Statistical bulletin

UK environmental accounts: 2016

Satellite accounts to the main UK National Accounts measuring the contribution of the environment to the economy, the impact of economic activity on the environment, and society's response to environmental issues.

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1. Main points

Energy consumption from renewable and waste sources has been increasing since 1990; reaching a record high of 14.4 million tonnes of oil equivalent in 2014. These sources contributed 7.1% of total energy consumption.

Emissions of greenhouse gases have decreased since 1990; peaking in 1991 at 845.2 million tonnes of carbon dioxide equivalent and falling to 608.6 million tonnes of carbon dioxide equivalent in 2014. This is the lowest level since 1990.

The amount of material resources consumed (per person) has decreased by 30.4% between 2000 and 2014, falling from 12.5 tonnes per person to 8.7 tonnes per person.

The trend of road transport fuel switching from petrol to diesel continued. Between 2013 and 2014, diesel use increased by 3.3%, whereas petrol use decreased by 2.0%.

Since 1997, UK government spend on environmental protection expenditure (EPE) has increased from £4.1 billion to £15.4 billion in 2014, and currently accounts for 1.9% of total government spending.

2. Overview

Environmental accounts show how the environment contributes to the economy (for example, through the extraction of raw materials), the impact that the economy has on the environment (for example, energy consumption and air emissions) and how society responds to environmental issues (for example, through taxation and expenditure on environmental protection).

Environmental accounts are “satellite accounts” to the main National Accounts and they are compiled in accordance with the System of Environmental Economic Accounting (SEEA), which closely follows the UN System of National Accounts (SNA). This means that they are comparable with economic indicators such as gross domestic product (GDP).

Environmental accounts are used nationally and internationally, primarily by governments, development organisations and researchers, to inform sustainable development policy, to evaluate the environmental impacts of different sectors of the economy, and to model impacts of fiscal or monetary measures.

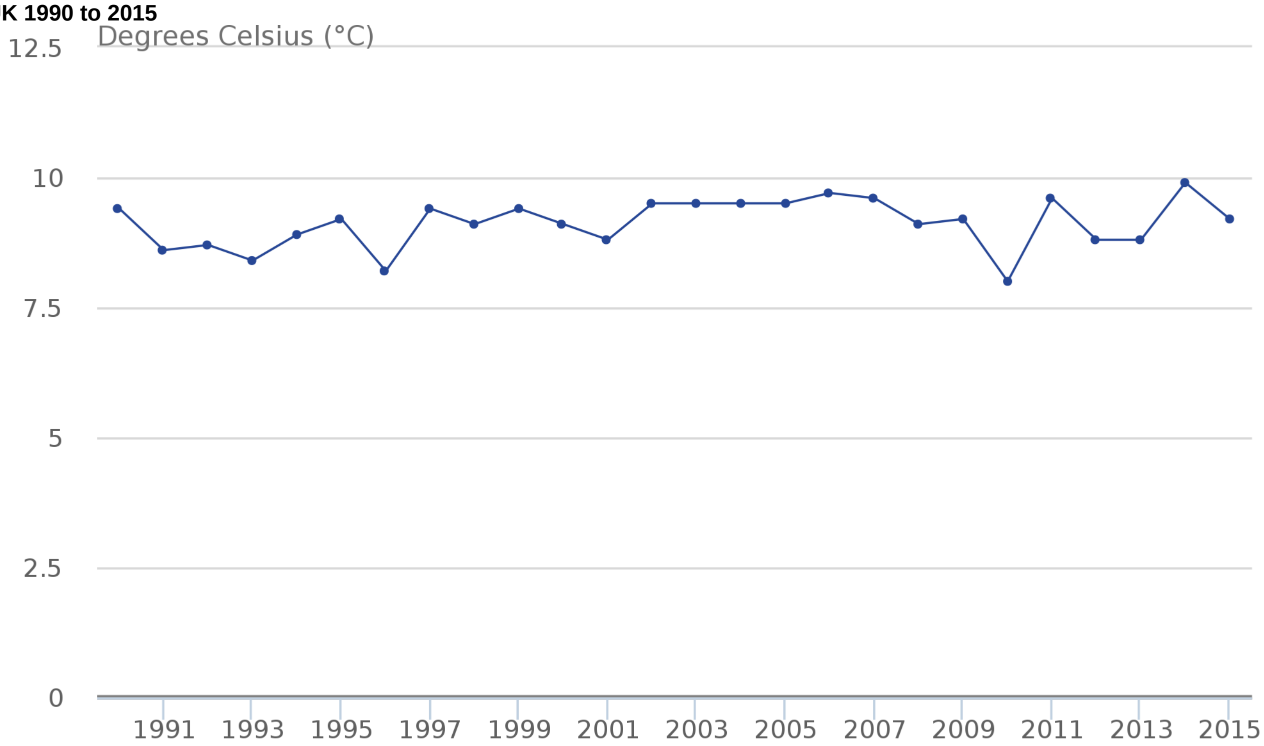
3. Changes in environmental and economic measures

Changes in mean air temperature and gross domestic product (GDP) between 1990 and 2015 are shown in Figures 3.1 and 3.2. These measures help to contextualise some of the changes observed across the environmental accounts. For example, the average temperature fell in 2010 to 8.0 degrees Celsius (°C), from 9.2°C in 2009, which contributed to increases in energy consumption and greenhouse gas emissions during that year. At the same time, GDP started to recover following the economic downturn, which may also explain the increases in energy consumption and greenhouse gas emissions. Between 2013 and 2014, the average air temperature increased by 1.1°C (from 8.8°C to a record high of 9.9°C). This warmer weather can help to partly explain the decline in energy consumption over this period.

The relationships between the environment and the economy are explored further throughout this bulletin.

Figure 3.1: Mean air temperature

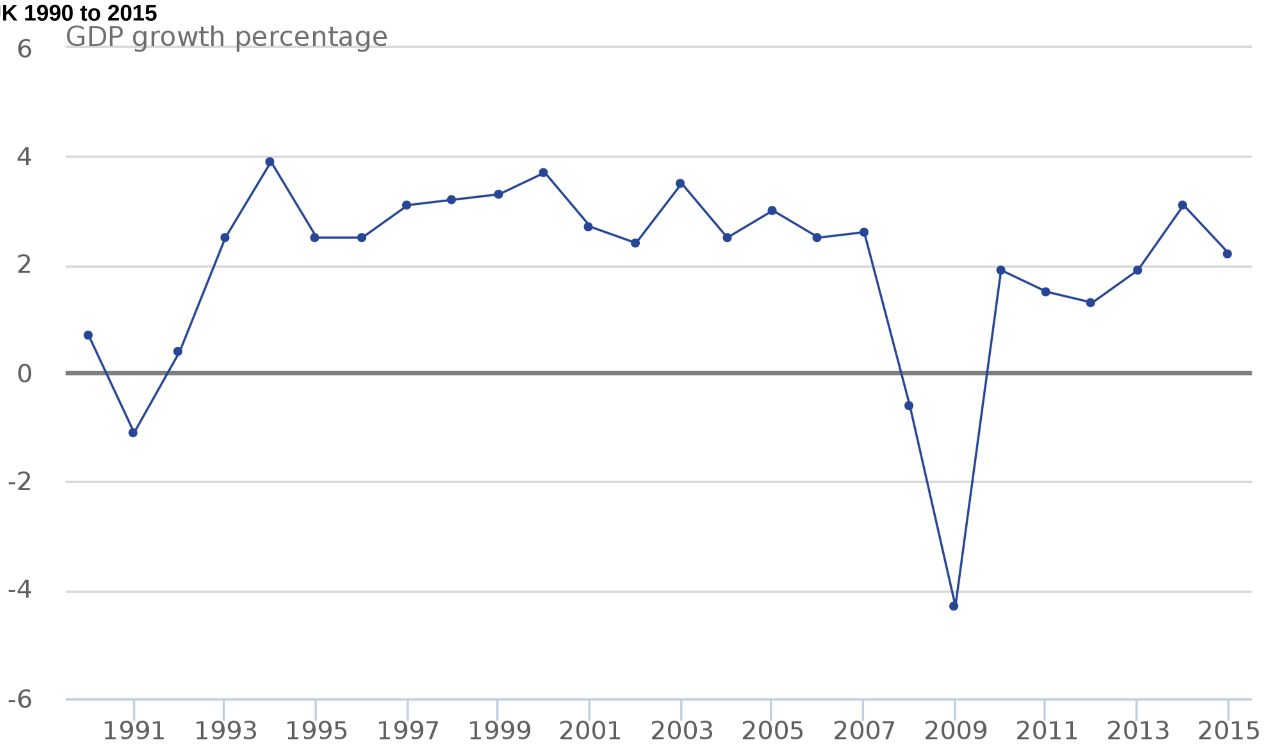
UK 1990 to 2015



Source: Met Office

Figure 3.2 Gross Domestic Product (GDP) (1)

UK 1990 to 2015



Source: Office for National Statistics

Notes:

1. GDP year on year growth: chain volume measure, in constant prices (2013-based).

4. Fuel use

Main points

Fuel use has decreased by 16.6% since 1990, falling from 213.6 million tonnes of oil equivalent (Mtoe) to 178.1 Mtoe in 2014 – the lowest point since 1990.

Natural gas has been the most used fuel since 1993. In 2014, natural gas represented 37.0% of total fuel consumption.

The trend of road transport fuel switching from petrol to diesel continued. Between 2013 and 2014, diesel use increased by 3.3%, whereas petrol use decreased by 2.0%.

Introduction

A fuel is a material which can store and release energy, usually as heat from combustion. Within the environmental accounts, “fuel use” refers to the consumption of combustible fuels and differs from “energy consumption”, which excludes fuels consumed for non-energy purposes, such as to produce chemicals or other fuels. In addition, energy consumption includes other sources of energy that are not from combustible fuels (such as nuclear and primary renewable electricity); as a result these are not included here within fuel use. For the purpose of this publication, “fuel use” is defined also to exclude combustible renewable and waste fuels as these are not associated with a net loss of energy from the environment in the same way as fossil fuels.

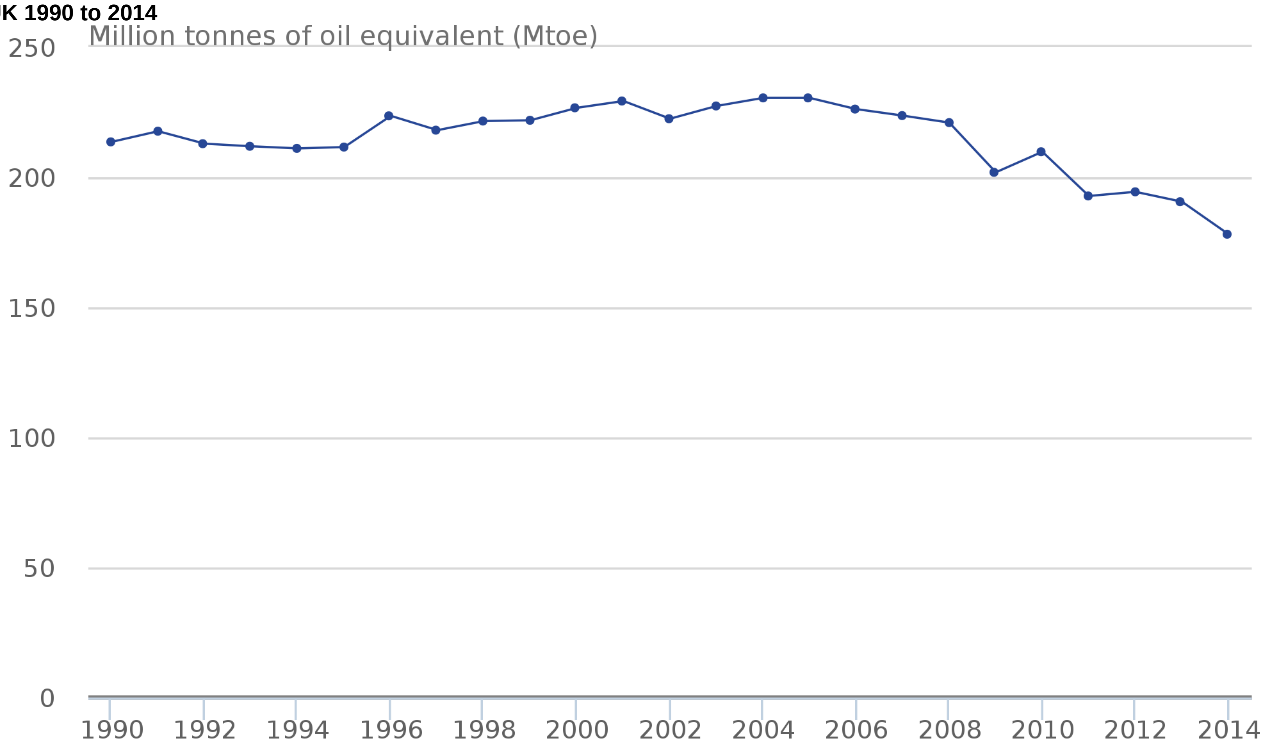
The methodology of the fuel use accounts are based on a UK “residency” basis (as opposed to a “territorial” basis) in line with the national accounts, which includes fuel use by UK resident persons and businesses visiting other countries, but exclude fuel use caused by visiting foreign persons and businesses in the UK.

Fuel use at its lowest point since 1990

Total fuel use fell by 16.6% between 1990 and 2014, from 213.6 million tonnes of oil equivalent (Mtoe) to178.1 Mtoe (Figure 4.1). There was a 6.6% decrease in fuel used between 2013 and 2014 (from 190.6 Mtoe to 178.1 Mtoe). This can partly be explained by the record warm weather in 2014, increasing from 8.8 degrees Celsius (°C) in 2013 to 9.9 °C in 2014. In 2005, fuel use peaked at 230.5 Mtoe but since then there has been an overall decrease, with fuel use being at its lowest in 2014 (22.8% decrease between 2005 and 2014). This decline has mainly been due to a shift in more efficient use of fuel and because of increases in the use of renewable and sustainable sources of energy. Since 2005, there have been some small increases in fuel use of 3.9% between 2009 and 2010, and 0.8% between 2011 and 2012. These increases were partly due to cooler temperatures, resulting in greater fuel demand.

Figure 4.1:Total fuel use

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

Natural gas most used fuel since 1993

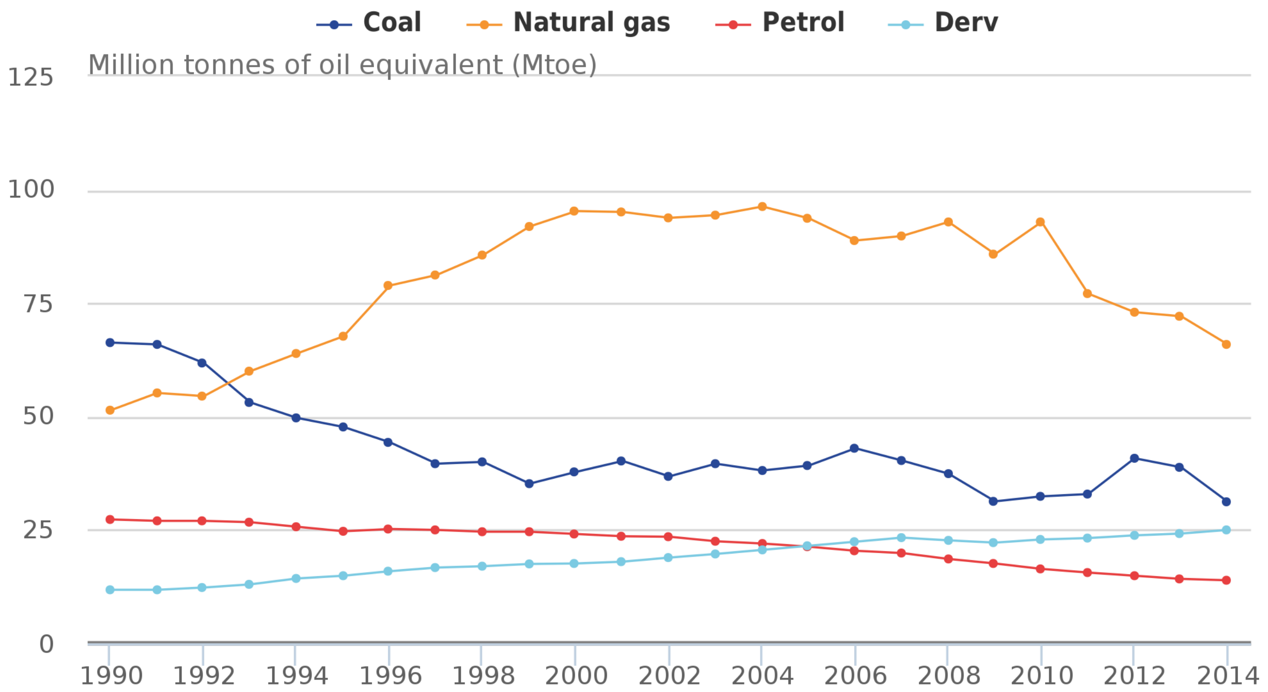
Since 1993, natural gas has been the most used fuel (Figure 4.2). In 2014, 65.9 Mtoe of natural gas was used, compared with 72.1 Mtoe in 2013 (decreasing by 8.6%). This decrease was due to a fall in consumption for domestic combustion. Natural gas use peaked in 2004 at 96.3 Mtoe, when it made up 41.8% of total fuels used. In comparison, natural gas made up 37.0% of total fuels used in 2014.

Coal use has decreased by 52.9% since 1990, with 66.3 Mtoe used in 1990 compared with 31.2 Mtoe in 2014. The largest annual increase in coal use was 24.0% between 2011 and 2012 (from 32.9 Mtoe to 40.8 Mtoe), partly because of a switch in the electricity generation sector from natural gas towards cheaper coal. However, between 2013 and 2014 coal use fell 19.5% (from 38.8 Mtoe to 31.2 Mtoe), the largest annual decrease. This decrease was mainly due to a fall in power stations' consumption.

Petrol use has been declining since 1990, falling from 27.3 Mtoe in 1990 to 13.9 Mtoe in 2014 (49.0% decrease), the lowest point in the series. In contrast, use of road diesel or DERV (Diesel-Engine Road Vehicle) has been gradually increasing (from 11.8 Mtoe in 1990 to 25.0 Mtoe in 2014, resulting in an increase of 112.6%). Between 2013 and 2014, petrol use fell by 2.0% while DERV use increased by 3.3%. Furthermore, in 1990, petrol comprised 12.8% of total fuel use while DERV comprised 5.5%. However, in 2014, petrol comprised 7.8% of total fuel consumption while DERV represented 14.0%. This continued trend of falling petrol and rising diesel consumption may indicate a switch to more efficient fuels for road use.

Figure 4.2: Fuel use: by type

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

For more detailed fuel use data, see "fuel use by type and industry" and "fuel use by industry, source and fuel".

5. Energy consumption

Main points

Between 2013 and 2014, total energy consumption fell by 5.4%, from 214.3 million tonnes of oil equivalent (Mtoe) to 202.7 Mtoe.

The vast majority of energy consumed in 2014 came from fossil fuels (85.2%). However, energy consumption from fossil fuels was at its lowest level since 1990.

Households consumed the most energy in 2014, using 74.8 Mtoe.

Energy consumption from renewable and waste sources reached a record high of 14.4 Mtoe in 2014. These sources contributed 7.1% of total energy consumption.

Introduction

Energy consumption is defined as the use of energy for power generation, industrial processes and heating and transport. This is essential to most economic activities, for example, as input for production processes and as a consumer commodity.

In this release, "direct use of energy" refers to the energy content of fuel for energy at the point of use, allocated to the original purchasers and consumers of fuels. Whereas, for "reallocated use of energy" the losses incurred during transformation[1] and distribution[2] are allocated to the final consumer of the energy rather than incorporating it all in the electricity generation sector.

The methodology of the energy accounts are based on a UK "residency" basis (as opposed to a "territorial" basis) in line with the national accounts, which includes energy consumed by UK resident persons and businesses visiting other countries, but excludes energy consumption by visiting foreign persons and businesses in the UK.

Total energy consumption

Energy use at its lowest point since 1990

Total energy consumption of primary fuels and equivalents fell by 19.6 million tonnes of oil equivalent (Mtoe) (8.8%) between 1990 and 2014 (from 222.3 Mtoe to 202.7 Mtoe) (Figure 5.1). Total energy consumption peaked in 2005 at 248.7 Mtoe.

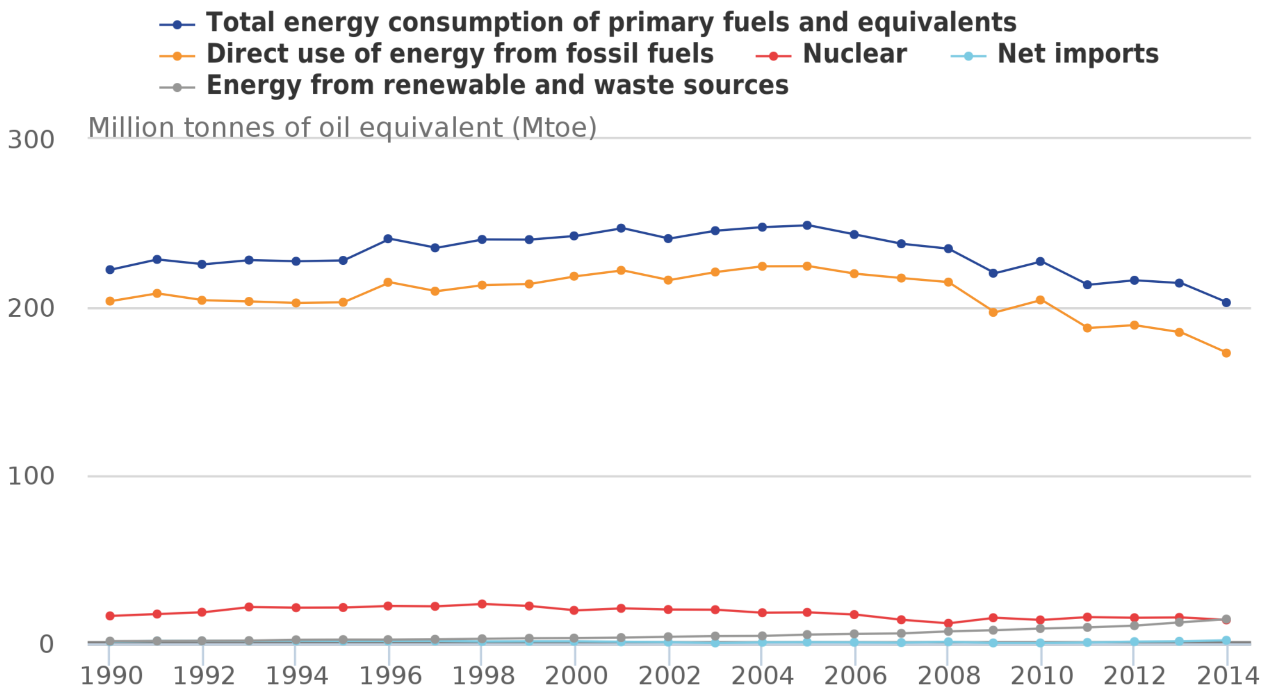
Since then, there has been an overall downward trend. However, deviations from this trend occurred between 2009 and 2010, and 2011 and 2012, with a 3.2% and 1.3% (respectively) increase in total energy consumed. These increases are in part due to cold weather, resulting in an increase in energy use by households. Between 2013 and 2014, total energy consumption decreased by 5.4%, from 214.3 Mtoe to 202.7 Mtoe. This can be partly attributed to warmer weather in 2014, where the average air temperature was 1.1 degrees Celsius higher than in 2013 (see section 3: Changes in environment and economic measures).

Fossil fuels remained the dominant source of energy throughout the 25 year period. However, consumption of fossil fuels for energy has decreased over time. In 1990, fossil fuels represented 91.6% of all sources of energy consumed, whereas this reduced to 85.2% by 2014. Between 1990 and 2014, energy consumption from fossil fuels decreased by 15.2% (from 203.6 Mtoe to 172.7 Mtoe). There was also a 6.6% decline in energy consumption from fossil fuels between 2013 and 2014, falling from 185.0 Mtoe to 172.7 Mtoe. This fall was primarily due to a reduction in power stations' coal combustion. There was also a decrease in domestic gas consumption from the consumer industry sector, partly due to warmer weather.

While energy consumption from fossil fuels has fallen, there has been an increase in energy consumption from other sources, particularly renewable and waste sources. In 2014, energy consumption from other sources comprised 14.8% (30.1 Mtoe) of all total energy consumption compared with 8.4% (18.6 Mtoe) in 1990.

Figure 5.1: Energy consumption of primary fuels and equivalents: by source

UK 1990 to 2014



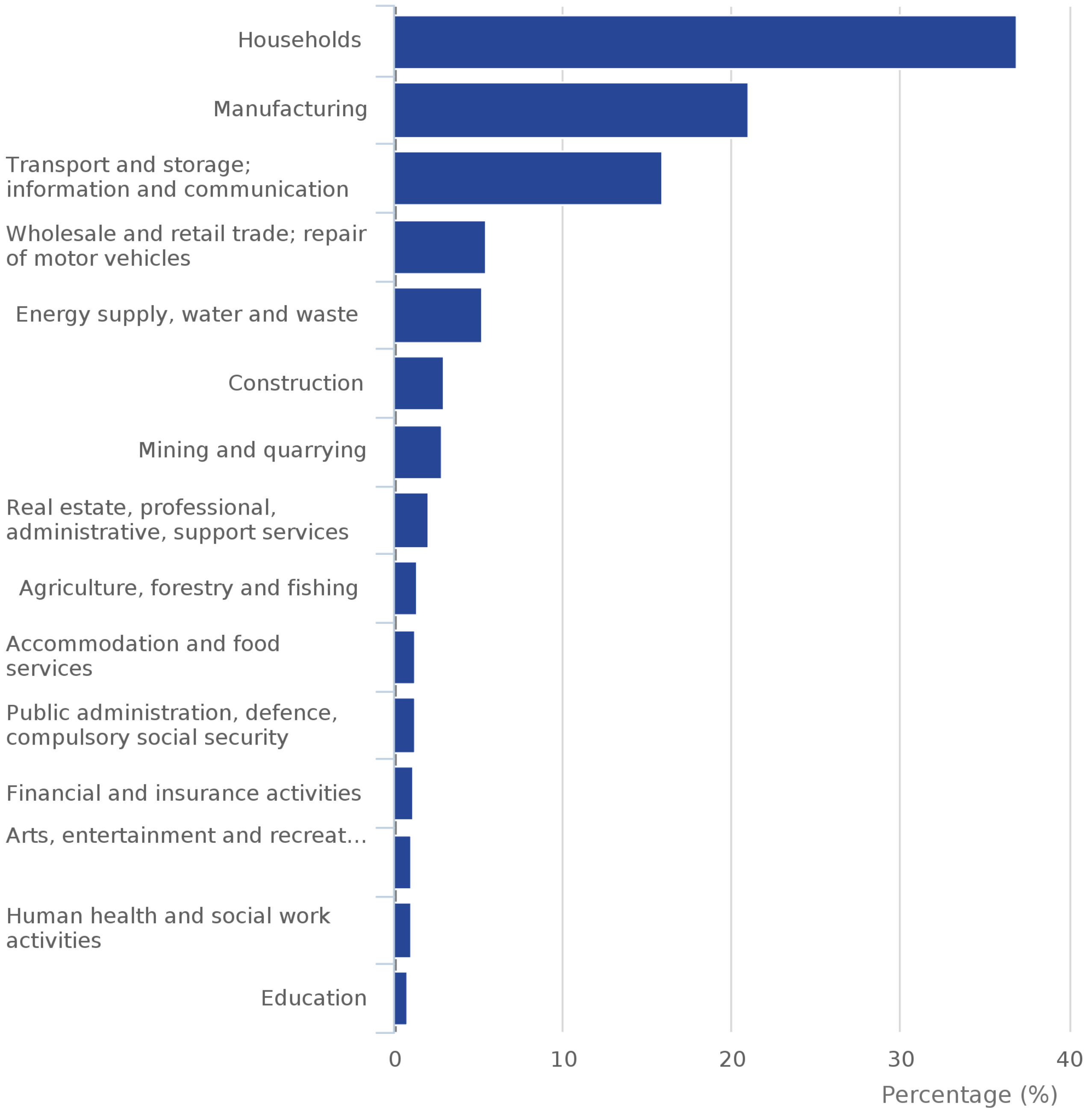
Source: Ricardo Energy and Environment, Office for National Statistics

Over a third of energy consumed by households in 2014

When considering reallocated use of energy[3], households[4] consumed the most energy in 2014, using 74.8 Mtoe. This represented 36.9% of total energy consumed (Figure 5.2). This was followed by the “manufacturing” sector, which used 42.6 Mtoe (21.0%) and the “transport, storage, information and communication” sector, which consumed 32.2 Mtoe (15.9%). These 3 sectors have been the largest consumers of energy since the series began in 1990.

Figure 5.2: Reallocated energy consumption: by industrial sector (1,2), 2014

UK



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. Industry aggregations are based on the UK Standard Industrial Classification (SIC) 2007.

