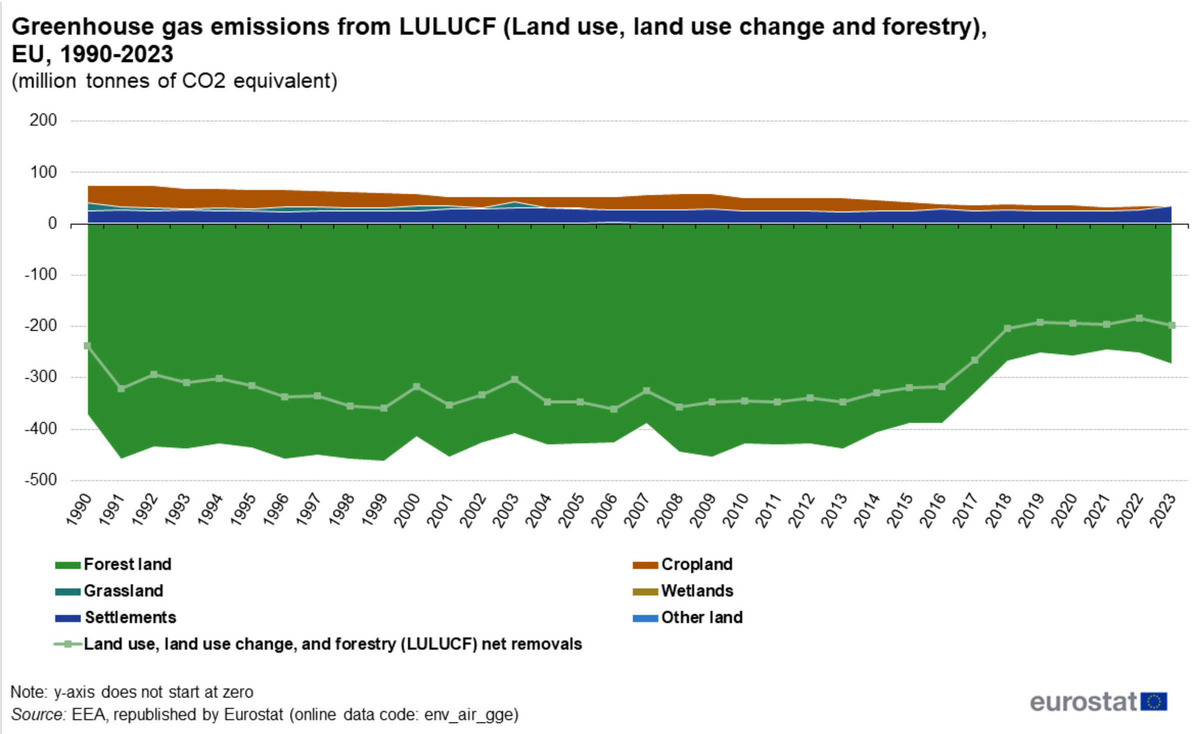


Figure 18: Greenhouse gas emissions from LULUCF (Land use, land use change and forestry), EU, 1990-2023 Source: EEA, republished by Eurostat (env_air_gge)

Figure 18 shows the sources and sinks of GHG in the LULUCF sector, by type of land use. Land-use types with positive values of GHG emissions, such as Settlements or Cropland, represent sources of GHG. The only actual sink of GHG emissions in the EU GHG emission inventory is Forest land. The sum for all land-use types is represented by the net removals of GHG emissions from total LULUCF. Hence, forests play an important role in the mitigation (in other words reduction) of GHG emissions counterbalancing also the net emissions from other land-use types. Harvested wood products are a sink of GHG emissions. Grassland and wetlands, if left undisturbed, can also become a sink.

The New EU forest strategy for 2030 sets out how to protect and restore forests in the EU to ensure they continue to deliver their many services on which society depends. The Commission published a biodiversity strategy for 2030 as part of the European Green Deal, with the aim to put EU biodiversity on the path to recovery by 2030. The Nature Restoration Regulation , aiming to restore EU's degraded ecosystems, in particular those with the most potential to capture and store carbon, and prevent and reduce the impact of natural disasters.

