



## UK's Carbon Footprint 1997 – 2016

GHG emissions associated with UK consumption (UK's 'carbon footprint') fell in 2016, according to data released today.

- Between 2015 and 2016, the UK's carbon footprint is estimated to have fallen by 6 per cent. This slight decrease reflects some decrease in emissions associated with imported goods and services, particularly from China and the rest of the World.
- The carbon footprint peaked at 997 million tonnes carbon dioxide equivalents in 2007 and in 2016 was 21 per cent lower than this.
- Greenhouse Gas (GHG) emissions relating to imports rose 61 per cent from 1997 (when this data series began) to a peak in 2007 and in 2016 were 28 per cent higher than 1997. Emissions associated with imports from China also showed a peak in 2007. In 2016 they were 276 per cent higher than in 1997.
- In 2016, emissions relating to the consumption of goods and services produced in the UK were 35 per cent lower than in 1997.
- The findings indicate that the UK's carbon dioxide footprint fell by 6 per cent between 2015 and 2016.

The total carbon footprint of the UK includes the six main Greenhouse Gases comprising: CO<sub>2</sub>, methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and fluorinated compounds<sup>1</sup>. The carbon dioxide footprint relates just to CO<sub>2</sub> emissions.

The carbon footprint refers to emissions that are associated with the consumption spending of UK residents on goods and services, wherever in the world these emissions arise along the supply chain, and those which are directly generated by UK households through private motoring etc. These emissions are often referred to as 'consumption emissions' to distinguish them from estimates relating to the emissions 'produced' within a country's territory or economic sphere. To find out what effect UK consumption has on GHG emissions we need to take into account where the goods we buy come from and their associated supply chains.

These are classified as experimental statistics because of inherent uncertainties in the estimation of both non-CO<sub>2</sub> and CO<sub>2</sub> emissions. The methodology is subject to ongoing review and refinement from time to time.

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<sup>1</sup> Hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride

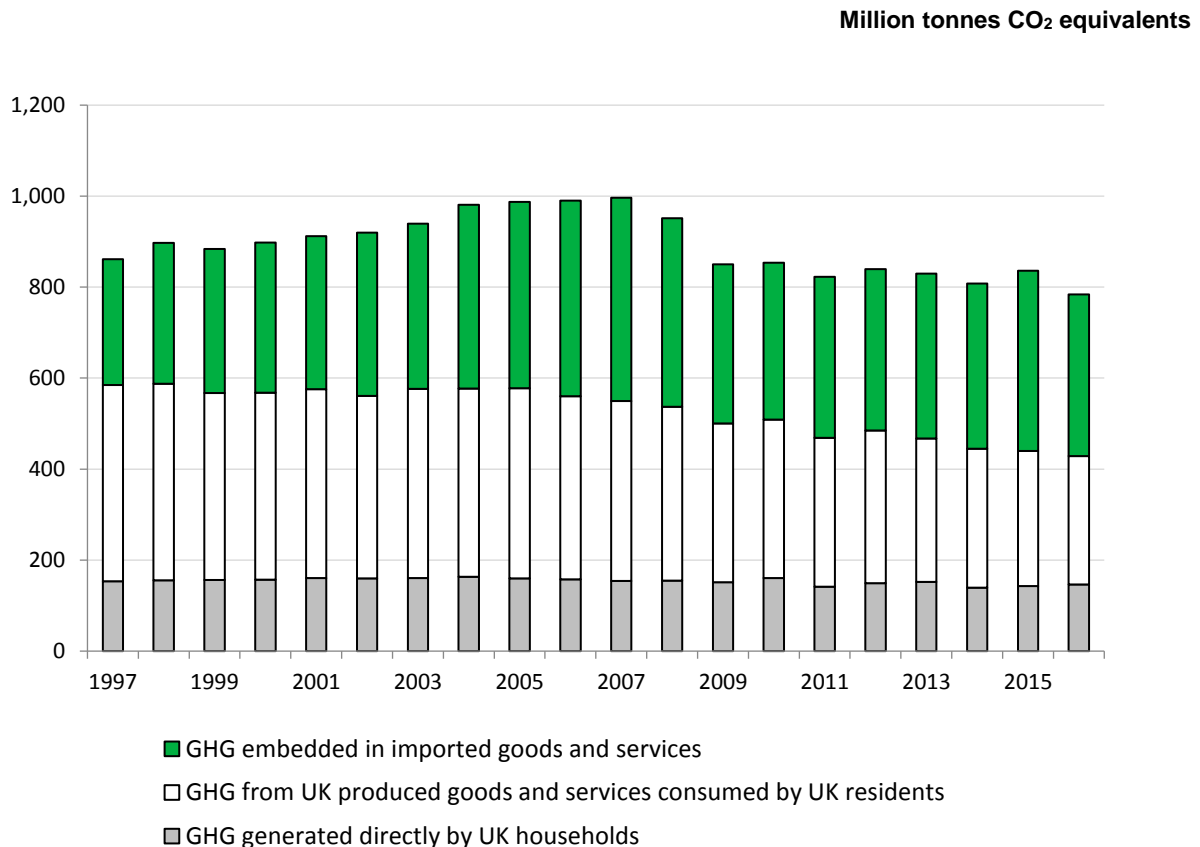
Since 1997, the UK economy has continued to move from a manufacturing base towards the services sector. One of the consequences of this is that more of the goods we buy and use are now produced overseas. This statistical release breaks down emissions into: those produced and consumed in the UK; those generated by households directly through heating and motoring; and those emissions relating to imports either from China, the EU or the Rest of the World. It excludes emissions arising from UK produced goods that are exported.