2. The "Household" category includes "Consumer" and "Activities of households as employers, undifferentiated goods and services-producing activities of households for own use".

Further information is available in the "energy consumption by industry" dataset.

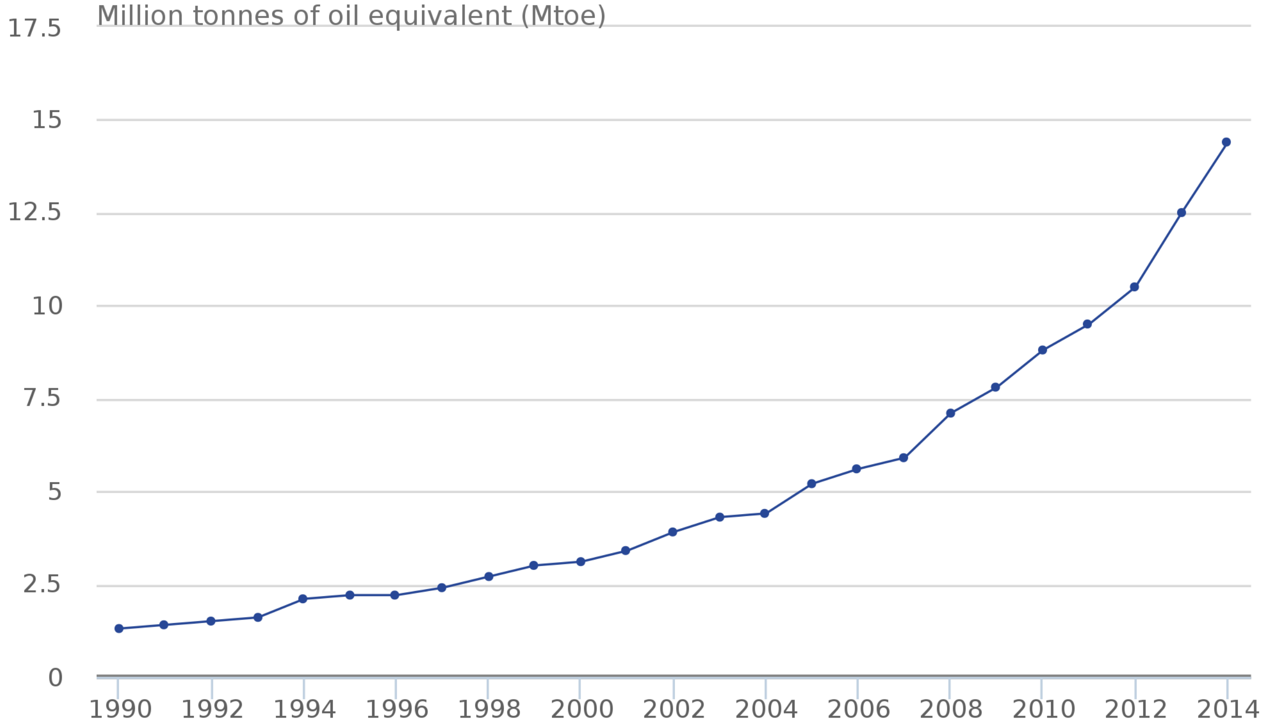
Energy consumption from renewable and waste sources

Energy consumption from renewable and waste sources reached a record high of 14.4 Mtoe in 2014

In 2014, 14.4 Mtoes of energy was consumed from renewable and waste sources, contributing to a record high of 7.1% of total energy consumption (Figure 5.3). This was 10.7 times greater than in 1990, where only 1.3 Mtoes of energy was consumed from renewable and waste sources. Between 2013 and 2014, energy consumption from renewable and waste sources increased by 15.1%, from 12.5 Mtoe to 14.4 Mtoe. This rise is primarily due to an increase in power stations' combustion of wood.

Figure 5.3: Energy consumption from renewable and waste sources

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

In 2014, a large proportion of energy consumed from renewable and waste sources came from solid biomass (40.3%). The remainder came from waste (25.6%), renewable primary electricity generation (25.0%) and liquid biofuels (8.9%) (Figure 5.4).

Energy consumed from these 4 collective renewable and waste sources were at their highest levels in 2014 since 1990. Energy consumption from these sources has increased substantially in recent years. For example, between 2013 and 2014, energy consumption from solid biomass increased by 22.3%, from 4.8 Mtoe to 5.8 Mtoe. This was due to an increase in wood combustion. This resulted in solid biomass becoming the most consumed of these 4 renewable and waste categories.

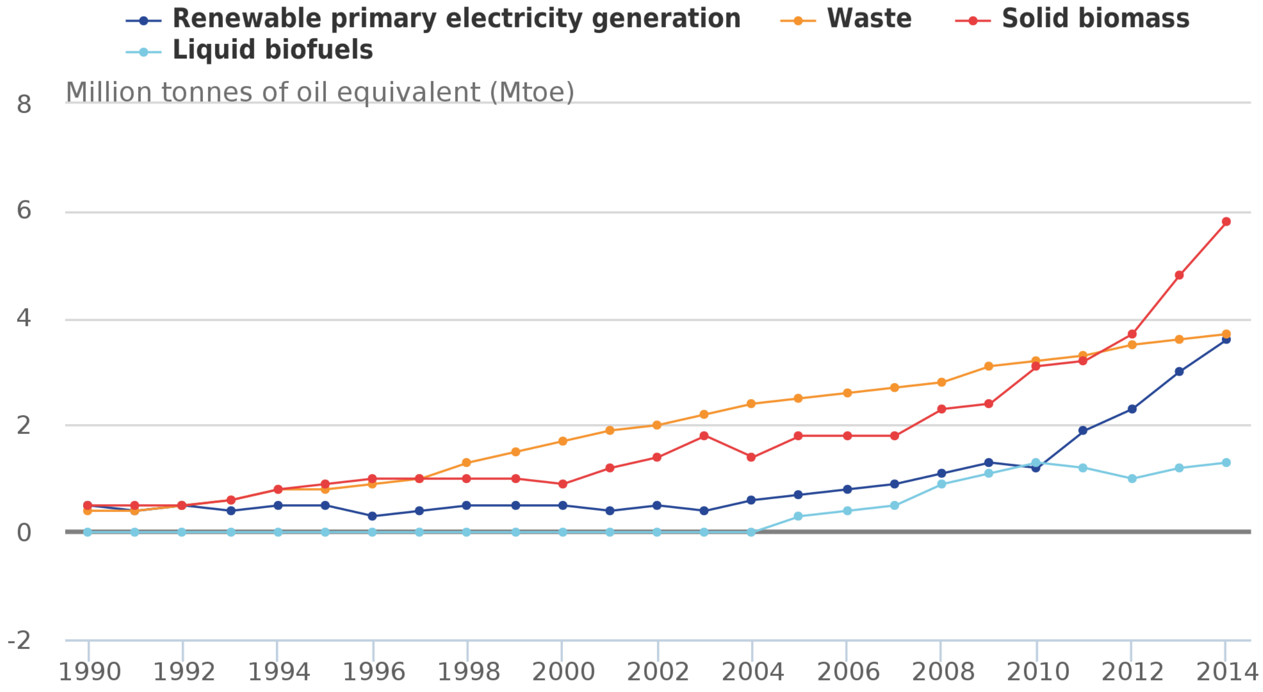
Since 2010, there has been a sharp increase in energy consumption from renewable primary electricity generation, from 1.2 Mtoe to 3.6 Mtoe. This was partly due to an increase in energy generation from wind sources.

Waste was the most consumed energy source of these categories between 1997 and 2011. In recent years, energy consumption from other renewable sources has been increasing at a faster rate. In 2004, waste accounted for 53.8% of all energy consumed from renewable and waste sources, compared with 25.6% in 2014. This resulted in waste no longer being the most consumed category of renewable and waste sources as energy from solid biomass increased in importance.

Energy consumed from liquid biofuels increased from 1.2 Mtoe in 2013 to 1.3 Mtoe in 2014, largely as a result of increased use of biodiesel.

Figure 5.4: Energy consumption: by source (1,2,3,4)

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. Renewable primary electricity generation includes hydroelectric power, wind, wave and tidal, solar photovoltaic and geothermal aquifers.

2. Waste includes landfill gas, sewage gas, municipal solid waste (MSW), poultry litter and biogas from anaerobic digestion used in autogeneration.

3. Solid biomass includes wood, straw, charcoal and biomass.

4. Liquid biofuels includes liquid biofuels used in power stations, bioethanol and biodiesel used in transport.

Since 1990, the largest consumers of renewable and waste energy sources have been households [4], energy suppliers, water and waste industries, and the manufacturing sector (Figure 5.5).

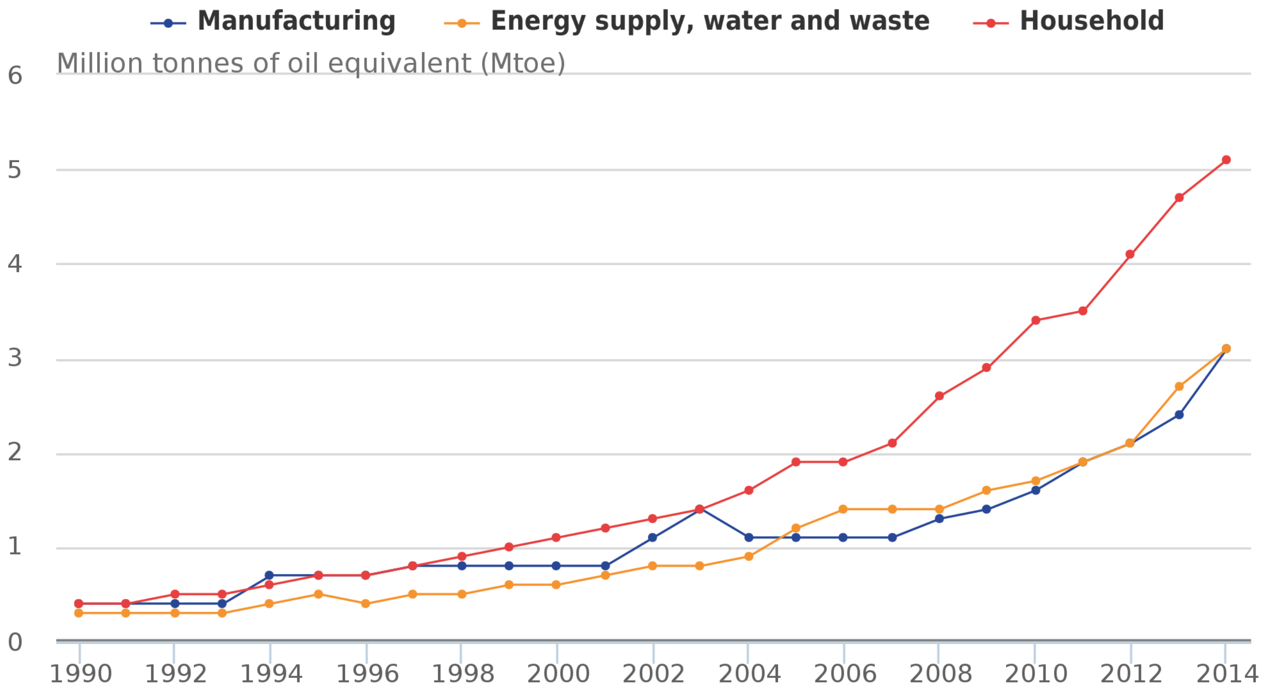
As mentioned above, the majority of energy is consumed by households. In line with this, households have also been the largest consumers of energy produced from renewable and waste sources. In 2014, households consumed 5.1 Mtoe from renewable and waste sources, accounting for 35.4% of all energy consumed from renewable and waste sources. Between 2013 and 2014, energy consumption from renewable and waste sources increased by 8.6% (from 4.7 Mtoe to 5.1 Mtoe). This rise was mainly due to increases in domestic wood combustion.

The “energy supply, water and waste” sector was the second largest consumer of energy from renewable and waste sources, consuming 3.1 Mtoe in 2014. This accounted for 21.7% of all energy consumed from these sources. The 15.7% increase between 2013 and 2014 (from 2.7 Mtoe to 3.1 Mtoe) was primarily due to an increase in wood combustion.

In 2014, the "manufacturing" sector was the third largest consumer, using 3.1 Mtoe and accounting for 21.4% of energy from renewable and waste sources. The 27.2% increase in renewable energy consumed in this sector between 2013 and 2014 was mainly due to an increase in solid biomass combustion.

Figure 5.5: Reallocated energy consumption from renewable and waste sources by top 3 sectors (1)

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. The "Household" category includes "Consumer" and "Activities of households as employers, undifferentiated goods and services-producing activities of households for own use".

Further information is available in the 'Renewables Waste' and 'Heat' reference' tables.

Reconciling environmental accounts estimates with Department of Energy and Climate Change (DECC) estimates

UK Environmental Accounts estimates follow the UN System of Environmental Economic Accounts (SEEA) framework which is an internationally agreed standard[5]. They are not reported on the same basis as published by the Department of Energy and Climate Change (DECC) in the Digest of UK Energy Statistics (DUKES) which follow Eurostat and IEA guidelines and the United Nations International Recommendations for Energy Statistics. The national accounts measure includes energy consumed by UK companies and households abroad and excludes energy consumption by foreign residents in the UK, as well as further differences in definition. As a result of this and other differences, the DUKES measure for UK energy consumption is1.7 Mtoe lower than the environmental accounts measure in 2014.

The energy bridging table shows the differences between the 2 estimates. Further information on the relationship between environmental accounts measures and those released by DECC can be found in the "energy bridging table and methodology" article.

Notes for Energy consumption

1. Transformation losses are the differences between the energy content of the input and output product arising from the transformation of one energy product to another.

2. Distribution losses are losses of energy product during transmission (for example losses of electricity in the grid) between the supplier and the user of the energy.

3. Energy consumption includes energy used during the process of transformation into electricity and the energy lost in distributing the electricity to end users, either directly allocated to the electricity generation sector, or indirectly to the consumers of the energy. “Direct use of energy including electricity” allocates the consumption of energy directly to the immediate consumer of the energy, while “reallocated energy” allocates these “electricity overheads” to the end user of the electricity.

4. The “household” category includes “consumer expenditure” and “activities of households as employers; undifferentiated goods and services – producing activities of households for own use”.

5. For more information see System of Environmental-Economic Accounting (SEEA) on the UN Statistics website.

6. Energy intensity

Main points

Between 1997 and 2014, energy intensity has fallen by 39.6% from 5.5 terajoules per million pounds (TJ/£m) to 3.3 TJ/£m.

Total energy intensity fell by 6.2% from 3.6 TJ/£m to 3.3 (TJ/£m) between 2013 and 2014. This continues the general downward trend between 1997 and 2014.

The “energy supply, water, and waste” and “manufacturing” sectors had the highest levels of energy intensity in 2014 (11.2 TJ/£m and 10.9 TJ/£m respectively).

Introduction

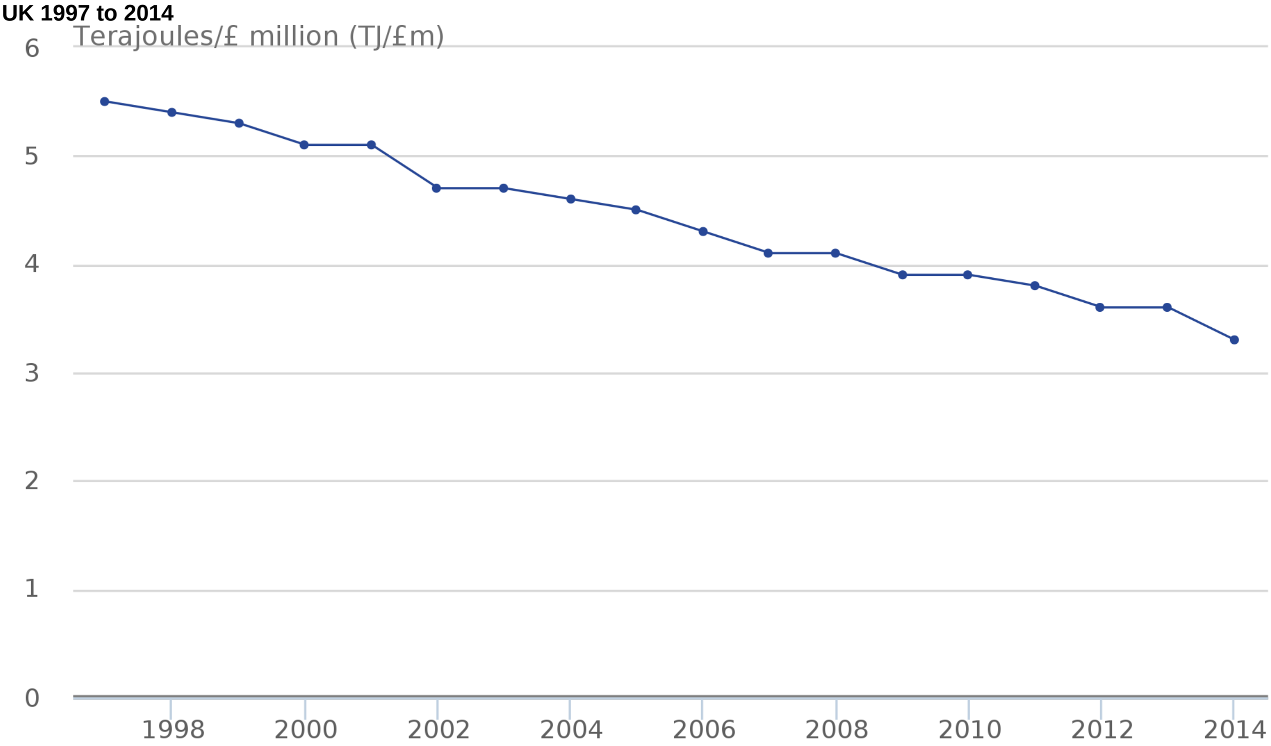
Energy intensity[1] can be interpreted as an indicator of energy efficiency in the economy. A reduction in energy intensity may indicate greater efficiencies in the production process, systematic changes in the economy or variations in temperature. All data in this section are presented in constant prices.

Energy intensity fell by nearly two-fifths between 1997 and 2014

Energy intensity in the economy has been declining since 1997, where it stood at 5.5 terajoules per million pounds (TJ/£m). Since then, energy intensity has fallen by nearly two-fifths (39.6%) to 3.3 TJ/£m in 2014. Between 2013 and 2014, energy intensity fell by 6.2% from 3.6 TJ/£m to 3.3 TJ/£m, the largest year on year fall over the period. Figure 6.1 illustrates the year on year decline in intensity, with the exception of 2010, when intensity increased by 0.1%.

Figure 6.1: Energy intensity

UK 1997 to 2014



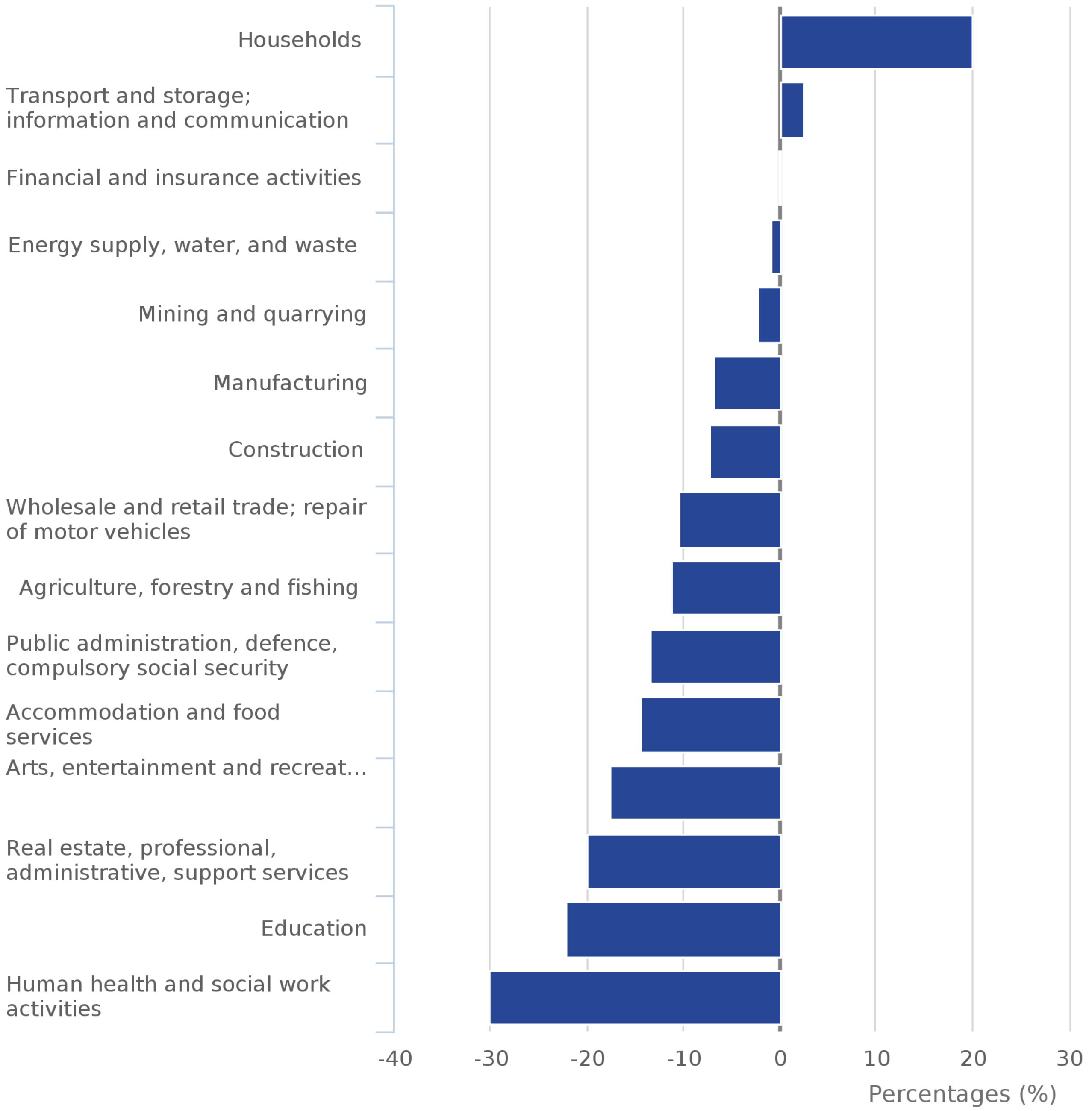
Source: Ricardo Energy and Environment, Office for National Statistics

Energy intensity can be broken down by industry. Between 1997 and 2014, the greatest decline in energy intensity was in the “human health and social work activities” sector, falling by 73.1%, from 2.6 TJ/£m to 0.7 TJ/£m. While the “mining and quarrying” sector had the greatest increase (66.7%) in energy intensity, from 5.1 TJ/£m to 8.5 TJ/£m. The “energy supply, water, and waste” and “manufacturing” sectors were the most energy intensive industries in 2014 (11.2 TJ/£m and 10.9 TJ/£m, respectively). However, between 2013 and 2014, energy intensity decreased by 6.8% in the “manufacturing” sector (from 11.7 TJ/£m to 10.9 TJ/£m) and 0.9% in the “energy supply, water and waste” sector (from 11.3 TJ/£m to 11.2 TJ/£m).

Figure 6.2 shows the percentage change in energy intensity for each sector between 2013 and 2014. During this period, the greatest decrease (30.0%) in energy intensity was observed in the “human health and social work activities” sector, falling from 1.7 TJ/£m to 1.4 TJ/£m. The “transport and storage; information and accommodation” sector was the only sector where energy intensity increased by 2.6%, from 7.8 TJ/£m to 8.0 TJ/£m.

Figure 6.2: Change in energy intensity: by industry between 2013 and 2014

UK



Source: Ricardo Energy and Environment, Office for National Statisticst

Notes for energy intensity

1.Energy intensity is calculated by dividing reallocated energy consumption by gross value added (GVA). GVA is the difference between output and intermediate consumption for any given sector or industry. That is, the difference between the value of goods and services produced (the output) and the cost of raw materials and other inputs which are used up in production (the intermediate consumption). Data are in constant prices with 2012 defined as the base year. Energy intensity calculations include reallocated energy from wood and straw, renewable generation, biofuels and waste sources. Energy use per unit of value added is in the United Nations (UN) Energy Intensity indicators as defined in the UN Sustainable Development indicators, although consumer expenditure is included by the UN. The Organisation for Economic Co-operation and Development (OECD) Green Growth indicators include the inverse, energy productivity, that is, GDP per unit of energy supply. All energy intensity figures exclude “consumer expenditure”.

More detailed energy intensity data are available in the "Energy intensity" dataset.

7. Atmospheric emissions

Main points

Emissions of greenhouse gases have decreased since 1990; peaking in 1991 at 845.2 million tonnes of carbon dioxide equivalent and falling to 608.6 million tonnes of carbon dioxide equivalent in 2014. This is the lowest level since 1990.

Carbon dioxide was the dominant greenhouse gas, accounting for 84.9% of all greenhouse gas emissions in 2014.

The "energy supply, water and waste" sector emitted the greatest amount (26.8%) of greenhouse gases in 2014 (163.4 Mt CO2e). Compared with 2013, emissions from this particular sector fell by 13.2%, from 188.3 Mt CO2e to 163.4 Mt CO2e.

Acid rain precursor (ARP) emissions have decreased sharply, falling by 72.2%, from 6.9 million tonnes of sulphur dioxide equivalent (Mt SO2e) in 1990 to 1.9 Mt SO2e in 2014.

Introduction

Air emissions show the physical flow of gaseous or particulate materials from the national economy (through production or consumption processes) into the atmosphere. This section contains data on greenhouse gas emissions, acid rain precursors, heavy metal pollutants, and other pollutants. Emissions related to fuel sources used by road transport are also included.

The 2014 estimates of atmospheric emissions are provided on a UK residency basis. This approach focuses on emissions which UK residents and UK-registered businesses are directly responsible for, whether in the UK or overseas, but exclude emissions from foreign visitors and businesses in the UK. The residency approach adopts UK national accounting principles, allowing environmental impacts to be compared on a consistent basis with economic indicators such as GDP. These estimates are also consistent with the System of Environmental-Economic Accounting – Central Framework, adopted by the United Nations Statistical Commission. The residency principle therefore provides an important indicator for the environmental pressure caused by the UK's economic activities.

Greenhouse gas emissions

Greenhouse gas emissions include:

- Carbon dioxide (CO_2),
- Methane (CH_4),
- Nitrous oxide (N_2O),
- Hydro-fluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6) and
- Nitrogen trifluoride (NF_3).

These gases are widely believed to contribute to global warming and climate change. The potential of each greenhouse gas to cause global warming is assessed in relation to a given weight of carbon dioxide. Consequently, all greenhouse gas emissions are measured as carbon dioxide equivalents (CO_2e).

Greenhouse gas emissions fell by more than a quarter since 1991

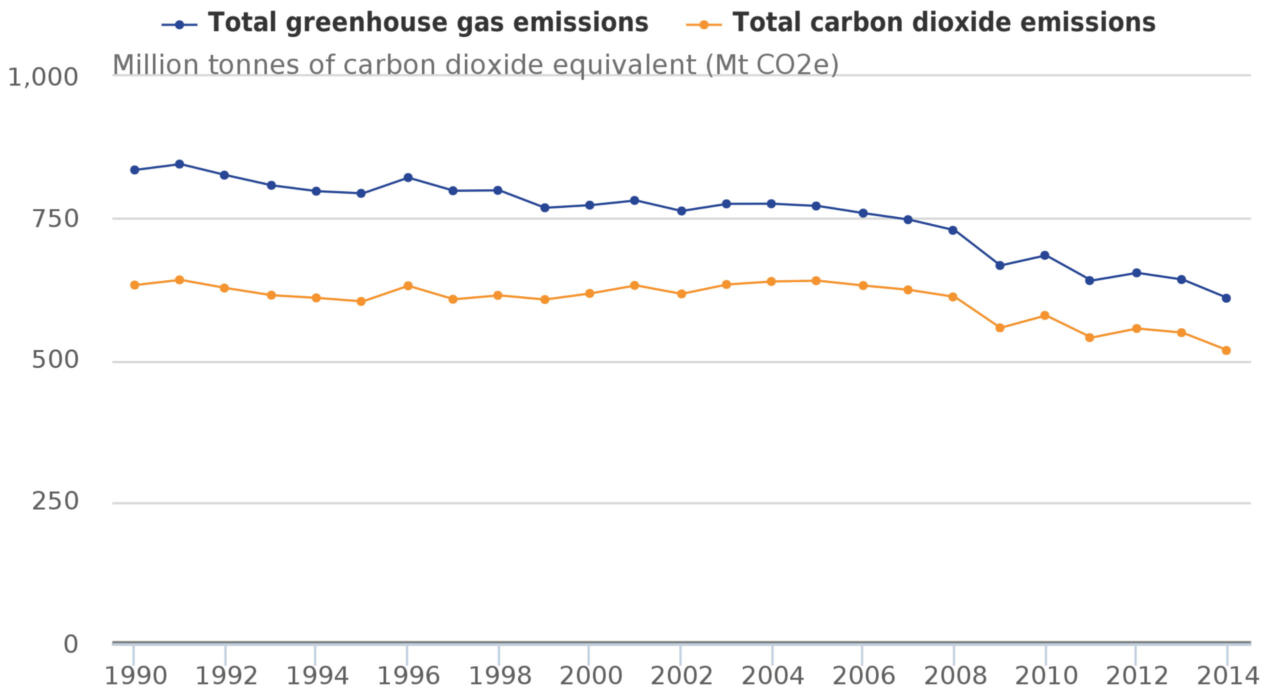
Emissions of greenhouse gases in 2014 were estimated to be 608.6 million tonnes of carbon dioxide equivalent (Mt CO_2e), the lowest level since 1990 (Figure 7.1). Greenhouse gas emissions peaked in 1991 at 845.2 Mt CO_2e. Since then, greenhouse gas emissions have decreased by 28.0%. This decrease has been driven by reductions in emissions from the “energy supply, water and waste” and “manufacturing” sectors.

