

Article

Net zero and the different official measures of the UK's greenhouse gas emissions

The UK government has announced a target of net zero for UK greenhouse gas (GHG) emissions by 2050. This article explains what net zero means, how progress towards it is measured and the differences between official measures of UK GHG emissions.

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1 . Background

The UK government announced a [target of net zero for UK greenhouse gas \(GHG\) emissions by 2050](#) following recommendations made by the [Committee on Climate Change](#). This change to legislation came into force on 27 June 2019 and amended the [Climate Change Act 2008](#) target of an 80% reduction in GHG emissions compared with the 1990 levels.

2 . Net zero can be achieved by emission reduction and removal

Net zero means that the UK's total greenhouse gas (GHG) emissions would be equal to or less than the emissions the UK removed from the environment¹. This can be achieved by a combination of emission reduction and emission removal.

The continued switch away from coal towards gas and renewable energy by the energy supply industry has resulted in a general reduction in GHG emissions since 1990. Reaching net zero would require continuing to reduce emissions from this industry, households and from other industries, in particular those with the highest associated emissions such as transport, manufacturing and agriculture².

GHG emissions can be removed by the natural environment or by using technologies like carbon capture (usage) and storage (CC(U)S).

The Committee on Climate Change estimate that in 2050 it is likely that somewhere between 75 to 175 million tonnes of carbon dioxide equivalent will need to be removed by CC(U)S annually in order to meet net zero, given it is unlikely that all sources of GHG emissions can be eliminated.

The amount of greenhouse gas removal or emissions possible from the UK's natural environment is dependent on how the UK uses its land and the land's condition. In 2017, an estimated 28 million tonnes of CO₂ and other carbon gases were removed by vegetation in the UK³. Such removals are included and netted off against the UK's GHG emissions in the Climate Change Act definition of how GHG emissions are measured.

However, potential GHG emissions from some areas of the UK's natural environment that are not in good condition are currently excluded from the definition. The Centre for Ecology and Hydrology (CEH) have reported estimates of [carbon dioxide emissions from peatland in the UK](#) as 23 million tonnes of carbon dioxide equivalent per year⁴.

Notes for: Net zero can be achieved by emission reduction and removal

1. House of Commons library: [Legislating for net zero](#) and [Net zero emissions: a new UK climate change target?](#)
2. For further information on progress in reducing UK GHG emissions by different industries and households see Office for National Statistics (ONS): [UK Environmental Accounts: 2019](#) or the Committee on Climate Change: [Reducing UK emissions, 2019 progress report to Parliament](#).
3. Estimates of CO2 and carbon gases removed by vegetation are available within ONS: [UK Environmental Accounts: 2019](#). Estimates of other air pollutants removed by vegetation are available in ONS: [UK natural capital: Ecosystem service accounts, 1997 to 2015](#).
4. Centre for Ecology and Hydrology: [Implementation of an Emissions Inventory for UK Peatlands](#). Peatlands are rich carbon stores, which have gradually pulled carbon in from the atmosphere over thousands of years. In near natural condition peatland can continue to slowly absorb carbon over the long-term. However, when peatlands are not left in good condition these long-term carbon stores relatively rapidly return that carbon to the atmosphere.

3 . Measuring the UK's progress to net zero

Estimates of the UK's greenhouse gas (GHG) emissions, published by the Department for Business, Energy and Industrial Strategy (BEIS), are used as the baseline for monitoring the Climate Change Act net zero target.

These estimates, known as territorial and which are production-based estimates, include GHG emissions or removals from:

- businesses based in the UK regardless of where in the world they are registered
- the activities of people that live in the UK as well as non-UK visitors
- land such as forest, crop or grazing land

They exclude emissions or removals from:

- international air travel
- international shipping
- UK residents abroad
- UK Crown dependencies and overseas territories
- the burning of biomass such as wood, straw, biogases and poultry litter for energy production
- land such as peatland
- the production of goods and services that the UK imports from other countries

Estimates on this basis were originally required under the international [Kyoto protocol](#) with the UK legally bound to meet a target of reducing 1990 territory-based emissions by 12.5% by 2012. The UK government subsequently legislated to reduce GHG emissions to 80% of 1990 levels by 2050 in the Climate Change Act 2008.

