Department for
Business, Energy
& Industrial Strategy

ENERGY CONSUMPTION IN THE UK

July 2017

Energy Consumption in the UK
July 2017

Overall energy consumption in the UK since 1970

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Contents

Introduction

Background

This report provides an overview of the trends and some key drivers that have influenced energy consumption in the UK since 1970. Analysis is based on the data presented as part of this publication. Its aim is to complement consumption data in The Digest of UK Energy Statistics (DUKES). It uses consumption by fuel and high level consumer group from the energy balances tables (tables 1.1 to 1.3), and combines other data sources and modelling techniques to provide additional insights into consumption trends. DUKES 2017 can be found via the following link;

https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2017-main-report

There are five sections in this report which focus on the following key sectors; Overall Energy, Transport, Domestic, Industry, and Services. There is also a set of tables providing the data on which the report is based.

There is also a separate user guide which includes an overview of the content of each sector and an explanation of technical concepts, and vocabulary. This can be found via the following link;

https://www.gov.uk/government/statistics/energy-consumption-in-the-uk

Revisions

As ECUK is dependent on consumption outputs from DUKES, revisions to DUKES in turn flow through into ECUK. Details on revisions to DUKES can be found in paragraph 1.64 (or section IX) on page 28 of the 2017 Digest. This includes a table indicating the period which has been subject to revision (for 2017, 2008 to 2015 were revised) and the actual key revisions by sector. More detailed descriptions are then referenced in the relevant chapter. In the tables accompanying this publication, data which are sourced from DUKES have been marked with an “r” to indicate those values which have been revised.

Other series incorporating external data sources, such as ONS Gross Value Added (GVA), used to calculate energy intensity in the services sector, are also subject to revision or changes, such as updating the base year. For example, for ECUK 2016, the base year for Gross Domestic Product (GDP) was 2012 whereas for this current publication, the base year has been updated to 2013. As GDP is used as a denominator to calculate energy intensity, shifts in the base year have only a very minor impact on the intensity calculation.

Energy intensity in the industry sector is similarly subject to revisions in line with the ONS series Index of Production. As with the services sector, any revisions to this series have a minor effect on the intensity calculation.

Values which have changed due to an updated index year, or are based on calculations using (for example) ONS data series, they have not been marked with an "r".

Generally as new evidence or research is undertaken, the new modelling will apply from the current year, unless evidence suggests that this applies to the historical series. However, occasionally new sources of data can indicate modelling for previous years could be improved.

Key terms

- **Final energy consumption (end use)** – this refers to energy consumed by final end users after transformation, as opposed to primary energy consumption which is energy in its original state
- **Primary energy equivalents** – is the amount of final energy consumed plus energy in the transformation sector and losses incurred during conversion and transformation. Therefore, primary energy is larger than final energy consumption estimates.
- **Non-energy use** – this category includes the consumption of petroleum, natural gas and manufactured fuels which have not been used directly to provide energy and are therefore excluded from this analysis. This category includes use for chemical feedstock, solvents, lubricants and road making material.
- **Tonne of oil equivalent (toe)** – this is a common unit of energy measurement which enables different fuels to be directly compared and aggregated. One tonne of oil equivalent is set equal to 41.868 Giga Joules (GJ) or 11,630 kilo Watt hours (kWh). Quantities in this report are generally quoted in thousand tonnes of oil equivalent (ktoe).
- **Temperature corrected consumption** – this measures energy consumption adjusted to remove the impact of temperature variations year on year to identify underlying trends. Details of the methodology used to calculate this can be found in the June 2011 and September 2011 editions of Energy Trends; http://webarchive.nationalarchives.gov.uk/20130109092117/http:/www.decc.gov.uk/en/content/cms/statistics/publications/trends/trends.aspx
- **Energy intensity** – the amount of energy required to produce one unit of output. A reduction in intensity could imply an improvement in energy efficiency.

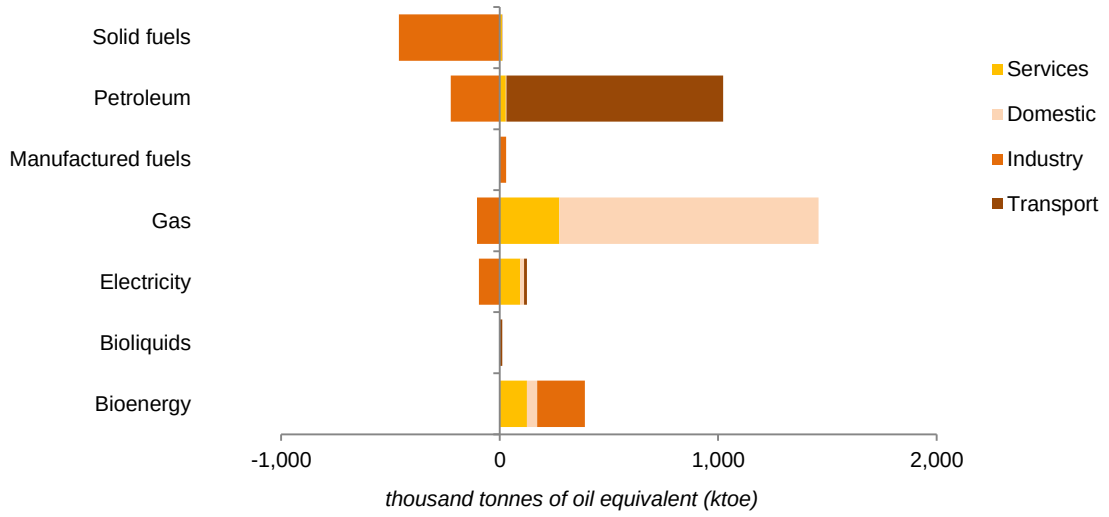
Overall Energy

Overall Final Energy Consumption

- Final energy consumption increased by 2,167 ktoe (1.6 per cent) in 2016 to 140,668 ktoe
- The majority of the increase was due to gas which increased by 1,356 ktoe (3.2 per cent)
- The domestic sector saw the biggest increase in both absolute and percentage terms; by 1,249 ktoe (3.1 per cent)
- On a temperature corrected basis (see key terms), consumption increased by 1,330 ktoe (0.9 per cent) with transport being the primary driver of this increase
- The transport sector accounted for the largest share of final consumption at 40 per cent in 2016, the same share as in 2015, with the domestic sector accounting for 29 per cent, industry 17 per cent, and the services sector 14 per cent

