

Statistical bulletin

# Estimates of quarterly greenhouse gas emissions (residence basis), UK: Quarter 4 (October to December) 2024

Estimates of greenhouse gas emissions using the Chow-Lin regression-based temporal disaggregation method.

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# 1 . Main points

- We estimated UK greenhouse gas (GHG) emissions on a residence basis to be 133 million tonnes of carbon dioxide equivalent (MtCO<sub>2</sub>e) in Quarter 4 (Oct to Dec) 2024; this was 1.7% higher than in Quarter 4 2023.
- Residence-based GHG emissions were 1.74 tonnes of CO<sub>2</sub>e per person in Quarter 4 2024; this was down 46.5%, or 1.51 tonnes of CO<sub>2</sub>e per person since Quarter 1 (Jan to Mar) 1999, when this series begins.
- The UK emitted 0.158 thousand tonnes of CO<sub>2</sub>e per million British pounds of economic activity (gross value added) in Quarter 4 2024; this is down 61.1% since Quarter 1 1999.
- These quarterly emissions estimates complement and draw on our annual residence-based emissions statistics.
- All estimates in this bulletin are produced using modelling techniques; estimates for all quarters of 2023 and 2024 are subject to greater uncertainty because final emissions estimates for 2023 and 2024 are not yet available, so we have modelled data over eight quarters.

We refer to residence-based (also known as production) emissions in this release. Territorial emissions, published by the Department for Energy Security and Net Zero, is the measure generally used for greenhouse gas 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. Please see [Section 7: Data sources and quality](#) for more information.

## 2 . Quarterly greenhouse gas emission estimates

We have produced estimates of total quarterly UK greenhouse gas (GHG) and carbon dioxide (CO<sub>2</sub>) emissions, on a residence basis up to Quarter 4 (Oct to Dec) 2024 using modelling techniques. All GHG and CO<sub>2</sub> estimates referred to in this bulletin are non-seasonally adjusted, unless otherwise specified.

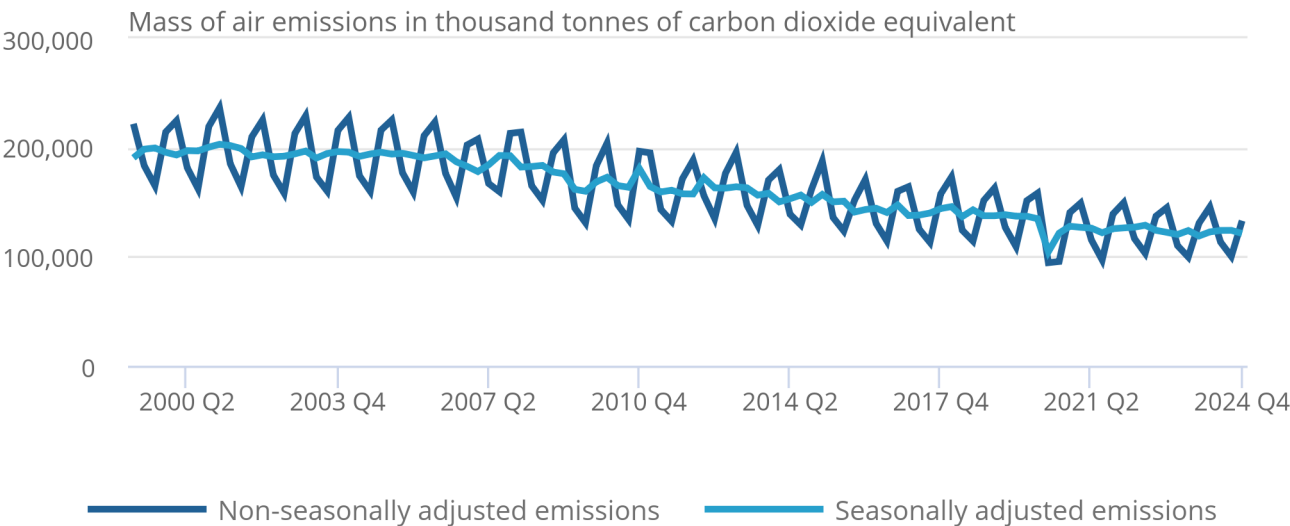
Our Quarter 4 2024 estimate of total emissions on a residence basis is 133 million tonnes of CO<sub>2</sub> equivalent (MtCO<sub>2</sub>e). This is an increase of 2.2 MtCO<sub>2</sub>e, or 1.7%, compared with the same quarter in 2023.