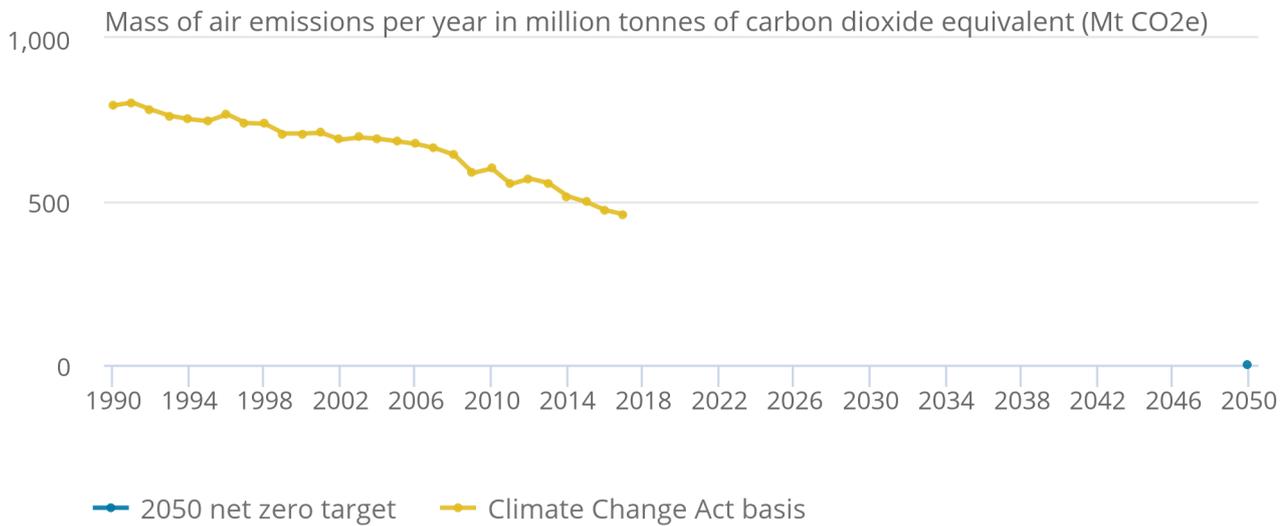
[The Paris Agreement](#) in 2016 did not set legally binding targets. Signatory countries (including the UK), agreed to plan, determine and report on how they would help keep the increase in global average temperature to less than 1.5 degrees above pre-industrial era levels.

Figure 1 shows progress towards net zero GHG emissions on the current Climate Change Act basis. In 2017, the UK emitted 460 million tonnes of carbon dioxide equivalent, compared with 794 million tonnes of carbon dioxide equivalent in 1990.

Figure 1: Net greenhouse gas emissions on a Climate Change Act basis were 460 million tonnes in 2017

Net greenhouse gas emissions on a Climate Change Act basis, UK, 1990 to 2017

Figure 1: Net greenhouse gas emissions on a Climate Change Act basis were 460 million tonnes in 2017. Net emissions in 2017 were 460 million tonnes. Reducing net emissions will potentially require 75 to 175 million tonnes emissions removal by capture and storage at the Committee on Cli



Source: Department for Business, Energy and Industrial Strategy, Ricardo Energy and Environment

4 . Other official measures of the UK’s greenhouse gas emissions

The UK is required to report its estimated greenhouse gas (GHG) emissions on a range of different bases in order to fulfil a wide range of international agreements.

Figure 2 shows how other official estimates of the UK’s GHG emissions in 2016 (the latest year for which data are available on all bases) differ from the Climate Change Act-based estimate.