Chart 1.01 shows the change in energy consumption from 2015 to 2016 split by fuel and sector;

Chart 1.01

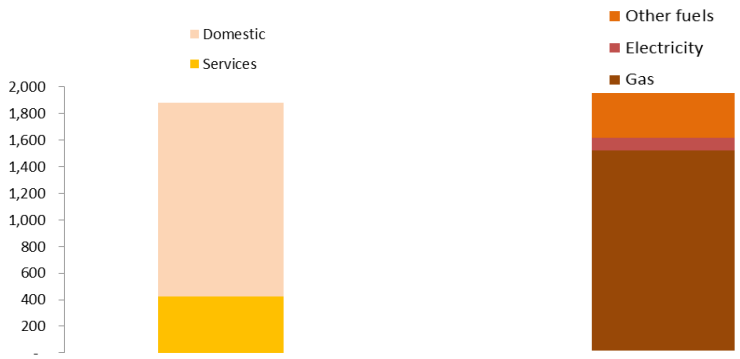


Where consumption increased between the two years, gas use in the domestic sector accounted for 42 per cent of the change and petroleum in the transport sector accounted for 35 per cent. Apart from a marginal decrease in solid fuel use in the domestic sector (3 ktoe, or 0.5 per cent), solid fuel and petroleum consumption in the industry sector accounted for those which decreased.

Some of the additional consumption of gas in the domestic sector can be explained by additional heating demand. Although average temperatures in 2016 were broadly similar to 2015, heating degree days increased from 5.3 to 5.5 in 2016; summer 2016 was warmer whilst November and December were colder than in 2015.

The difference between temperature corrected consumption and actual consumption was 1,878 ktoe. This represents the additional energy consumed due to weather factors. Chart 1.02 below shows how the additional consumption was made up for 2016;

Chart 1.02

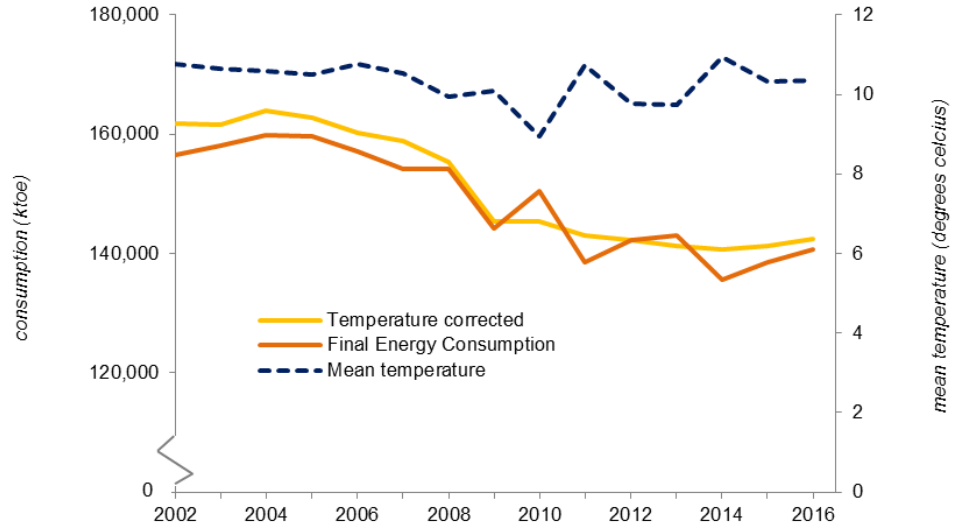


The majority of the additional consumption was in the domestic and service sectors as these sectors consume proportionally more energy for space and water heating, particularly the domestic sector. On a fuel basis, gas represents the largest proportion of the difference; gas is more commonly used for space and water heating, particularly for residential consumers.

The domestic sector showed the biggest increase in both absolute and percentage terms; this sector is the most responsive to fluctuations in temperatures as a bigger proportion of household consumption is for space and water heating.

Chart 1.03 below shows the trend in final consumption both on a temperature corrected basis and actual consumption from 2002.

Chart 1.03: Final energy consumption, actual and temperature corrected



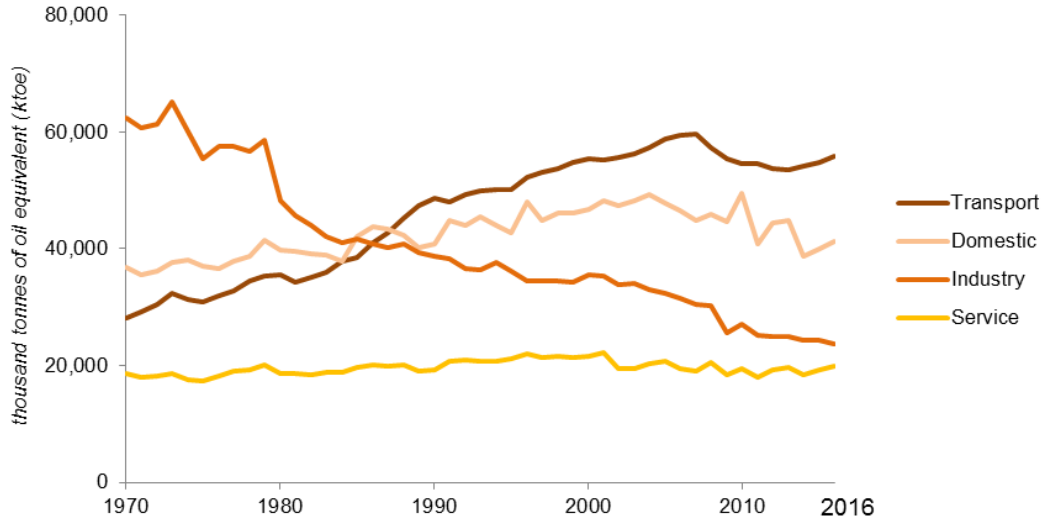
Source; BEIS ECUK Table 1.01

Since 2002, actual consumption has fallen by 10 per cent and 12 per cent on a temperature corrected basis. During this period, actual consumption has increased or decreased year on year depending on average temperature changes. However, the last two years are the first to have increases since 2004 (on a temperature corrected basis) due to increased demand for travel.