Overall, there has been a downward trend in emissions over this 25 year period. The greatest year-on-year decrease was in 2009, following the onset of the economic downturn in 2008, when emissions decreased by 8.5% (from 728.4 Mt CO_2e in 2008 to 666.4 Mt CO_2e in 2009). Between 2013 and 2014, emissions decreased by 33.0 Mt CO_2e (5.1%). This was primarily due to reductions in carbon dioxide and methane emissions from the “energy supply, water and waste” sector.

Since the 1990s, there have been some annual increases. The greatest year-on-year increase (3.5%) occurred in 1996, when emissions increased from 793.6 Mt CO_2e in 1995 to 821.4 Mt CO_2e. A likely factor behind this rise was the 1.0°C drop in mean average air temperature in 1996 compared with 1995. Between 2009 and 2010, there was a 2.7% (17.9 Mt CO_2e) rise in emissions of greenhouse gases. This rise was driven by the recovery of economic activity following the downturn coupled with particularly cold weather at the beginning and end of 2010. The rise of 2.1% (13.6 Mt CO_2e) in greenhouse gas emissions between 2011 and 2012 was the result of both an increase in the proportion of electricity generated from coal and increased fuel consumption for heating due to a fall in average air temperature.

Figure 7.1 Greenhouse gas emissions

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

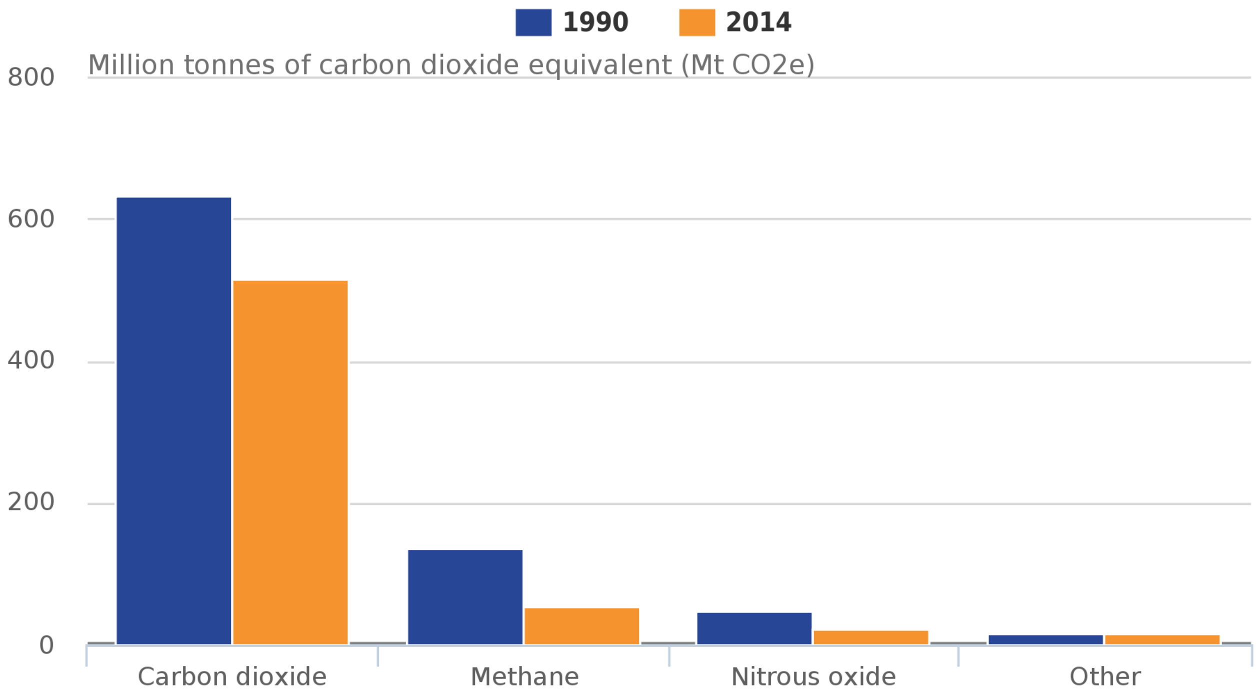
Carbon dioxide emissions accounted for the majority of all greenhouse gas emissions in 2014

Carbon dioxide was the dominant greenhouse gas, representing 84.9% of the UK's greenhouse gas emissions in 2014. The remainder of greenhouse gas emissions comprised methane (8.8%), nitrous oxide (3.6 %) and fluorinated gases (2.8%).

Between 1990 and 2014, carbon dioxide emissions decreased by 18.3% (from 631.9 Mt CO2e to 516.4 Mt CO2e) (Figure 7.2). This was mainly due to a decrease in carbon dioxide emissions from the "energy supply, water and waste" sector. Emissions of methane decreased by 61.0% (from 137.1 Mt CO2e to 53.5 Mt CO2e) and nitrous oxide fell by 55.4% (from 48.7 Mt CO2e to 21.7 Mt CO2e). One of the main reasons for this decline was due to the large reductions in the "energy supply, water and waste" sector, as a result of a fall in methane emissions from landfill. A decline in nitrous oxide emissions was largely caused by a decrease from the manufacturing sector. This was due to a decrease in emissions from processes in the chemical industry.

Figure 7.2 Greenhouse gas emissions: by type of gas, 1990 and 2014(1)

UK



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

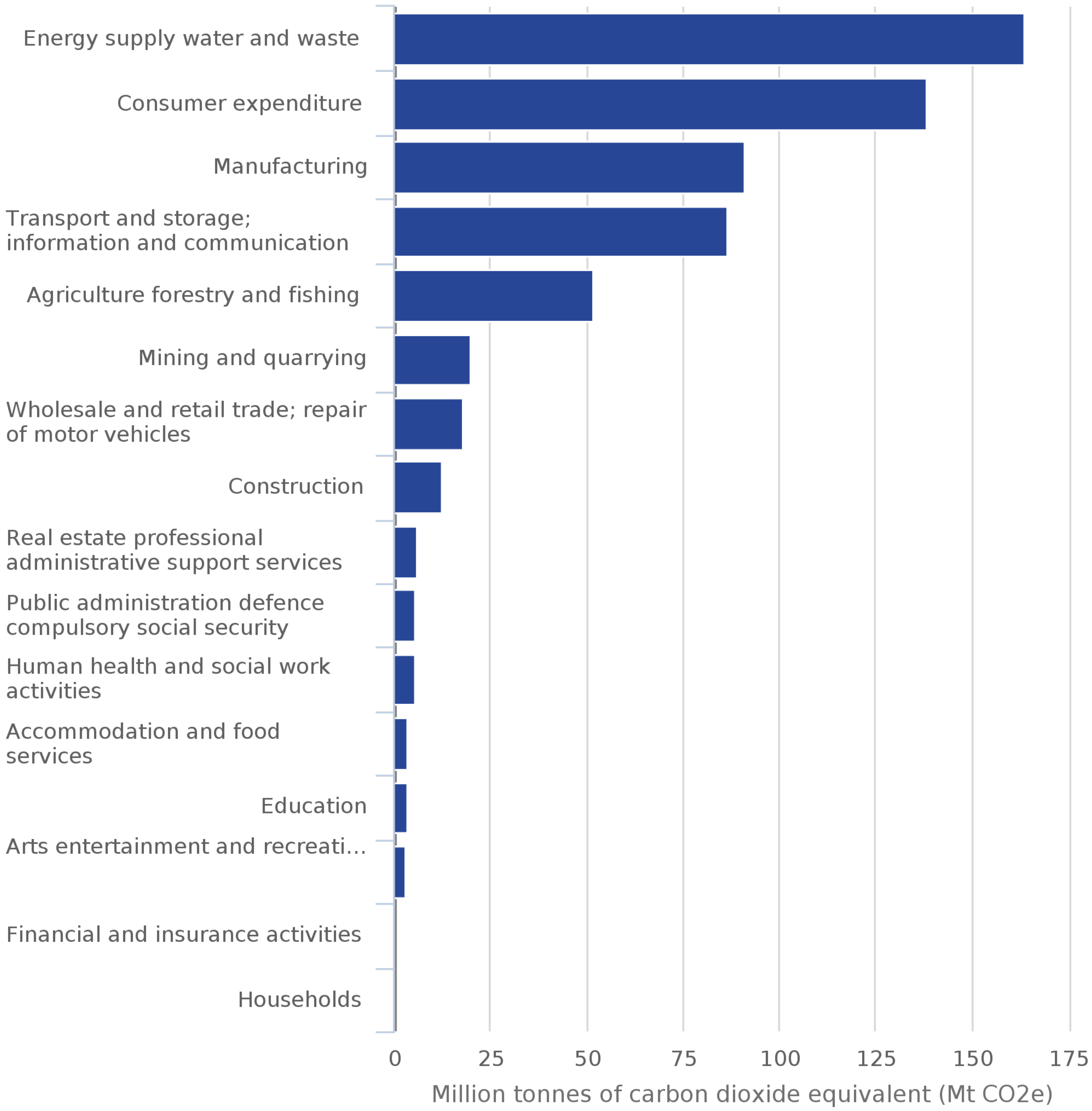
1. Other greenhouse gases include: Hydro-fluorocarbons; Perfluorocarbons; Sulphur hexafluoride and Nitrogen trifluoride.

“Energy supply, water and waste” sector emitted the largest amount of greenhouse gases in 2014

The “energy supply, water and waste” sector emitted the greatest amount (26.8%) of greenhouse gases in 2014 (163.4 Mt CO2e) (Figure 7.3). Compared with 2013, emissions from this particular sector fell by 13.2%, from 188.3 Mt CO2e to 163.4 Mt CO2e. This was driven by a change in the mix of electricity generation, namely a decrease in fossil fuel combustion at power stations, primarily coal and natural gas, offset by increased combustion of renewable fuels and generation from wind. A fall in emissions of methane from landfill also contributed to the reduction of emissions from this sector. Consumer expenditure accounted for the second highest amount of greenhouse gas emissions in 2014 at 138.4 Mt CO2e (22.7%), of which 132.5 million tonnes (95.7%) were carbon dioxide emissions. This includes emissions caused by household expenditure on fuel consumption.

Figure 7.3: Greenhouse gas emissions: by economic sector (1), 2014

UK



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. Industry aggregations are based on the Standard Industrial Classification (SIC) 2007.

Further information is available in the "Greenhouse gas" reference table

Acid raid precursor emissions

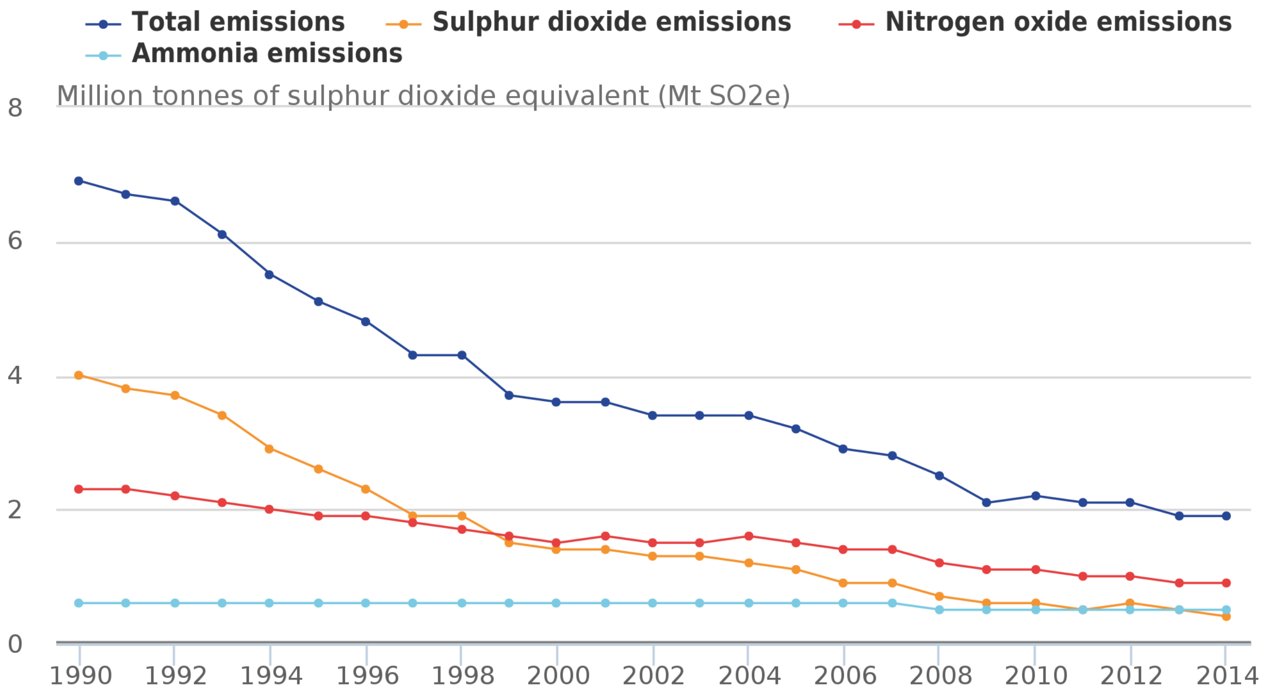
Acid rain can have harmful effects on the environment and is caused primarily by emissions of sulphur dioxide (SO_2), nitrogen oxide (NO_X) and ammonia (NH_3). For comparability, all figures are weighted according to their acidifying potential, and presented as sulphur dioxide equivalents (SO_2e).

Acid rain precursor emissions have fallen by 72.2% since 1990

Since 1990, acid rain precursor (ARP) emissions (excluding natural world) have decreased sharply, falling by 72.2%, from 6.9 million tonnes of sulphur dioxide equivalent (Mt SO2e) in 1990 to 1.9 Mt SO2e in 2014 (Figure 7.4). While the overall ARP emissions have reduced, there was a slight increase (1.3%) in the emissions between 2013 and 2014. This has been the largest year-on-year increase over the 25 year period.

Figure 7.4: Acid rain precursor emissions (1): by type of gas

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. Figures exclude emissions from natural world.

Throughout the 1990s, sulphur dioxide was the dominant ARP. However, sulphur dioxide emissions fell sharply between 1990 and 2014, and was largely due to decreases in emissions from coal use in power stations within the "energy supply, water and waste" sector. Between 2013 and 2014, sulphur dioxide emissions decreased by 7.2% (from 472.0 thousand tonnes of SO2e to 437.8 thousand tonnes of SO2e). This was primarily due to a decrease in sulphur dioxide emissions from the "energy supply, water and waste" sector.

Nitrogen oxide emissions decreased by 59.3% between 1990 and 2014, which was primarily due to a large decrease in emissions from petrol-fuelled cars. However, between 2013 and 2014, nitrogen oxide emissions increased by 4.3% (from 904.7 thousand tonnes of SO2e to 943.6 thousand tonnes of SO2e) due to an increase from the "transport and storage; information and communication" sector.

Emissions of ammonia fell by 11.9% between 1990 and 2014. This was partly due to an overall decrease in emissions from agricultural soils in the "agriculture, forestry and fishing" sector during this period. However, ammonia emissions increased by 3.7% (517.7 thousand tonnes of SO2e to 537.1 thousand tonnes of SO2e) between 2013 and 2014, following an increase in emissions from agricultural soils.

Further information is available in the "acid rain precursor emissions" reference table.

Emissions from heavy metal pollutants

Emissions of heavy metal pollutants can have adverse affects on air quality and individuals' health.

Emissions of lead down by 97.6% since 1990

Table 7.1 shows emissions from heavy metal pollutants in 1990, 2013 and 2014. Emissions of all heavy metal pollutants declined between 1990 and 2014. The most notable reduction was in emissions of lead, which fell by 97.6% from 2,901.7 tonnes to 68.7 tonnes. This was mostly due to the decrease in the use of leaded petrol, the marketing of which was prohibited within the EU from 2000. Despite the long-term downward trend, emissions of 8 out of the 10 heavy metal pollutants increased between 2013 and 2014. The largest increases were in cadmium and nickel emissions, rising by 21.5% and 20.1% respectively.

Table 7.1: Emissions of heavy metal pollutants, 1990, 2013 and 2014, UK

tonnes

	1990	2013	2014
Arsenic	51.6	18.6	18.7
Cadmium	23.9	3.6	4.4
Chromium	161.9	28.7	29.4
Copper	146.2	54.0	55.4
Lead	2,901.7	63.8	68.7
Mercury	37.6	6.1	5.5
Nickel	397.7	177.5	213.1
Selenium	78.0	17.3	17.0
Vanadium	1,232.3	781.1	894.5
Zinc	1,070.2	443.1	443.7

Source: Ricardo Energy and Environment, Office for National Statistics

Further information is available in the "Heavy metal" reference table.

Emissions from other pollutants

There are a number of other pollutants that affect air quality. Table 7.2 shows emissions of other pollutants for 1990 and 2014.

Emissions of carbon monoxide fell by nearly three-quarters between 1990 and 2014

Carbon monoxide (CO) emissions were 72.7% lower in 2014 compared with 1990 (from 7,816.5 thousand tonnes to 2,131.3 thousand tonnes). During the same period, non-methane volatile organic compound (NMVOC) emissions also fell by 67.9%. These decreases were mainly due to reductions in road transport emissions, which fell by 97.0% for NMVOC and 91.3% for CO. This is a result of stricter emission standards for road vehicles leading to a large switch from petrol to diesel cars, as petrol engines emit more CO and NMVOC than diesel engines.

Airborne particulate matter (PM) consists of very small liquid or solid particles that are generated from both manmade and natural sources (for example, sea spray or Saharan dust). Between 1990 and 2014, PM10 and PM2.5 emissions decreased by 45.6% and 40.2%, respectively. Residential and industrial coal combustion had been a major source of PM emissions in the UK. However, the Clean Air Act 1993 restricted coal combustion and consequently led to reductions in emissions across many sectors.

Table 7.2: Emissions from other pollutants, 1990 and 2014, UK

Thousand tonnes

	1990	2014
PM10[2]	330.3	179.8
PM2.5[2]	225.4	134.8
Carbon monoxide	7,816.5	2,131.3
Non-methane volatile organic compound	2,810.1	902.5
Benzene	58.0	12.5
1,3-Butadiene	10.5	1.8

Source: Ricardo Energy and Environment, Office for National Statistics

1. Figures exclude emissions from natural world.

2. Particulate matter (PM) is classified according to its size. For example, PM10 braodly represents the concentration of particules that are less than 10 µm in diameter.

Further information is available in the “other pollutants” reference table.

Road transport emissions

Various pollutants are emitted from road transport into the atmosphere. Figure 7.5 shows greenhouse gas emissions generated from combustion by road vehicles from 1990 to 2014.

Road transport emissions accounted for nearly a fifth of total greenhouse gas emissions in 2014

Greenhouse gas emissions from road transport generally increased from the 1990s until 2007 (from 111.4 Mt CO2e to 123.5 Mt CO2e). However, greenhouse gas emissions have generally fallen since 2008 (from 119.5 Mt CO2e in 2008 to 114.0 Mt CO2e in 2014), which in part reflects both the economic downturn and an increase in more energy efficient vehicles. Despite this downward trend, greenhouse gas emissions increased between 2013 and 2014 by 1.7% (from 112.1 Mt CO2e to 114.0 Mt CO2e).

In 2014, road transport emissions accounted for 18.7% (114.0 Mt CO2e) of total greenhouse gas emissions (608.6 Mt CO2e). This consisted of:

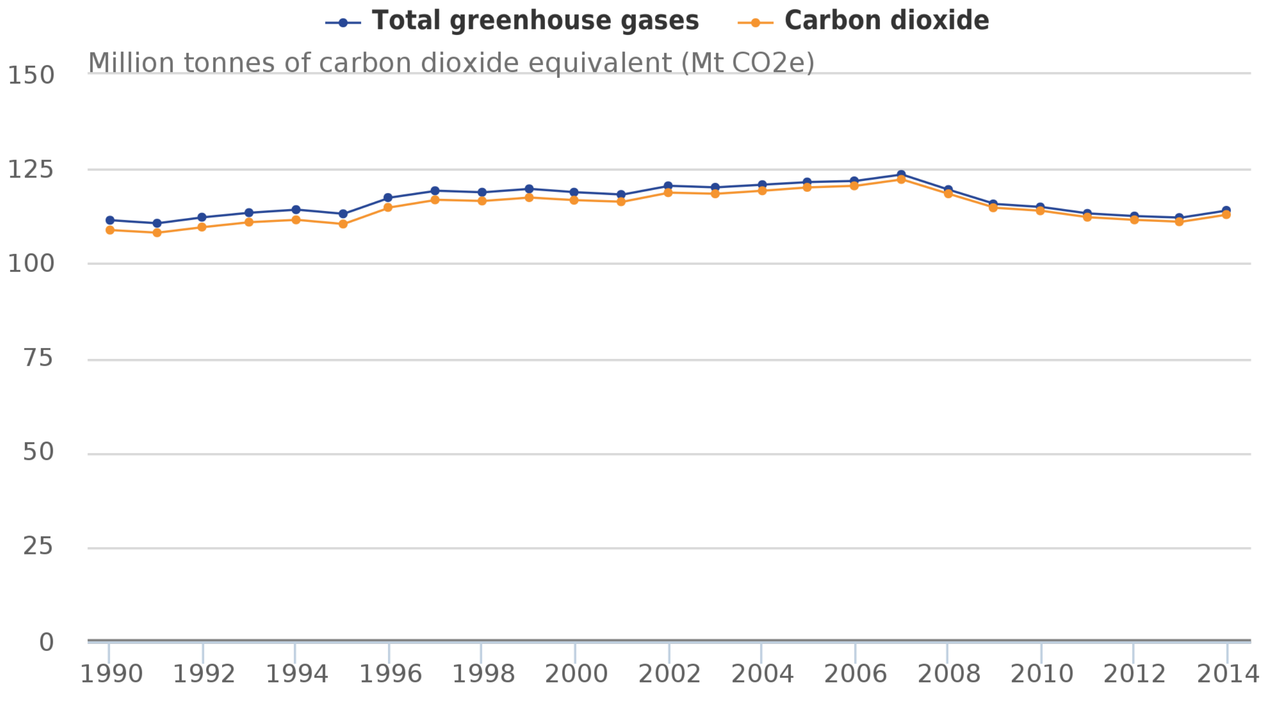
- 112.9 Mt of carbon dioxide,
- 0.1 Mt CO2e of methane, and
- 1.0 Mt CO2e of nitrous oxide.

Road transport emissions of acid rain precursors decreased by 76.2% between 1990 and 2014 (from 933.1 thousand tonnes of SO2e to 222.1 thousand tonnes of SO2e, respectively).

Overall, road transport particulate matter (PM) emissions have declined since 1990, where PM10 emissions have decreased by 40.6% (35.2 thousand tonnes to 20.9 thousand tonnes) and PM2.5 have decreased by 50.2% (from 28.7 thousand tonnes to 14.3 thousand tonnes). While PM emissions peaked in 1996, they also decreased to their lowest levels in 2014. Diesel engine vehicles emit a greater mass of PM per kilometre than petrol engine vehicles. Since 1992, diesel vehicles have had to meet tighter PM emission regulations. This has led to reductions in PM emissions, despite the use of diesel vehicles increasing.

Figure 7.5: Greenhouse gas emissions produced by fuel sources from road vehicles

UK 1990 to 2014



Source: Ricardo Energy and Environment, Office for National Statistics

Further information is available in the "Road transport emissions" reference table.

Reconciling environmental accounts with UNECE and UNFCCC estimates

Estimates within environmental accounts are produced in accordance with the UN System of Environmental-Economic Accounting (SEEA), which is an internationally agreed standard. UK Environmental Accounts are reported on a UK "residency" basis, which include emissions that UK resident persons and businesses are directly responsible for in other countries (dominated by travel and transport overseas), but exclude emissions caused by visiting foreign persons and businesses in the UK. This is consistent with UK National Accounts and enables comparison with economic indicators such as gross domestic product (GDP).

UK air emissions estimates that are reported internationally to the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Economic Commission for Europe (UNECE) are reported on a "territory" basis, which only include emissions that occur within the UK's territorial boundaries.

Tables that illustrate the differences between UK Environmental Accounts estimates and UNFCCC and UNECE estimates can be found in the Emissions bridging table.

Notes for Atmospheric emissions

1. Information on alternative approaches to reporting UK greenhouse gas emissions is available on the Department of Energy and Climate Change's website.

2.Figures exclude emissions arising from the natural world.

8. Greenhouse gas emissions intensity

Main points

Greenhouse gas emissions intensity was 48.2% lower in 2014 compared with 1997 and 9.4% lower compared with 2013.

Emissions intensity was greatest in the "energy supply, water and waste" and the "agriculture, forestry and fishing" sectors.

Introduction

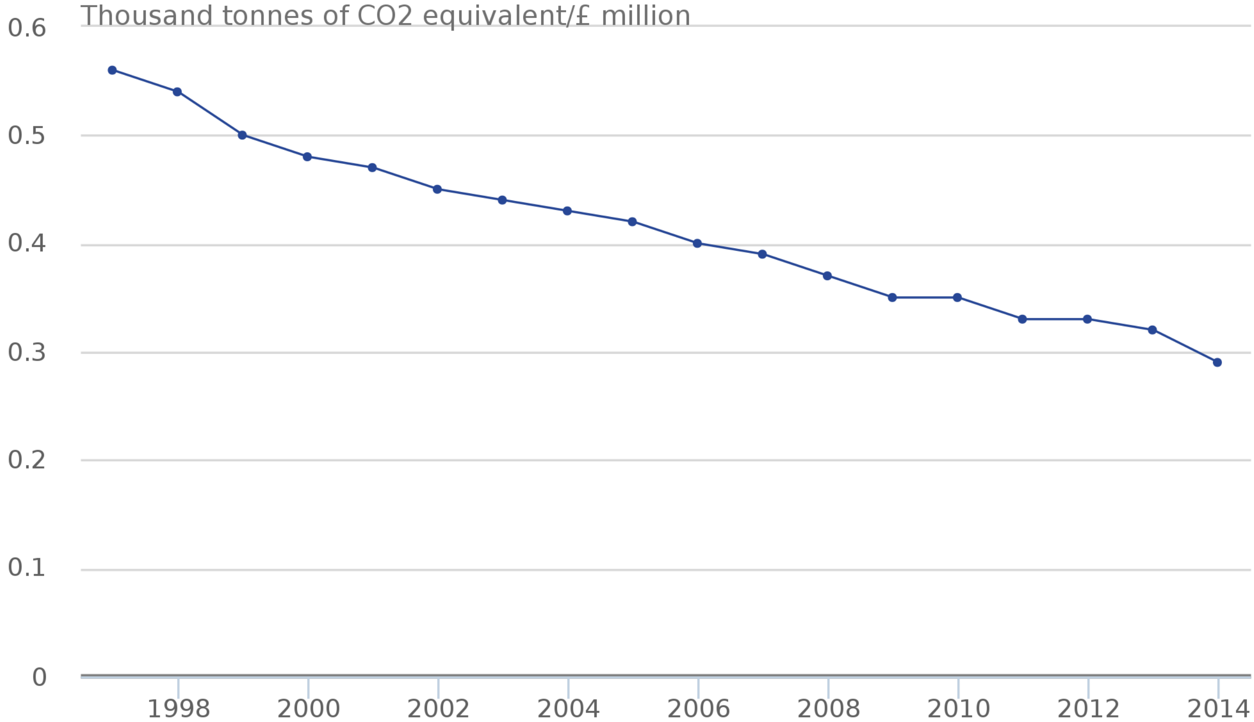
Greenhouse gas emissions intensity measures the level of emissions per unit of economic output (constant price level)[1]. It can be used to examine the relationship between economic growth and greenhouse gas emissions. For example, a reduction in greenhouse gas emissions intensity may indicate the UK is moving towards a greener and more sustainable economy. At the same time, it may also reflect changes to the structure of the economy, for example, a change from manufacturing industries to services.

Emissions intensity declined by 48.2% between 1997 and 2014

Since 1997, greenhouse gas emissions intensity of the UK economy, excluding consumer expenditure, has fallen by an average of 3.8% per year. It has declined from 0.6 thousand tonnes of carbon dioxide equivalent (CO2e) per £ million value added in 1997 to 0.3 thousand tonnes of CO2e per £ million value added in 2014; a fall of 48.2% (Figure 8.1). Although economic output considered here in terms of gross value added (GVA) has generally increased, greenhouse gas emissions have generally decreased, helping to explain the falls in emissions intensity.