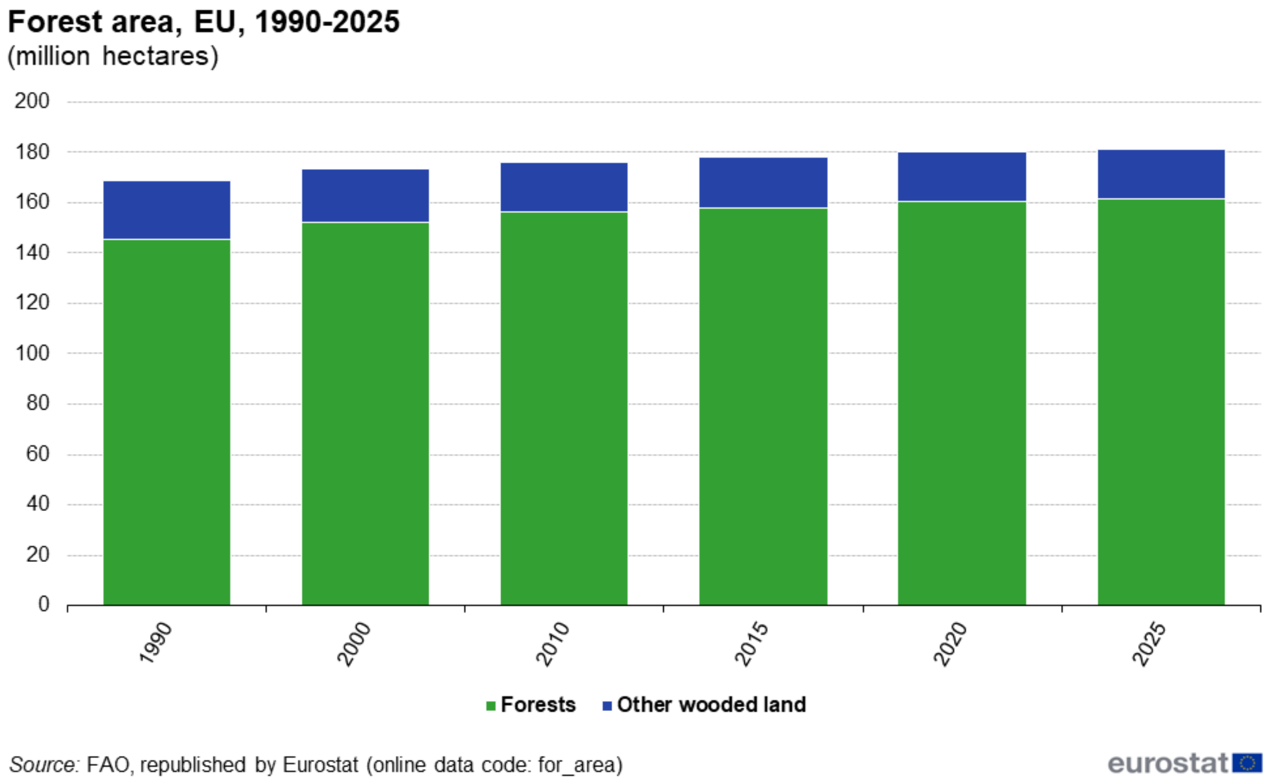


Figure 19: Forest area, EU, 1990-2025 Source: Eurostat (for_area)

Forestry statistics show that the total forest area within the EU has increased from 1990 to 2025 by 16 thousand hectares (11%), see Figure 19. The area of other wooded land has decreased over those years by 3 thousand hectares (14%). This has resulted in an increasing trend for the sum of both categories.

