Office for National Statistics

Statistical bulletin

Estimates of quarterly greenhouse gas emissions (residence basis), UK: Quarter 1 (Jan to Mar) 2024

Estimates of greenhouse gas emissions using the Chow-Lin regression-based temporal disaggregation method. These are official statistics in development.

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6 November 2024

Correction

18 October 2024 10:59

We have corrected a error in the title of Table 1 which referenced the incorrect quarter.

The data in the table remains unaffected.

Notice

14 April 2025

Please note that the intensity of quarterly greenhouse gas emissions section erroneously refers to tonnes instead of the correct thousand tonnes. We apologise for any inconvenience caused and recommend you use the latest bulletin in this series for the correct text.

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1 . Main points

- UK greenhouse gas (GHG) emissions on a residence basis were estimated to be 137 million tonnes of carbon dioxide equivalent (Mt CO2e) in Quarter 1 (Jan to Mar) 2024, which was 1.5% higher than in Quarter 1 2023.
- The UK emitted 0.183 tonnes of CO2e per million pounds of economic activity (gross value added), a measure of emissions intensity, in Quarter 1 2024; this is a level similar to that seen since Quarter 2 (Apr to June) 2021 and broadly in line with our final 2022 estimate.
- All emissions estimates in this bulletin are produced using modelling techniques; estimates for all quarters of 2023 and Quarter 1 2024 are subject to greater uncertainty because full-year emissions data for 2023 are not yet available, so they are modelled over five quarters.
- These quarterly emissions estimates complement and draw on our annual residence-based emissions statistics.
- Total emissions fell in every quarter of 2023 compared with the same quarters in 2022; this is similar to the quarterly provisional UK GHG emissions on a territorial basis estimates from the Department for Energy Security and Net Zero (DESNZ).

We refer to residence-based emissions (also known as production emissions) in this bulletin. Territorial emissions, published by DESNZ, is the measure generally used for GHG emissions targets, including net zero by 2050. Footprint (or consumption) emissions, published by the Department for Environment, Food and Rural Affairs, account for emissions from trade. For more information on these three official measures of UK GHG emissions, please see our Measuring UK GHG emissions explainer.

Because of differences in how the annual and quarterly greenhouse gas emissions are produced, quarterly emissions cannot be added together to arrive at a provisional 2023 estimate. This estimate will be published in autumn 2024.

2 . Quarterly greenhouse gas emission estimates

Using modelling techniques, we have produced estimates of total quarterly UK greenhouse gas (GHG) and carbon dioxide (CO2) emissions, on a residence basis, up to Quarter 1 (Jan to Mar) 2024. All GHG estimates referred to in this bulletin are non-seasonally adjusted, unless otherwise specified.

Our Quarter 1 2024 estimate of total emissions on this measure is 137 million tonnes of CO2 equivalent (Mt CO2e). This is an increase of 2.1 Mt CO2e, or 1.5%, compared with the same quarter in 2023. This is the first year-on-year increase since Quarter 3 (July to Sept) 2022, following five quarters of decreasing emissions on this modelled measure. There was a similar increase of GDP also seen in Quarter 1 2024.