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

Estimates of quarterly greenhouse gas emissions on a residence basis, UK, Quarter 1 (Jan to Mar) 1999 to Quarter 4 (October to December) 2024

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

Estimates of quarterly greenhouse gas emissions on a residence basis, UK, Quarter 1 (Jan to Mar) 1999 to Quarter 4 (October to December) 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. The predictor indicators for the seasonally adjusted estimates used X-13ARIMA-SEATS.
4. Because of differences in how the annual and quarterly greenhouse gas emissions estimates are produced, quarterly emissions for 2023 and 2024 should not be summed to provide a provisional full-year estimate.

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 4 (October to December) 2024 sees the fourth year on year increase  
Change in non-seasonally adjusted UK greenhouse gas emission estimates, Quarter 1 2020 to Quarter 4 2024.

**Time Period      Change in quarterly totals from same quarter the previous year (%)**

<b>Quarter 1 2020</b>	-2.9%
<b>Quarter 2 2020</b>	-25.4%
<b>Quarter 3 2020</b>	-12.5%
<b>Quarter 4 2020</b>	-7.2%
<b>Quarter 1 2021</b>	-5.7%
<b>Quarter 2 2021</b>	22.1%
<b>Quarter 3 2021</b>	1.5%
<b>Quarter 4 2021</b>	-1.0%
<b>Quarter 1 2022</b>	0.3%
<b>Quarter 2 2022</b>	1.1%
<b>Quarter 3 2022</b>	6.3%
<b>Quarter 4 2022</b>	-1.4%
<b>Quarter 1 2023</b>	-3.1%
<b>Quarter 2 2023</b>	-5.5%
<b>Quarter 3 2023</b>	-3.3%
<b>Quarter 4 2023</b>	-4.7%
<b>Quarter 1 2024</b>	0.4%
<b>Quarter 2 2024</b>	2.9%
<b>Quarter 3 2024</b>	0.6%
<b>Quarter 4 2024</b>	1.7%

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

### 3 . Per head estimates of greenhouse gas emissions and gross value added

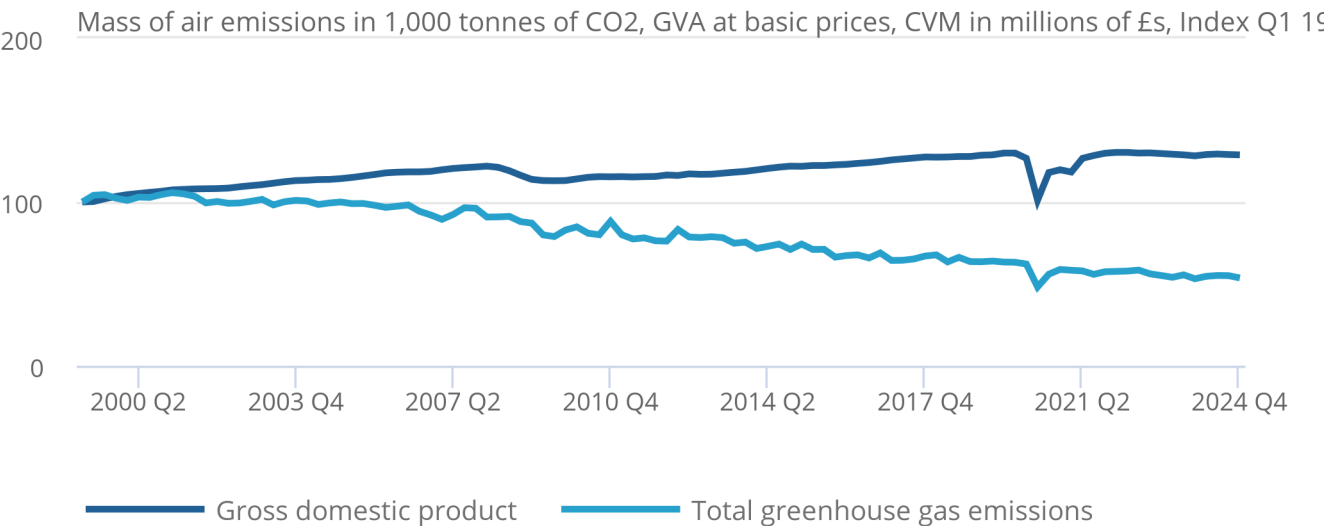
Residence-based greenhouse gas (GHG) emissions were 1.74 tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) per person in Quarter 4 (Oct to Dec) 2024. Residence-based GHG emissions per person have decreased by 46.5%, or 1.51 tonnes of CO<sub>2</sub>e, since 1999 when this time series began.