Inherently the emissions relating to overseas production of imports to the UK, often referred to as emissions that are 'embedded' in imports, are not as easily measured as emissions generated within the UK borders. There are general conventions on how to do this but the results cannot be viewed as being as robust as the estimates of carbon emissions generated domestically.

## Greenhouse Gas emissions associated with UK consumption

The UK's total carbon footprint includes Carbon dioxide emissions with the other greenhouse gases<sup>2</sup> and this has decreased by about 6 per cent between 2015 and 2016. These estimates are less robust than estimates for CO<sub>2</sub> only, largely because of inherent uncertainties in their estimation. Therefore these statistics are currently classified as experimental statistics.

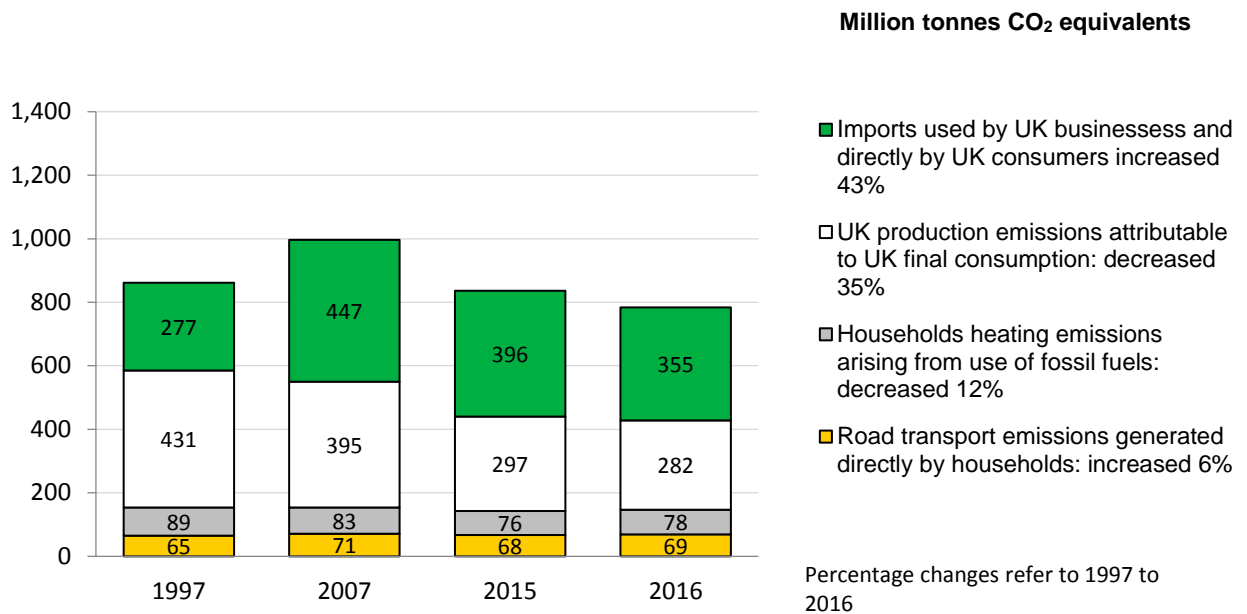
**Figure 1 Greenhouse gas emissions associated with UK consumption 1997 to 2016**