Figure 8.1: Greenhouse gas emissions intensity

UK 1990 to 2014



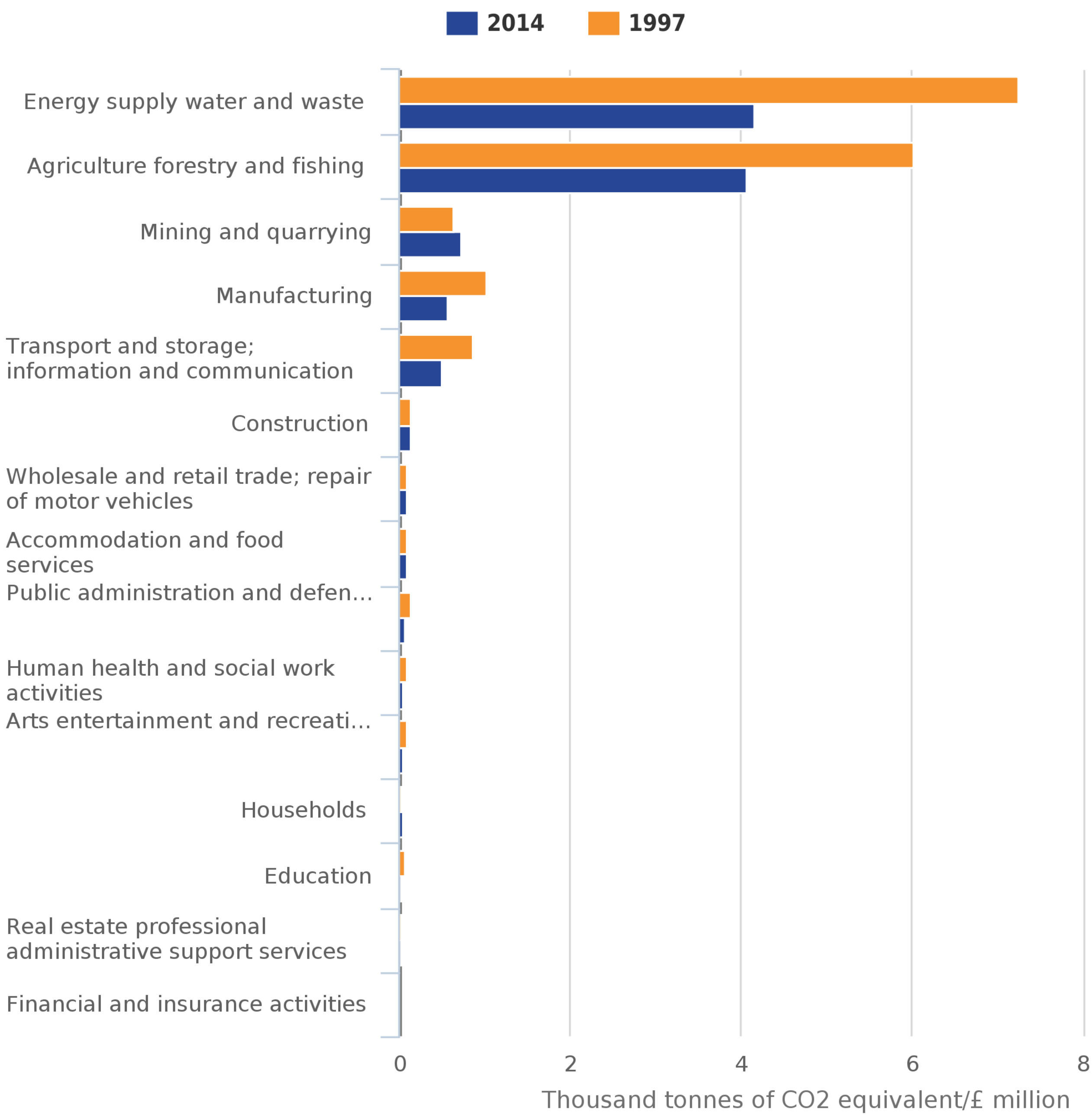
Source: Ricardo Energy and Environment, Office for National Statistics

Between 2013 and 2014, greenhouse gas emissions intensity fell by 9.4%. This was the largest percentage annual decrease since 1997 and was mainly due to a larger than average fall (4.1%) in greenhouse gas emissions between 2013 and 2014, relative to GVA.

In 2014, greenhouse gas emissions intensity was greatest within the “energy supply, water and waste” (4.2 thousand tonnes of CO2e per £ million) and the “agriculture, forestry and fishing” (4.1 thousand tonnes of CO2e per £ million) sectors (Figure 8.2). The emissions intensity levels in these sectors were lower in 2014 compared with 1997, reducing by 42.7% for the “energy supply, water and waste” sector and by 32.5% for the “agriculture, forestry and fishing” sector.

Figure 8.2: Greenhouse gas emissions intensity by industry (1), 1997 and 2014

UK



Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1.These industry aggregations are based on the Standard Industrial Classification (SIC) 2007.

Compared with 1997, greenhouse gas emissions intensity was higher in 2014 in only 2 sectors. These were: “households as employers” (33.3% increase, from 0.03 to 0.04 thousand tonnes CO2e per £ million) and “mining and quarrying” (12.5% increase, from 0.64 to 0.72 thousand tonnes CO2e per £ million).

More detailed greenhouse gas emissions intensity data are available in the [Atmospheric emissions: Greenhouse gas emissions intensity dataset].

Notes for Greenhouse gas emissions intensity

1. Greenhouse gas emissions intensity is calculated by dividing the level of greenhouse gas emissions by gross value added (GVA) in constant prices. This is the difference between output and intermediate consumption for any given industry or sector. This means 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). Data are in constant prices with 2012 defined as the base year. All emissions intensity figures exclude consumer expenditure.

9. Material flows

Main points

In 2014, the UK consumed 563.0 million tonnes of material.

The amount of material resources consumed (per person) has decreased by 30.4% between 2000 and 2014, falling from 12.5 tonnes per person to 8.7 tonnes per person.

Extraction of raw materials in the UK has decreased by 37.0% since 1992, falling from 691.1 million tonnes to 435.1 million tonnes in 2014. However, raw material extraction increased by 3.8% between 2013 and 2014.

The decline in raw material extraction has been partly offset by a rise in physical imports. In 2014, the amount of materials and products imported to the UK was almost twice the amount of materials and products that were exported.

Resource productivity (the total amount of materials used by an economy in relation to economic activity) increased by 66.6% during the period 2000 to 2014.

Introduction

Material flow accounts estimate the physical flow of materials through our economy. This includes the amount of raw materials extracted within the UK (domestic extraction) and the import and export of materials. This information is used to calculate indicators showing the quantity of materials that are available for use and that are consumed within the economy. It also helps to understand resource productivity. For example, they shed light on the depletion of natural resources and seek to promote a sustainable and more resource-efficient economy.

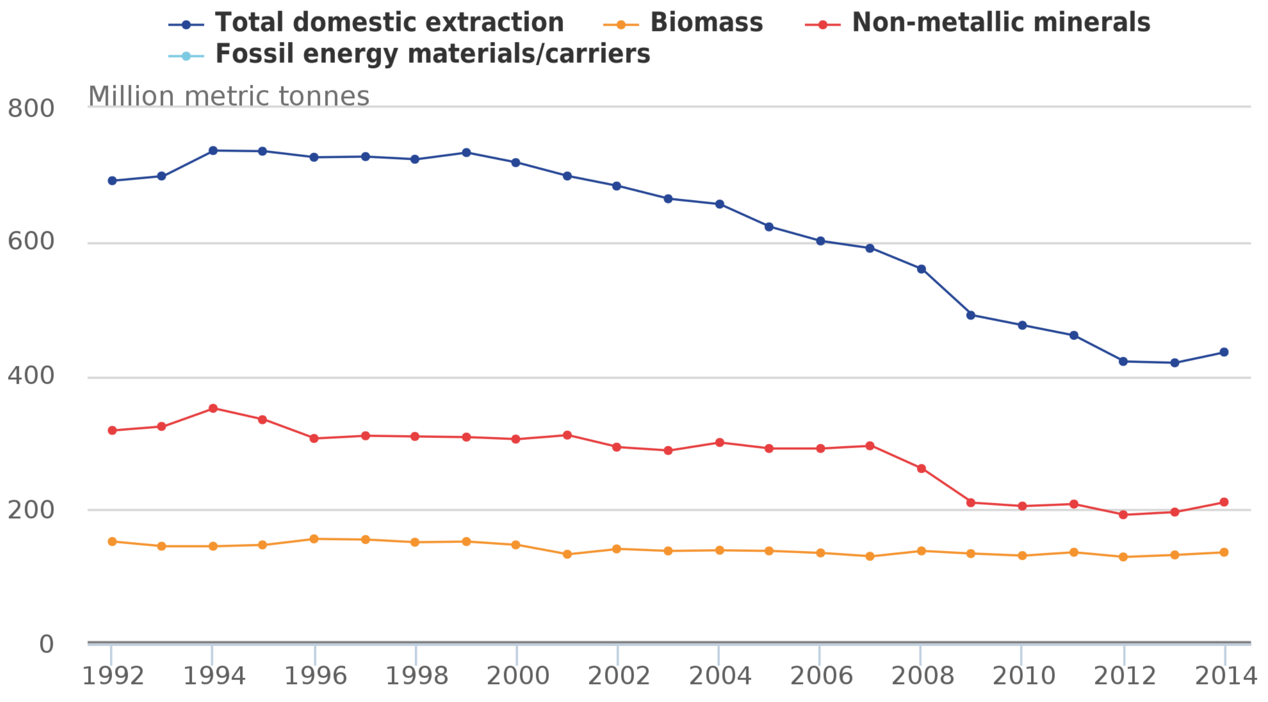
Raw material extraction increased by 3.8% between 2013 and 2014

Since 1992, the extraction of raw materials (for example, crops, metal ores, non-metallic minerals and fossil fuels) for use[1] in the UK reached a peak of 736.3 million metric tonnes in 1994 (Figure 9.1). After remaining broadly stable between 1994 and 2000, the quantity of raw materials extracted gradually declined and fell to 419.0 million metric tonnes in 2013, the lowest point since 1992. However, between 2013 and 2014, total domestic extraction increased by 3.8% to 435.1 million metric tonnes. This was mainly driven by increases in the extraction of non-metallic minerals such as limestone and gypsum.

In 2014, domestic extraction represented 6.7 tonnes per person. This was 3.1% more than 2013, where domestic extraction was 6.5 tonnes per person. Since 1992, domestic extraction has reduced by 44.2% from 12.0 tonnes per person.

Figure 9.1: Quantity of raw material extracted (1)

UK 1992 to 2014



Source: Department for Environment, Food and Rural Affairs; Food and Agricultural Organization of the United Nations; Eurostat; Kentish Cobnuts Association; British Geological Survey

Notes:

1. Metal ores are not included on the chart as the quantity extracted is small.

Domestic extraction is divided into 4 categories: biomass, non-metallic minerals, fossil energy materials/carriers and metal ores.

Biomass[2]

Biomass includes material of biological origin that is not from fossil and includes crops, wood and wild fish catch. Since 1992, the quantity of biomass extracted in the UK has remained fairly stable. In 2014, 135.6 million tonnes were extracted, 3.2 million tonnes more than in 2013 (132.4 million tonnes). Of this, crop residues, fodder crops and grazed biomass accounted for 66.1% (89.7 million tonnes).

Non-metallic minerals

Non-metallic minerals consist mainly of construction and industrial minerals, including limestone and gypsum, clays and kaolin, and sand and gravel. The extraction of non-metallic minerals has declined by 33.7% since 1992, falling from 318.3 million tonnes to 211.2 million tonnes in 2014. The majority of this fall is a result of falling demand for aggregates (granular material formed from natural rock substances). This is the result of a combination of factors including a decline in infrastructure projects, increased use of non-aggregate materials in buildings, less waste and increased use of recycled aggregates in construction.

The rapid decline observed from 2007 is related to the global economic downturn, which greatly reduced construction and demand for aggregates in the UK. However, extraction of non-metallic minerals increased by 7.7% between 2013 and 2014 (from 196.2 million tonnes to 211.2 million tonnes). This was mainly in the form of sand and gravel where 121.3 million tonnes was extracted.

Fossil energy materials/carriers

Fossil energy materials/carriers include coal, peat, crude oil and natural gas. During the 1990s, extraction of fossil energy materials/carriers increased and peaked at 273.2 million tonnes in 1999. Since then, production has declined and fell to 88.3 million tonnes in 2014, a further 2.4% lower than in 2013 (90.4 million tonnes). The decline in extraction of fossil energy materials is primarily due to a drop in North Sea oil and gas production, as major producing fields begin to decline and exploration of new fields is focused on smaller resources that are more difficult to exploit. The economic downturn also had an effect.

Metal ores

Metal ores include iron and non-ferrous metals. Each year, small quantities of metal ores are extracted in the UK, although this has notably decreased since 1992. In 2014, only 0.8 thousand tonnes of metal ores were extracted in the UK, a fall of 99.6% compared to 1992 (207.6 thousand tonnes) and 20.0% decrease compared to 2013 (1.0 thousand tonnes).

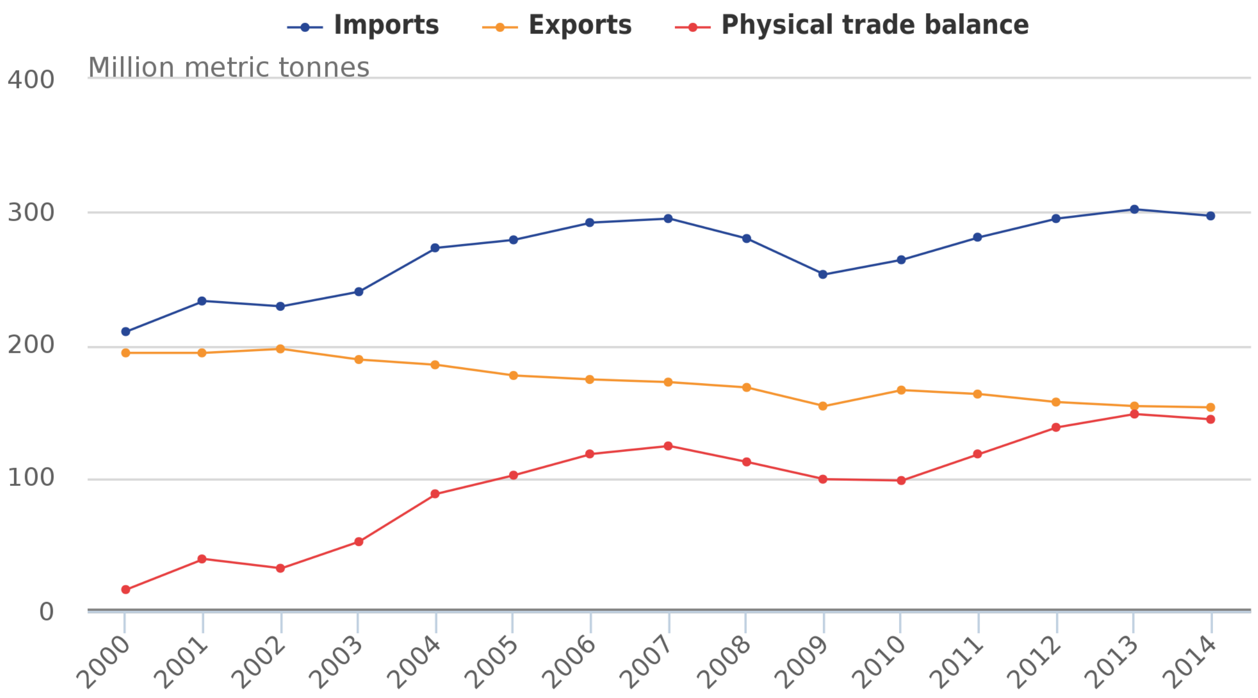
Almost twice the amount of products imported than exported in 2014

Figure 9.2 shows the total quantity of materials imported to, and exported from the UK. Physical imports increased by 41.2% between 2000 and 2014, rising from 210.2 million tonnes to 296.7 million tonnes in 2014. Contrary to this, physical exports have gradually decreased (peaking at 196.7 million tonnes in 2002 and falling to 153.0 million tonnes in 2014 – the lowest point since 2000). The rise in imports partly offsets the decline in domestic extraction.

In 2014, 4.6 tonnes of material were imported per person. This is an increase of 27.8% from 2000, where 3.6 tonnes of material were imported per person. However, between 2013 and 2014, total imports per person decreased by 2.1%, falling from 4.7 tonnes per person to 4.6 tonnes per person. In contrast, the amount of material exported per person fell by 27.3% between 2000 and 2014, from 3.3 tonnes per person to 2.4 tonnes per person. There was no difference in total exports per person between 2013 and 2014.

Figure 9.2: Total quantity of materials imported to and exported from the UK, and the Physical Trade Balance (1,2)

UK 2000 to 2014



Source: HM Revenue & Customs, Office for National Statistics

Notes:

1. The Physical Trade Balance (Imports – Exports) is defined in reverse to the Monetary Trade Balance (Exports – Imports). Physical estimates can differ quite significantly to monetary estimates.

2. Data are only available for 2000 onwards.

Across the 2000 to 2014 period, fossil energy materials/carriers were the largest component of UK imports and exports. In 2014, fossil energy materials/carriers accounted for 54.5% of imports and 53.9% of exports. Trade in other materials remained fairly stable over the series, apart from a sharp drop in the trade of metal ores and concentrates in 2009, where, compared with 2008, imports fell by 36.7% and exports fell by 23.8%. This is likely to be due to the economic downturn.

The physical trade balance[3] (PTB) shows the relationship between imports and exports and is calculated by subtracting the weight of exports from the weight of imports. The UK has a positive PTB, meaning that more materials and products are imported than exported.

In 2000, the PTB was relatively small at 15.7 million tonnes. It generally increased until 2007, but then fell between 2008 and 2010 during the economic downturn. Since 2010, the PTB has increased, peaking at 148.1 million tonnes in 2013. However, the PTB decreased by 2.9% in 2014 (to 143.7 million tonnes). Despite this, the amount of materials and products that were imported (296.7 million tonnes) was almost twice the amount of materials and products that were exported (153.0 million tonnes); suggesting that the UK is becoming more reliant on the production of materials in other countries.

Consumption of materials declined by over a fifth since 2000

Direct material input (DMI) (domestic extraction + imports) measures the total amount of materials that are available for use in the economy.

Domestic material consumption (DMC) (domestic extraction plus imports minus exports) measures the amount of materials used in the economy and is calculated by subtracting exports from DMI.

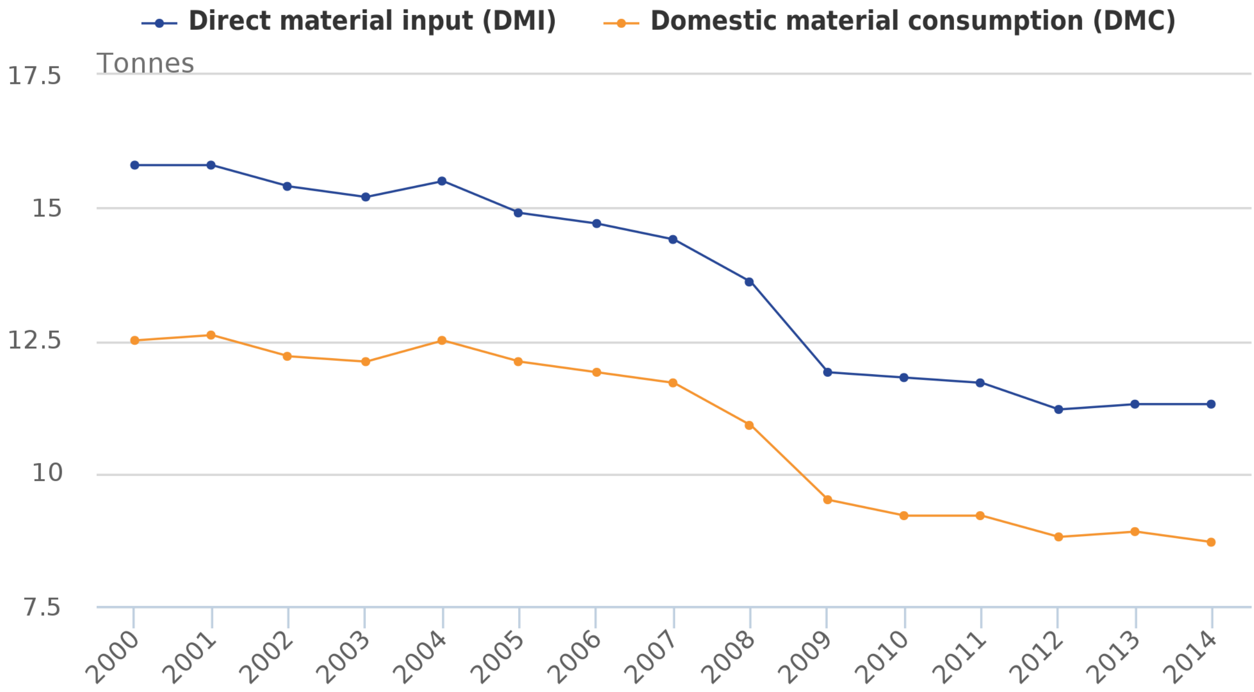
In 2014, the UK consumed 563.0 million tonnes of material, consisting of 205.4 million tonnes of non-metallic minerals (36.5%), 172.5 million tonnes of biomass (30.6%), 170.0 million tonnes of fossil fuels (30.2%) and 15.1 million tonnes of metal ores and other products (2.7%).

Between 2000 and 2014, DMI and DMC, on a per person basis, decreased by 28.5% and 30.4%, respectively (Figure 9.3). DMI represented 15.8 tonnes per person in 2000 but declined to 11.3 tonnes per person in 2014. DMC decreased from 12.5 tonnes per person in 2000 to 8.7 tonnes per person in 2014.

Between 2013 and 2014, DMC decreased by 2.2% (falling from 8.9 tonnes per person). There was no change in DMI per person.

Figure 9.3: Direct material input (DMI) and domestic material consumption (DMC) per capita

UK 2000 to 2014



Source: Office for National Statistics

Resource productivity has increased between 2000 and 2014

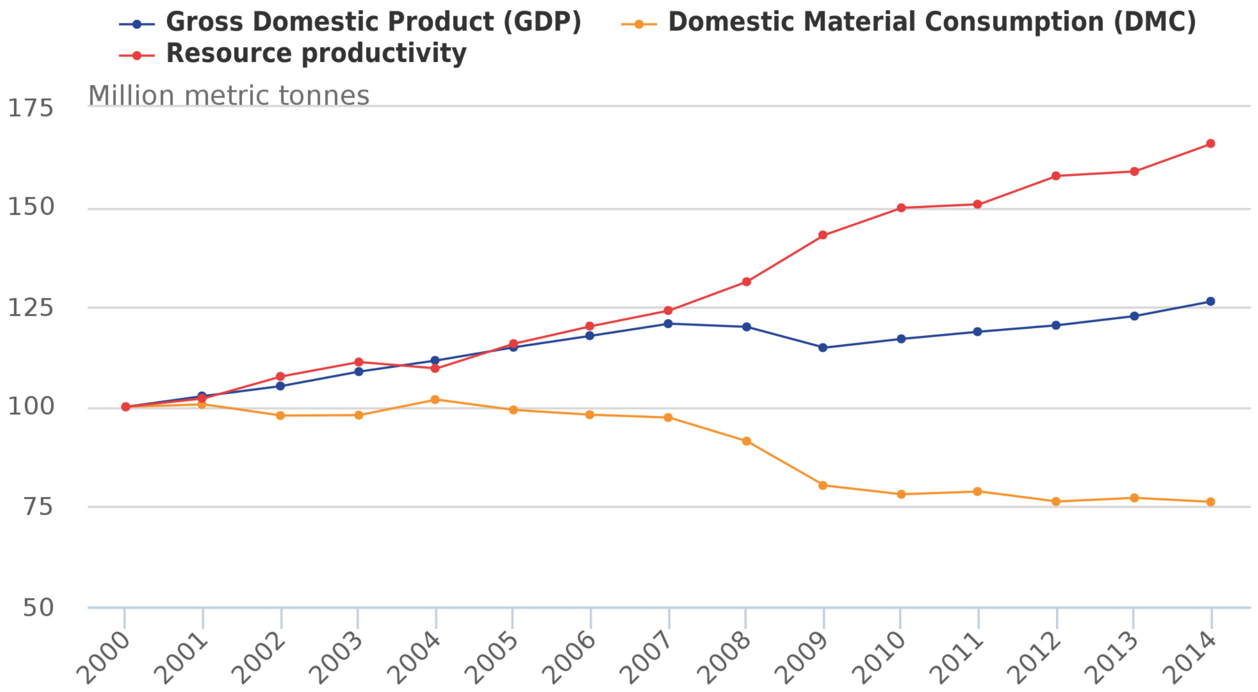
"Resource productivity" is a measure that can be used to determine the relationship between economic activity and the total amount of materials consumed by the economy. On a national level, it is calculated by dividing gross domestic product (GDP) by material consumption (DMC). This shows the amount of economic value generated in relation to every kilogram of material consumed.

One might expect that as an economy grows, its demand for resources (for example, construction materials for building new homes or fuels to power industrial plants) also rises. Resource productivity is an aggregate indicator of an economy's material efficiency. It shows whether material consumption and economic growth are closely associated or whether they are becoming "decoupled". "Decoupling" in this context means breaking the link between an environmental and economic variable. This can be either absolute or relative. Absolute decoupling in this context occurs when material consumption is stable or decreases while GDP increases. A move in this direction might indicate a greener and more sustainable economy. Relative decoupling occurs when the rate of change in material consumption is less than the rate of change in GDP.

Figure 9.4 shows that DMC has generally decreased and that GDP has generally increased since 2000. Between 2000 and 2014, on average, DMC fell by 1.8% each year while GDP grew by 1.7%. This represents absolute decoupling between resource use and economic growth. During 2000 and 2014, resource productivity was estimated to have increased by 65.9%, suggesting a move towards a more sustainable economy.

Figure 9.4: Resource productivity (1)

UK 2000 to 2014



Source: HM Revenue and Customs, Office for National Statistics

Notes:

1. Resource productivity was calculated using GDP in chain linked volumes (series ABMI).

Experimental estimates of raw material consumption using raw material equivalents

A limitation of the DMC indicator is that it does not provide an entirely accurate picture of material and product consumption. This is because the way materials are extracted from the environment are recorded differently to the way materials are recorded through imports and exports. Imports and exports are recorded as the actual weight of the final product instead of the weight of materials (in its raw form) used to produce the product. As a result, the weight of the final product that is imported and exported does not take into account the weight of the raw materials (known as raw material equivalent, RME) extracted to produce the manufactured product (Eurostat, 2015).

To overcome this, the Office for National Statistics (ONS) has used a new model developed by Eurostat to estimate the RME of traded goods. For example, using this approach, one tonne of imported steel is transformed into the equivalent of crude iron ore which had to be extracted and processed in order to produce one tonne of steel. This helps to provide a more accurate picture of environmental impact and gives a better indicator of our "global material footprint". Using the RME of traded goods, an improved raw material consumption (RMC) indicator can be calculated:

RMC = Domestic extraction plus imports (RME) minus exports (RME)

However, RME and RMC estimates are still under development at European level and should be used and interpreted with caution.

A publication on RME and RMC estimates for 2000 to 2013 was published earlier this year, titled " How much material is the UK consuming?". Updated estimates will be published when data are available.

Notes for Material flows

1. In Eurostat's Economy-Wide Material Flow Accounts Compilation Guide 2013 a distinction is made between 'used' and 'unused' domestic extraction. "Used" refers to an input for use in any economy (for example, where a material acquires the status of a product) and "unused" flows refer to materials that are extracted from the environment without the intention of using them. Only domestically extracted items that are "used" are included within the UK's material flow accounts.

2. The residual biomass from primary crop harvest, such as straw and leaves, is often subject to further economic use. A large fraction of crop residues is used as bedding material in livestock husbandry, but may also be used as animal feed, for energy production, or as industrial raw material.

   Fodder crops consist of beets, cabbage, maize and turnips for fodder, as well as hay and silage from grass. The quantity of grazed biomass used is estimated according to demand for animal feed that cannot be met by fodder crops, and the area of grazing land available.

3. The physical trade balance (imports minus exports) is defined in reverse to the monetary trade balance (exports minus imports). Physical estimates can differ quite significantly to monetary estimates.

Further information is available in the "material flows" reference table

10. Environmental taxes

Main points

Environmental taxes raised £46.0 billion in the UK in 2015.

Despite rising by an average of 3.7% per year since 1997 (in current prices), environmental tax revenue has remained stable as a percentage of GDP (2.5% in 2015).

Environmental taxes provided 7.4% of all revenue from taxes and social contributions in 2015.

Hydrocarbon oil duties (including transport fuels) accounted for 59.6% of all environmental taxes in 2015.