**Figure 2: UK residence-based greenhouse gas emissions per head have steadily declined since 1999**

Estimates of quarterly greenhouse gas emissions and gross value added (GVA) per head, Index Quarter 1 (Jan to Mar) 1999 = 100, UK, Quarter 1 1999 to Quarter 4 (Oct to Dec) 2024

Figure 2: UK residence-based greenhouse gas emissions per head have steadily declined since 1999

Estimates of quarterly greenhouse gas emissions and gross value added (GVA) per head, Index Quarter 1 (Jan to Mar) 1999 = 100, UK, Quarter 1 1999 to Quarter 4 (Oct to Dec) 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. Per head estimates are calculated by dividing the level of greenhouse gas emissions and GVA by quarterly population estimates. GVA is the difference between the value of goods and services produced (output) and the cost of raw materials and other inputs, which are used up in production (intermediate consumption) for any given industry. GVA are chained volume measures (CVM), in constant prices with 2022 as the base and reference year.

These estimates are subject to uncertainty, so should be interpreted with caution. The underlying input data, the estimates informing the model, and the modelling process itself each introduce uncertainty that affects the accuracy of these estimates. The level of uncertainty is particularly high for all quarters of 2023 and 2024 in this bulletin. This is because we will not publish the final 2023 annual estimate of GHG emissions on a residence basis, to which we constrain these estimates, until June 2025.

More information can be found in [Section 6: Methods used to produce the data in our Estimates of UK quarterly GHG emissions \(residence basis\) quality and methodology information \(QMI\)](#).

## 4 . Greenhouse gas emissions intensity

Our residence-based emissions estimates are compiled in accordance with the [United Nations System of Environmental Economic Accounting](#), which aligns with the UK System of National Accounts. This enables comparisons with important economic indicators, such as gross domestic product (GDP), and the calculation of greenhouse gas (GHG) emissions intensity, that is emissions per unit of economic output.

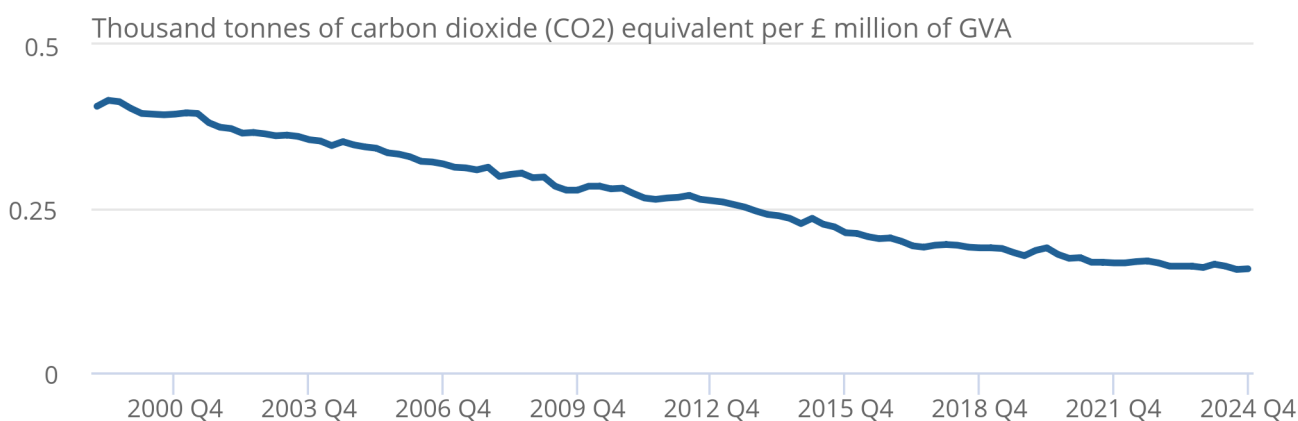
The UK emitted 0.158 thousand tonnes of carbon dioxide equivalent (CO<sub>2</sub>e) per million British pounds of gross value added (GVA) in Quarter 4 (Oct to Dec) 2024. Emissions intensity has fallen 61.1% from 0.406 thousand tonnes of CO<sub>2</sub>e per million British pounds of GVA in Quarter 1 (Jan to Mar) 1999, when this series starts (Figure 3).

### Figure 3: UK residence-based emissions intensity fell by around 60% between 1999 and 2024

Estimates of quarterly greenhouse gas emissions and gross value added (GVA), seasonally adjusted, UK (residence basis), Quarter 1 (Jan to Mar) 1999 to Quarter 4 (Oct to Dec) 2024

#### Figure 3: UK residence-based emissions intensity fell by around 60% between 1999 and 2024

Estimates of quarterly greenhouse gas emissions and gross value added (GVA), seasonally adjusted, UK (residence basis), Quarter 1 (Jan to Mar) 1999 to Quarter 4 (Oct to Dec) 2024



Source: Environmental Accounts from the Office for National Statistics, 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. Emissions intensity is calculated by dividing the level of greenhouse gas emissions by GVA. GVA is the difference between the value of goods and services produced (output) and the cost of raw materials and other inputs, which are used up in production (intermediate consumption), for any given industry. GVA are chained volume measures (CVM), in constant prices with 2022 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 consumer expenditure).