The carbon footprint (measured by GHG emissions) peaked in 2007 at 997 mt CO<sub>2</sub> equivalent. In 2016 it was 21 per cent lower than the 2007 peak (784 mt CO<sub>2</sub> equivalent). Figure 1 shows that the proportion of the total GHG footprint accounted for by the production of imports was higher in 2016 (at 45 per cent) than in 1997 (32 per cent). This is due to a higher level of embedded emissions in imports from China in 2016 compared to 1997. The proportion of the total GHG footprint generated directly by UK households has remained between 15 and 19 per cent between 1997 and 2016.

<sup>2</sup> Methane, nitrous oxide, and three fluorinated compounds - hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

**Figure 2 Greenhouse gas emissions associated with UK consumption 1997, 2007, 2015 and 2016**



In 2016 total greenhouse gas emissions associated with UK consumption were 3 per cent lower than in 1997 when this series begins. Figure 2 sets out the changes in each of four main activities that make up the total, including the peak in 2007.

**Emissions associated with UK production**, were 35 per cent lower than 1997 levels in 2016. These emissions accounted for 36 per cent of the total GHG footprint in 2016. UK production emissions were 282 mt CO<sub>2</sub>e in 2016, which was a decrease on the 2015 level of 297 mt CO<sub>2</sub>e.

The level of **emissions generated directly by households** had remained broadly constant at around 140 - 160 mt CO<sub>2</sub>e and was 147 CO<sub>2</sub>e in 2016. Within the category, emissions from heating have fluctuated around 72 to 93 mt CO<sub>2</sub>e, depending largely upon the severity of the winter. In 2016 emissions from heating were 78 mt CO<sub>2</sub>e, this is a slight increase from 2015, due to a colder weather particularly in November and December.

**Embedded emissions from imports** increased by 61 per cent from 1997 to 2007 when they reached a peak. In 2016 they were 355 mt CO<sub>2</sub>e which was 21 per cent lower than the peak.

**Figure 3 Breakdown of consumption emissions by region of import 1997 to 2016**

Million tonnes CO<sub>2</sub>e

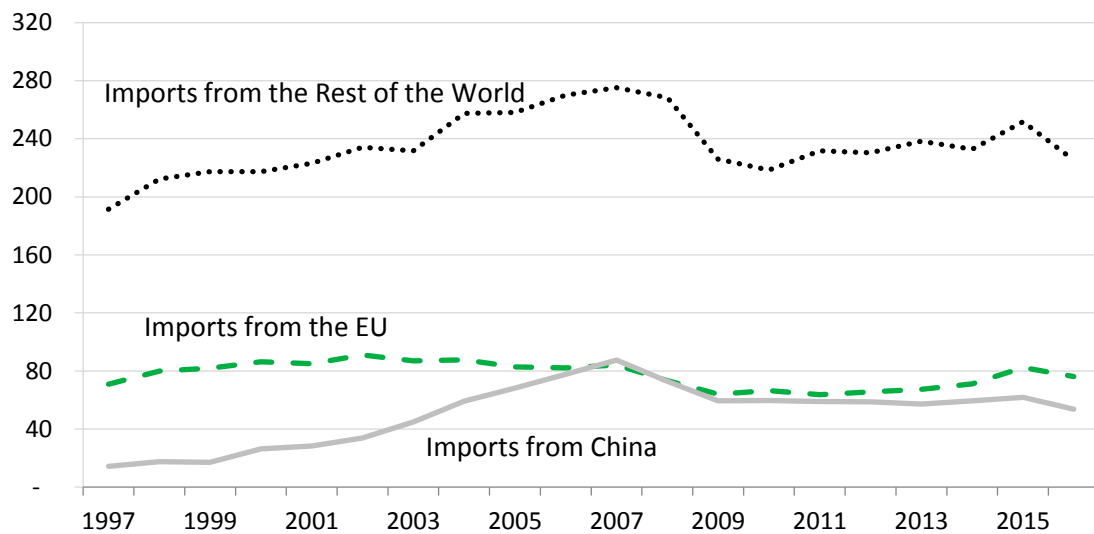


Figure 3 shows that in 2016, emissions associated with imports from China were 54 mt CO<sub>2</sub>e, which is 276 per cent higher than the 1997 level of 14 mt CO<sub>2</sub>e. In 2016 these emissions accounted for 7 per cent of the UK carbon footprint as opposed to 2 per cent in 1997. They now account for 15 per cent of the emissions associated with imports, compared to 5 per cent in 1997.