GHG intensities of economic activities

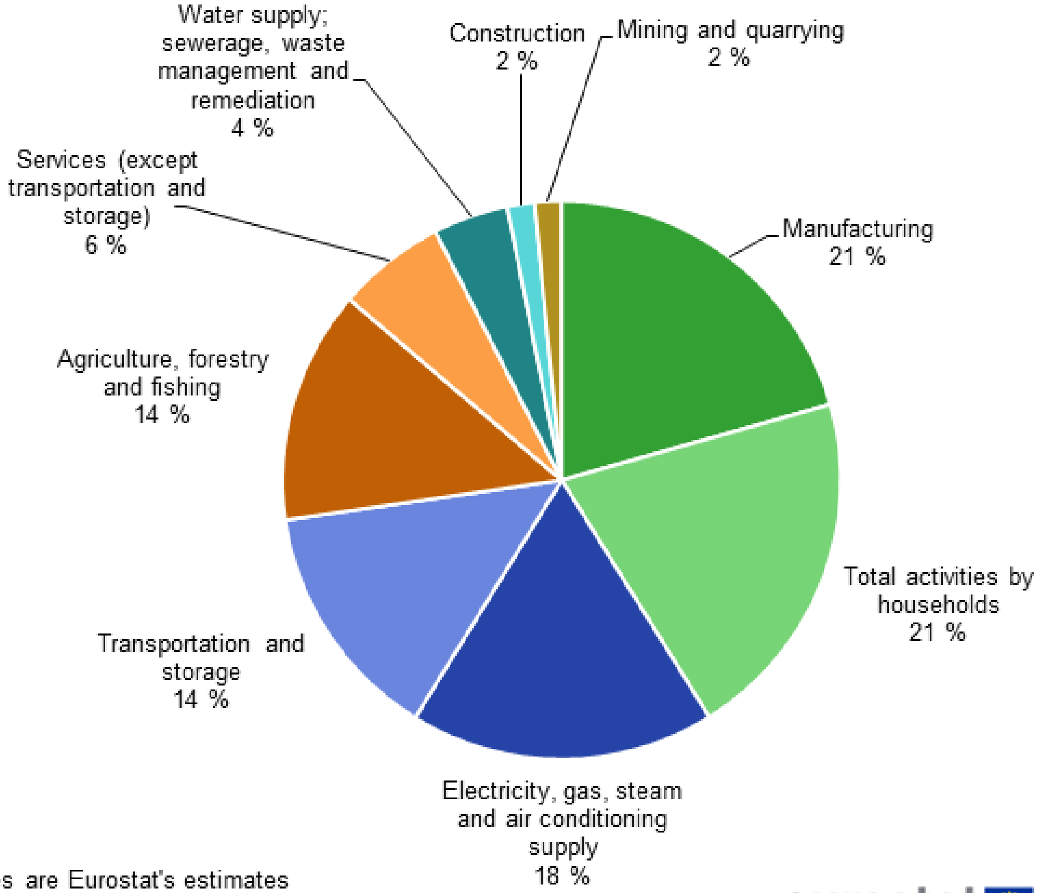
The GHG emission intensity of the total economy, expressed as the amount of GHG emissions in grams of CO2-equivalents per euro of value added in the EU, has decreased by 40.4%, when comparing 2023 with 2008 (Table 2).

Estimating the emission intensities of economic activities requires data on emissions that are conceptually aligned to national accounts data. GHG emission inventories are the primary reporting format for GHG emissions, but the inventory source sectors cannot be matched one-to-one with economic activities (industries) as recorded in national accounts. The scope of each of the source sectors in the GHG emission inventories is defined in a way that best fits the underlying technical processes that result in GHG emissions, but not necessarily the economic classification.

Within the System of Environmental-Economic Accounting (SEEA) , air emissions are recorded in accounts that apply the same accounting concepts, structures, rules and principles as the System of National Accounts.[2]These air emissions accounts are consistent with national accounts, including the break-down by economic activity according to the NACE Rev.2 classification. Air emissions accounts also enable the analysis of changes in economic structure and the effect on GHG emissions.

[2]See also the Statistics Explained article ' Environmental accounts - establishing the links between the environment and the economy '.

Greenhouse gas emissions by economic activity according to the NACE classification, EU, 2023



Note: values are Eurostat's estimates
Source: Eurostat (online data code: env_ac_ainah_r2)

Figure 20: Greenhouse gas emissions by economic activity according to the NACE classification, EU, 2023
Source: Eurostat (env_ac_ainah_r2)

The shares of GHG emissions by economic activity are presented in Figure 20. In the air emissions accounts, emissions are assigned to the economic activities for which the GHG are emitted. For example, emissions reported as transportation in the GHG emission inventories are partly assigned to households and other economic activities that operate their own transport fleet.

By combining information from air emissions accounts and national accounts, GHG emission intensities of economy activities can be calculated. Emission
intensities express the amount of GHG emissions produced per unit of output or value added of the economic activity.