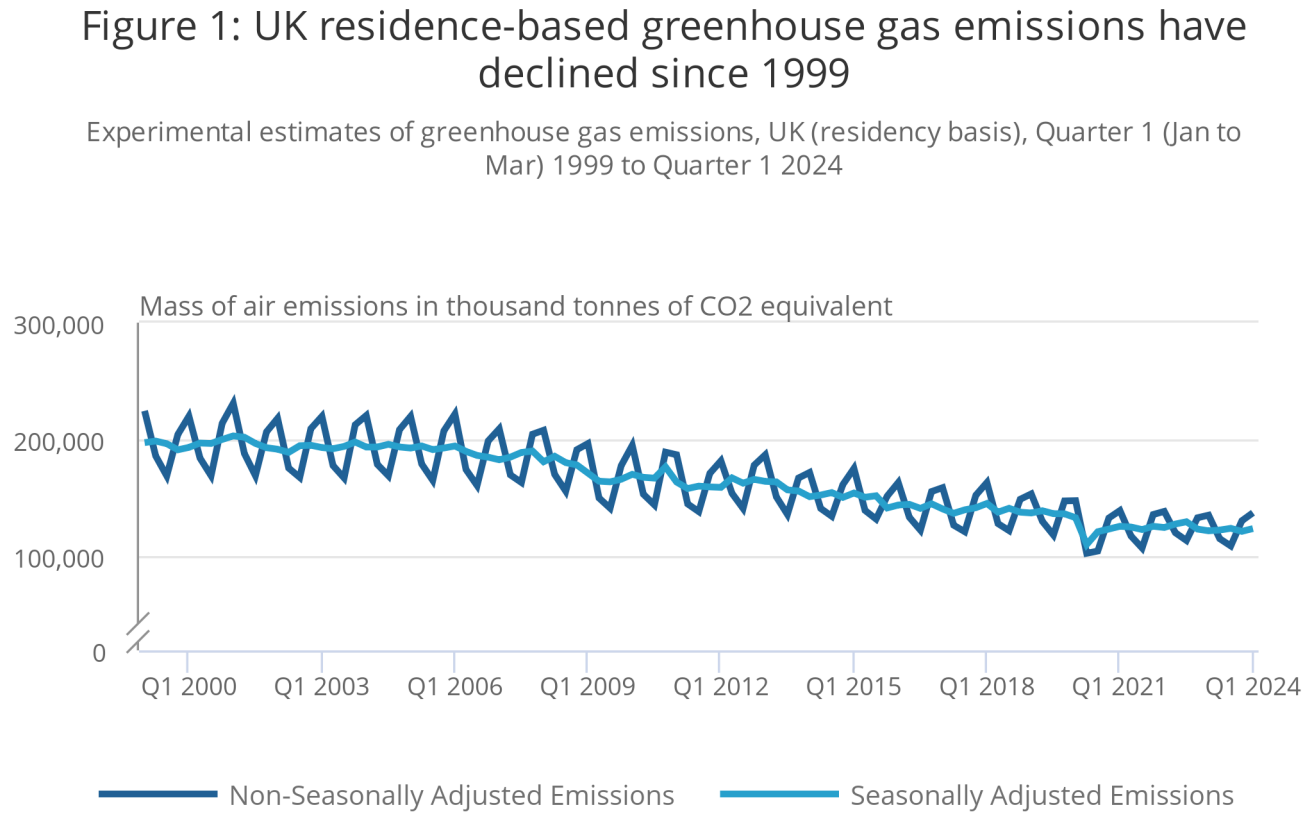
Total residence-based GHG emissions were 1.80 tonnes of CO2e per person in Quarter 1 2024. This is similar to the level seen in Quarter 1 2023, but continues the downward trend seen since 1999, the start of the time series for this measure. Since 1999, residence-based GHG emissions have decreased by 1.57 tonnes, or 46.6% of CO2e per person.

Importantly, these experimental estimates are subject to uncertainty, so should be interpreted with caution. The underlying input data, estimates informing the model, and the modelling itself all introduce uncertainty, which affects the accuracy of these estimates. The level of uncertainty is particularly high for all quarters of 2023, and Quarter 1 2024 in this bulletin. The annual estimate of GHG emissions on a residence basis that we constrain these estimates to will not be published until autumn 2024.

More information on methods used to produce quarterly estimates can be found in Section 6 of our accompanying Estimates of UK quarterly GHG emissions (residence basis) Quality and Methodology Information (QMI).