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

This could be influenced by several factors, including changes in the structure of the economy and behavioural changes that may affect 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 emissions technologies
- changes in the composition of the economy, where there is a growing shift from higher-to lower-emitting economic activities, for example, from manufacturing to services activities
- a combination of these factors

All estimates of GVA are subject to revisions. For more information, please see Section 6: Revisions to GDP in our [GDP quarterly national accounts, UK: October to December 2024](#).

## 5 . Data

### [Estimates of quarterly greenhouse gas emissions](#)

Dataset | Released 30 April 2025

Estimates of UK quarterly greenhouse gas emissions (GHG) and carbon dioxide (CO<sub>2</sub>) emissions on a residence basis.

### [Energy Trends](#)

Dataset | Last updated 27 March 2025

Quarterly publication from the Department for Energy Security and Net Zero, which presents data on the supply and demand of all the major fuels in the UK.

## 6 . Glossary

### Greenhouse gases

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

- Carbon dioxide (CO<sub>2</sub>)
- Methane (CH<sub>4</sub>)
- Nitrous oxide (N<sub>2</sub>O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF<sub>6</sub>)
- Nitrogen trifluoride (NF<sub>3</sub>)

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 CO<sub>2</sub>, so all GHG emissions are measured as carbon dioxide equivalent (CO<sub>2</sub>e).

## Residence basis

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

## Temporal disaggregation

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

# 7 . Data sources and quality

All greenhouse gas emission estimates presented in this bulletin and in our accompanying dataset have been produced using temporal disaggregation and modelling techniques. They are therefore subject to uncertainty.

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

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

We refer to residence-based (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. More information on these three official measures of UK GHG emissions can be found in our [Measuring UK greenhouse gas emissions explainer](#).

All estimates of the annual GHG series and the latest quarter of the energy trends are provisional and subject to revisions. We have published provisional estimates of emissions for 2023. However, a complete breakdown of emission data by more granular standard industrial classification (SIC) codes are required for our quarterly emissions model. Annual estimates for 2023 will not be finalised until our June 2025 release. The whole time series is updated for each instance of this release, which means that the latest version supersedes all previous versions.

Both non-seasonally adjusted and seasonally adjusted data are available in our accompanying dataset.

## Official statistics status

As official statistics, these are produced in line with the Code of Practice for Statistics. We are committed to the continued innovation and improvement of these data. You can read more about the different types of official statistics on the [UK Statistics Authority website](#).

We have published quarterly GHG emissions estimates regularly since July 2023. We have automated the production process using Reproducible Analytical Pipelines (RAPs), as described in [GOV.UK's blog post](#).

For more information on the methods used, the data they provide, and their strengths and limitations, see our [Estimates of UK quarterly GHG emissions \(residence basis\) quality and methodology information \(QMI\)](#).

For further information, or if you have any views on these statistics or suggestions for improvement, you can contact us at [environment.accounts@ons.gov.uk](mailto:environment.accounts@ons.gov.uk).

## Strengths and limitations

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 eight quarters. This implies that the estimates for those periods are less accurate, compared with periods where a base or reference year is available.

For more detailed information on the strengths and limitations of the estimates presented in this bulletin, see Section 6: Methods used to produce the data in our associated QMI.

## More quality and methodology information

More quality and methodology information on strengths, limitations, appropriate uses, and how the data were created is available in our [Estimates of UK quarterly greenhouse gas emissions \(residence basis\) QMI](#).

## 8 . 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.

### [Greenhouse gas emission, UK: provisional estimates, 2023](#)

Bulletin | Released 17 October 2024

The emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, nitrogen trifluoride, and total greenhouse gas emissions by industry (SIC 2007 group of around 130 categories), for the UK from 1990 to 2023.

### [UK territorial greenhouse gas emissions statistics](#)

Statistics | Last updated 23 January 2025

Final and provisional estimates of UK territorial greenhouse gas emissions from 1990 from the Department for Energy Security and Net Zero.

### [UK and England's carbon footprint to 2021](#)

Statistics | Last updated 15 May 2024

Annual greenhouse gas and carbon dioxide emissions relating to UK and England consumption from the Department for Environment, Food and Rural Affairs.

### [Measuring UK greenhouse gas emissions](#)

Article | Last updated 17 October 2024

Summary of the three measures of UK greenhouse gas (GHG) emissions: territorial, residence and footprint.

## 9 . Cite this statistical bulletin

Office for National Statistics (ONS), released 30 April 2025, ONS website, statistical bulletin, [Estimates of quarterly greenhouse gas emissions \(residence basis\), UK: October to December 2024](#)