Estimates of the UK's GHG emissions in 2016 ranged from a minimum of 473 million tonnes of carbon dioxide equivalent on a Climate Change Act basis, to a maximum of 784 million tonnes of carbon dioxide equivalent on a footprint basis.

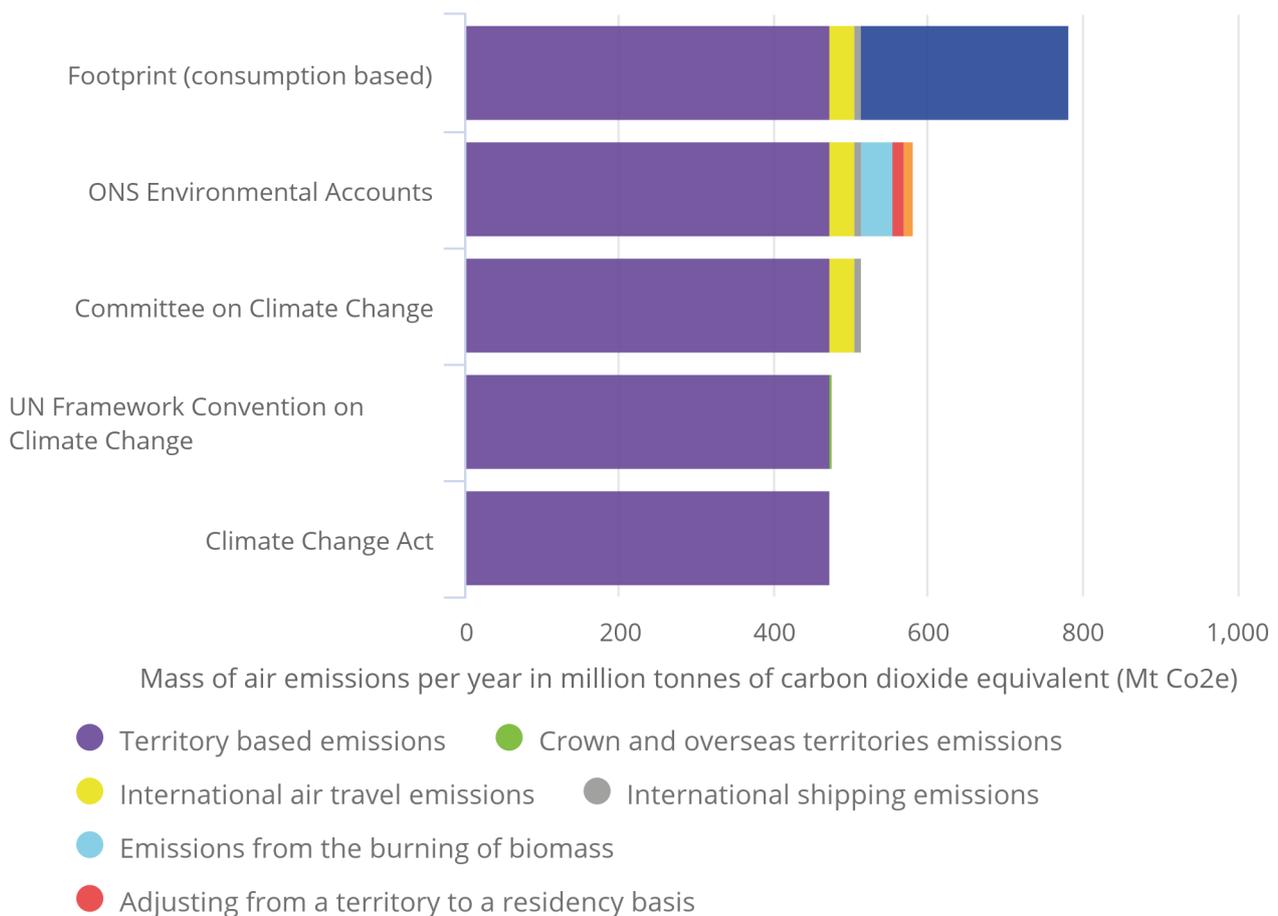
Each official measure has differences in what is included and excluded in their totals. When international agreements were put in place requiring estimates on these bases, exclusions were sometimes made due to data sources being unavailable or in development (for example, emissions from peatland) and/or their measurement was not internationally agreed upon (for example, emissions from international shipping or air travel). Both international and domestic agreements may be updated in future as our ability to measure sources of GHG emissions increases.