Introduction

Our environmental taxes data are based on the definition outlined in Regulation (EU) No 691/2011 on European Environmental Economic Accounts. The European Statistical Office (Eurostat) definition of an environmental tax is one whose base is a physical unit (for example, a litre of petrol or a passenger flight) that has a proven negative impact on the environment. These taxes are designed to promote environmentally positive behaviour, reduce damaging effects on the environment and generate revenue that can potentially be used to promote further environmental protection. Data on UK environmental tax revenue are available for the years 1997 to 2015.

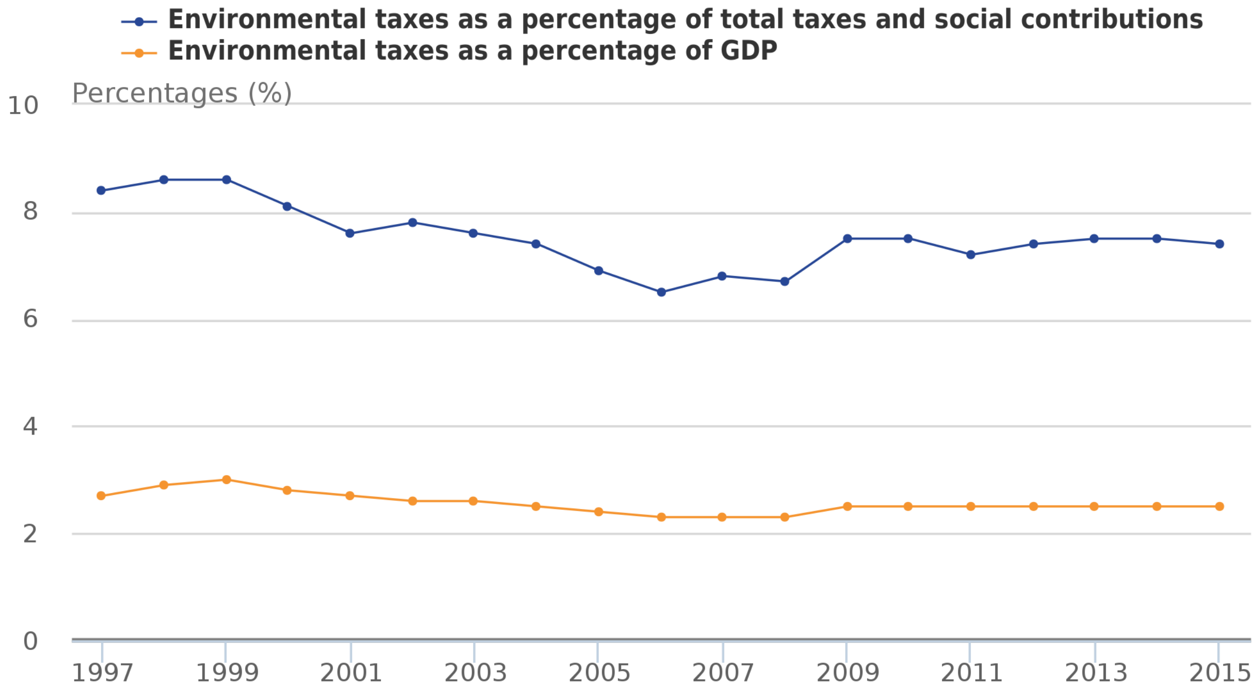
Environmental tax revenue broadly stable as a percentage of GDP

In 2015, revenue from environmentally-related taxes stood at £46.0 billion, equivalent to 2.5% of the UK's gross domestic product (GDP). Between 1997 and 2015, environmental taxes as a share of GDP have remained at a broadly consistent level of between 2.0% and 3.0% (Figure 10.1).

In 2015, environmental tax revenue was 7.4% of total taxes and social contributions (TSC). After peaking at 8.6% of TSC in 1998, environmental taxes generally fell as a percentage of TSC to reach 6.5% of TSC in 2006. In 2009, as a possible result of the fall in other government revenue following the most recent economic downturn, the share of TSC-comprised environmental taxes rose to 7.5% and since then has remained consistent.

Figure 10.1: Environmental tax revenue, as a percentage of GDP and total taxes and social contributions

UK 1997 to 2015



Source: Office for National Statistics

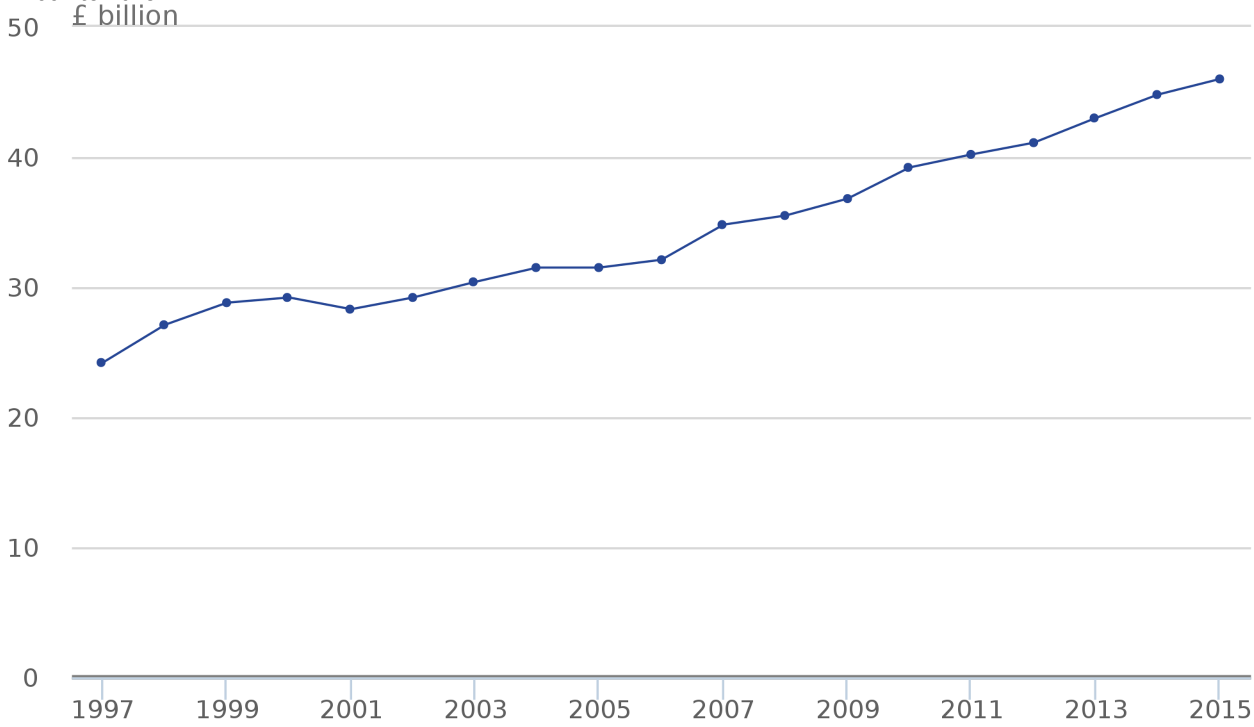
Revenue from environmental taxes has almost doubled between 1997 and 2015

UK government revenue from environmentally-related taxes has increased by, on average, 3.7% (in current prices) per year since 1997 (Figure 10.2). Total revenue in 2015 (£46.0 billion) was 1.9 times greater than revenue in 1997 (£24.2 billion).

The largest annual increase in environmental tax revenue was 12.1% in 1998. An increase of £2.6 billion (14.4%) in revenue from hydrocarbon oil duty (which includes taxes on transport fuels) explained much of this rise. The fuel price escalator, which set the rate for year-on-year increases in this particular duty, rose from 5% in 1997 to 6% in 1998. The larger than average increase in income from environmental taxes was also partly explained by a rise of £0.4 billion in revenue from air passenger duty. The duty was doubled to £10 for flights to most European countries and £20 for other flights from 1 November 1997. A further increase in air passenger duty in 2007 which was doubled again also partly led an 8.4% increase in revenue from environmental taxes, equivalent to £2.7 billion.

Figure 10.2: Environmental tax revenue (1)

UK 1997 to 2015



Source: Office for National Statistics

Notes:

1. Data are presented in current prices and have not been adjusted for inflation.

Between 1997 and 2015, there were 2 periods where there was a fall in environmental tax revenue: 2001 (3.1%) and 2005 (0.1%). In 2001, which saw the largest fall, a series of national protests against the rising costs of fuel prices for road vehicle use in the autumn of 2000 had a considerable impact and led to a £1.0 billion fall in revenue from taxes on hydrocarbon oils. A fall of £0.6 billion was also observed in revenue generated from motor vehicle tax paid by businesses. This followed a change in the base for the tax from engine size (for cars and light goods vehicles registered before 1 March 2001) to fuel type and carbon dioxide emissions (for cars and light goods vehicles registered on or after 1 March 2001).

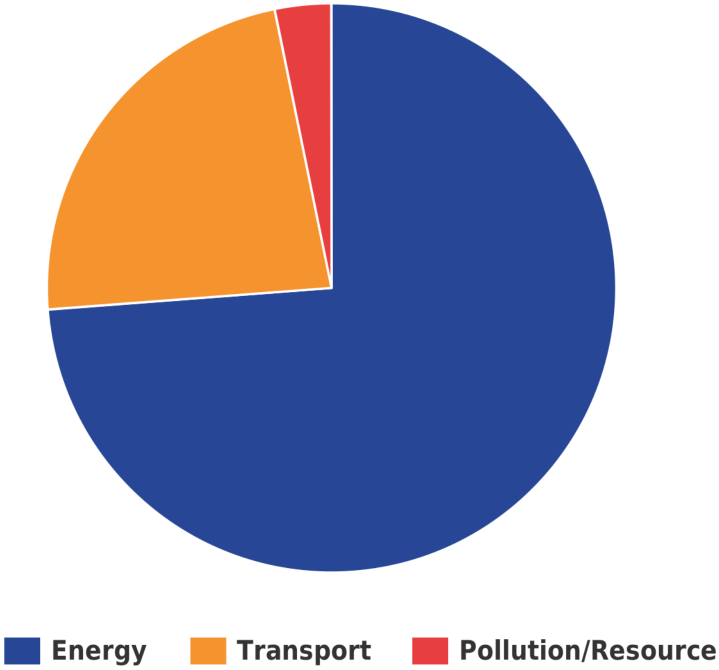
Nearly three-quarters of all environmental tax revenue is from energy taxes

There are 4 types of environmental taxes: energy, transport, pollution and resource [1]. Energy taxes include taxes on energy production and energy products (for example, coal, oil products, natural gas and electricity) used for both transport and stationary purposes. In 2015, nearly three-quarters (73.8%) of all income from environmental taxes were energy taxes (Figure 10.3). The largest contributor to energy taxes was tax on hydrocarbon oils (which includes taxes on transport fuels). In 2015, this tax accounted for 80.8% of all income from energy taxes and 59.6% of total revenue from all environmental taxes.

Transport taxes consist mainly of taxes related to the ownership and use of motor vehicles, although taxes on other transport and related transport services are also included. In 2015, transport taxes contributed 23.0% of all environmental tax revenue. Motor vehicle taxes paid by households made the most important contribution, accounting for 45.2% of total transport tax revenue. Pollution and resource taxes include taxes on the extraction of raw materials and on the management of waste. Only 3.2% of total environmental tax revenue comprised pollution and resource taxes in 2015. Landfill tax made the largest contribution (74.3%) to pollution and resource taxes equivalent to £1.1 billion.

Figure 10.3: Environmental tax revenue: by tax type, 2015

UK



Source: Office for National Statistics

Notes on environmental taxes

1. For ease of interpretation this article combines pollution and resource taxes together.

Further information is available in the "environmental taxes" reference table

11. Environmental protection expenditure

Main points

Since 1997, UK government spend on environmental protection expenditure (EPE) has increased from £4.1 billion to £15.4 billion in 2014 and currently accounts for 1.9% of total government spending.

Waste management activities accounted for just over three-quarters (78.6%) of government EPE spend in 2014.

EPE as a percentage of gross domestic product (GDP) was equivalent to 0.8% in 2014.

Introduction

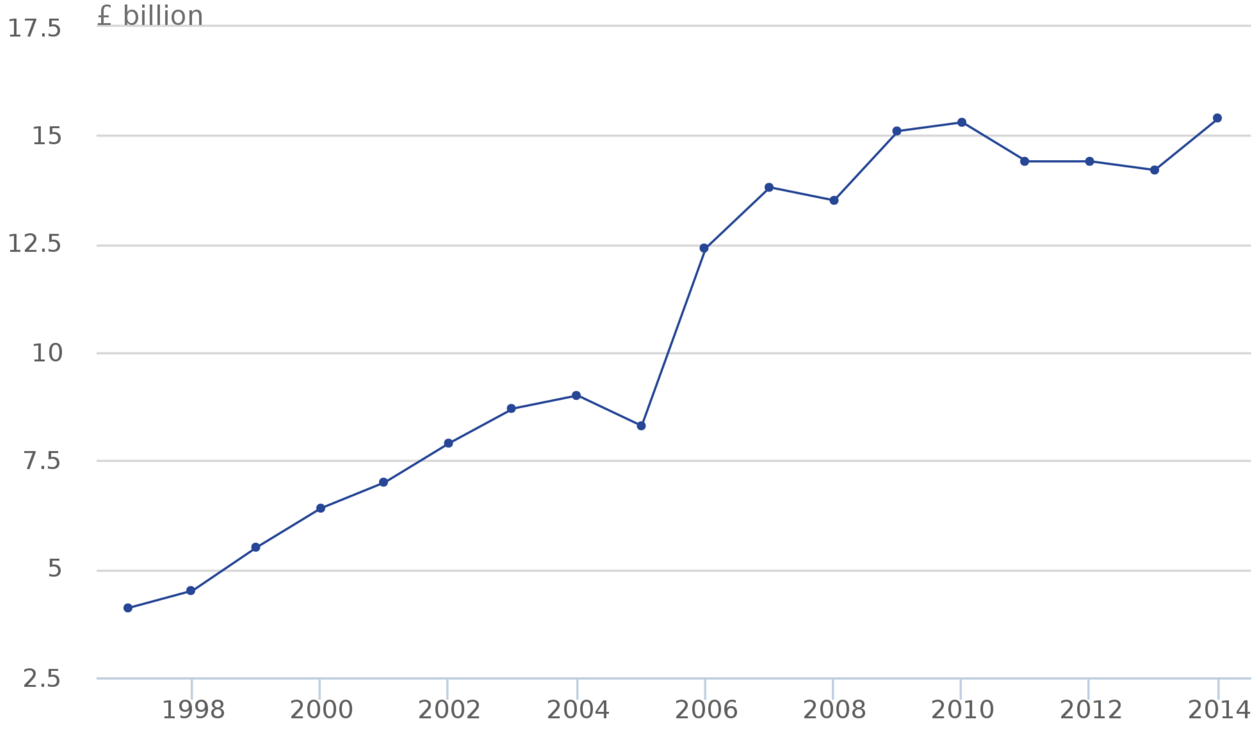
Environmental protection expenditure (EPE) includes all activities and actions which have as their main purpose the prevention, reduction and elimination of pollution or any other degradation of the environment. Examples of EPE include sewerage, waste management, treatment of exhaust gases and protection of natural landscapes. The purpose of reporting EPE is to enable identification and measurement of society's response to environmental concerns through the supply of and demand for environmental protection services and through the adoption of production and consumption behaviour aimed at preventing environmental degradation. All data in this section are presented in current prices.

Environmental protection expenditure by government has tripled since 1997

UK government data for EPE are derived using annual expenditure data disaggregated by Classification of Functions of Government (COFOG). Figure 11.1 shows EPE by the UK government from 1997 to 2014. Between this period EPE increased by £11.3 billion from £4.1 billion to £15.4 billion. The general trend has been year on year increases, with a few notable exceptions. Between 2004 and 2005, EPE fell by 7.8% (from £9.0 billion to £8.3 billion) as a result of the decommissioning of British Nuclear Fuels plc (BNFL). In April 2005, BNFL (classified as a public corporation) transferred some nuclear reactors to the Nuclear Decommissioning Authority (classified as central government). Between 2013 and 2014, EPE by general government increased by 8.5% from £14.2 billion to £15.4 billion, the largest year-on-year increase since 2009. EPE as a percentage of total government spend has been relatively consistent since 2006 and stood at 1.9% in 2014.

Figure 11.1: Environmental protection expenditure by UK government (1)

UK 1997 to 2014



Source: Office for National Statistics

Notes:

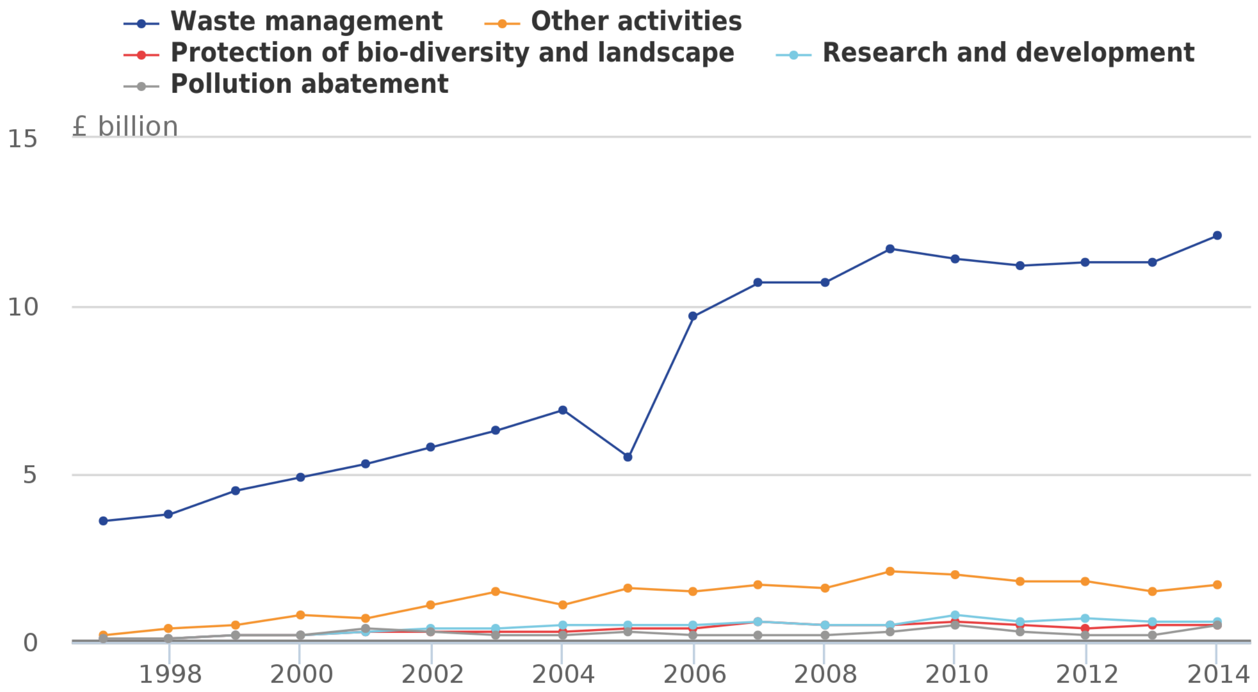
1. Data are presented in current prices and have not been adjusted for inflation.

Over three-quarters of environmental protection expenditure was spent on waste management activities in 2014

Figure 11.2 shows general government EPE, by activity. Since 1997, waste management activities accounted for the highest overall expenditure of all EPE activities. In 2014, the government spent 78.4% of total EPE on waste management. Between 2013 and 2014, expenditure on waste management increased by 7.1% from £11.3 to £12.1 billion.

Figure 11.2: Environmental protection expenditure by UK government by activity (1)

UK 1997 to 2014



Source: Office for National Statistics

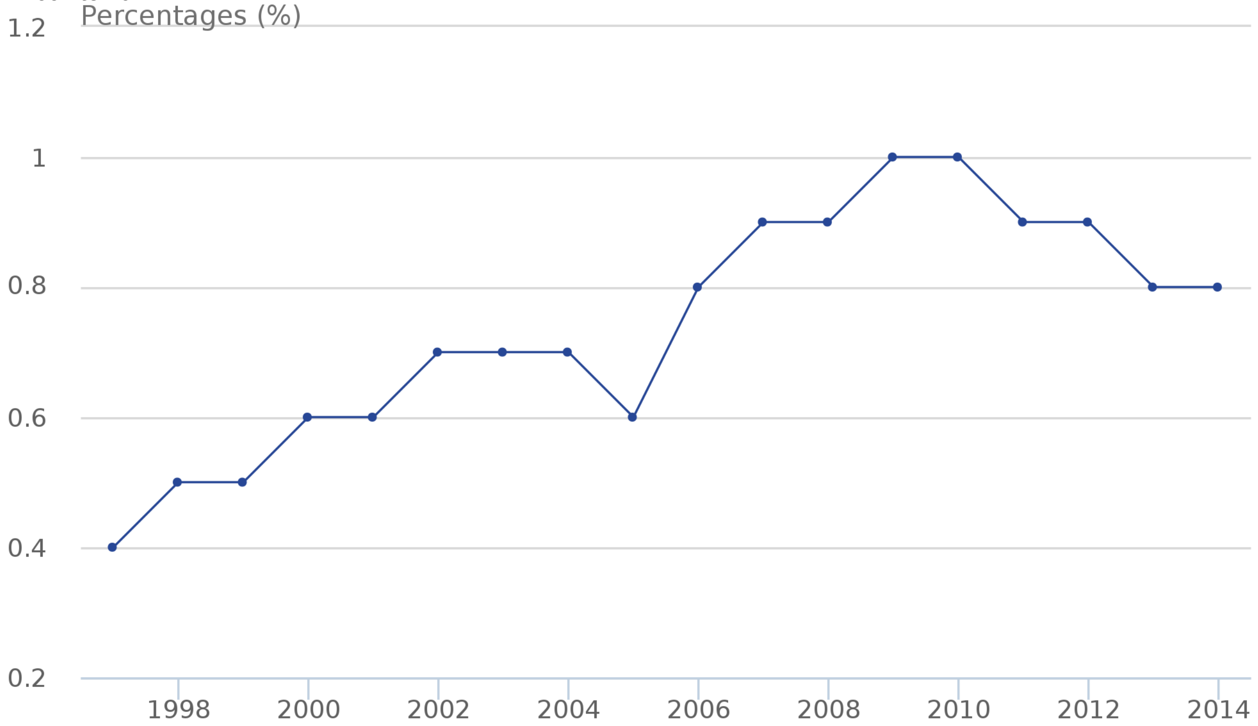
Notes:

1. Data are presented in current prices and have not been adjusted for inflation.

Figure 11.3 shows that EPE as a percentage of GDP has observed a generally positive trend. Notable exceptions to this trend occurred during 2005 for the reasons outlined above. Between 2008 and 2009, GDP fell as a result of the economic downturn while EPE increased. The largest fall in EPE since 2005 occurred between 2010 and 2011 (5.9%), with all activities contributing to a fall in EPE. In 2014, EPE as a percentage of GDP was unchanged from the previous year at 0.8%.

Figure 11.3: UK Government environmental protection expenditure as a percentage of GDP (1)

UK 1997 to 2014



Source: Office for National Statistics

Notes:

1. Data are presented in current prices and have not been adjusted for inflation.

Environmental protection expenditure by industry

Prior to 2015, data for EPE by industry were estimated from an annual EPE survey commissioned by the Department for Environment, Food and Rural Affairs (Defra). In 2015, Defra ceased to run the survey and from 2016 onwards the survey will be commissioned by the Office for National Statistics (ONS). Estimates for 2015 will be available in the 2017 UK Environmental Accounts Bulletin. It is expected that 2014 estimates will also be available in the 2017 bulletin. Estimates prior to 2014 can be found in the 2015 UK Environmental Accounts publication.

Further information is available in the "Environmental protection expenditure" reference table.

12. Waste

Main points

In 2014, household waste in the UK amounted to 26.8 million tonnes; 83.4% of this was produced in England.

Wales had the highest recycling rate among the UK countries in 2014 at 54.8%.

Introduction

Waste is defined by the European statistical office (Eurostat) as "any substance or object which the holder disposes of or is required to dispose of". Each year a large amount of resources are lost to waste, both in terms of materials and energy. The following section presents a selection of statistics on UK waste generation and recycling. Further information is available in the UK Digest of waste and resource statistics publication.

The "waste from households" indicator, published by the Department for Environment, Food and Rural Affairs (Defra), was introduced for statistical purposes to enable comparability across the 4 UK countries. It also enabled a consistent reporting of recycling rates to the EU under the Waste Framework Directive (2008//98/EC).

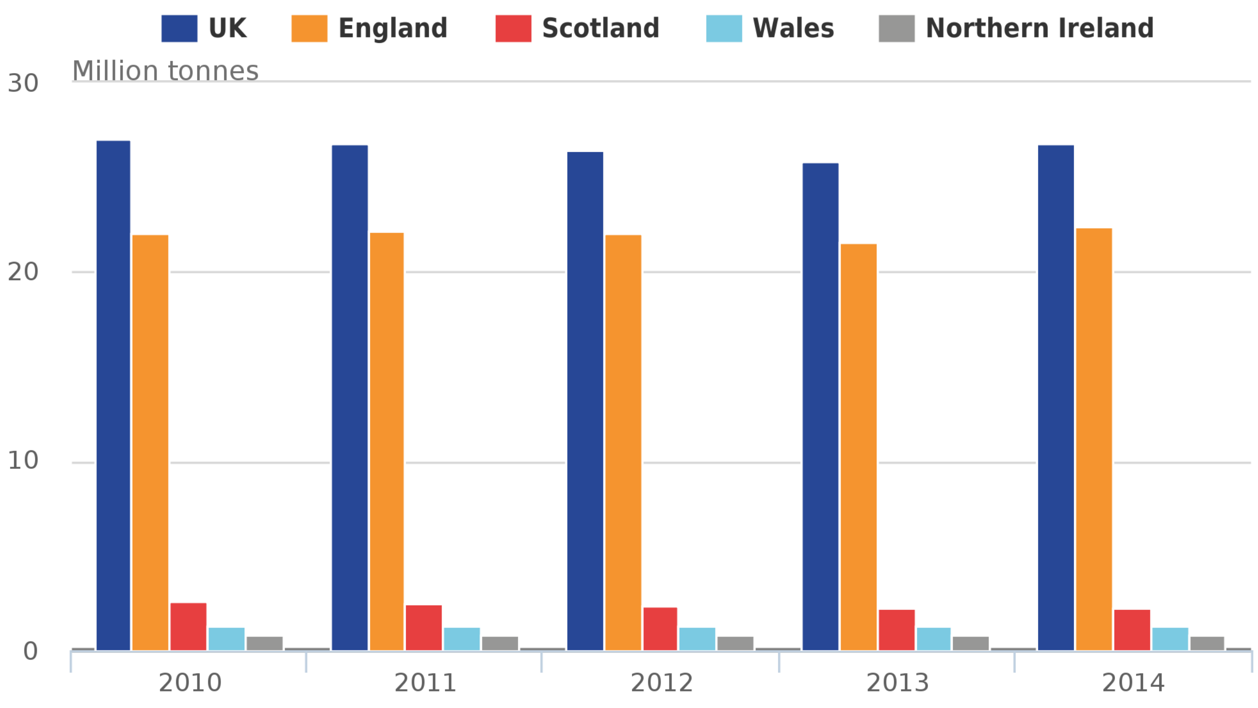
Over four-fifths of household waste produced in England in 2014

Of the 26.8 million tonnes of household waste produced in the UK in 2014, 83.4% (22.4 million tonnes) was produced in England. Scotland produced 8.8% (2.3 million tonnes), Wales produced 4.8% (1.3 million tonnes) and Northern Ireland produced 3.0% (0.8 million tonnes) (Figure 12.1).

Between 2010 and 2013, household waste in the UK fell by 3.8% (1.0 million tonnes), from 27.0 million tonnes to 25.9 million tonnes. However, between 2013 and 2014, household waste rose by 3.3% (0.9 million tonnes). This increase may be due to increases in waste from kerbside collections and bulky waste at civic amenity centres which were subsequently sent for disposal.

Figure 12.1: Waste from households (1)

UK 2010 to 2014



Source: Department for the Environment, Food and Rural Affairs

Notes:

1. Waste from households includes waste from regular household collection, civic amenity sites, "bulky waste" and "other household waste". It does not include street cleaning/sweeping, gully emptying, separately collected healthcare waste, asbestos waste.