After a steady increase to a peak of 91 mt CO<sub>2</sub>e in 2002, emissions relating to EU imports have decreased 16 per cent to 76 mt CO<sub>2</sub>e in 2016. This is higher than the 1997 level of 71 mt CO<sub>2</sub>e.

Emissions embedded in imports from the Rest of the World accounted for 63 per cent of imported emissions in 2016, and they have increased by 18 per cent since 1997 to 225 mt CO<sub>2</sub>e in 2016.

## Carbon Dioxide emissions associated with UK consumption

Figure 4 CO<sub>2</sub> emissions associated with UK consumption 1997 to 2016

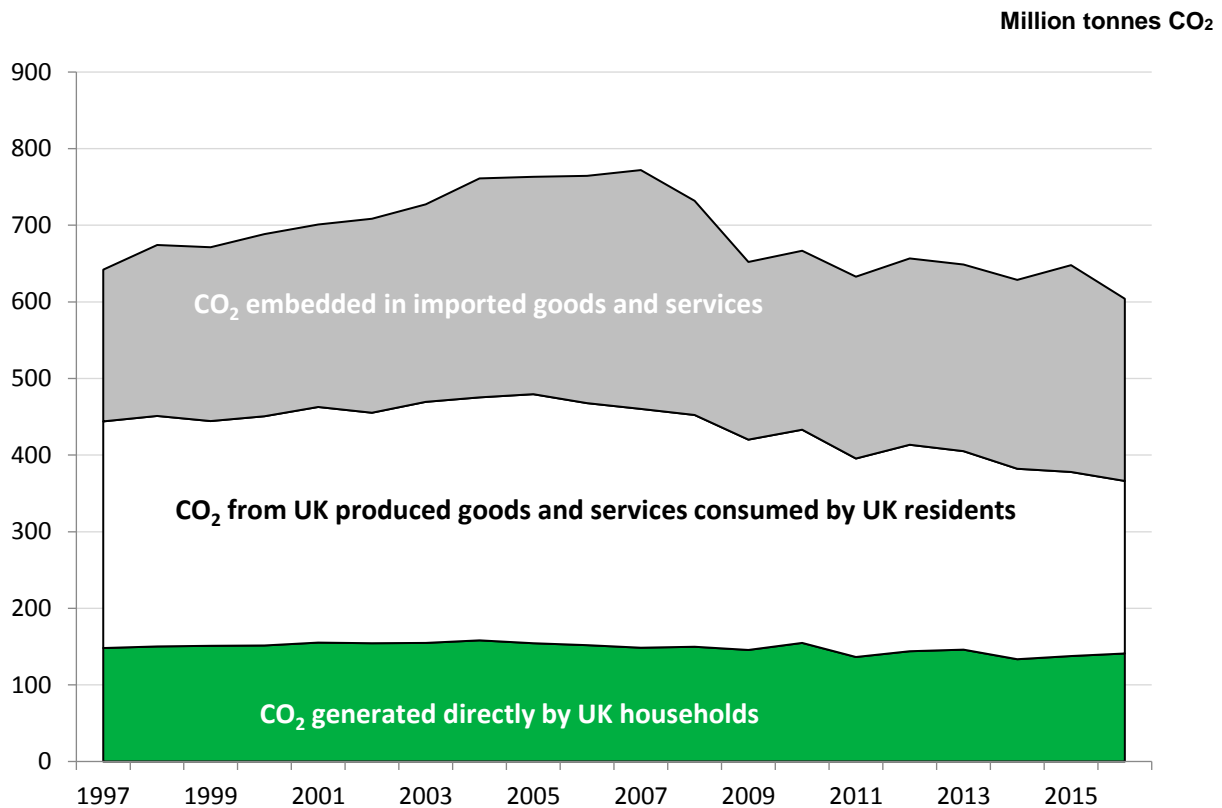


Figure 4 looks at emissions from CO<sub>2</sub> only. CO<sub>2</sub> is the main greenhouse gas, accounting for 78 per cent of total UK consumption greenhouse gas emissions in 2016.