Consumption by sector

Chart 1.04 below shows how each sector's share of final consumption has changed since 1970.

Chart 1.04: Final Energy Consumption by Sector



Source; BEIS ECUK Table 1.01

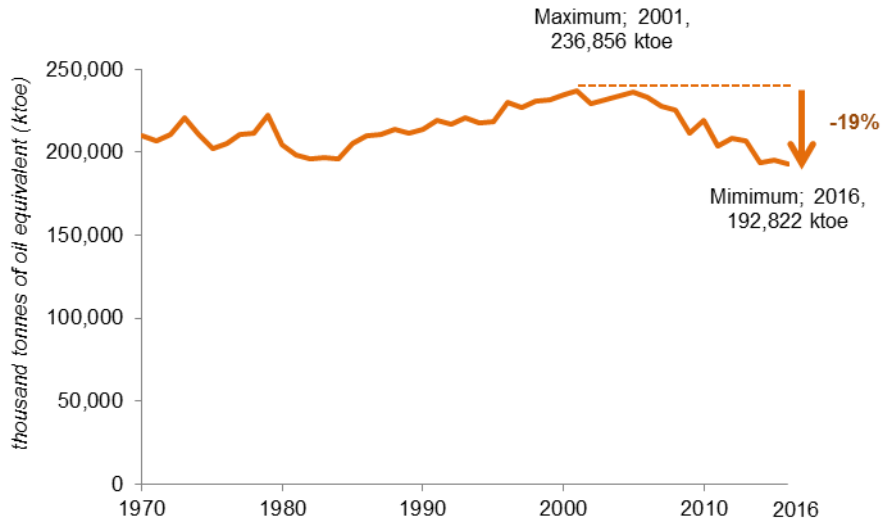
Transportation accounted for the largest proportion of final consumption in 2016 at 40 per cent, followed by the domestic sector (29 per cent), industry (17 per cent) and the service sector (14 per cent). Between 1970 and 1984, the industrial sector accounted for the largest share of consumption and in 1985, the domestic sector surpassed industry. Transportation then became the largest consumer in 1988 and has maintained its dominant share since. A shift in economic activity away from heavy, energy intensive industries accounts for the decrease in the industry sector's share, whilst increasing mobility and rates of car ownership account for a large proportion of the increase in transportation. These effects are discussed in further detail within the sections for each sector.

Fuel mix (in primary energy equivalents)

Primary energy equivalent is the energy value of the source fuel rather than final consumption. For example, electricity generated by a gas fired power station will include the energy value of the input gas rather than the electricity output. Electricity includes only primary generation from nuclear power plants and renewable technologies such as wind and solar.

Chart 1.05 below shows the long term trend for consumption in primary energy equivalents.

Chart 1.05: Total consumption in primary energy equivalents

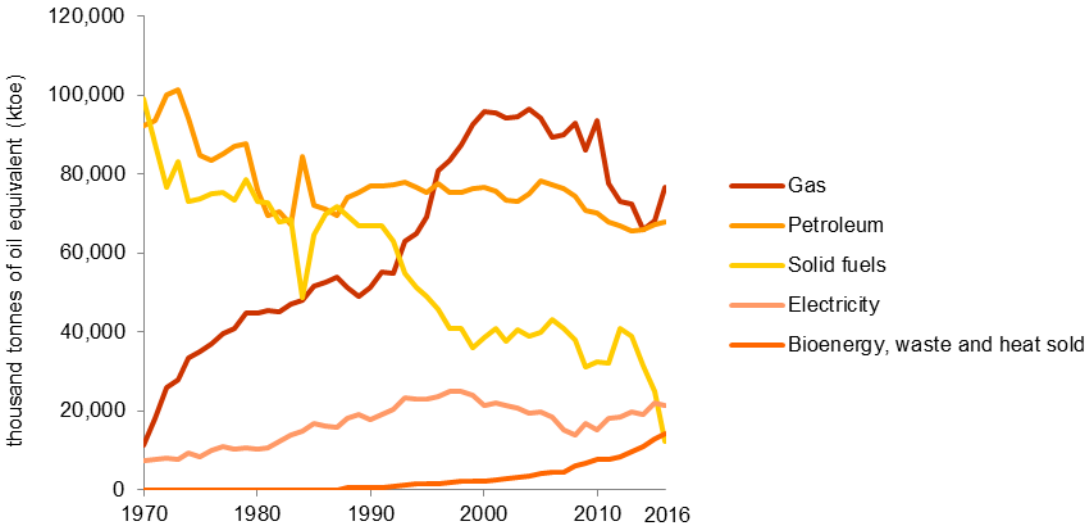


Source; BEIS ECUK Table 1.09

Consumption increased from 1970, peaking in 2001 at 236,856 ktoe. Since then, primary energy consumption has fallen by 19 per cent to 192,822 ktoe.

Chart 1.06 below shows the changing mix of fuel sources on a primary energy basis (i.e. taking into account the fuel input prior to any transformation process) and total consumption in ktoe.