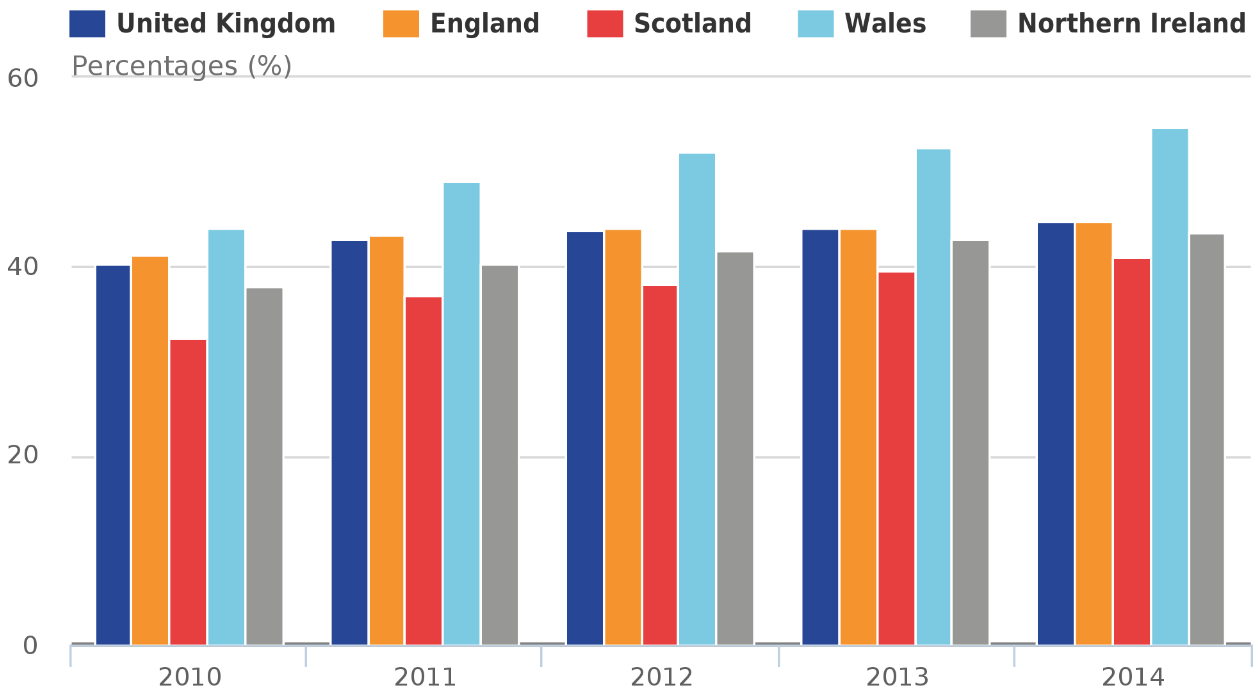
Wales had the highest recycling rate in 2014

Figure 12.2 shows the recycling rates for the UK and its constituent countries between 2010 and 2014. During this period, the recycling rate in all 4 countries increased. Wales had the highest recycling rate in 2014 (54.8%), showing a 10.8 percentage point increase since 2010 (44.0%). This was followed by England (44.8%), Northern Ireland (43.6%) and Scotland (41.0%).

There is an EU target to recycle at least 50% of waste by 2020. In 2014, the UK achieved a recycling rate of 44.9%, increasing by 4.5 percentage points from 2010 (40.4%).

Figure 12.2: Household recycling rates

UK 2010 to 2014



Source: Department for the Environment, Food and Rural Affairs

13. Water use

Water use is the physical amount of water removed (extracted) from any source for consumption and production activities. Water use data for 2012 are currently unavailable. The most recent (2011) data on water use is reported in the 2015 UK Environmental Accounts publication.

14. Environmental goods and services sector

There is increasing demand in the UK and internationally to measure the progress towards a green economy. There is particular interest in establishing how the economy is moving towards improving and protecting the environment from further deterioration (sustainable development) and the amount of green jobs being created.

The environmental goods and services sector (EGSS) statistics provide information on:

- how much of the UK economy is engaged in producing goods, services and technologies for environmental protection purposes and resource management activities

- the contribution of the EGSS production to the wider economy

- the number of jobs created in this sector; and how the EGSS is changing through time

The most recent (2012) data have been reported in the 2015 UK Environmental Accounts publication.

A detailed publication on the EGSS was published in April 2015, which fully describes the scope and composition of the EGSS estimates, provides additional statistics relating to the EGSS and presents the methodology used to derive the estimates. Work to update these estimates is ongoing and we hope to publish 2013 and 2014 estimates by the end of 2016.

Notes for Environmental goods and services sector

1. The methodology to produce EGSS estimates is under development and therefore data are experimental and should be interpreted with caution. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement. A full description of experimental statistics can be found on our website.

15. Low carbon

Main points

Around 96,500 businesses in the UK operated in the low carbon and renewable energy (LCRE) economy in 2014, equivalent to 4.4% of all non-financial businesses. This activity generated £46.2 billion turnover and employed 238,500 full-time equivalent (FTE) employees.

In 2014, the majority of businesses undertaking LCRE activity in the UK operated in the construction industry. This activity generated £12.4 billion LCRE turnover and employed 96,500 FTE employees.

The energy-efficient products group was the largest LCRE group in terms of number of businesses, turnover and employees in 2014.

Introduction

Analysis of the low carbon and renewable energy (LCRE) economy is included in the UK Environmental Accounts for the first time using data from the Low Carbon and Renewable Energy Economy Survey. The survey was sent to a sample of 41,483 UK businesses for the first time in 2015 (for the reporting year 2014). A business was classified as operating in the LCRE economy if they undertook activity in any of these 6 groups:

- low carbon electricity
- low carbon heat
- energy from waste and biomass
- energy efficient products
- low carbon services
- low emission vehicles

Full results from the first UK Low Carbon and Renewable Energy Economy Survey for the reporting year 2014 were published in May 2016.

Low carbon and renewable energy activities generated a turnover of over £46 billion

Around 96,500 businesses, equivalent to 4.4% of all UK non-financial businesses [1], were directly engaged in low carbon and renewable energy (LCRE) activity in 2014. The LCRE activities of these businesses generated a total turnover of £46.2 billion, accounting for 1.3% of total UK non-financial turnover in 2014. LCRE activities resulted in employment of 238,500 full-time equivalent (FTE) employees [2], accounting for 1.3% of UK FTE employees in the non-financial business economy.

LCRE activities led to £5.9 billion in imports (1.1% of total UK non-financial imports) and £4.8 billion in exports (1.0% of total UK non-financial exports). Regarding capital assets [3], LCRE activity resulted in £8.7 billion in acquisitions (4.8% of total UK non-financial acquisitions) and £500 million in proceeds from disposals (1.5% of total UK non-financial disposals) (Table 15.1).

Table 15.1: Low carbon and renewable energy economy activity, 2014, UK

	Low carbon and renewable energy economy	Percentage (%) of total non-financial business economy activity
Number of businesses[1]	96,500	4.4
Turnover (£ thousands)[2]	46,193,500	1.3
Employees (FTEs)[3]	238,500	1.3
Imports (£ thousands)[4]	5,890,000	1.1
Exports (£ thousands)[4]	4,755,000	1.0
Acquisitions (£ thousands)[2]	8,731,500	4.8
Disposals(£ thousands)[2]	511,000	1.5

Source: Office for National Statistics

1. Total number of businesses in the UK Non-Financial Business Economy derived from UK Business: Activity, Size and Location 2015. This is based on an extract taken from the ONS Interdepartmental Business Register in March 2015. Low Carbon Survey results are based on the calendar year 2014, this should be considered when making comparisons.

2. Total turnover and acquisitions and disposals of capital assets in the UK are derived from the ONS Annual Business Survey, UK Non-Financial Business Economy, 2014 Provisional Results (released 12th November 2015). To ensure a like-for-like comparison, data by industry are required to remove those industries that are not selected for the Low Carbon and Renewable Energy Economy Survey. The Annual Business Survey excludes the following Agricultural industries that are included in the Low Carbon Survey: 01.1 Growing of non-perennial crops, 01.2 Growing of perennial crops, 01.3 Plant production, 01.4 Animal production and 01.5 Mixed farming. This should be considered when making comparisons.

3. Total FTE employees in the UK Non-financial Business Economy are derived from the Business Register and Employment Survey (BRES) and the Northern Ireland Quarterly Employment Survey (QES). Figures for Great Britain derived from BRES exclude employees in all industries that are excluded from the Low Carbon Survey. Figures for Northern Ireland however, derived from QES do include employees in industries 63 Information service activities, and industries 95 Repair of computers and personal and household goods. This should be considered when making comparisons.

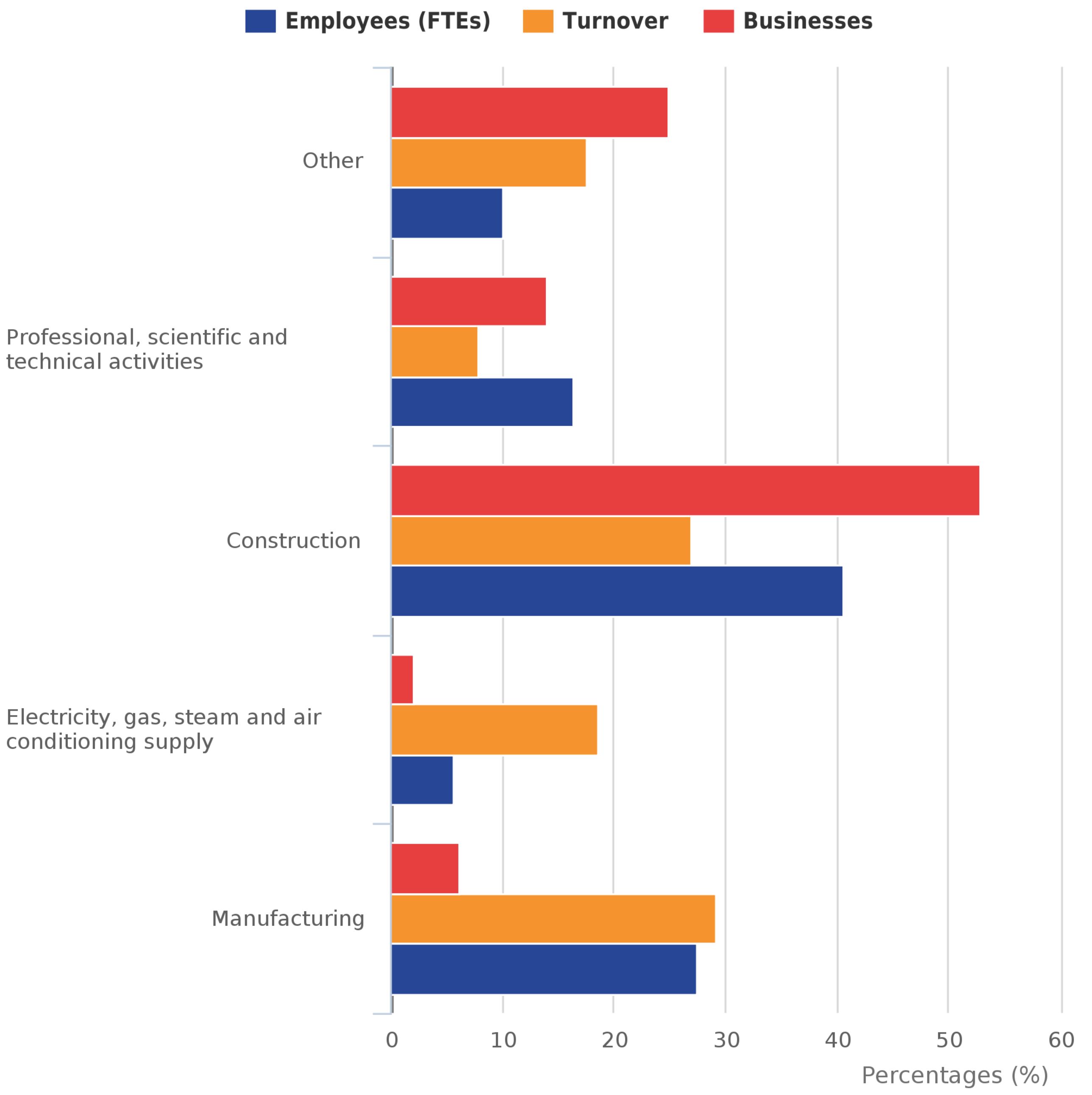
4. Total UK Non-financial Business Economy imports and exports are derived from UK Balance of Payments, The Pink Book, 2015. To ensure a like-for-like comparison, data by industry are required to remove those industries that are not selected for the Low Carbon and Renewable Energy Economy Survey. UK imports and exports figures are not available by industry and therefore an exact comparison is not possible. However, figures are available for Financial imports and exports. As Financial industries are excluded from the Low Carbon and Renewable Energy Economy Survey sample, these have been excluded from calculations, which will improve comparability. Figures may not sum due to rounding.

Over half of low carbon and renewable energy businesses were in the construction industry

In 2014, the majority of businesses undertaking LCRE activity[4] in the UK were operating in the construction industry (52.8%). Businesses operating in this industry generated 26.9% (£12.4 billion) of LCRE turnover and employed 40.5% (96,500) of FTE employees. The greatest proportion of LCRE turnover (29.2%) was generated in the manufacturing industry, equivalent to £13.5 billion. However, businesses in this industry accounted for just 6.2% (6,000) of LCRE businesses and employed 27.5% (65,500) of LCRE FTE employees (Figure 15.1).

Figure 15.1: Low carbon and renewable energy businesses, turnover and employees: by industry (1,2), 2014

UK



Source: Office for National Statistics

Notes:

1. “other” includes “agriculture, forestry and fishing”, “mining and quarrying”, “water supply; sewerage, waste management and remediation activities”, “wholesale and retail trade; repair of motor vehicles and motorcycles”, “transportation and storage”, “accommodation and food service activities”, “information and communication”, “real estate activities”, “administrative and support service activities”, “public administration and defence; compulsory social security”, “education” and “other activities”.

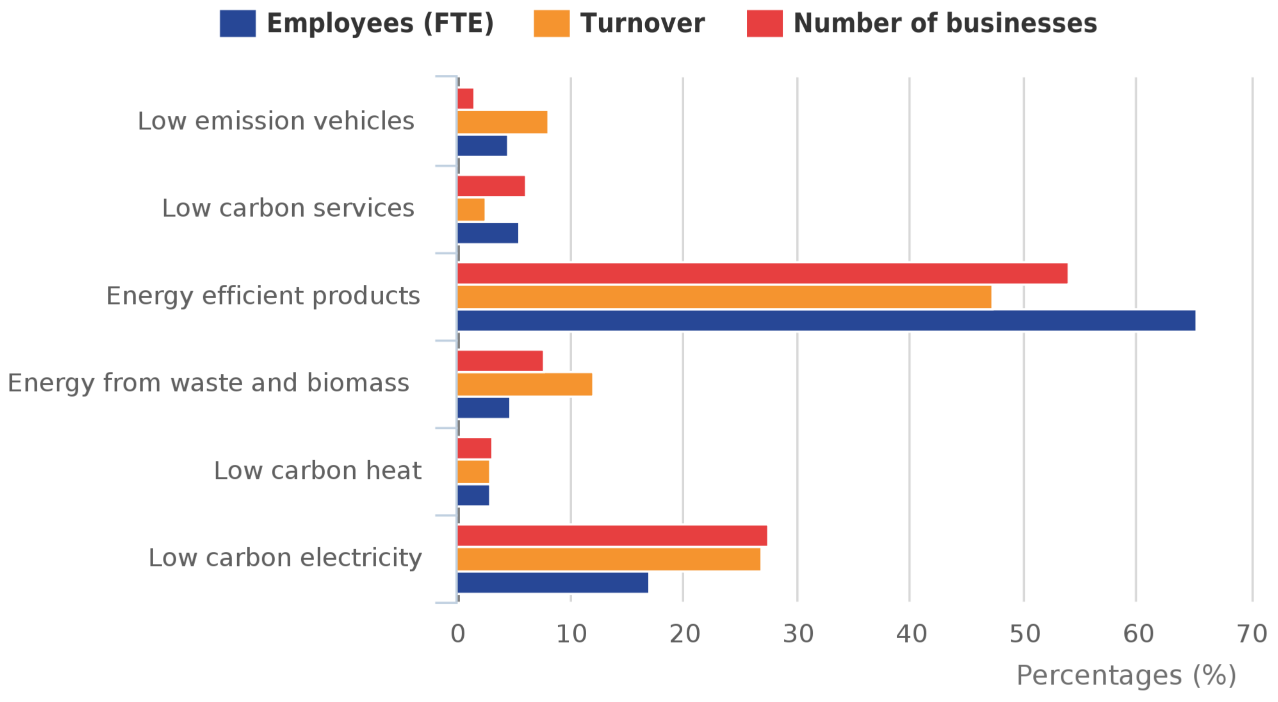
2. UK low carbon and renewable energy (LCRE) activity estimates are presented by UK Standard Industrial Classification (SIC) 2007. While SIC is a description of the main activity of the industry it may not fully match the description of the underlying LCRE business.

Energy efficient products group generated nearly half of low carbon and renewable energy turnover

In 2014, the energy efficient products group[5] was the largest LCRE group in terms of number of businesses, turnover and employees. The group employed 65.2% (155,500) of LCRE FTE employees and generated 47.3% (£21.9 billion) of LCRE turnover. The second largest LCRE group in respect of the number of businesses, turnover generated and employees was the low carbon electricity group[6]. However, while businesses operating in this group generated 26.9% of LCRE turnover (£12.4 billion), they employed only 17% (40,500) of LCRE FTE employees (Figure 15.2).

Figure 15.2: Low carbon and renewable energy businesses, turnover and employees: by group (1,2), 2014

UK



Source: Office for National Statistics

Notes:

1. The estimates for waste and biomass should be treated with caution due to high coefficients of variation (CV). CVs can be used as a guide to the accuracy of the estimate. The lower the CV the greater the accuracy of the estimate. The ranges used for the purpose of this bulletin are: “very good”, “good”, “acceptable” and “treat with caution”.

2. Low emission vehicles include low emission vehicles and infrastructure, and fuel cells and energy storage.

Notes for low carbon and renewable energy economy

1. Industries which do not deal with financial or investment-related goods or services include construction and distributive trades and services.

2. One full-time equivalent (FTE) employee may be thought of as one person year. For example, a person who normally spends 30% of their time in one sector and the rest in other sectors should be considered as a 0.3 FTE employee.

3. Total turnover and acquisitions and disposals of capital assets in the UK are derived from the ONS Annual Business Survey (ABS), UK Non-Financial Business Economy, 2014 Provisional Results (released 12 November 2015). To ensure a like-for-like comparison, data by industry are required to remove those industries that are not selected for the Low Carbon and Renewable Energy Economy Survey.

4. UK LCRE activity estimates are presented by Standard Industrial Classification (SIC) 2007. While SIC is a description of the main activity of the industry it may not fully match the description of the underlying LCRE business.

5. Sectors included in the energy efficient products group are energy efficient lighting, energy monitoring, saving or control systems and other energy efficient products.

6. Sectors included in the low carbon electricity group are offshore wind, onshore wind, solar photovoltaic, hydropower, other renewable energy and nuclear.

7. The methodology to produce LCRE estimates is under development and therefore data are experimental and should be interpreted with caution. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement. A full description of experimental statistics can be found on our website

16. Natural capital accounting

Natural capital can be thought of as the stock of our natural resources and the services to society that they provide.

Gross domestic product (GDP) tells us only part of our economic story. Not only do we need to account for the value of our goods and services produced through economic activity, but also the benefits provided by our natural assets, which lie outside the “economy”.

By addressing the need to account properly for our natural assets and the services they provide, natural capital accounting can inform and improve decision-making surrounding the natural environment. Furthermore, it can provide an insight on the losses, gains and relative importance of services provided by natural assets; highlight links with economic activity and pressures on natural environment; and inform priorities for investment and management decisions for natural capital.

In 2011, the government committed to working with us to incorporate natural capital into the UK Environmental Accounts by 2020 in order to better recognise the benefits provided by ecosystems. This work is being produced in partnership with the Department for Environment, Food and Rural Affairs (Defra) and has utilised and applied the UN System of Environmental-Economic Accounting (SEEA) frameworks.

In the 2015 Environmental Accounts we published our first estimates. In this version, we have updated them and introduced some new estimates. Sections 17 to 22 include the experimental environmental asset accounts:

- oil and gas
- carbon
- hydropower
- timber
- pollution removal

as well as an updated experimental woodland ecosystem account.

A land cover account and a freshwater ecosystem account were presented in the 2015 Environmental Accounts, but have not been updated in this publication.

These accounts are experimental (apart from oil and gas non-monetary account which are National Statistics) and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

Notes for Introduction to natural capital

1. Experimental statistics are those statistics that are in the testing stage and are not fully developed. A full description of experimental statistics can be found on our website.

17. Oil and gas asset accounts

Main points

At the end of 2014, the expected level of discovered oil reserves was estimated to be 716 million tonnes (mt), 4.0% lower than in 2013.

Expected reserves of discovered gas at the end of 2014 were estimated to be 407 billion cubic metres (bcm), 10.0% lower than in 2013.

Introduction

This section presents non-monetary estimates of the oil and gas reserves and resources in the UK.

In the context of oil and gas reserves and resources presented here, reserves refer to discovered oil and gas reserves which are recoverable and commercially viable, whereas resource refers to oil and gas that are potentially valuable and for which reasonable prospects exist for eventual extraction. Table 17.1 presents definitions for oil and gas reserves.

Table 17.1 Definitions of oil and gas reserves, UK

Deposit type		Definition
Discovered reserves	Proven reserve	Virtually certain to be technically and commercially producible i.e. have a better than 90% chance of being produced
	Probable reserve	Not yet proven, but have a more than 50% chance of being produced
Possible reserve		Cannot be regarded as probable, but which are estimated to have a significant – but less than 50% – chance of being technically and commercially producible
Potential additional resources (PAR's)		Not currently technically or commercially producible.
Undiscovered		Provide a broad indication of the level of oil resources which are expected to exist. However, they are subject to higher levels of uncertainty than reserves and PARs.

Source: SEEA Central Framework, OGA

Oil reserves and resources

Oil is defined as both oil and the liquids that can be obtained from gas fields. Shale oil is not included in these estimates.

The total (discovered; proven and probable, plus possible, PARs and undiscovered) oil reserves and resources for 2014 were estimated at between 1,614 million tonnes (mt) and 3,064 mt. The upper range for total oil reserves increased between 2013 and 2014 by 3.0%, whilst the lower range decreased by 1.7%. This is mainly due to greater uncertainty and a fall in proven reserves.

Discovered oil reserves

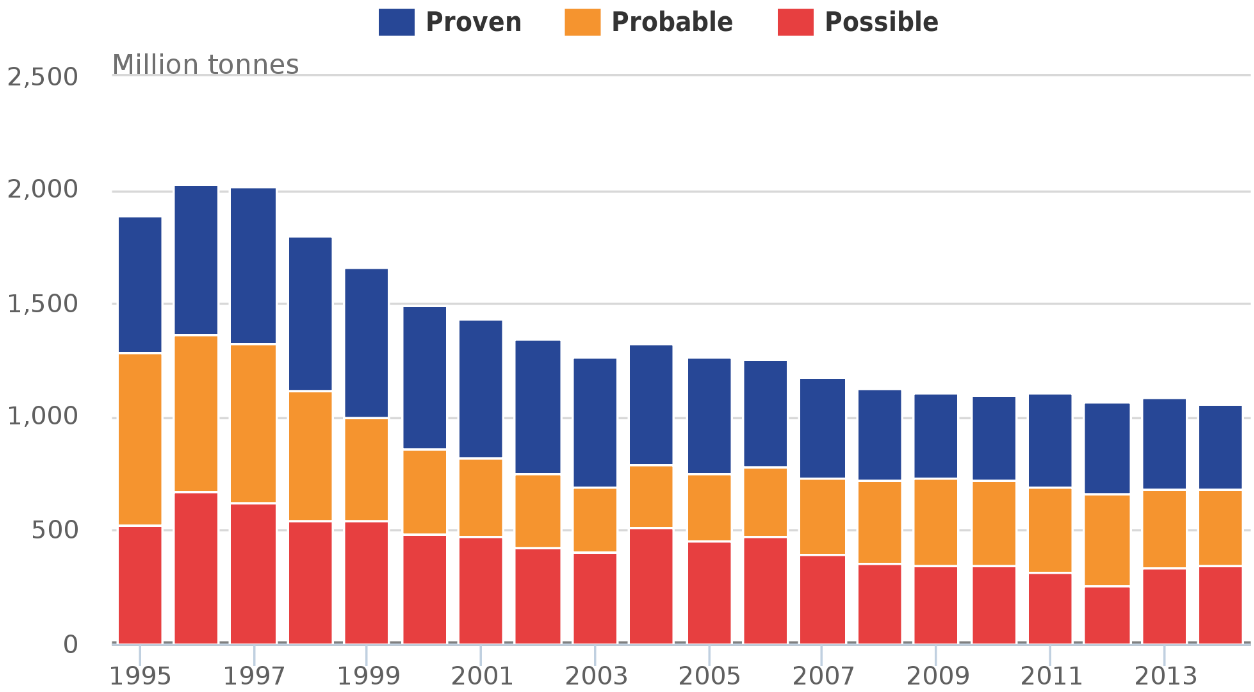
The expected level of discovered oil reserves is the sum of proven and probable reserves. In 2014, this was estimated at 716 mt, 4.0% lower than in 2013. Maximum reserves refer to the sum of proven, probable and possible reserves (Figure 17.1). Total maximum oil reserves fell by 2.2% between 2013 and 2014. The fall came entirely from a fall in proven reserves which fell 7.4%, although this was offset slightly by a small increase in possible reserves.

Proven levels of oil reserves were estimated to be 374 mt in 2014, representing 35.3% of maximum reserves. Probable reserves represented 32.3% of maximum reserves in 2014, a larger contribution compared with 2013.

Revisions to oil reserves data in established oil fields, additions to reserves from new field developments and the rate of production during the year are the reasons for changes in oil reserves between 2013 and 2014.

Figure 17.1: Estimates of discovered oil reserves

UK 1995 to 2014



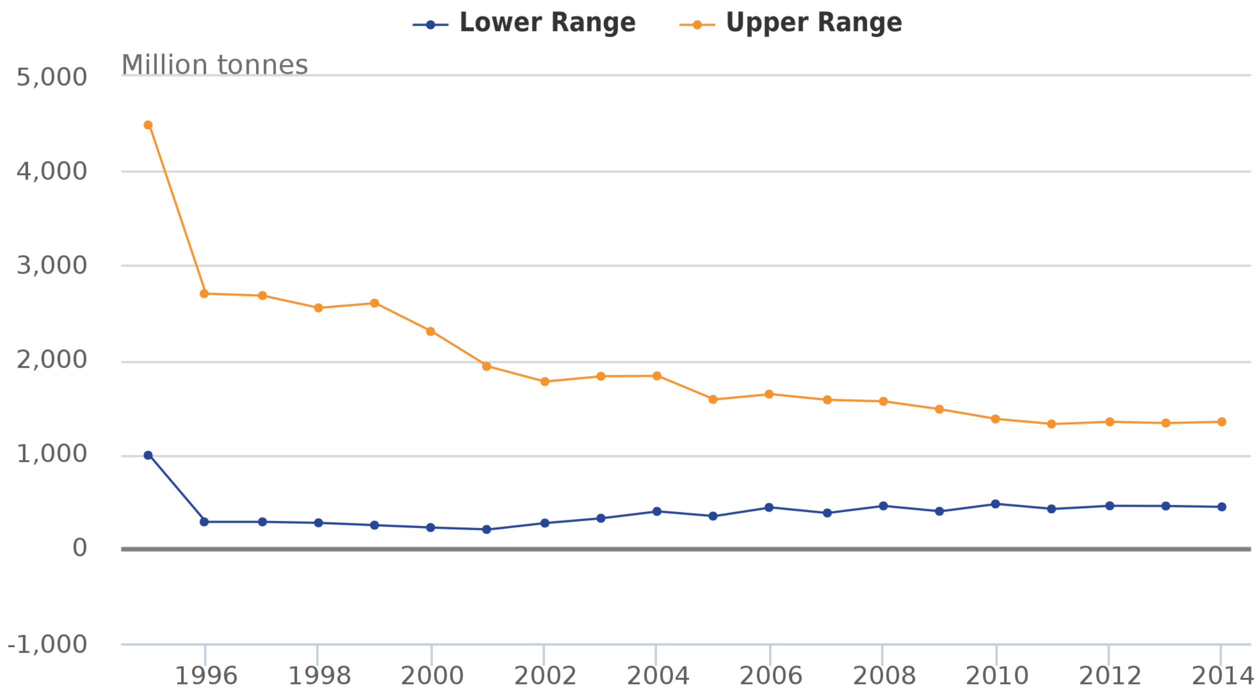
Source: Department of Energy and Climate Change

Undiscovered oil resources

Undiscovered oil resources provide a broad indication of the level of oil resources which are expected to exist, however, are subject to higher levels of uncertainty than reserves. The lower range of undiscovered oil resources was 444 mt in 2014, changing a little from 453 mt estimated in 2013. The upper range was an estimated 1.0% higher in 2014 than in 2013, at 1,344 mt compared with 1331 mt (Figure 17.2).

Figure 17.2: Estimates of undiscovered oil resources

UK 1995 to 2014



Source: Department of Energy and Climate Change

Gas reserves and resources

Gas includes gas expected to be available for sale from dry gas fields, gas condensate fields, oil fields with associated gas and a small amount from coal bed methane projects. Shale gas is not included in these estimates. These reserves include onshore and offshore discoveries but not flared gas or gas consumed in production operations.