Figure 2: Estimates of the UK's greenhouse gas emissions range from 473 to 784 million tonnes of CO2 equivalent in 2016

Official estimates of greenhouse gas emissions according to different domestic and international bases, UK, 2016

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Official estimates of greenhouse gas emissions according to different domestic and international bases, UK, 2016



Source: Office for National Statistics – UK Environmental Accounts, Department for Business, Energy and Industrial Strategy, Department for Environment, Food and Rural Affairs, University of Leeds, Committee on Climate Change, Ricardo Energy and Environment

Notes:

1. Territory-based emissions include emissions released in the UK by tourists and foreign transport operations and exclude the emissions of UK residents abroad. Similarly, they include emissions from businesses based in the UK but registered abroad, but exclude those from businesses registered in the UK but based abroad.
2. Territory-based emissions from Crown dependencies of Guernsey, Jersey and the Isle of Man. Territory based emissions from the UK's overseas territories of Gibraltar, the Falkland Islands, the Cayman Islands, Montserrat and Bermuda.
3. Emissions relating to international air travel and shipping are included as explanatory memorandum items for both UNFCCC reporting and the Climate Change Act, but are not currently formally included in their targets. There is currently no international agreement on how to allocate such emissions to individual countries or measure such emissions in a robust manner.
4. Emissions from the burning of biomass includes burning of wood, straw, biogases and poultry litter for energy production.
5. Residency-based estimates include the emissions of UK residents based abroad but exclude emissions released in the UK by tourists and foreign transport operations. Similarly, they include emissions from businesses registered in the UK but based abroad and exclude those from businesses based in the UK but registered abroad. This basis allows comparability with the international United Nations System of National Accounts (SNA) and System of Environmental Economic Accounting (SEEA).
6. Footprint estimates are calculated on a consumption basis and provide estimates of emissions associated with the consumption of goods and services by households within the UK. They include estimates of emissions associated with each stage of the supply chain for those goods and services, irrelevant of whether or not their production process occurs within the UK.
7. Theoretically, footprint-based estimates of net imported emissions (emissions associated with imports minus emissions associated with exports) should be the same as the difference between the total footprint estimate of 784 Mt CO₂e and the territorial-based (including aviation and shipping) estimate of 515 Mt CO₂e. However, in practice, the different approaches used to calculate these estimates mean that they make different assessments of the emissions resulting from UK production for UK consumption.
8. Footprint estimates are classified as Experimental Statistics and are subject to uncertainty. The methodology used to produce them is subject to ongoing review and refinement.
9. ONS Environmental Accounts air emissions bridging tables provide further detail of the relationship between the estimates of emissions provided in this figure.
10. Sub-totals may not sum to totals due to rounding.

5 . The UK's carbon footprint

Estimates of the UK's greenhouse gas (GHG) emissions known as the carbon footprint are calculated on a consumption basis and published by [the Department for Environment, Food and Rural Affairs \(Defra\)](#).

They provide estimates of UK GHG emissions based on the consumption of all goods and services by households within the UK. They include estimates of emissions associated with each stage of the supply chain for those goods and services, irrelevant of whether or not their production process occurs within the UK. They therefore include emissions associated with what the UK imports but exclude emissions associated with UK exports.