GHG intensity by economic activity, EU, 2008 and 2023

(grams CO_2-equivalent per euro, chain linked volumes 2010)

NACE Rev. 2 codes	labels	2008 g CO_2-eq / EUR	2023 g CO_2-eq / EUR	2008-2023 % change
TOTAL	Total - all NACE activities	376	224	-40.4
A	Agriculture, forestry and fishing	2 686	2 370	-11.7
B	Mining and quarrying	1 481	1 592	7.5
C	Manufacturing	616	343	-44.2
D	Electricity, gas, steam and air conditioning supply	6 442	4 832	-25.0
E	Water supply; sewerage, waste management and remediation activities	1 953	1 410	-27.8
F	Construction	97	96	-1.7
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	89	54	-38.8
H	Transportation and storage	918	859	-6.4
I	Accommodation and food service activities	68	43	-36.5
J	Information and communication	21	7	-68.3
K	Financial and insurance activities	14	10	-33.2
L	Real estate activities	7	4	-45.6
N	Administrative and support service activities	56	42	-24.7
O	Public administration and defence; compulsory social security	46	30	-35.6
P	Education	28	20	-27.5
R	Arts, entertainment and recreation	75	34	-55.4
S	Other service activities	63	50	-20.6
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	4	6	39.8

Notes: Sectors for which values are missing have been excluded.

Source: Eurostat (online data code: env_ac_aeint_r2)

Table 2: CO2 intensity by economic activity, EU, 2008 and 2023 Source: Eurostat (env_ac_aeint_r2)

Table 2 shows the GHG emissions in grams of CO2-equivalents emitted for each euro of value added generated by the different economic activities in more detail. Electricity, gas, steam and air conditioning supply shows by far the largest amount of GHG emitted per euro of value added (4 832 g of CO2-equivalent per euro for reference year 2023). Other production activities with high GHG intensities are agriculture, forestry and fishing; water supply, mining and quarrying and sewerage, waste management and remediation activities. Service production activities emit much less GHG per euro of value added. Overall for the EU, all economic activities except for mining and quarrying (NACE B) and the activities of households as employers (NACE T) have reduced their GHG intensity over 2008-2023. In general, economic structural changes towards a bigger service sector implies less GHG emissions for the economy as a whole.

Source data for tables and graphs

- Climate change - driving forces 2025: figures and tables

Data sources

GHG emission inventories are taken from Eurostat’s dataset Greenhouse gas emissions by source sector (env_air_gge). This dataset is originally produced and published by the European Environment Agency (EEA). The EEA GHG emission inventory data are accessible through the EEA greenhouse gas data viewer .

The Directorate-General for Climate Action of the European Commission has an overall responsibility for the GHG emission inventory of the EU and the reporting to the United Nations Framework Convention on Climate Change (UNFCCC) . The EEA is responsible for the preparation of the EU’s GHG emission inventory and the quality assurance and quality control (QA/QC) procedures on the GHG emission inventories reported by EU Member States, the United Kingdom and Iceland. Each Member State compiles its national inventory and submits it to both the UNFCCC and to the EEA. Eurostat collects national energy statistics reported under the EU Energy Statistics Regulation and is responsible for supplying the energy data for the IPCC reference approach for CO2emissions from fossil fuel combustion. This is a key verification procedure of the energy data reported in the EU GHG emission inventory. The Joint Research Centre is responsible for the QA/QC of the LULUCF and agriculture source sectors in the EU's GHG emission inventory.

Data on transport performance are from the EU transport in figures Statistical Pocketbook of the Directorate-General for Mobility and Transport, which includes data from Eurostat, other sources and own estimates.

All other statistics are from Eurostat and accessible through Eurostat's online database . Each dataset can be identified an online data code reported as the source below the figure or table.

Direct hyperlinks to each Eurostat dataset, for the selection of variables and lay-out of dimensions used for this article are included in the attached Excel file (see above).

Definition and coverage

Greenhouse gas emissions include emissions of carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and several fluorinated gases: sulphur hexafluoride (SF6), nitrogen trifluoride (NF3), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). Carbon dioxide represents 78% of total GHG emissions in 2023, as shown in Figure 21.