Total gas reserves and resources were estimated between 1,064 billion cubic metres (bcm) and 1,944 bcm in 2014 (Figure 17.3). The lower range for total gas reserves and resources had fallen by 4.5% between 2013 and 2014, and the upper range had fallen 3.4%.

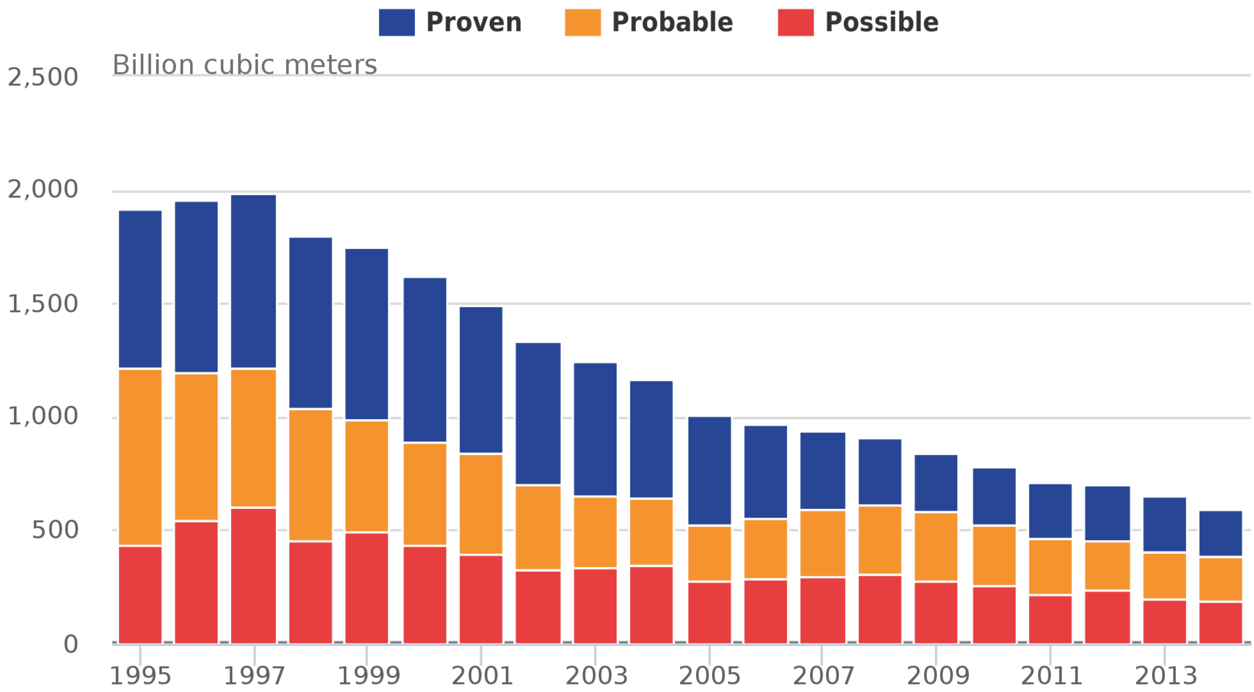
Discovered gas reserves

The expected level of gas reserves (proven plus probable) in 2014 was estimated to be 407 bcm, 10.0% lower than in 2013. The fall in expected reserves was driven primarily by a fall in proven reserves. In 2014, proven gas reserves were 205 bcm, 14.9% lower than in 2013 where they were estimated to be 241 bcm. The estimates for probable reserves fell from 211 bcm to 201 bcm, representing a fall of 4.7%.

The change in gas reserves for 2013 was the result of revisions to reserves in established fields and new field developments as well as production during the year. Overall, gas production has fallen by 67.6% since 2000.

Figure 17.3: Estimates of discovered gas reserves

UK 1995 to 2014



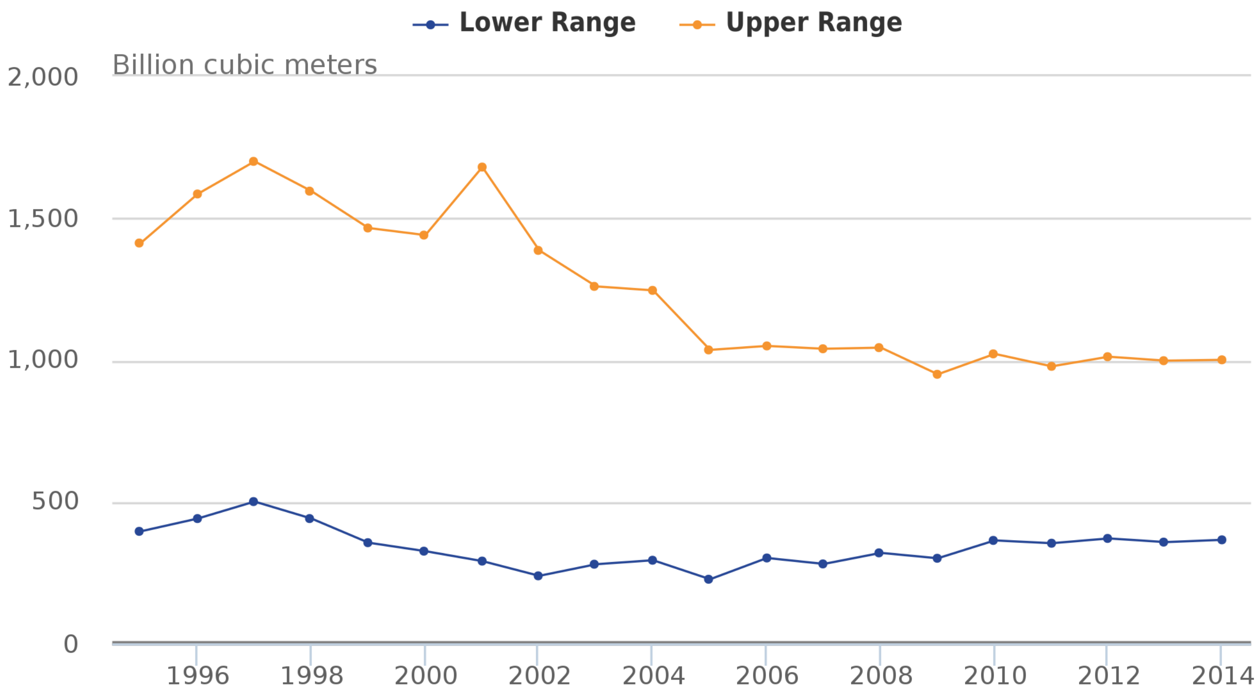
Source: Department of Energy and Climate Change

Undiscovered gas resources

Undiscovered gas resources are estimated to have been 578 bcm in 2014, lying between the upper and lower limits of 1,000 and 365 bcm respectively (Figure 17.4). The lower range was 2.2% higher than in 2013 where the estimate stood at 357 bcm. The upper estimate for gas was estimated to be 0.3% higher than in 2013 where the estimate stood at 997 bcm.

Figure 17.4: Estimates of undiscovered gas resources

UK 1995 to 2014



Source: Department of Energy and Climate Change

Monetary valuation of oil and gas (experimental statistics)

This section presents the monetary valuation for UK Continental Shelf oil and gas. It is estimated using the residual method in line with the System of Environmental-Economic Accounting (SEEA). A joint accounting structure has been adopted as oil and gas are often extracted jointly and so identifying extraction costs for each resource is not possible.

The valuation methodology used follows that outlined by Khan, Greene and Hoo (2013) [2]. A subsequent paper by Greene and Johnson (2014)[3] recommended the use of a 3-year moving average to calculate the cost of capital to better reflect the decisions which would be made by investors. However, as the current bond yields (from which the cost of capital is calculated) are abnormally low and thus not reflective of future bond yields, a 10-year moving average has been adopted.

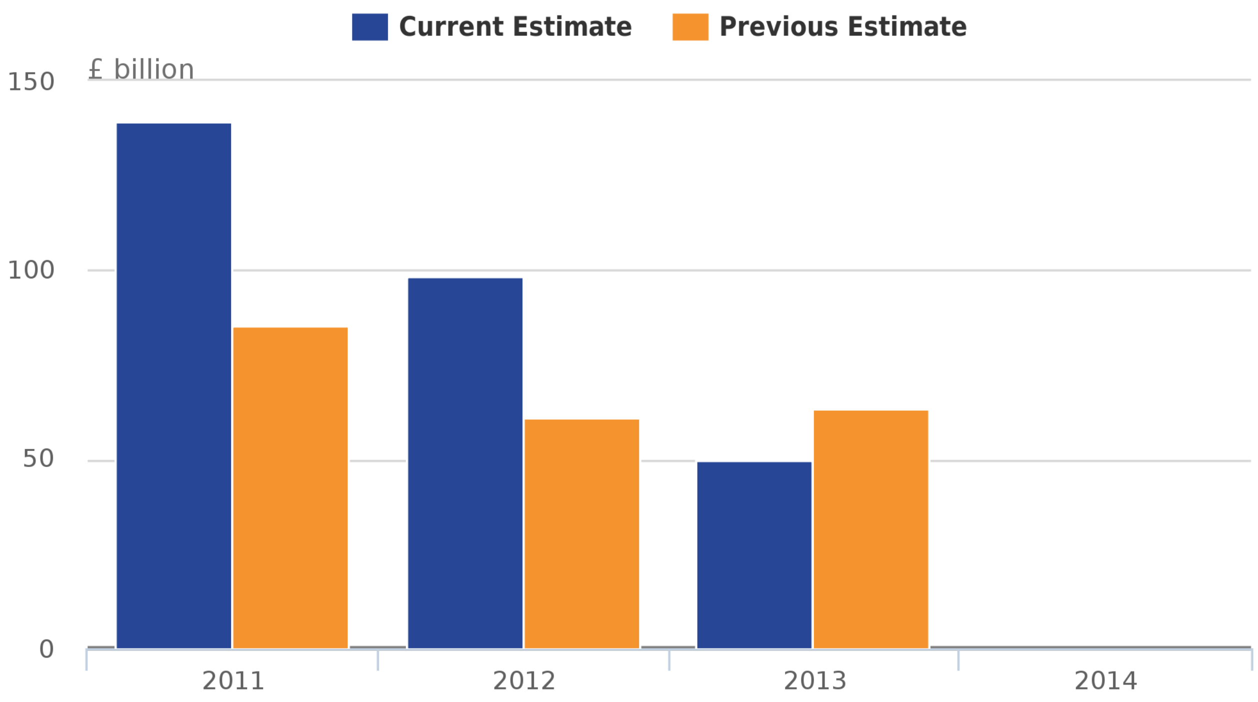
The data used in valuing oil and gas in monetary terms are sourced from the Office for Budget Responsibility (OBR) 2015 Fiscal Sustainability Report. The OBR forecast figures are based on a number of components, one of which is the dollar price of oil – a volatile component. In light of this, we have revalued estimates for the monetary value for oil and gas previously presented in Monetary Valuation of UK Continental Shelf Oil and Gas Reserves. We are currently undertaking research to improve the methodology discussed in the work of Greene and Johnson (2014). We welcome any comments on future improvements of the methodology.

The value of remaining oil and gas in 2014 was estimated to be negative; therefore we assume the value to be zero. This is compared to the revised estimate for 2013 which stood at £50.0 billion.

The 2014 monetary estimate for oil and gas was zero due to negative resource rents predicted in future years, which are estimated using OBR's forecasts. Oil and gas production and oil and gas prices are forecast to be low in the near term. These two combined factors have lead to negative resource rents and subsequently a negative asset value, so we assumed no value. Figure 15.5 illustrates the current estimates for 2011 to 2014.

Figure 17.5: Current monetary estimates for oil and gas

UK 2011 to 2015



Source: Office for Budget Responsibility

Notes for oil and gas

1. The oil and gas non-monetary accounts are National Statistics, however the monetary valuations are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

2. Khan, Greene and Hoo (2013) Monetary Valuation of UK Continental Shelf Oil and Gas Reserves (256.3 Kb Pdf).

3. Greene and Johnson (2014) (73.8 Kb Pdf).

Further information is available in the "oil and gas" reference table

18. Carbon stock account

Main points

143 billion tonnes of carbon was estimated to be stored in the UK's fossil fuel (coal, oil and natural gas) stocks at the end of 2013. The vast majority (98%) of which was stored within coal.

Approximately 94.2% (4 billion tonnes of carbon) of recorded biocarbon in the UK was contained in soil stocks, compared with 5.8% (0.25 billion tonnes of carbon) in vegetation stocks in 2007.

Introduction

This is a brief summary of the main findings presented in the preliminary experimental carbon stock account. The estimates are for selected types of carbon stocks, namely: geocarbon (coal, oil, gas) and biocarbon (soil and vegetation). A cross-cutting carbon account was proposed and developed to enable changes in the UK stocks of carbon to be monitored over time. The accounting framework adopted in this work is based upon the System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA-EEA) carbon stock account.

Vast majority (98%) of geocarbon found in coal stocks

Geocarbon refers to the carbon stored in the geosphere – the solid part of the earth consisting of the crust and outer mantle. It can be disaggregated into: oil, gas, coal resources, rocks (primarily limestone) and minerals. The high commercial interest in certain forms of geocarbon, notably fossil fuels, means data availability is good relative to the other carbon stock categories.

Approximately 143,095 million tonnes of carbon (MtC) relating to UK oil, gas and coal deposits was stored in the geosphere at the end of 2013. Of this, coal stocks accounted for 98% of total stocks.

The carbon contained in UK coal resources totalled 140,523 MtC at the end of 2013. Hard coal represents almost the entire share of UK coal stocks (99.8%). Stock data for coal is only available for 2013 and it has been assumed there have been no significant changes in coal stocks over the year when aggregating to 2014 figures.

The total amount of carbon stored in UK natural gas deposits was 739 MtC in 2014. Definitions for the types of oil and gas reserves are given in Table 15.1. Undiscovered gas contained the largest stock of carbon followed by proven plus probable gas reserves. Total UK stocks of oil held a carbon mass equal to 1,796 MtC. Of this, undiscovered deposits held the largest proportion of total oil carbon stocks, followed by proven plus probable reserves.

Largest biocarbon stocks found in open wetlands (peat soils) habitat

The carbon stored in plants, soils, animals and ecosystems as a whole are all components of the biocarbon stock. Biocarbon reservoirs can be separated by type of ecosystem, which at the highest level are terrestrial, aquatic and marine (SEEA-EEA, 2012). The primary focus of this summary is on terrestrial (land) habitat-based ecosystems. A lack of data on the carbon stored within, and sequestered by, open water (aquatic) ecosystems means they are excluded from the analysis at this stage. The carbon content of animals living within the ecosystems are also absent from current estimates due to a lack of available data.

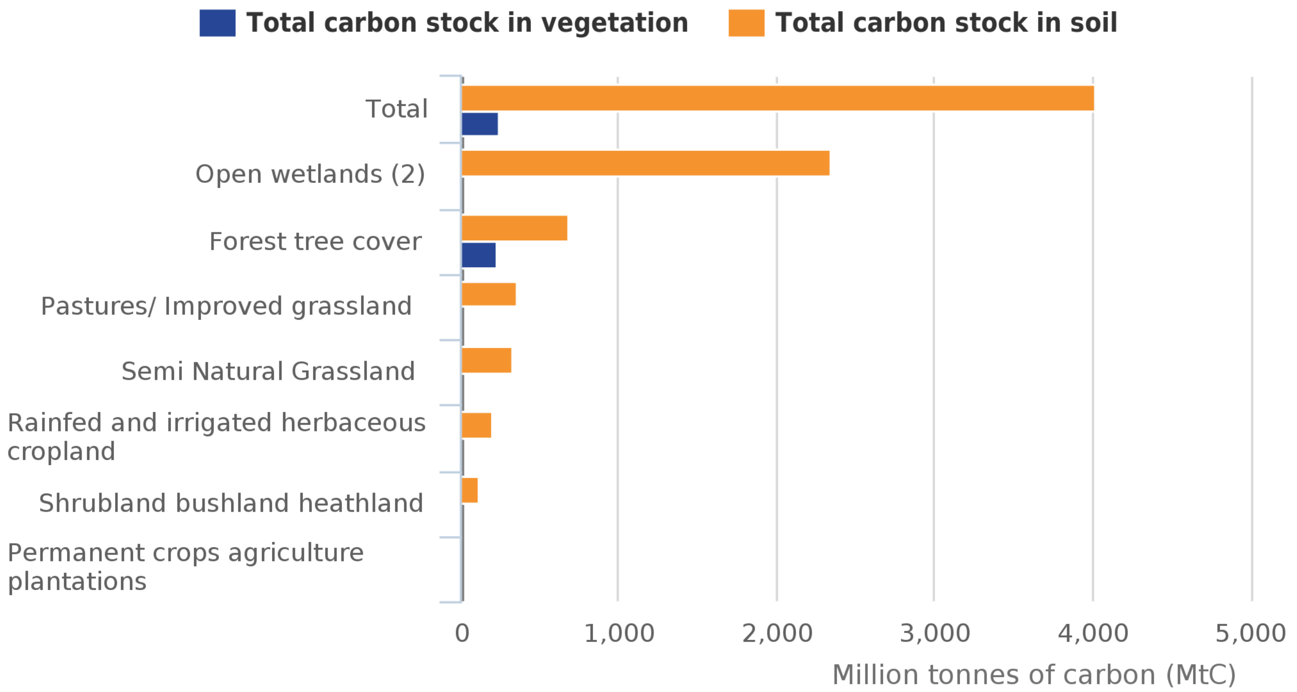
Approximately 4,266 million tonnes of carbon (MtC) was stored within the UK's land-based biocarbon reservoirs3 in 2007. This is an under-estimate since the vegetation carbon data excludes data for the certain wetland habitats, as well as the carbon content of animals living within the ecosystem habitats.

As Figure 18.1 shows, the carbon stored in UK soils is by far the largest component of the biocarbon stock containing approximately 4,019 million tonnes of carbon (MtC) or 94.2% of the total4. The amount of carbon stored in UK terrestrial vegetation was considerably lower containing an estimated stock of 247 MtC, or 5.8% of the total.

The carbon stored in open wetlands (peat soils) makes up the largest portion of soil carbon stocks (57.3 %), followed by improved grassland habitat (9.0%). The volume of carbon stored in the latter is primarily down to the wide extent of this habitat class rather than its capacity to store carbon, that is, carbon density. Soil carbon contained in forest tree cover habitats also makes a significant contribution to total soil carbon stocks (16.7%).

In terms of the carbon stored in UK vegetation, forest tree cover habitats had the largest proportion of total stocks (91.4%). Vegetation carbon in forest tree cover can be further disaggregated into coniferous woodland habitat, and broadleaf, mixed and yew woodland habitat, which contain 48.0% and 43.4% of total stocks respectively.

Figure 18.1: Biocarbon stock estimates: by SEEA-EEA habitat class, 2007 (1)



Source: The Centre for Ecology & Hydrology, Office for National Statistics

Notes:

1. Unless otherwise stated in the reference tables.
2. Excludes vegetation carbon stored in the "Fen, marsh and swamp" habitats classification.

Notes for carbon stock accounts

1. Estimate is partial owing to the exclusion of certain UK habitats, including coastal margins.
2. Total carbon in this case equates to the combined estimated value for soil carbon and vegetation carbon.
3. Total carbon in this case equates to the combined estimated value for soil carbon and vegetation carbon.
4. See: [UN Statistics, The System of National Accounts](#).
5. The oil and gas non-monetary accounts are National Statistics, however the monetary valuations are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.
6. The carbon accounts are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

19. Monetary value of hydropower

Main points

The asset value of hydropower has decreased by 7.5% between 2012 and 2013, from £10.4 billion to £9.7 billion (2013 prices).

Introduction

The following section presents the first monetary estimates of the value of the UK's hydropower industry. It is estimated using the residual method in line with the System of Environmental-Economic Accounting (SEEA).

The value of hydropower is estimated using financial data from companies generating electricity through hydropower1. Company reports available publically provide information on turnover, gross operating surplus, net capital stock and depreciation to create a resource rent for the given year (see initial and partial monetary estimates), for more information on estimating resource rent).

Company reports provided data only for the years 2010 to 2013. Valuations for 2007 to 2009 resource rents were estimated by taking the average unit resource rent (resource rent divided by the gigawatt hours generated in a year) for the available years and multiplying this gigawatt hours (GWh) of electricity produced in the years 2007 to 2009. A 5 year moving average was used to smooth out the difference in resource rents for those years, giving us averaged resource rents for the years 2007 to 2013.

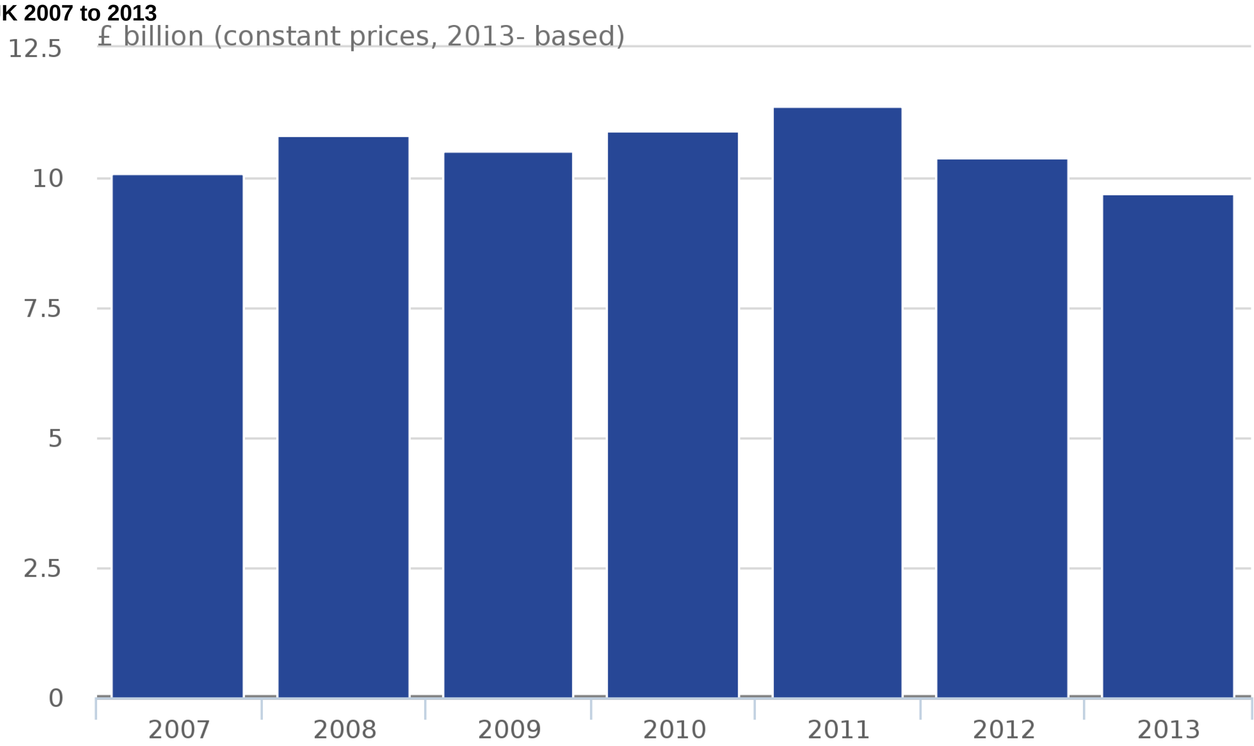
All estimates presented in this section are asset values. The asset values are estimated by projecting the resource rents out over a 50-year life span and, applying the Green Book social discount rate [2]. These estimates, therefore, only give an initial estimate to the monetary value of UK hydropower.

The monetary value of hydropower fell 16% between 2011 and 2013

The experimental monetary value of UK hydropower at 2013 is estimated to be £9.7 billion, down by 7.5% compared with 2012. Figure 19.1 shows the change in value in recent years. The monetary value of UK hydropower increased between 2007 and 2011, from £10.1 billion (2013 prices) in 2007 to £11.4 billion in 2011. However, since 2011, the value has fallen by £1.8 billion, representing a fall of 16%.

Figure 19.1: Monetary value of hydropower (1)

UK 2007 to 2013



Source: Office for National Statistics

Notes:

1. A list of companies generating hydropower is provided by the Department for Energy and Climate Change.

Notes for the monetary value of hydropower

1. The hydropower accounts are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

2. HM Treasury (2003). The Green Book: Appraisal and Evaluation in Central Government

20. Air pollution absorption estimates

Main points

Removing pollution from the atmosphere is one of the important services provided by vegetation.

In 2012, experimental estimates show over 220,000 tonnes of particulate matter 10 (PM10) and 3,000 tonnes of sulphur dioxide (SO2) were absorbed by UK vegetation, the majority by woodland habitats.

In 2012, the annual value of removing PM10 and SO2 in the UK was estimated to be £4.5 billion (current price).

Introduction

The value of the air quality regulation service was estimated in a [pilot ecosystem accounts for selected protected areas in England and Scotland](), commissioned by the Department for Environment, Food and Rural Affairs (Defra) and completed by AECOM. Results suggested air quality regulation is one of the most economically valuable ecosystem services provided by the UK's natural capital.

Estimates were based on the amount of particulate matter 10 (PM10) absorbed by different habitats and Defra air quality damage cost guidance. The Office for National Statistics (ONS) commissioned AECOM to extend this project to value pollution removal at a UK level, including sulphur dioxide (SO2) as an additional pollutant and allow better accounting for the impact of population density on the value of this service.

The method is fully described in the ####Annex to this release. Estimates use Corine Land Cover1 habitat classification data for 2012 and combine with a model for quantifying pollution removal rates set out in Powe and Willis (2004)[1].

The Annex also includes a sensitivity test where results are given using the Land Cover Map (2007) as the primary data source, rather than Corine. The Land Cover Map (LCM) provides a more detailed dataset which is able to include smaller areas of vegetation, such as those in urban areas, however, was last updated in 2007. Results from this show the level of absorption of PM10 and SO2 was around 18% lower in Corine 2006 when compared with LCM 2007 and there were significant differences in the area of different habitat types across the 2 datasets, with Corine 2006 recording around 34% less woodland cover than LCM 2007.

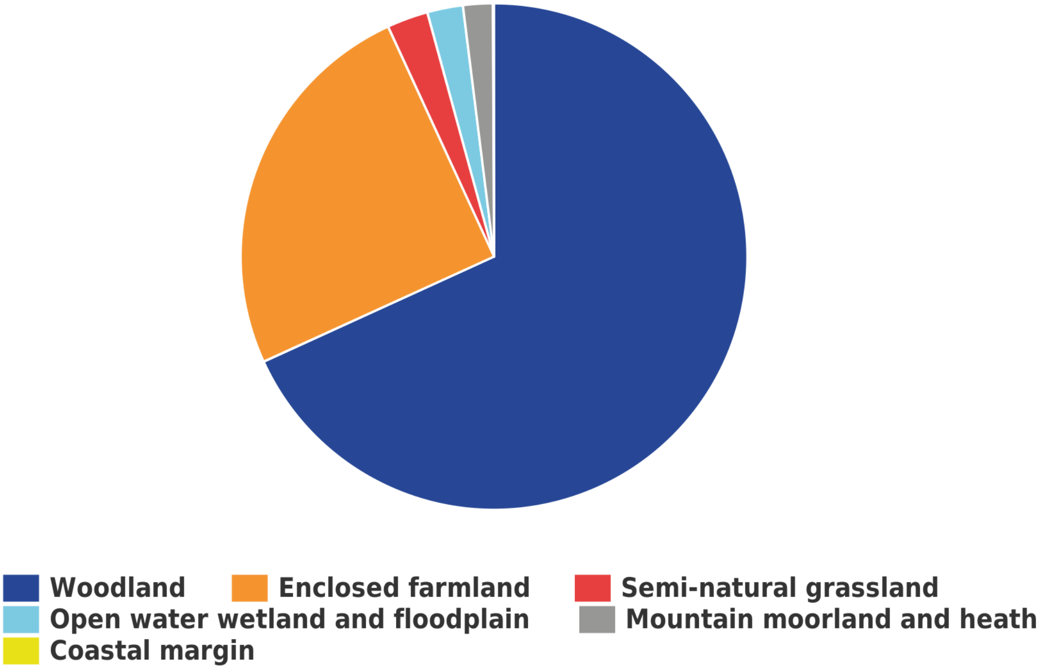
This implies the results presented in this section are significantly under-estimated and more work is required to assess the change over time and the breakdown by habitat.

220,000 tonnes of PM10 and 2,800 tonnes of SO2 was removed by vegetation in 2012

The level of pollutant absorption by the UK's natural capital in 2012 was around 220,000 tonnes of PM10 and 2,800 tonnes of SO2. Most deposition occurred on woodland habitats, as shown in Figure 20.1, both in absolute terms and in terms of the amount per hectare.

Figure 20.1: Quantity of PM10 and SO2 absorbed by natural capital in the UK in 2012 using Corine 2012

UK



Source: AECOM

Notes:

1. Urban and marine habitats are defined in such a way as there is no vegetation. Any large areas of vegetation in urban areas are classified into the habitats given above. See annex 1 attached to this release for more information.

It is important to note that the estimated quantity of PM10 absorbed is higher than the total annual emissions of PM10 presented the emissions section of this release, while that for SO2 is lower. The reason that the estimates of PM10 absorption are higher than the estimated emissions appears to be due to the fact that the emissions statistics do not include natural or secondary sources of PM10. Further discussion is given in the Annex of this release.