In 2016, CO<sub>2</sub> accounted for 96 per cent of GHG emissions generated directly by UK households, 80 per cent of the GHG emissions from UK produced goods and services consumed in the UK, and 69 per cent of the GHG emissions embedded in imported goods and services.

Patterns of emissions vary by product group.

All broad product groups saw a fall between 2015 and 2016 with percentage falls ranging from 2 to 16 per cent. The greatest falls were:

- Power and water decreased by 13 mt CO<sub>2</sub>, (16 per cent);
- Trade decreased by 1 mt CO<sub>2</sub> (13 per cent)

## **Background to the statistics**

The University of Leeds has been contracted for five years by Defra to provide estimates of the UK's carbon footprint. The project updates previous work carried out by the Stockholm Environment Institute (SEI) published by Defra in 2008. It uses a multi-region input-output (MRIO) model, to link the flows of goods and services described in monetary terms, with the emissions generated in the process of production. The latest estimates benefit from recent modelling developments at the University of Sydney where data from their "Eora" feeds directly into the UK model. In brief, this is a sophisticated computer model that can assimilate data on emissions and product flows from different countries and years in different classifications and valuations, dealing with the data gaps and reconciling inconsistencies.

## **Revisions**

Each year the estimates relating to previous years are subject to revision, as a result of either revisions to the underlying data or because of methodological improvements. The most significant of these is the use of the 2010 Analytical tables – used in the model to understand the proportion of imports to UK intermediate and final demand. There have also been methodological improvements in the way that the trade data has been reconciled with the structure of the UK classification. These changes are detailed in a methodological note which is available on request. The net effect of these changes is a downward revision of the UK carbon footprint for the years before 2008, whilst estimates from 2009 onwards show little change. The carbon dioxide emissions show a slight upward revision from 2002 onwards. The methodology will continue to be improved, which may well lead to further revisions to the past time series.

## **Greenhouse gas emissions uncertainty**

Defra published research on the uncertainty in the estimates as part of a previous report on consumption-based CO<sub>2</sub> emissions between 1992 and 2004. The research showed that the relative standard error for total CO<sub>2</sub> consumption emissions in any one year lies within the range of 3.3 per and 5.5 per cent. Since then there have been a number of improvements in the model, with more up-to-date and reliable financial data, which should have reduced the range of errors for the more recent years. However, the uncertainty relating to the changes in the UK's greenhouse gas footprint has not yet been researched and the estimates must therefore be treated with caution and have been classified as experimental.

## **Relationship with other measures of GHG emissions**

The UK's carbon footprint is measured in different ways for different purposes. Each basis of measurement is published by the government. The different bases should be viewed as complementary ways of accounting for carbon emissions.

### *Territorial basis*

Emission estimates are based on the UK greenhouse gas inventory and published by the Department for Business, Energy and Industrial Strategy (BEIS) – this is used as the basis for our reporting to the EC and United Nations Framework Convention on Climate Change (UNFCCC), and forms the basis for reporting on progress towards our domestic and international emissions reduction targets. The inventory measures emissions on a territorial

basis, so only includes emissions which occur within the UK's borders. GHG emissions emitted in international territory, i.e. from international aviation and shipping, are reported as memorandum items.

*Production basis*

Emissions estimates are reported in the UK Environmental Accounts, published by the Office for National Statistics (ONS) - these measure GHG emissions on what is referred to as a "residents" basis, which means that the figures represent emissions produced by UK residents and industry whether in the UK or abroad but exclude emissions within the UK which can be attributed to overseas residents and businesses. International aviation and shipping emissions are allocated to countries based on the operator of the vessel.