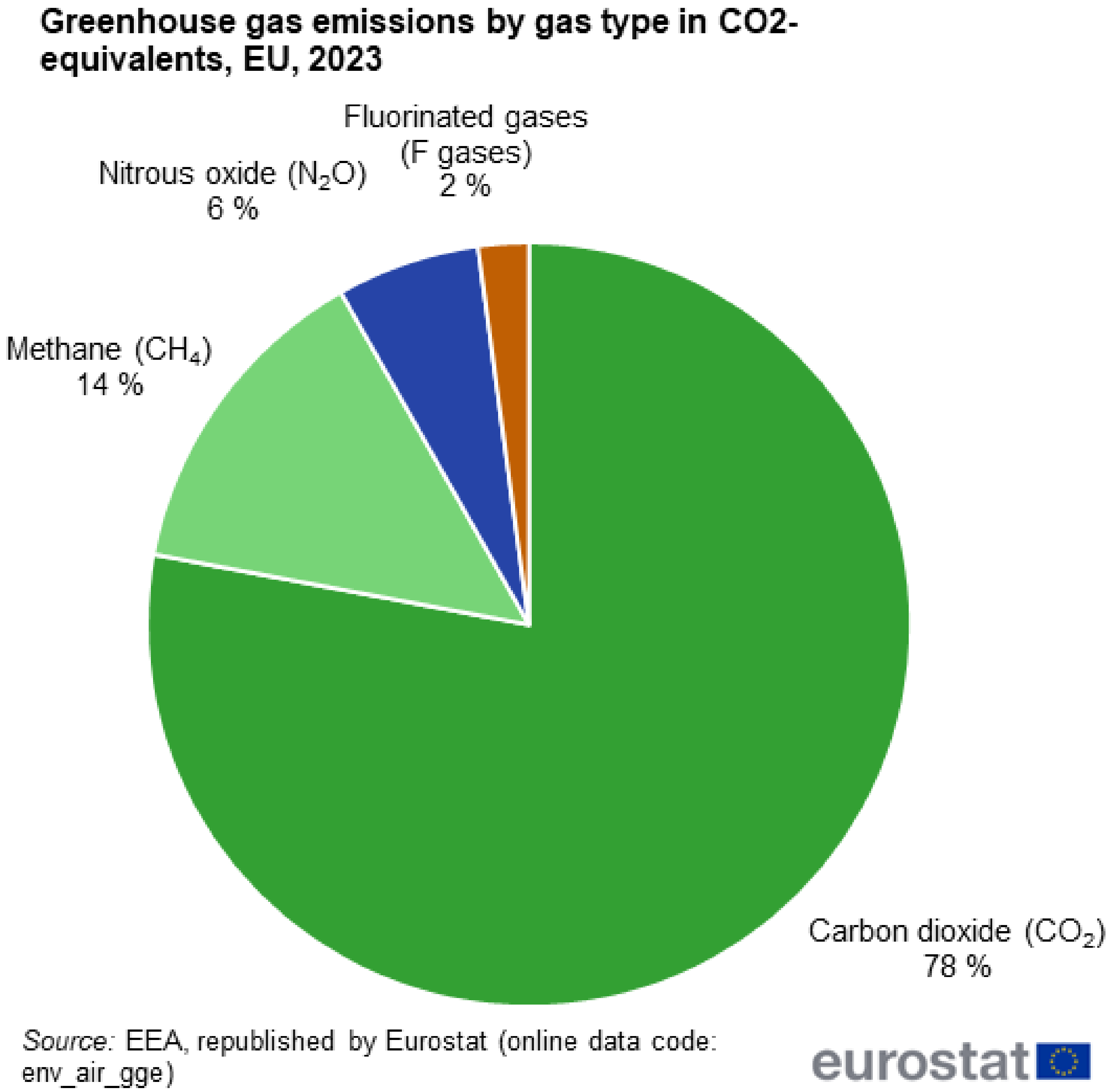


Figure 21: Greenhouse gas emissions by gas type in CO2-equivalents, EU, 2023 Source: EEA, republished by Eurostat (env_air_gge)

To be able to compare and add up the GHG emissions together, each GHG is expressed in CO2- equivalent based on its global warming potential (GWP) relative to carbon dioxide. For example, methane absorbs 28 times more thermal infrared radiation than carbon dioxide and is therefore 28 times more potent as a greenhouse gas than carbon dioxide. To calculate methane emissions in CO2-equivalent, the amount of methane is multiplied by its GWP value of 28. The relative composition shown in Figure 21 takes the GWP of GHG into account. Note that these GWPs are updated when new information on the energy absorption or lifetime of the gases becomes available from research. Currently, the GWP values used to compile GHG emission inventories in Europe are based on the IPCC's Fifth Assessment Report .[3].