Chart 1.06: Final energy consumption in primary energy equivalents by fuel type



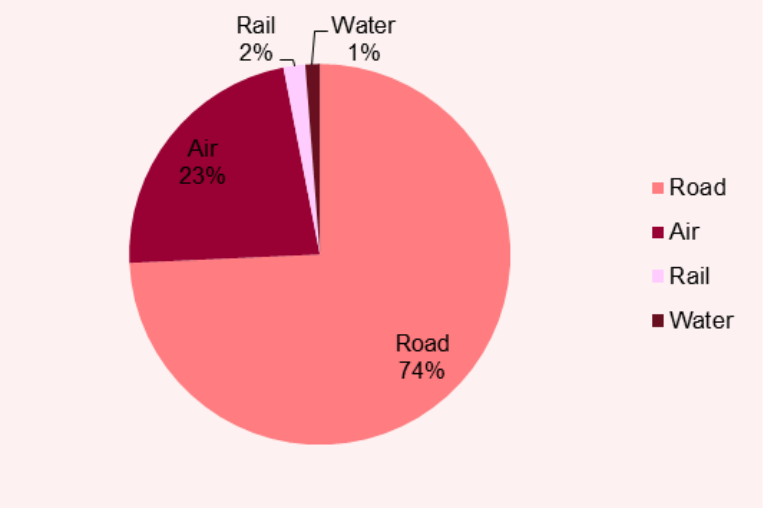
Source; BEIS ECUK Table 1.10

In 1970, solid fuels[1] and petroleum dominated the fuel mix accounting for 47 per cent and 44 per cent respectively. As solid fuel's share decreased sharply in 1984 during the miners' strike, use of petroleum spiked due to substitution for low coal production. Solid fuels' share recovered to 1987 before steadily declining to a 16 per cent share in 1999. During this period, North Sea Gas increased its share from just 5 per cent in 1970 to a maximum of 43 per cent in 2010. Electricity's share also increased during this period, and more recently, renewables share has increased from 1 per cent in 1999 to 7.4 per cent in 2016, the result of various drives to reduce reliance on fossil fuels and production of greenhouse gasses[2].

[1] Solid fuels include coal, manufactured solid fuels, benzole, tars, coke, oven gas and blast furnace gas. Wood and wood waste is included in renewable fuels and waste.
[2] For more information on renewable energy, BEIS' renewable statistics home page; https://www.gov.uk/government/collections/renewables-statistics

Transport

Final Energy Consumption in transport

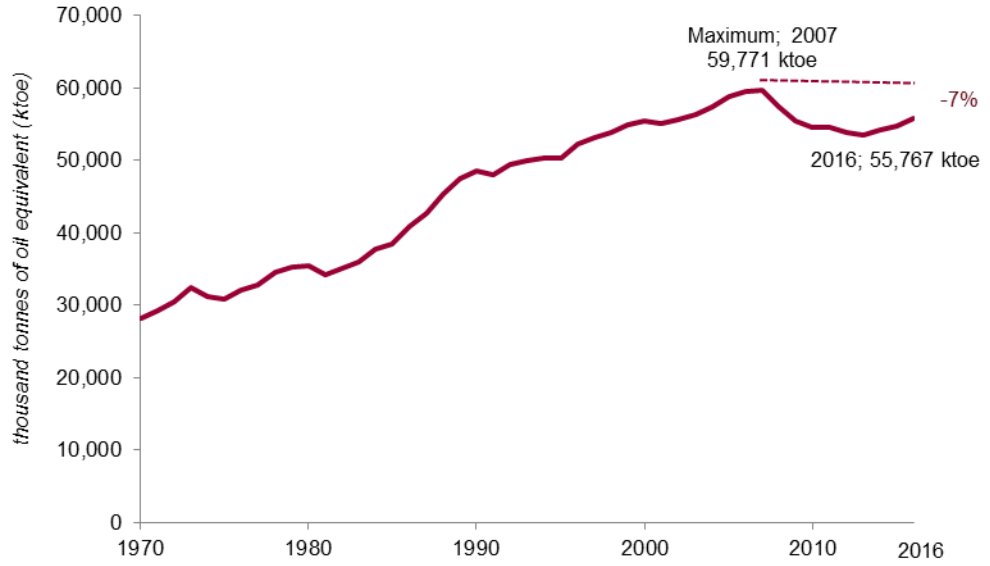


- Transport is the largest consuming sector representing 40 per cent of total energy consumption in 2016, an equivalent share to 2015
- Final energy consumption in the transport sector increased by 1,018 ktoe (1.9 per cent) between 2015 and 2016 to 55,767 ktoe; the third year of positive growth following the economic slowdown
- The majority of the increase was due to road transport which increased by 934 ktoe (2.3 per cent) to 41,450 ktoe in 2016
- Air transport and rail transport increased by 106 ktoe (0.8 per cent) and 6 ktoe (0.6 per cent) respectively, whilst water transport fell by 4.1 per cent
- Energy intensity[3] fell by 1 million tonnes of oil equivalent from 2014 to 2015 (the latest year for which data are available)
- The domestic sector accounted for 65 per cent of transport consumption in 2015 (the latest year for which data are available) whilst the industrial sector accounted for 21 per cent and services, 14 per cent[4], all equivalent shares to 2014.

[3] Energy intensity is defined as energy consumption per unit output.
[4] Source; table 2.03

Chart 2.01 below shows the long term trends; negative growth in the transport sector tends to coincide with recessions such as during the mid1970s, 1980, 1991, and 2008 to 2009.

Chart 2.01: Total consumption in the transport sector



Source; BEIS ECUK Table 2.01

Following previous recessions, transport consumption generally recovered in the year following the recession. However, following the 2008 to 2009 recession growth didn't turn positive again until 2014, and transport consumption is still 6.7 per cent below its 2007 peak.