Figure 1: UK residence-based greenhouse gas emissions have declined since 1999

Experimental estimates of greenhouse gas emissions, UK (residency basis), Quarter 1 (Jan to Mar) 1999 to Quarter 1 2024



Source: Environmental Accounts from the Office for National Statistics, and Energy Trends from the Department for Energy Security and Net Zero

Notes:

1. Q1 refers to Quarter 1 (Jan to Mar), Q2 refers to Quarter 2 (Apr to June), Q3 refers to Quarter 3 (July to Sept), and Q4 refers to Quarter 4 (Oct to Dec).

2. These estimates have been modelled using the Chow-Lin regression-based temporal disaggregation method.

3. For seasonal adjusted estimates, the predictor indicators used in the modelling were seasonally adjusted using X-13ARIMA-SEATS.

Table 1 shows the change in total quarterly non-seasonally adjusted emissions estimates, compared with the same quarter in the previous year.

Table 1: Quarter 1 (Jan to Mar) 2024 had the first increase in quarterly UK residence-based greenhouse gas (GHG) emissions since Quarter 3 (July to Sept) 2022
Change in non-seasonally adjusted estimates, Quarter 1 (Jan to Mar) 2020 to Quarter 1 2024

Time Period	Change in quarterly totals from same quarter the previous year (%)
Quarter 1 2020	-3.8%
Quarter 2 2020	-21.0%
Quarter 3 2020	-11.6%
Quarter 4 2020	-9.9%
Quarter 1 2021	-5.7%
Quarter 2 2021	14.3%
Quarter 3 2021	2.5%
Quarter 4 2021	2.3%
Quarter 1 2022	-0.5%
Quarter 2 2022	2.4%
Quarter 3 2022	6.0%
Quarter 4 2022	-2.0%
Quarter 1 2023	-2.3%
Quarter 2 2023	-4.2%
Quarter 3 2023	-4.1%
Quarter 4 2023	-1.9%
Quarter 1 2024	1.5%

Source: Environmental Accounts from the Office for National Statistics, and Energy Trends from the Department for Energy Security and Net Zero

3 . Intensity of quarterly greenhouse gas emissions

Our residence-based emissions estimates are compiled in accordance with the UN System of Environmental Economic Accounting, which aligns with the UK System of National Accounts. This enables comparisons with key economic indicators, like gross domestic product (GDP). It also enables the calculation of greenhouse gas (GHG) emissions intensity, or emissions per unit of economic output.

In Quarter 1 (Jan to Mar) 2024, the UK emitted 0.183 tonnes of carbon dioxide equivalent (CO2e) per million pounds of gross value added (GVA). This was similar to levels seen since Quarter 2 (Apr to June) 2021. On a quarterly basis, GHG emissions intensity is down 61.1%, or 0.287 tonnes of CO2e per million pounds of GVA since 1999 (see Figure 2).