All GHG totals in this article include indirect CO2emissions. Carbon dioxide emissions from the burning of biomass are recorded as 'memorandum item (memo item)' in GHG emission inventories and are not included in the various totals. Emissions from international aviation and international navigation are included in the totals in figures of this

[3] See the column 'GWP 100-year' in Table 8.A.1 of Appendix 8.A of the report Climate Change 2013: The Physical Science Basis - Contribution of Working Group I to the IPCC's Fifth Assessment Report, page 731.

articles if specified so in the footnote or the legend; other they are excluded. LULUCF is included in the totals. All other memo items (transport and storage of CO2and multilateral operations) are excluded.

Although GHG emission inventories and air emissions accounts both report GHG emissions, there are differences in definition and scope that result in differences in the reported values both at the total level and for individual components. The table below lists the main differences between GHG emission inventories and air emissions accounts. Data from the latter have been used to compile GHG emissions by economic activity (Figure 20) and GHG intensities (Table 2).

Note: National and EU totals differ between the two approaches, as different boundaries apply. GHG emission

National inventories for greenhouse gases and other air pollutants	Air emissions accounts
Emissions are assigned to the country **where the emission takes place** (territory principle).	Emissions are assigned to the country **where the company causing the emission is based** (residence principle as used in the system of national accounts).
Emissions are assigned to **technical processes** (e.g. combustion in power plants, solvent use).	Emissions are classified by **economic activity** (using the NACE classification as used in the system of national accounts).
Emissions from international shipping and aviation are assigned to the countries **where the associated fuel is purchased** regardless of where the purchasing company is based.	Emissions from international shipping and aviation are assigned to the countries **where the airline/shipping company is based** , regardless of where the emission takes place.

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 emission inventory databases can differ significantly from the total reported in air emissions accounts for countries with a large international aircraft and/or shipping fleet, but data can be reconciled using bridging tables.
Source: dedicated section on climate change related statistics

Significant differences between the totals for GHG emission inventories and air emissions accounts may occur in certain countries where very large resident businesses engage in international water- and air transport services. For instance, in Denmark, carbon dioxide emissions reported in the accounts are more than 2 times the amount of emissions reported in GHG inventories. This difference is due to a very large Danish shipping company, which operates vessels worldwide, and hence bunkers most of its fuel and emits most of its emissions outside Denmark. These emissions abroad are not accounted for in the Danish GHG emission inventory, but they are included in the air emissions accounts. For the EU as a whole, the differences between totals from the GHG emission inventories and the air emissions accounts are much less pronounced.

More detail on the definition and scope of the statistics reported on in this article can be found in the metadata accompanying the respective datasets.

Context

Climate change as a result of human activities is a major threat to society due to the wide-ranging impacts on ecosystems, the economy, human health and wellbeing. It is a problem of common concern and requires a global response. The European Commission aims to address the causes and consequences of climate change through policies and by being an ambitious partner in the international negotiations. To monitor the progress in reducing GHG emissions and trends of climate change drivers, the impact and the adaptation to climate change, high quality data are essential.

EU policy context

The EU's progress on greenhouse gas (GHG) emission reduction is evaluated against targets set in its political commitments. The EU succeeded in reducing its GHG emissions beyond the amounts agreed on in the first commitment period (2008-2012) of the Kyoto Protocol . The target set for 2020 in the 2020 climate & energy package , a 20% reduction of GHG emissions compared with 1990, was also met. The EU is working towards cutting 55% of its emissions in 2030 compared with 1990, as target set in the 2030 climate & energy framework and in accordance with the EU's commitment to the Paris agreement. By 2050 the EU aims to be climate neutral.

The two main instruments to achieve the EU GHG targets are the EU Emissions Trading System (EU ETS) and the Effort Sharing Regulation . The EU ETS is a market for trading carbon that works on the basis of a cap set on the amount of GHG emissions that can be emitted by installations covered by the system. Within the cap, companies receive or buy emission allowances. If a company produces less GHG emissions than it has allowances for, it can sell these to a company that needs more. The market forces of supply and demand, and the resulting prices help ensure that the lowest-cost solutions for reducing GHG emissions are implemented. The Effort Sharing Regulation covers emissions from most source sectors not included in the EU ETS and establishes binding annual GHG emission targets for EU Member States for these source sectors.