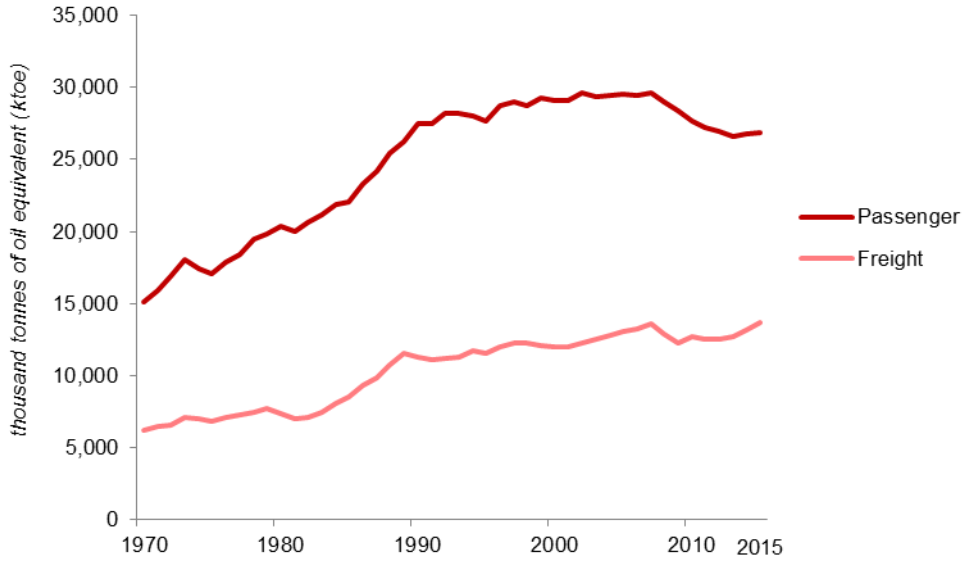
Road transport

- Road transport consumption increased by 2.3 per cent from 2015 to 41,450 ktoe in 2016
- Road transport accounted for the largest share of transport consumption representing 74 per cent of transport consumption in 2016, equivalent to its 2015 share

Chart 2.02 below shows road transport consumption[5] from 1970 to 2015[6] split by passenger transport and freight;

[5] Excluding electricity which represented just 0.01 per cent of consumption in transport for 2015
[6] 2015 is the latest year for which data are available.

Chart 2.02: Road transport consumption split by passenger and freight



Source; BEIS ECUK Table 2.01

Consumption in **passenger transport** showed steady growth between 1970 and 1990, increasing by an average of 2.8 per cent per annum. Although the proportion of households with one car or van remained stable during this period (44 per cent in 1971 compared with 45 per cent in 1989-1991[7]), the proportion with access to two cars or vans increased from 8 per cent in 1981 to 22 per cent in 1989-1991. Growth then remained fairly stable until it peaked at 29,622 ktoe in 2007, the year prior to the recession. Growth in consumption turned positive again in 2014, and continued to increase in 2015[6].

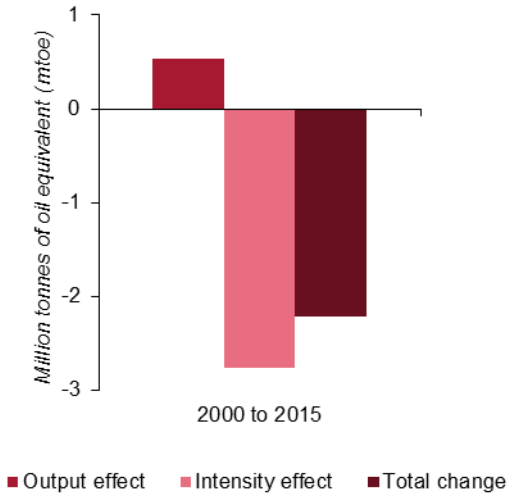
Drivers of energy consumption in passenger road transport can be split into two key factors;

- Output – a measure of demand in passenger kilometres (see key terms on page 17), and
- Intensity – a measure of energy consumed per passenger kilometre which can vary with structural changes and vehicle efficiency

Chart 2.03 below shows how these factors have affected road transport consumption between 2000 and 2015.

[7] Source Department for Transport National Travel Survey vehicles table NTS0205; https://www.gov.uk/government/collections/national-travel-survey-statistics

Chart 2.03: Output and intensity factors affecting passenger road transport



Source; BEIS ECUK Table 2.04

Between 2000 and 2015, the effect on consumption due to a modest increase in demand (from 694 billion passenger kilometres in 2000 to 707 billion passenger kilometres in 2015[8] [9]) was more than offset by a reduction in energy intensity, i.e. increasing efficiencies and positive structural changes.

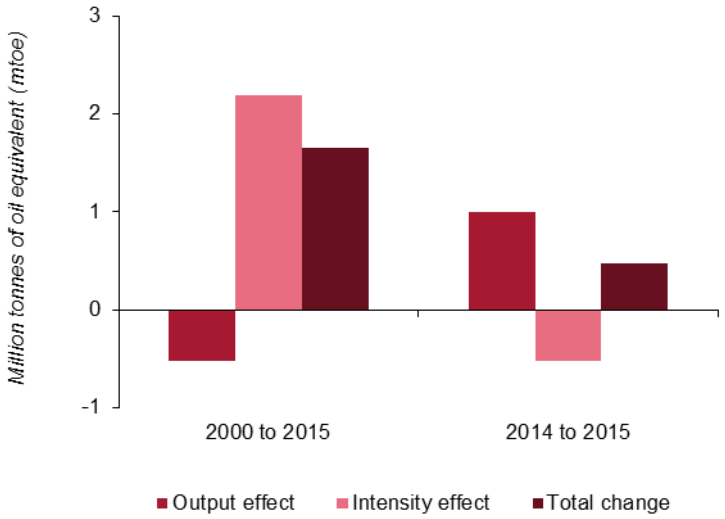
From 2014 to 2015, a bigger proportion of the total change in consumption was due to an increase in demand (from 704 billion passenger kilometres in 2014 compared to 707 in 2015) with the intensity effect being more muted.

Growth in **freight transport** consumption was modest from 1970 to 1981 averaging just 1.1 per cent per annum. Growth then increased from 1982 to 1989 averaging 6.4 per cent per annum. This was the result of increasing volumes of freight being transported by road; in 1981, 94 billion tonne kilometres were moved[10] compared to 138 billion tonne kilometres in 1989. Consumption for freight transport peaked in 2007, the same year as passenger transport. However, unlike passenger transport which saw 6 years of negative growth following the recession, freight transport turned positive after just two years (although 2011 saw negative growth of 2.1 per cent). Freight transport continued to rise in 2015, up 3.5 per cent (478 ktoe) from 2014.