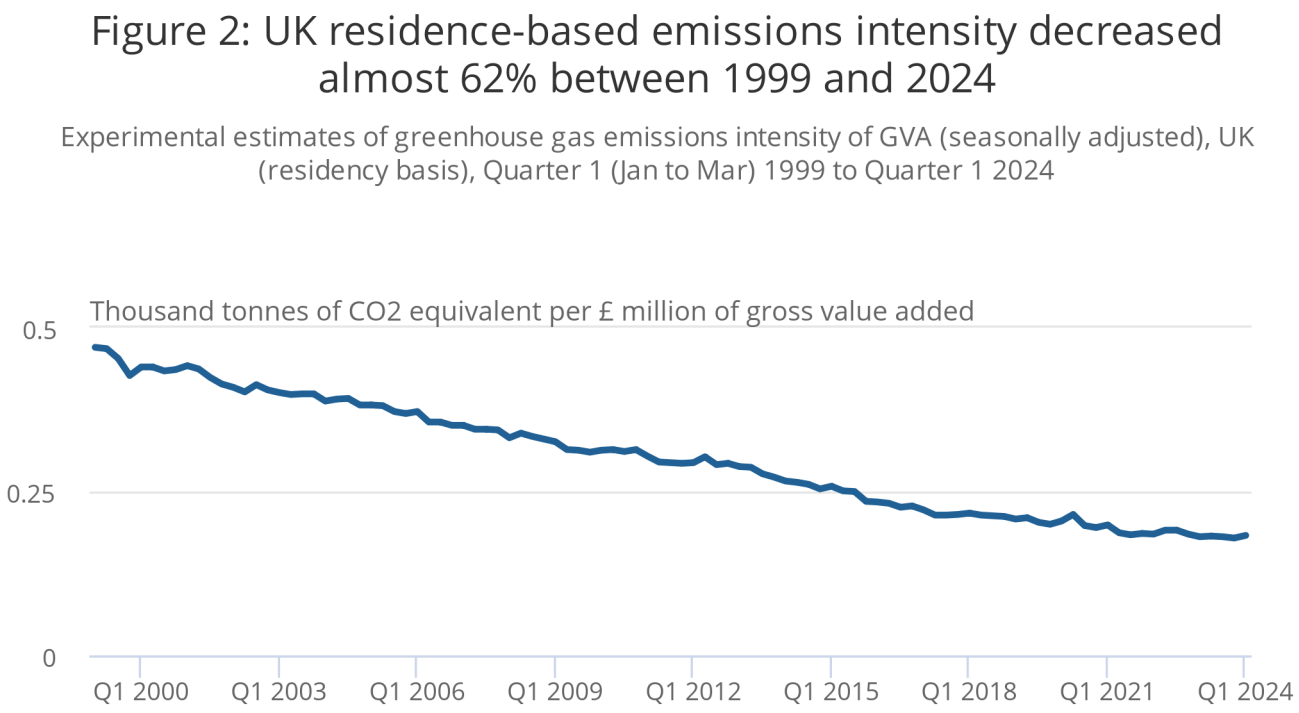
This bulletin uses a data vintage for GVA based on published Blue Book 2023 data. Data up to Quarter 4 (Oct to Dec) 2022, published on 7 August 2024, will be used in future releases, likely resulting in revisions to these data.

Emissions intensity can be used to examine the relationship between economic growth and GHG emissions on a residence basis. The reduction in overall emissions intensity is an indication that the UK is moving towards a lower carbon economy.

This could be because of several factors, including changes in the structure of the economy and behavioural changes that may show the interaction between the economy and the environment. For example, it could be related to some industries becoming more efficient in their production processes through the adoption of lower-emission technologies. It could also be related to changes in the composition of the economy, where there is a growing shift from higher- to lower-emitting economic activities, like from manufacturing to services activities. Or it could be a combination of these factors.

Figure 2: UK residence-based emissions intensity decreased almost 62% between 1999 and 2024

Experimental estimates of greenhouse gas emissions intensity of GVA (seasonally adjusted), UK (residency basis), Quarter 1 (Jan to Mar) 1999 to Quarter 1 2024



Source: Environmental Accounts from the Office for National Statistics

Notes:

1. Q1 refers to Quarter 1 (Jan to Mar), Q2 refers to Quarter 2 (Apr to June), Q3 refers to Quarter 3 (July to Sept), and Q4 refers to Quarter 4 (Oct to Dec).

2. Emissions intensity is calculated by dividing the level of greenhouse gas emissions by Gross Value Added (GVA). GVA is the difference, for any given industry, between the value of goods and services produced (output) and the cost of raw materials and other inputs that are used up in production (intermediate consumption). GVA is a chained volume measure, in constant prices with 2019 as the base and reference year.

3. All emissions intensity figures are calculated using seasonally adjusted estimates of greenhouse gas emissions, excluding those from households that refer to consumer expenditure travel and non-travel.

4. For seasonal adjusted estimates, the predictor indicators used in the modelling were seasonally adjusted using X-13ARIMA-SEATS.

4 . Data on estimates of quarterly greenhouse gas emissions

Experimental estimates of quarterly greenhouse gas emissions
Dataset | Released 8 August 2024
Experimental estimates of UK quarterly greenhouse gas emissions (GHG) and carbon dioxide (CO2) emissions on a residence basis.