For the commitment period from 2021-2030, two new Regulations have been adopted; the Regulation on binding annual GHG emission targets by Member States for 2021-2030 for the sectors not regulated under the EU ETS, such as transport, agriculture and waste, and the Regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework . The second Regulation includes binding commitments for each Member State to ensure that accounted emissions from land use are entirely compensated by an equivalent removal of CO from the atmosphere through action in the sector. It also specifies the accounting rules to determine compliance. Also, the burning of biomass will count towards the 2030 commitments of each Member State.

Predictions and modes suggest that EU Members States are likely to face severe challenges such as heat extremes, water scarcity, forest fires, sea level rise, storm surges, floods and landslides as a result of climate change. As a results, in 2021, the EU adopted the its new EU Adaptation Strategy to enhance preparedness and resilience in Europe. Complementing the activities of Member States, the strategy supports action by promoting greater coordination and information-sharing between Member States, and by ensuring that adaptation considerations are addressed in all relevant EU policies.

In July 2021, the European Commission adopted a series of legislative proposals setting out how it intends to achieve climate neutrality in the EU by 2050, including the intermediate target of an at least 55% net reduction in greenhouse gas emissions by 2030 .

EU contribution to the global policy context

The EU is an ambitious contributor to the global efforts to fight climate change and reduce GHG emissions. The fight against climate change at global level is governed by the United Nations Framework Convention on Climate Change (UNFCCC). The Convention is an international environmental treaty that entered into force in 1994 and has been ratified by 198 countries, including all EU Member States, as well as the EU itself. The objective of the UNFCCC as expressed in the Convention text is "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

The Kyoto Protocol was the first international agreement to operationalize the UNFCCC setting binding emission reduction targets for industrialized countries, among them the EU as a region. It included two commitment periods: from 2008 to 2012, and from 2013 to 2020, the latter agreed upon in the Doha Amendment to the Protocol.

The successor of the Kyoto protocol, the Paris Agreement , entered into force on 4 November 2016. The Paris Agreement is the first-ever universal, legally binding global climate agreement. It was adopted during the 21st Conference of the Parties in December 2015 in Paris. The objectives of the Paris Agreement are to keep the global temperature rise well below 2 degrees Celsius above pre-industrial levels, pursuing efforts to limit the increase to 1.5 degrees Celsius, and enhancing adaptive capacity, strengthening resilience and reducing vulnerabilities. The goals of the Paris Agreement should be met by working towards achieving the nationally determined contributions (NDCs) put forward by the Parties to the Agreement, and planning for and implementing adaptation action.

In parallel, the sustainable development goals (SDGs) agreed upon in 2015 include a climate action goal . The targets related to this goal do not address GHG emissions directly, but are important to combat climate change and its impacts through capacity building, promoting climate change measures, and strengthening resilience and adaptive capacity to withstand the impacts of climate change. In addition to the dedicated climate action goal, several of the other SDGs are related to climate change, either directly or indirectly.

Footnotes

Explore further

Other articles

- Statistics on climate change mitigation
- Electricity and heat statistics
- Energy statistics - an overview
- Freight transport statistics - modal split
- Agricultural production - livestock and meat
- Municipal waste statistics
- Environmental accounts - establishing the links between the environment and the economy

Database

- Climate change
- Environment
- Emissions of greenhouse gases and air pollutants
- Energy statistics
- Transport statistics
- Agriculture statistics
- Waste statistics
- Forestry statistics
- National accounts (including GDP)
- Population statistics
- Short-term business statistics

Thematic section

- Climate change

Publications

- Sustainable development in the European Union — Monitoring report on progress towards the SDGs in an EU context — 2025 edition
- SDGs & me - digital publication
- Eurostat digital publication on energy

External links

European Commission - Directorate-General for Climate Action

- Directorate-General for Climate Action home page
- Climate strategies & targets
- Consequences of climate change
- Climate and nature - joint action

European Environment Agency

- European Environment Agency European Environment Agency - Climate change mitigation
- European Environment Agency European Environment Agency - Climate change impacts, risks and adaptation
- EEA greenhouse gas - data viewer

United Nations Framework Convention on Climate Change (UNFCCC)

- UNFCCC home page
- The Paris Agreement

Intergovernmental Panel on Climate Change (IPCC)

- IPCC home page
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Other

- CLIMATE-ADAPT - European Climate Adaptation Platform