[8] Transport Statistics GB table TSGB0101. Source Department for Transport statistics; https://www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons
[9] Note these statistics are for Great Britain only
[10] Sourced from table TSGB0401; https://www.gov.uk/government/statistical-data-sets/tsgb04-freight

Chart 2.04 below shows the impact of output factors (billion tonne kilometres moved) compared with intensity effects for 2014 to 2015 and over the longer term 2000 to 2015. Between 2000 and 2015 demand decreased from 159 billon tonne kilometres in 2000 to 152 in 2015. However, between 2014 and 2015 demand increased by 12 per cent from 136 to 152.

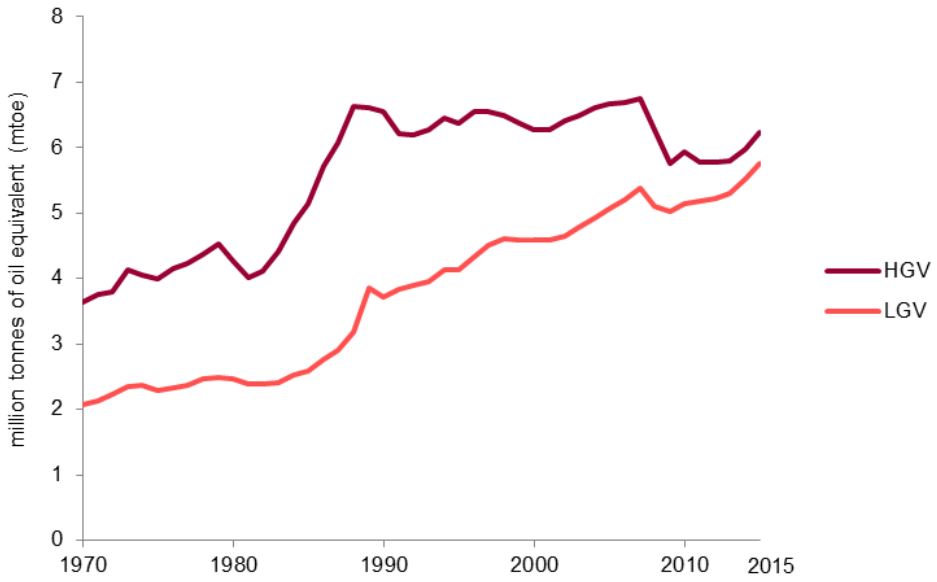
Chart 2.04: Output and intensity factors affecting freight road transport



Source; BEIS ECUK Table 2.04

Chart 2.05 below shows freight transport consumption (in million tonnes of fuel) split by Heavy and Light Goods Vehicles (HGV and LGV respectively).

Chart 2.05: Fuel consumption by HGVs and LGVs in million tonnes



Source; BEIS ECUK Table 2.04

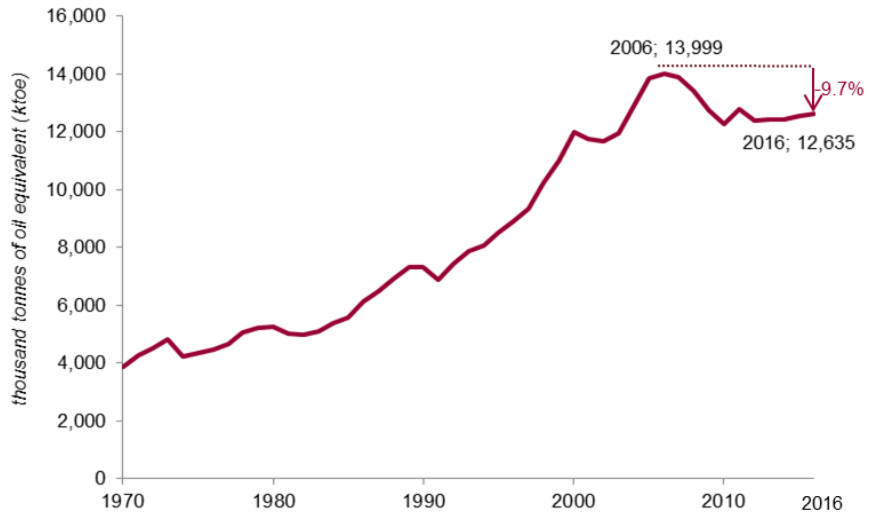
Historically, HGV consumption has been higher than for LGVs; in 1970, HGV consumption was 1.7 times that for LGVs but this margin has decreased over the years and although HGV consumption is still higher than LGV the factor has decreased to just 1.1.

Air transport

- Air transport accounted for 23 per cent of total transport consumption in 2016, an equivalent share to 2015
- Consumption in air transport increased by 0.8 per cent in 2016 to 12,635 ktoe, remaining 9.7 per cent below its peak of 13,999 ktoe in 2006
- Between 2014 and 2015 (the latest year for which data are available) total passengers to and from the UK increased by 9.6 per cent[11]
- International travel accounts for approximately 90 per cent of fuel consumption used in aviation with 5 per cent for domestic use and 5 per cent military use[12]

Over the longer term, consumption in air transport has more than trebled; chart 2.06 below shows the long term trend;

Chart 2.06: Total consumption in air transport



Source; BEIS ECUK Table 2.01

[11] Source; tables 2.07 and 3.07 Office for National Statistics (ONS) Travel Trends statistics 2015; https://www.ons.gov.uk/peoplepopulationandcommunity/leisureandtourism/articles/traveltrends/2015

[12] Source DUKES 2017 Chapter 3, paragraph 3.58; https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2017-main-report

Short term fluctuations in air passenger numbers are generally caused by a number of factors such as currency exchange rates, weather, government policy, economic (such as the recessions in the mid 1970s, 1981, 1991, and 2008 to 2009), and political conditions in the UK and abroad, in addition to special events[13]. Some of these special events are analysed in a 50th anniversary release of The Office for National Statistics' (ONS) Travel Trends Survey[14]. Some special events caused a short term interruption to growth such as the terrorist attacks of September 2011, whereas others have caused a structural shift in travel behaviour such as the introduction in low cost airlines.