**Figure 5 Relationship of different measures of the UK's CO<sub>2</sub> emissions 1997 to 2016**

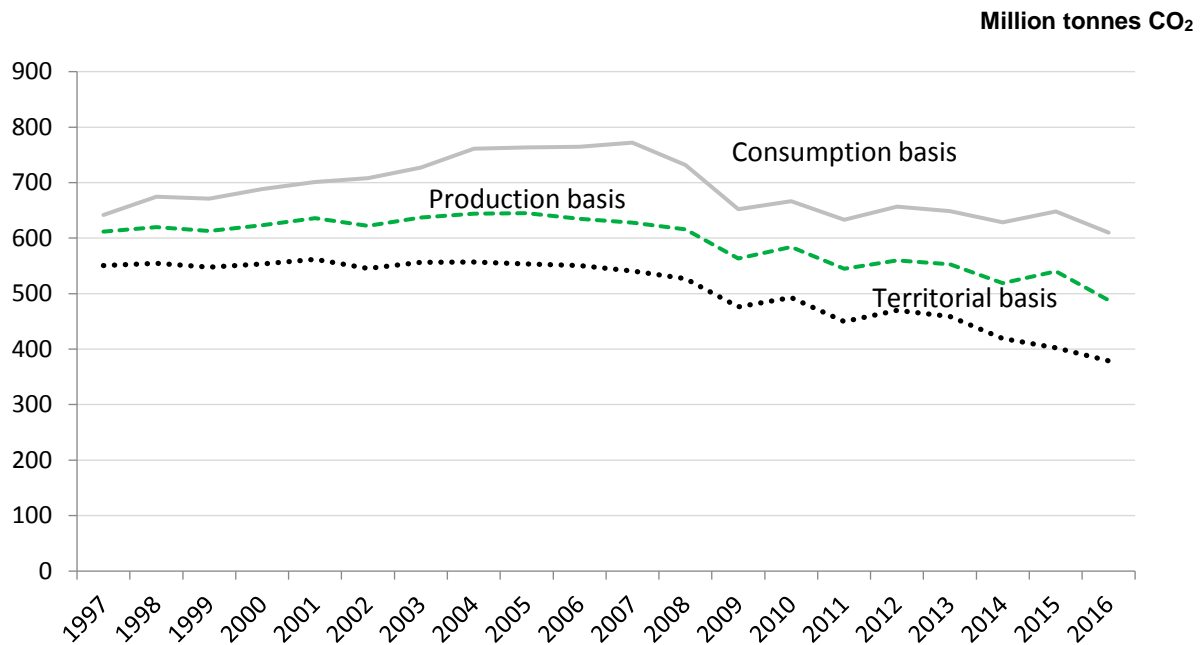


Figure 5 shows the relationship between three different measures of CO<sub>2</sub> emissions relating to the UK. The carbon dioxide footprint on a consumption basis is notably biggest due to the impact of embedded emissions from imports. Whilst the carbon dioxide footprint has decreased 5 per cent over the time period, emissions on a territorial basis have decreased 31 per cent whilst emissions on a production or residents basis have decreased 20 per cent. The larger reduction in territorial emissions may be due to the UK economy further moving from a manufacturing base to a service base with a greater dependence upon imports and their associated embedded emissions.



## **References**

Wiedmann, T., Wood, R., Lenzen, M., Minx, J., Guan, D. and Barrett, J. (2008) *Development of an Embedded Carbon Emissions Indicator – Producing a Time Series of Input-Output Tables and Embedded Carbon Dioxide Emissions for the UK by Using a MRIO Data Optimisation System*, Report to the UK Department for Environment, Food and Rural Affairs by Stockholm Environment Institute at the University of York and Centre for Integrated Sustainability Analysis at the University of Sydney, June 2008. Defra, London, UK

Wiedmann, T., Lenzen, M. and Wood, R. (2008) *Uncertainty Analysis of the UK-MRIO Model – Results from a Monte-Carlo Analysis of the UK Multi-Region Input-Output Model (Embedded Emissions Indicator)*; Report to the UK Department for Environment, Food and Rural Affairs by Stockholm Environment Institute at the University of York and Centre for Integrated Sustainability Analysis at the University of Sydney. Defra, London, UK.

[Office for National Statistics Environmental Accounts](#) – For Production (Residents) Emissions

[www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics](http://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics) – For Territorial Emissions

## **Notes**

Whilst the research has not been subject to National Statistics assessment standards, in other respects the analysis has been conducted in line with the National Statistics' Code of Practice.

Website: <https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs>

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