Atmospheric emissions: greenhouse gases by industry and gas
Dataset | Released 5 June 2024
The emissions of carbon dioxide, methane, nitrous oxide, hydro-fluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride and total greenhouse gas emissions, by industry (SIC 2007 group -- around 130 categories), UK, 1990 to 2022.

Energy Trends: June 2024
Department for Energy Security and Net Zero publication | Published 27 June 2024
Quarterly bulletin containing statistics on all major aspects of energy in the UK.

5 . Glossary

Greenhouse gases

Greenhouse gases (GHGs) are those covered by the Paris Agreement, which has superseded the Kyoto Protocol. These include:

- carbon dioxide (CO2)
- methane (CH4)
- nitrous oxide (N2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF6)
- nitrogen trifluoride (NF3)

These gases contribute directly to global warming and climate change, because of their positive radiative forcing effect. The potential of each GHG to cause global warming is assessed in relation to a given weight of CO2, so all greenhouse gas emissions are measured as carbon dioxide equivalent (CO2e).

Residence basis

Estimates compiled on a residence basis include data relating to UK residents and UK-registered businesses, regardless of whether they are in the UK or overseas. Emissions released in the UK by tourists and foreign transport operations are excluded. For more detailed comparisons of UK emissions measures, please see our Measuring UK greenhouse gas emissions methodology.

Temporal disaggregation

Temporal disaggregation is the process of deriving high-frequency data (for example, quarterly) from low-frequency data (for example, annual).

6 . Data sources and quality

All estimates presented in this bulletin and our accompanying dataset have been produced using temporal disaggregation and modelling techniques, so they are subject to uncertainty.

The main source of information and predictor indicators for producing these experimental estimates are:

- the UK annual estimates of greenhouse gas (GHG) emissions on a residence basis
- the Energy Trends publication from the Department for Energy Security and Net Zero, which provides information on UK energy production, consumption, and trade for energy overall, and specific fuels

All estimates of the annual GHG series, and the latest quarter of the energy trends, are provisional and subject to revisions. The whole time series is updated for each iteration of this bulletin, which means that the latest version supersedes all previous versions.

This bulletin presents non-seasonally adjusted estimates. Both non-seasonally adjusted and seasonally adjusted data are available in our accompanying Estimates of quarterly GHG emissions dataset.

Official statistics in development

These statistics are labelled as "official statistics in development". Until September 2023, these were called "experimental statistics". Read more about the change in our Guide to official statistics in development.

We are developing how we collect and produce the data to improve the quality of these statistics, like refining and improving the code used. Once the developments are complete, we will review the statistics with the Statistics Head of Profession. We will decide whether the statistics are of sufficient quality and value to be published as official statistics, or whether further development is needed. Production may be stopped if they are not of sufficient quality or value. Users will be informed of the outcome and any changes. We value your feedback on these statistics, please contact us at environment.accounts@ons.gov.uk.

Uncertainty

These estimates are subject to uncertainty, both in the underlying estimates used with the model and through uncertainty introduced by the modelling itself. For instance, for periods where a base or reference year is unavailable (such as this quarter), we use "nowcasting" measures to extend the series for five quarters. This implies that the estimates for those periods are less accurate, compared with periods where a base or reference year is available.

For information on the strengths and limitations of the estimates presented in this bulletin, see Section 6 of our Estimates of UK quarterly GHG emissions (residence basis) Quality and Methodology Information (QMI).

7 . Related links

UK Environmental Accounts: 2024
Bulletin | Released 5 June 2024
Measuring the contribution of the environment to the economy, impact of economic activity on the environment, and response to environmental issues.

8 . Cite this statistical bulletin

Office for National Statistics (ONS), released 8 August 2024, ONS website, statistical bulletin, Estimates of quarterly greenhouse gas emissions (residence basis), UK: Quarter 1 (Jan to Mar) 2024