The value of removing PM10 was around £4.5 billion in 2012, creating a total asset value of £114 billion

In 2012, the total value of PM10 absorbed was around £4.5 billion, while the value for SO2 was £5.2 million (Table 20.1). The asset value of pollution absorption, estimated in terms of the ability of vegetation to provide air quality regulation services into the future2, was estimated to be around £114.1 billion for PM10 and £134.0 million for SO2.

Rural areas accounted for around 80% of the value of PM10 absorption although the average value of PM10 absorption in a rural grid square (£6,000) was much lower than in an urban (£13,000) or London grid square (£24,000). This is due to higher population densities and therefore higher damage costs in urban areas. For SO2, rural areas accounted for around 92% of the value and the average value in a rural grid square (£8) was higher than in an urban (£7) or London grid square (£3). This is because the damage cost estimates for SO2 have not accounted for population density.

Table 20.1: Change in asset value of PM10 and SO2 pollution absorption between 2006 and 2012, UK

	PM10			SO2		
	2006	2012	Change	2006	2012	Change
Absorption	280,507	221,925	58,582	4,009	2,845	1,164
Total area (km^2)	280,827	280,827	0	280,827	280,827	0
Average background pollution concentration (g /m^3)	11	10	1	11	10	1
No. of on-leaf days	220	222	-2	220	222	-2
Average no. of dry days	217	199	18	217	199	18
Annual Flow (£m)	5,000	4,500	500	7	5	1
Asset Value (£m)	128,800	114,100	14,700	167	134	33

Source: AECOM

Notes for pollution removal accounts

1. Corine Land Cover databases are provided by the European Environment Agency.
2. Asset life is set at 50 years.
3. The pollution removal accounts are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

21. Timber asset account

Main points

In 2015, the total stock of standing timber resource in the UK was estimated at 618.1 million cubic metres overbark.

Between 2014 and 2015, the total stock of standing timber resource increased by 6.9 million cubic metres overbark (1.1%), as natural growth exceeded removals and other losses.

The monetary value of all UK timber resources was estimated to be £7.8 billion in 2015 (2013 prices), an increase of 2.9% compared with 2014.

Introduction

These accounts have been developed in accordance with the System of Environmental Economic Accounting (SEEA) Central Framework, while applying some flexibility in its implementation due to UK-specific context and needs.

The compilation of the non-monetary timber asset account can help to monitor changes in the physical extent of UK timber resources, whilst the monetary timber asset account allows the value of UK timber resources to be estimated.

This valuation is based upon the understanding that in the UK all timber resources can theoretically be regarded as available for wood supply, although in practice harvesting of timber is not expected to reach these levels.

This section presents changes between 2014 and 2015; the datasets in this release contain a longer timeframe.

The volume of timber continued to increase between 2014 and 2015

The total stock of standing timber resource was estimated at 618.1 million cubic metres overbark in 2015. Of the total stock of standing timber resources 314.4 million cubic metres overbark (51.4%) were coniferous timber (also known as softwood) and 296.9 million cubic metres overbark (48.6%) broadleaf timber (or hardwood).

The non-monetary asset account for UK timber resources for 2014 to 2015, which is based on the methodology we published in June 2013, is displayed in Table 21.1.

The volume of timber increased between 2014 and 2015, by 6.9 million cubic metres overbark. The majority of removals (harvesting) were coniferous timber (or softwood). A total of 11.8 million cubic metres overbark of coniferous timber were removed compared with broadleaf (or hardwood) removals of 0.5 million cubic metres overbark. Natural growth is estimated at 20.4 million cubic metres overbark, therefore exceeded the reduction in standing timber resources, which amounted to 12.4 million cubic metres overbark.

Since 2007, the volume of timber has increased by 10% or 57.8 million cubic metres overbark.

Table 21.1: Non-monetary timber asset account (1), 2014 to 2015, UK

Million cubic metres overbark

	Type of timber resources				Total
Species types	Conifers		Broadleaves		
Ownership types	Public	Private	Public	Private	
Opening stock of timber resources as at 1 April 2014	146.1	168.3	25.1	271.8	611.2
Additions to stock					
Natural growth	5.5	9.2	0.3	5.4	20.4
New planting and resstocking reclassification	:	:	:	:	:
Total additions to stock	5.5	9.2	0.3	5.4	20.4
Reductions in stock					
Removals[2]	5.2	6.6	0.1	0.5	12.4
Fellings residues[2]	0.8	0.2	0.0	0.1	1.0
Natural losses	:	:	:	:	0.1
Catastrophic losses[3]	:	:	:	:	:
Reclassifications	:	:	:	:	:
Total reduction in stocks	6.0	6.8	0.1	0.5	13.5
Closing stock of timber resources as at 31 March 2015	145.6	170.7	25.3	276.7	618.1

Source: National Forest Inventory (Forestry Commission, 2011); UK Wood Production and Trade: 2015 provisional figures (Forestry Commission, 2015); 50-year forecast of softwood timber availability (Forestry Commission, 2015); 50-year forecast of hardwood timber availability (Forestry Commission, 2015).

Notes:

1. Timber is defined as stemwood with a minimum top diameter of 7 cm. Therefore new planting and restocking are not captured in this account because the trees are too small to contain timber

2. The data for removals and fellings relate to calendar years. For simplicity, it is assumed that felling activity is similar throughout the year and that the figures for financial years are similar to those for calendar years.

3. No data are currently available on catastrophic losses, although such losses are expected to be very small.

4. Components may not sum to totals due to rounding.

5. : denotes unavailable data

Monetary value of UK timber resources increased from £7.6 billion in 2014 to £7.8 billion in 2015

The value of timber presented here is its value as standing timber before felling, extraction and processing and represents the value accruing from the timber resource itself.

Table 21.2 shows the experimental monetary asset account for UK timber resources for 2014 to 2015, which is based on the methodology we published in June 2013. It relies on the physical asset account outlined above.

This account is currently under development and includes a number of underlying assumptions:

- the stumpage price is the same across all timber resources – a moving 5 year average is used
- the stumpage price is received when the timber is harvested – the harvesting age is 50 years and discounted using HM Treasury (2003) discount rates
- all timber is available for wood supply
- as the timber grows until it is harvested, the expected volume of standing timber for each age class is fixed at harvesting age

Table 21.2 shows the experimental monetary value of UK timber resources at 2015 is estimated to be around £7.8 billion. This is an increase of 2.9% compared with 2014, as the monetary value for natural growth and new planting exceeded the monetary value removals and other losses.

Table 21.2: Timber resources monetary account, 2014 to 2015, UK

	£ million (2013 prices)[3]
Opening balance as at 31 March 2014	7,617
Additions to stock	
Natural growth	297
New planting and restocking (reclassification)	124
Total additions to stock	422
Reductions in stock	
Removals[1]	180
Fellings residues[1]	15
Natural losses	2
Catastrophic losses[2]	
Reclassifications	:
Total reduction in stocks	197
Revaluation	:
Closing balance as at 31 March 2015	7,841

Source: National Forest Inventory (Forestry Commission, 2011); UK Wood Production and Trade: 2015 provisional figures (Forestry Commission, 2015); Woodland Area, Planting & Restocking - 2015 edition (Forestry Commission, 2015); 50-year forecast of softwood timber availability (Forestry Commission, 2015); 50-year forecast of hardwood timber availability (Forestry Commission, 2015); Timber Price Indices: Data to March 2015 (Forestry Commission, 2015;. Office for National Statistics calculations.

Notes:

1. The data for removals and fellings relate to calendar years. For simplicity, it is assumed that felling activity is similar throughout the year and that the figures for financial years are similar to those for calendar years.

2. No data are currently available on catastrophic losses, although such losses are expected to be very small.

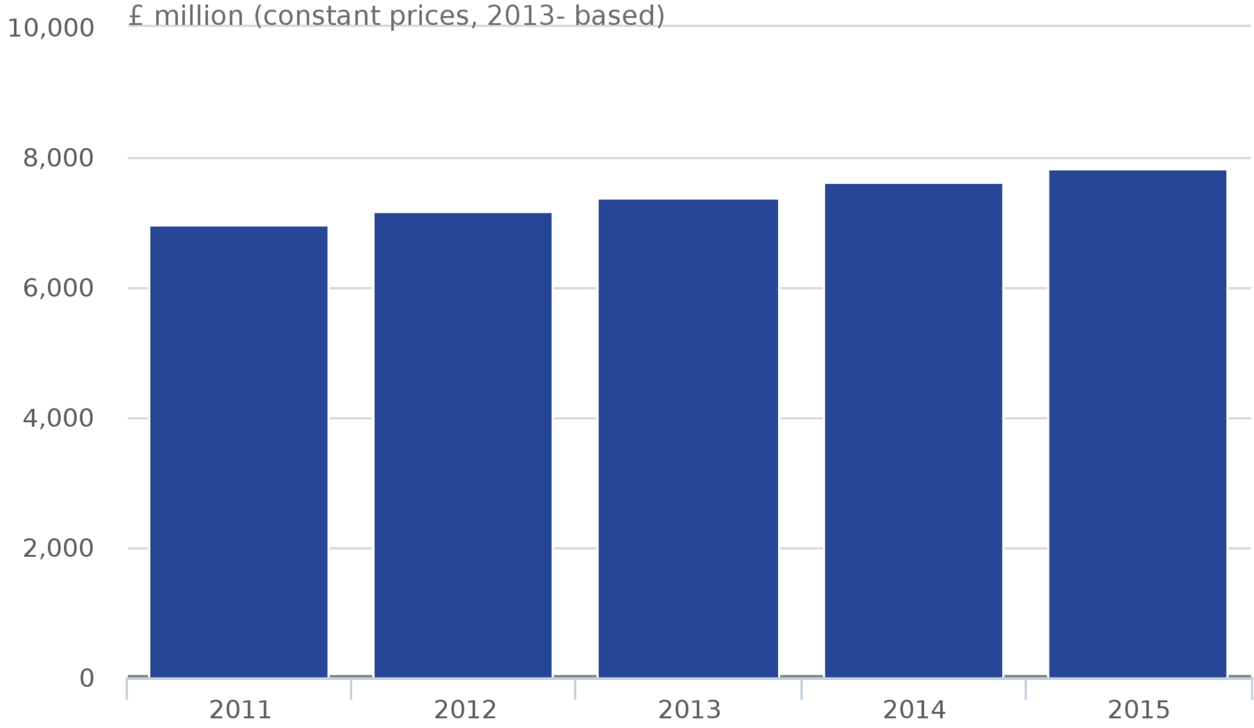
3. Components may not sum to totals due to rounding.

4. : denotes unavailable data

Figure 21.1 shows the monetary value of UK timber resources has been increasing steadily between 2011 and 2015. The value of timber has risen from £7.0 billion (2013 prices) in 2011 to £7.8 billion in 2015, with an annual growth rate of 2.9% between 2014 and 2015.

Figure 21.1: Monetary value of timber resources

UK 2011 to 2015



Source: Forestry Commission, Office for National Statistics

Notes for Timber asset accounts

1. United National (2014): System of Environmental-Economic Accounting 2012 Central Framework.
2. Khan, Greene, Hoo (2013) Monetary valuation of UK timber resources.
3. Khan and Hoo: Measuring UK Woodland Area and Timber Resources.
4. The timber accounts are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

22. Woodland ecosystem asset and services accounts

Main points

Woodland provides many services, including timber, carbon sequestration, pollutant removal and recreation.

Non-monetary estimates indicate 12.4 million cubic metres of timber were removed from UK woodlands in 2014, whilst woodland vegetation also removed 15.6 million tonnes of carbon dioxide equivalent (CO2e) and 141 thousand tonnes of particulate matter (PM10) from the atmosphere in 2014. Additionally, 634 million visits were made to UK woodlands in 2014.

Monetary estimates when added together give an indicative estimate of the value of UK woodland. Based on these 4 services, in 2014, the annual flow value was estimated at £6.4 billion, whilst the overall asset value of UK woodland was £168 billion.

It can be deduced from this that the value of a tree left standing provides up to 30 times more in other services, than it would provide if cut down for timber.

Introduction

Ecosystem services are central to the ecosystem accounting framework since they provide the link between ecosystem assets on the one hand and the benefits received by society on the other. People benefit from both the materials that ecosystems provide (such as the harvesting of timber from woodland) and from the outcomes of natural processes (such as the benefits from clean air that has been filtered by an ecosystem).

Ecosystem services that contribute to human well-being are classified into:

- provisioning services – these are generally the material products that ecosystems provide, for example, food (crops, fish), materials (timber), or water
- regulating services – these are the benefits provided by ecosystems in the regulation of various aspects of the planet, for example, climate regulation (carbon sequestration), noise and air pollution reduction and flood hazard reduction
- cultural services – non-material benefits, for example, through cultural heritage, recreation or aesthetic experience
- supporting services – such as biodiversity, soil function

The results in this section include 4 of the most significant services to woodland areas which can be generated on an annual basis: these are timber production, carbon sequestration, air filtration and recreation.

Timber quantities are estimated through surveys of removals by the forestry industry, and are measured in terms of the felled volume of standing timber, including the bark, in cubic metres.

The timber estimates in the woodland account differ to the approach adopted within the timber asset accounts, whereby the valuation only applies to the timber which is expected to be harvested as a woodland ecosystem service. This is because all the provisioning service of timber competes directly with the regulating and cultural services trees provide when standing. If other ecosystem services are measured, only those trees which are actually used for timber should be included.

Carbon sequestration estimates are generated through modelling for the greenhouse gas emissions inventory, taking account of the type and age profile of the trees in our forests [2]. Air filtration is measured by reference to recent research on the level of particle matter (PM10) absorption per hectare and estimates of the change in the extent of wooded land[3]. These estimates are provisional and should be taken as indicative pending further research. Recreation is measured in terms of the number of visits we make to woodland in the UK [4].

Woodland non-monetary accounts show timber removals have increased in the last few years and levels of pollution removal and carbon sequestration have fallen

Table 22.1 shows the non-monetary services accounts for UK woodland ecosystems for 2009 to 2014 for these four services (recreation only from 2009). Timber removals have increased in the last few years whilst carbon sequestration has fallen over the same period (from 17.8 million tonnes CO2e in 2008 to 15.6 million tonnes CO2e in 2014). The amounts of particulate matter absorbed by woodland are also estimated to have decreased over the period, following reductions in the amounts emitted.

Table 22.1: Woodland non-monetary ecosystem service account, 2007 to 2014, UK

	2007	2008	2009	2010	2011	2012	2013	2014
Total timber removals (million cubic metres overbark standing)	10.4	10.0	9.8	10.0	10.7	11.3	11.9	12.4
Carbon sequestration (million tonnes carbon dioxide equivalent)	18.0	17.8	17.6	17.7	17.6	16.6	16.9	15.6
Air filtration (thousand tonnes of particles removed)	167.2	161.9	156.2	150.8	157.0	151.8	146.7	141.4
Recreation (million visits to woodland)	:	:	482.0	495.0	545.0	542.0	575.0	634.0

Source: Defra, Office for National Statistics

Notes:

1. : denotes unavailable data

The value of tree left standing provides around 30 times more in other services, than it would provide if cut down for timber

These four services provided by woodland ecosystems in the UK can be valued in a variety of ways [5]. For timber, the value can be approximated by the stumpage price for coniferous wood, which is assumed to apply to all the timber that is harvested[6]. For carbon sequestration, the value of carbon removed can be based upon the non-traded carbon price estimated by the Department of Energy and Climate Change (DECC) [7]. For air filtration, values are based on the damage costs estimated by the Department for Environment, Food and Rural Affairs (Defra)[8]. These estimates are provisional and should be taken as indicative pending further research. For recreation, the average value of each visit can be taken from a meta-analysis carried out by Sen et al. (2014) [9].

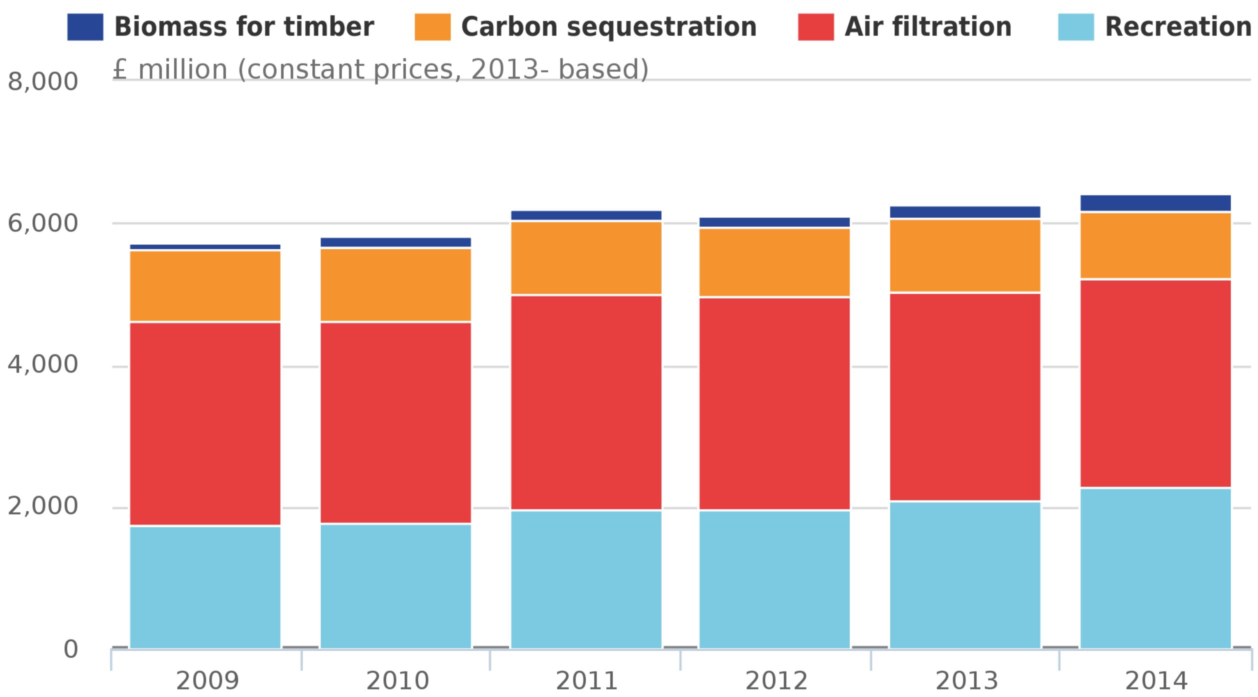
The monetary services account (Figure 22.1) shows that the value of the timber removed from UK woodland is only a small part of the total value of these 4 ecosystem services provided by UK woodland. The total value of all 4 services in 2014 was £6.4 billion, up from £5.7 billion in 2009 (in 2013 prices).

Absorption of PM10 and recreational services were valued at the largest component of the total woodland value. Particle matter absorption was valued at £2.9 billion in 2014, whereas, recreation services were valued at £2.3 billion. The value of recreation in UK woodland increased by over £200 million on the year and £500 million since 2009, the largest increase of any other service. This increase is entirely due to the change in the number of visits made, as the value of each visit has been assumed to be constant over the period.

Carbon removals were valued at £954 million and timber removals were valued at £228 million in 2014. Timber provision is up from £102 million in 2009. This increase is due mainly to an increase in the stumpage price over the period.

Figure 22.1: Annual Value of 4 woodland ecosystem services (1)

UK 2009 to 2015



Source: Department for the Environment, Food and Rural Affairs, Office for National Statistics

Notes:

1. Prices are in 2014 constant prices.

The total asset value of woodland ecosystems in the UK can be estimated by calculating the net present value of each of the service flows over a prescribed period (in this case 50 years).

A partial and experimental estimate of the total value of woodland ecosystems in the UK is £168 billion in 2014, based on the net present value of the expected future flows of the 4 main services (timber, carbon sequestration, air filtration and recreation) over a 50 year period, using the social discount rate [10].

Table 22.2 provides estimates of the asset value of UK woodland ecosystem services for 2009 to 2014.

Table 22.2: Annual value of 4 woodland ecosystem services (1), UK, 2009 to 2014 (constant prices, 2013-based)

£ billion

	2009	2010	2011	2012	2013	2014
Biomass for timber	2.8	3.3	3.8	4.1	4.7	5.2
Carbon sequestration	34.4	35.1	35.9	36.6	37.4	38.3
Air filtration	71.8	71.8	71.9	71.8	71.7	69.3
Recreation	44.7	46.4	48.1	49.9	52.3	54.9
Total for woodland	153.7	156.6	159.6	162.4	166.1	167.7

Source: Department for the Environment, Food and Rural Affairs, Office for National Statistics

Notes:

1. Prices are in 2013 constant prices.

For timber, the average level of harvesting and average stumpage price in recent years have been assumed to be constant into the future in order to smooth out year-on-year fluctuations. For carbon sequestration, the estimates of future flows of services are based on projections for the National Atmospheric Emissions Inventory [2], whilst projected prices are taken from the DECC carbon price estimates [7]. For air filtration, the latest year and the associated monetary value have been assumed to remain constant into the future. Finally, for recreation the average number of visits over recent years has been upgraded by projected increases in population [11].

Notes for woodland ecosystem asset and services accounts

1. Khan and Hoo (2013): Measuring UK Woodland Area and Timber Resources (197.6 Kb Pdf).

2. National Atmospheric Emissions Inventory (2014): Projections of emissions and removals from Forest Land. These estimates are no longer available on the NAEI website and should be used with caution until the revised estimates have been published.

3. Research commissioned by ONS has estimated the amounts of PM10 absorbed by woodland in the UK, based on the CORINE Land Cover inventory for 2012. These estimates have been used to generate estimates of the amounts absorbed for the years 2004 to 2014, based on the changes in woodland reported by the Forestry Commission and the change in absorption levels per hectare of woodland between 2006 and 2012 as estimated by the ONS study.

4. Natural England (2015), Monitor of Engagement with the Natural Environment. Estimates of the number of visits to woodland in England have been scaled up to the UK level on the basis of mid-year population estimates.

5. The 4 services of woodland ecosystems covered in the accounts (timber production, carbon sequestration, air filtration and recreation) do not include the value of the services to the wood products or tourism and other sectors further down the economic production chain.

6. Forestry Commission (2015). Timber Price Indices.

7. Department of Energy and Climate Change (2015). Carbon data tables 1 to 20: supporting the toolkit and guidance.

8. Defra (2015) "Damage costs by location and source". These values have been used in a study commissioned by ONS to estimate the value of pollutant absorption by the natural environment in the UK. The average value per hectare of woodland in 2006 and 2012 derived from the study has been used to estimate values for the whole period 2004 to 2014.

9. The methodology for the valuation of recreation services is currently under review. For this account, the values from Sen et al (2014) (Sen, A., Harwood, A. R., Bateman, I. J., Munday, P., Crowe, A., Brander, L., Raychaudhuri, J., Lovett, A.A. Foden J. and Provins, A. (2014). Economic assessment of the recreational value of ecosystems: Methodological development and national and local application. Environmental and Resource Economics, 57(2), 233-249) have been used. It is unlikely that this approach will be used in the accounts in future once the review has been completed.

10. HM Treasury (2003). The Green Book: Appraisal and Evaluation in Central Government.

11. Office for National Statistics (2013). National Population Projections (no change variant).

12. The woodland accounts are experimental and continuously under development and therefore should be interpreted in this way. We welcome comments on all aspects of the methodology used and feedback for further improvement and refinement.

23. Revisions

Since the publication of UK Environmental Accounts 2015, there have been revisions and updates to some of the accounts. These are largely due to revisions in data sources and improvements to methodology.

Atmospheric emissions and energy consumption

Revisions to atmospheric emissions and energy data are primarily due to:

- revisions to the core energy statistics presented in the Digest of UK Energy Statistics (DUKES)
- revisions to the inventory methodologies and emission factors based on new evidence
- revisions to other datasets or to the additional details used to generate the detailed industry splits from the core UK inventory categories (for example, sharing road transport among the industry sectors)
- the adoption of methodologies to reflect inclusion of newly compiled sources

Updates, particularly those involving revised methodologies, may affect the whole time series, so estimates of emissions for a given year may differ from estimates of emissions for the same year reported previously.

Table 23.1 shows the differences in air emissions and energy consumption estimates published in UK Environmental Accounts, 2015 and 2016.

Table 23.1: Air emissions and energy consumption estimates published in UK Environmental Accounts, 2015 and 2016

Measure	1990	1995	2000	2005	2010	2013
Greenhouse gas emissions[1] 2015	841,966	799,824	777,951	774,946	687,085	643,087
Acid rain precursor emissions[2] 2015	6,874	5,101	3,543	3,176	2,149	1,889
Energy consumption[3] 2015	222	228	242	248	227	213
Greenhouse gas emissions[1] 2016	834,902	793,591	772,833	771,341	684,279	641,631
Acid rain precursor emissions[2] 2016	6,893	5,135	3,579	3,208	2,162	1,894
Energy consumption[3] 2016	222	228	242	249	227	214
Greenhouse gas emissions percentage change	-0.8	-0.8	-0.7	-0.5	-0.4	-0.2
Acid rain precursor emissions percentage change	0.3	0.7	1.0	1.0	0.6	0.3
Energy consumption percentage change	0.0	-0.1	0.1	0.2	0.3	0.5

Source: Ricardo Energy and Environment, Office for National Statistics

Notes:

1. Thousand tonnes of carbon dioxide equivalent (CO2e).

2. Thousand tonnes of sulphur dioxide equivalent(SO2e), excluding natural world.

3. Million tonnes of oil equivalent (Mtoe).

Greenhouse gas emissions have been revised down. The change to nitrous oxide (N2O) emissions is due to reductions in the estimates of emissions from non-fuel fertilisers within the agriculture sector.

Total acid raid precursor emissions have been revised up. This is mainly due to revisions to nitrogen oxide (NOX), for which emissions have been revised because of the inclusion of Intergovernmental Panel on Climate Change (IPCC) and European Monitoring and Evaluation Programme, European Environment Agency (EMEP /EEA) guidebook on emissions factors from small-scale combustion replacing some existing factors, which were identified as having high uncertainty, particularly those for solid and liquid fuel combustion.

Energy consumption figures have mostly been revised up, and have remained fairly constant over time. This is due to a number of factors; the most prominent of which is due to a significant increase in estimates of domestic wood combustion, which has a major impact on emissions of some pollutants in the consumer expenditure sector.

Material flows

An Improvements to UK Environmental Accounts paper, published in May 2014, details the revisions that have been applied to the material flow account. In summary, changes have been made to data sources and methodology to bring the account in line with European regulation requirements.

Table 23.2 shows the differences between estimates published in UK Environmental Accounts, 2015 and 2016.

Table 23.2: Material flow estimates published in UK Environmental Accounts, 2015 and 2016

Million metric tonnes

Measure	2000	2005	2010	2013
Domestic extraction 2015	724	629	496	449
Imports 2015	210	279	264	294
Exports 2015	194	177	166	154
Direct Material Input (DMI) 2015	934	908	760	742
Domestic Material Consumption (DMC) 2015	740	731	594	588
Domestic extraction 2016	718	622	475	419
Imports 2016	210	279	264	302
Exports 2016	194	177	166	154
Direct Material Input (DMI) 2016	928	902	739	721
Domestic Material Consumption (DMC) 2016	739	733	577	570
Domestic extraction % change	-0.8	-1.0	-4.2	-6.6
Imports % change	0.0	0.0	0.0	3.0
Exports % change	0.0	0.0	0.0	0.0
Direct Material Input (DMI) % change	-0.6	-0.7	-2.8	-2.8
Domestic Material Consumption (DMC) % change	-0.1	0.2	-2.8	-3.1

Source: Office for National Statistics

Between 2000 and 2013, domestic extraction figures decreased by an average of 2.9% each year. This was largely due to decreases in biomass totals, which fell by an average of 10.2% each year. As a result of the decreases to domestic extraction, the Direct material input (DMI) and Domestic material consumption (DMC) indicators also decreased by an average of 1.7% and 1.3%, respectively, each year.

An improved method was used to calculate DMC in 2016, based on a method adopted by Eurostat. This only had a small impact on the figures when compared with those published in 2015.

Environmental taxes

An Improvements to UK Environmental Accounts paper, published in May 2014, details the revisions that have been applied to the environmental taxes account. In summary, changes have been made to the list of taxes included to bring the account in line with European regulation requirements.

Table 23.3 shows the differences between estimates published in UK Environmental Accounts, 2015 and 2016.

Table 23.3: Environmental taxes published in UK Environmental Accounts, 2015 and 2016

£ million

Environmental taxes	1997	2000	2005	2010	2014
Total 2015	24,151	29,204	31,502	39,235	44,585
Total 2016	24,151	29,204	31,502	39,196	44,756
% change	0.0	0.0	0.0	-0.1	0.4

Source: Office for National Statistics, HM Treasury

24. Feedback

If you have any comments or suggestions, we'd like to hear them. Please email us at Environment.Accounts@ons.gsi.gov.uk.

25. Background notes

1. Figures in the text may not sum due to rounding.

2. Details of the policy governing the release of new data are available from the UK Statistics Authority website.