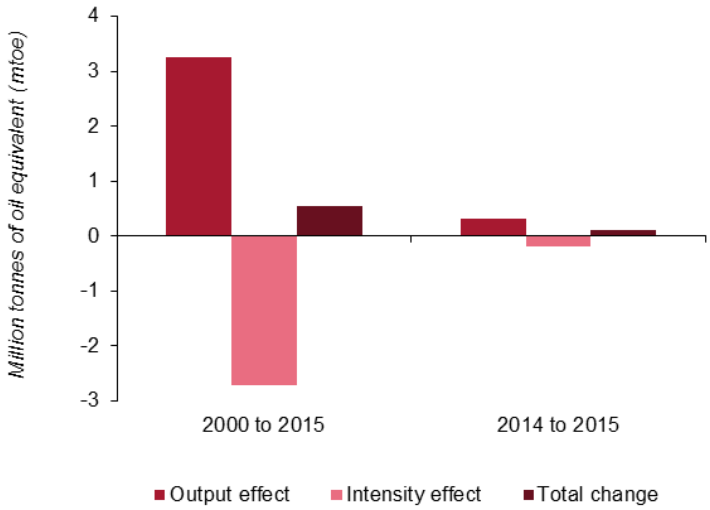
A summary of some of the special events is below;

- From the 1970s, more holidays were being taken and there was an increase in the number of affordable package holidays. Low cost airlines also made a debut with the introduction of the "Skytrain"
- During the 1990s, several UK regional airports underwent substantial development increasing the volume of passengers travelling through them. This period saw high growth in energy consumption in air transport averaging 5.1 per cent per annum
- The terrorist attacks of September 2001 contributed to negative growth during the early 2000s. Growth then picked up again due to a growing economy and the increase in the use of online booking systems.
- The global economic recession started in late 2007 affecting business travel in particular and with several years of slow or negative growth, energy in air transport is still 8 per cent below its peak in 2006

Chart 2.07 below shows the effect on energy consumption in the air transport sector split by output and intensity effects for the periods 2000 to 2015 (the latest year for which data are available) and also 2014 to 2015;

[13] ONS Travel Trends 2015
[14] ONS Travel Trends 2010; http://webarchive.nationalarchives.gov.uk/20160105160709/http:/www.ons.gov.uk/ons/rel/ott/travel-trends/2010/index.html

Chart 2.07: Output and intensity factors affecting air transport



BEIS ECUK Table 2.04

Over both the longer and shorter time periods, passenger numbers increased, which would have increased energy consumption by the amount indicated as "output effect", had there been no improvements in energy intensity (a combination of improved fuel efficiency and / or the density of passengers per aeroplane). The intensity effect considerably reduced energy consumption between 2000 and 2015, but over the shorter term, between 2014 and 2015, the output and intensity effects virtually offset each other; consumption was just 0.9 per cent lower in 2015 compared to 2014.

Rail transport

Key terms

- **Train kilometres** – the number of kilometres a train travels. This measure does not relate directly to fuel consumption, as it does not take into account all factors that affect fuel consumption, such as weight being transported.

  Separate measures are used to represent energy consumption in freight and passenger trains, **train kilometres** are therefore used to compare trends between the two categories.

- **Passenger kilometres** – this measure accounts for the number of passengers in addition to the distance travelled and is an indicator of energy intensity, i.e. the amount of energy consumed per unit output.

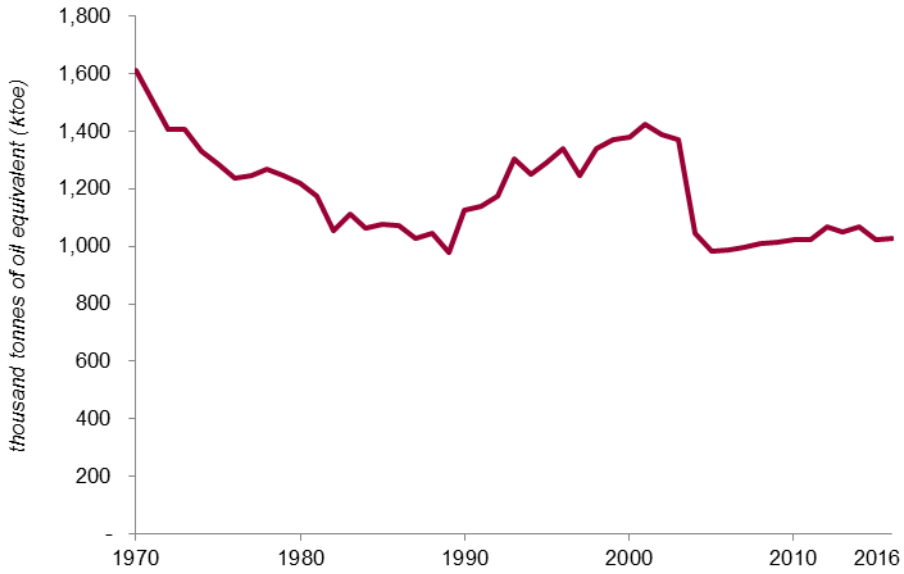
- **Freight moved** – takes into account the weight of freight moved in addition to the number of kilometres transported, measured in tonne kilometres.

Whilst passenger train kilometres and freight kilometres (see key terms section on page 17) provide useful measures for changes in energy intensity for passenger rail travel and freight transport, it does not provide a useful comparator for comparing trends between passenger and freight transport. Energy consumption in transport depends on weight hauled and this varies considerably between transporting passengers and freight. Train kilometres provides a more useful metric for estimating the split between the two modes as both are measured in the same unit; kilometres.