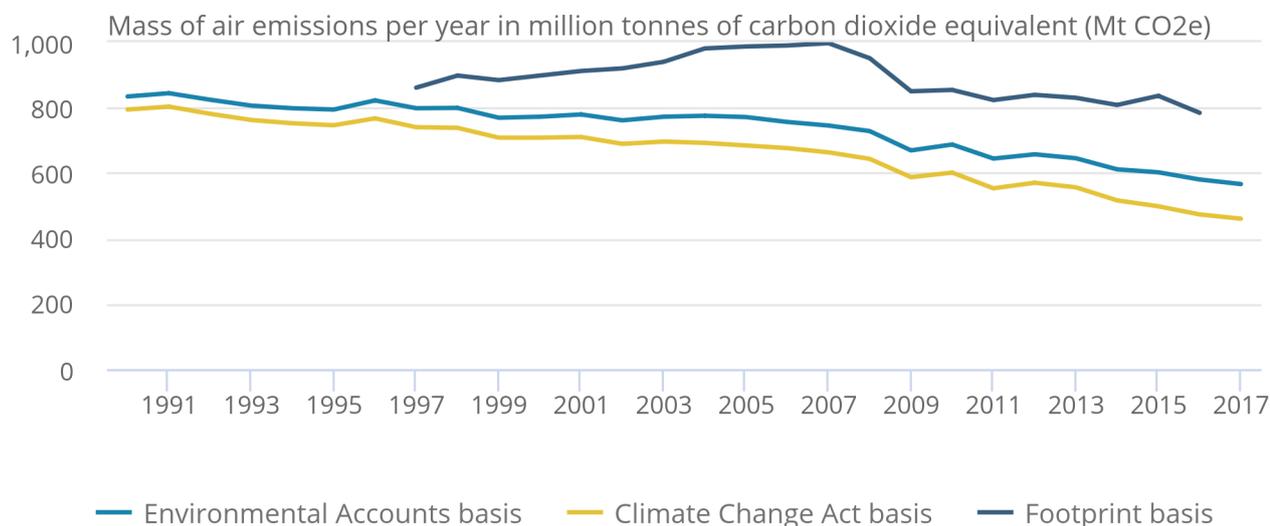
The UK's carbon footprint is classed as an [Experimental Statistic](#) due to inherent uncertainties in the estimates produced. The methodology used to produce them is subject to ongoing review and refinement.

Figure 3: Estimates of UK greenhouse gas emissions on a footprint (consumption) basis have fallen more slowly than estimates on other basis

Greenhouse gas emissions on a Climate Change Act, Environmental Accounts and Footprint basis: UK, 1990 to 2017

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Greenhouse gas emissions on a Climate Change Act, Environmental Accounts and Footprint basis: UK, 1990 to 2017



Source: Office for National Statistics – UK Environmental Accounts, Department for Business, Energy and Industrial Strategy, Department for Environment, Food and Rural Affairs, University of Leeds, Ricardo Energy and Environment

Notes:

1. Footprint estimates are classified as Experimental Statistics and are subject to uncertainty. The methodology used to produce them is subject to ongoing review and refinement.
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Figure 3 shows the greenhouse gas footprint basis provides notably the biggest estimate of the UK's GHG emissions. This is due to this basis being the only one that includes emissions generated during the production of goods and services imported by the UK.

Whilst the carbon footprint estimate has decreased 9% from 1997 to 2016, emissions on a Climate Change Act (territorial, production-based) have decreased 36% and emissions on the environmental accounts (residency, production-based) have decreased 27%.

The smaller percentage reduction in the carbon footprint estimates over this period may reflect the UK economy moving further from a manufacturing base to a services base with a greater dependence on imports and their associated emissions. Such a measure highlights the global considerations necessary when considering the UK's contribution to climate change.

6 . Glossary

Bioenergy with carbon capture and storage (BECCS)

Process of capturing and storing carbon emissions from burning biomass.

Biomass

Plant or animal material used as a fuel.

Carbon budgets

Under the Climate Change Act 2008, the UK government must set five-yearly carbon budgets, 12 years in advance, from 2008 to 2050. The government is required to consider the advice of the Committee on Climate Change when setting these budgets.

Carbon budgets restrict the amount of greenhouse gas the UK can legally emit in a five-year period. The UK is currently in the third carbon budget period (2018 to 2022). There are powers under the Climate Change Act to “borrow” or “bank” amounts from one budgetary period to another. This allows the government to increase the budget by borrowing up to 1% from the succeeding period, which is consequently reduced by the amount borrowed. Conversely, if it has a surplus in a budgetary period, it can carry all or some of it forward to the next period.

Carbon capture (usage) and storage (CC(U)S)

CC(U)S processes remove carbon dioxide that would otherwise be emitted from fossil fuel power stations and other industrial processes and transport it for alternative usage or permanent underground storage. In November 2018, the government published a [Carbon Capture, Usage and Storage Action Plan](#).

Committee on Climate Change

The (UK) Committee on Climate Change is an independent, statutory body established under the Climate Change Act 2008. The purpose of the CCC is to advise the UK government and devolved administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

Conference of the Parties (COP)

Annual negotiations of the parties involved in the United Nations Framework Convention on Climate Change (UNFCCC).

Emissions Trading System (ETS)

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare – emissions permitted them but not “used” – to sell this excess capacity to countries that are over their targets.

Footprint (consumption-based) emissions estimates

Measure emissions based on the consumption of all goods and services by households within the UK. They include estimates of emissions associated with each stage of the supply chain for those goods and services, irrelevant of whether or not their production process occurs within the UK. They therefore include emissions associated with what the UK imports but exclude emissions associated with UK exports.

Greenhouse gases (GHG)

Greenhouse gases per the Kyoto protocol are: Carbon dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Hydro-fluorocarbons (HFC), Perfluorocarbons (PFC), Nitrogen Trifluoride (NF₃) and Sulphur Hexafluoride (SF₆).

Intergovernmental Panel on Climate Change (IPCC)

The IPCC is the United Nations body for assessing the science related to climate change.

Kyoto protocol

The Kyoto Protocol, adopted in Kyoto, Japan, in 1997, came into force on 16 February 2005 and involved 37 industrialised countries and the European Union. It committed them to reducing their greenhouse gas emissions by an average of 5% against 1990 levels, over the 2008 to 2012 period. At the 2012 United Nations Climate Change Conference, there was an agreement to extend the life of the Kyoto Protocol until 2020.

Net zero

The government target for at least a 100% reduction of greenhouse gas emissions (compared with 1990 levels) in the UK by 2050. This can be achieved by a combination of emission reduction and emission removal.

Paris Agreement

On 12 December 2015, parties to the United Nations Framework Convention on Climate Change reached agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Production-based emissions estimates

Measure emissions by looking at emissions produced by UK residents and UK-registered businesses for the residency-based estimate or produced within the UK's borders for the territorial estimate. They include emissions associated with exports but exclude emissions associated with imported goods and services

Residency-based

Relating to UK residents and UK-registered businesses – that is, estimates on this basis exclude emissions released in the UK by tourists and foreign transport operations, and include the emissions of UK residents abroad. Similarly, emissions from businesses based in the UK but registered abroad are excluded, those from businesses registered in the UK but based abroad are included. Office for National Statistics (ONS): [UK Environmental Accounts: 2019](#) estimates are compiled on this basis.

Territory-based

Within the UK's borders – that is, estimates on this basis include emissions released in the UK by tourists and foreign transport operations and exclude the emissions of UK residents abroad. Similarly, emissions from businesses based in the UK but registered abroad are included, those from businesses registered in the UK but based abroad are excluded. Climate Change Act estimates are compiled on this basis.

United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC entered into force on 21 March 1994 with the ultimate objective of stabilising greenhouse gas concentrations “at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system.” The main distinction between the Kyoto Protocol and the Convention is that while the Convention encouraged industrialised countries to stabilise emissions, the Protocol sets binding targets.