- Rail transport accounted for 1.8 per cent of energy consumption in the transport sector
- Energy consumption in rail transport increased by 0.6 per cent from 2015 to 1,028 ktoe in 2016, while passenger kilometres increased by 2.3 per cent[15]
- Freight moved (in tonne kilometres) fell by 11.8 per cent from 2015 to 2016
- Passenger trains accounted for 94 per cent of all kilometres travelled by trains. Freight train kilometres accounted for the remainder

Chart 2.08 below shows the longer term trend for energy consumption by rail transport;

Chart 2.08: Energy consumption in rail transport



Source; BEIS ECUK Table 2.01

[15] Source; Office of Rail Regulation Statistics tables 12.13 (passenger) and 13.25 (freight); http://orr.gov.uk/statistics/published-stats/statistical-releases

Energy consumption in rail transportation fell from a peak of 1,611 ktoe in 1970 to a minimum of 977 ktoe in 1989. This period coincided with a rapid increase in car ownership, particularly second car ownership (see road passenger section). A period of positive growth then resumed until 2001. This period of growth coincided with the privatisation of the railways in 1994 to 1995[16]. A step change occurred between 2003 and 2004 due to a change in methodology; up until 2003, electricity consumption in transport included use for both traction and services such as lighting within train stations. In order to be consistent with the European Union Renewable Energy Directive methodology, only electricity used for traction was included in transport consumption from 2004 onwards with other uses being re-classified to the services sector.

In rail transport, as the majority of rail transport is passengers, output effects are measured using passenger kilometres. Chart 2.09 below shows the impact of output effects compared to intensity effects for the period, 2000 to 2015. Energy intensity effects include more energy efficient trains and / or an increase in the number of passengers travelling in each train.

Chart 2.09: Output and intensity factors affecting rail transport

Source; BEIS ECUK Table 2.04

Over the long term (2000 to 2015), the impact of increasing passenger kilometres was more than offset by improvements in energy intensity. During this period, consumption fell by 26 per cent.

[16] Source; Office of Rail Regulation Statistics; http://orr.gov.uk/statistics/published-stats/statistical-releases

Water transport

Fuel for water transport includes fuel sourced from inland bunkers, i.e. fuel oil and gas/diesel oil delivered, other than under international bunker contracts, for fishing vessels, UK oil and gas exploration and production, coastal and inland shipping and for use in ports and harbours[17].

- Water transport accounted for 1.2 per cent of consumption in the transport sector as a whole, an equivalent share to 2015
- Fuel consumed by water transport decreased by 4.1 per cent to 654 ktoe in 2016

[17] Source DUKES 2016 Chapter 3, paragraph 3.58; https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2017-main-report

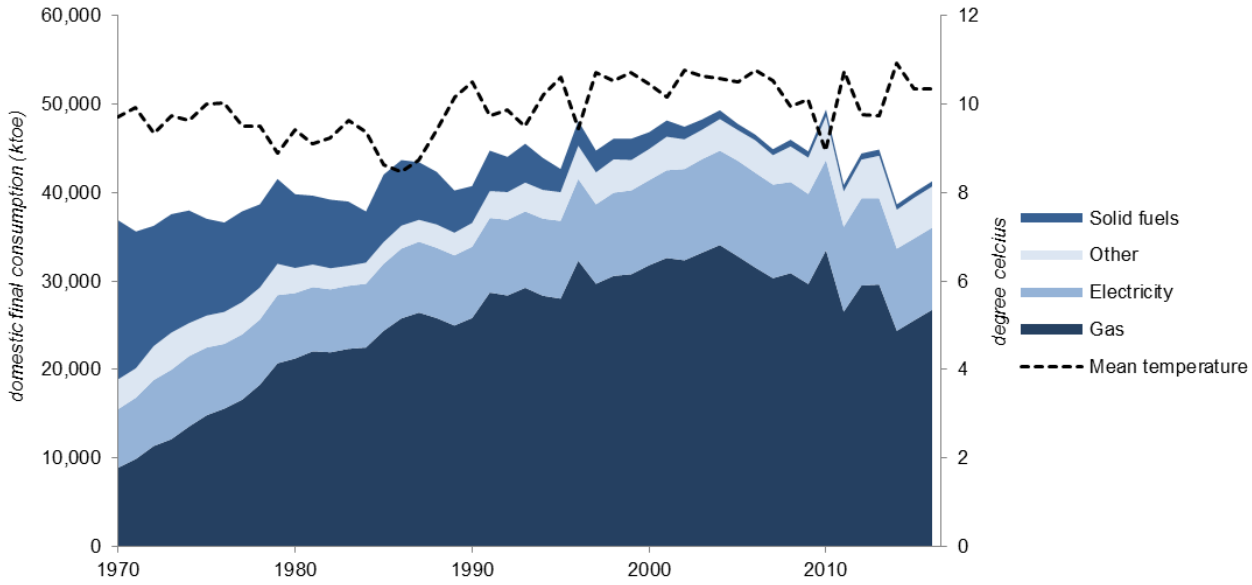
Domestic

- Since 2015, final energy consumption in the domestic sector increased by 1,249 ktoe (3.1 per cent) to 41,295 ktoe in 2016; although mean temperatures were broadly the same as 2015, heating degree days were higher in 2016.
- The majority of the increase was gas consumption which was 1,186 ktoe (4.6 per cent) higher in part reflecting additional heating requirements
- On a temperature corrected basis, final consumption was 349 ktoe (0.8 per cent) higher than in 2015. This is the first year since 2004 where temperature corrected consumption increased
- In 2015, the domestic sector accounted for 29 per cent of total final energy consumption
- Average gas consumption (see table 3.03) increased by 4.6 per cent to 13,801 kWh, and by 1.7 per cent on a temperature corrected basis
- Average electricity consumption continued to fall, by 0.8 per cent to 3,889 KWh in 2016

The domestic sector is the most susceptible to temperature fluctuations of the four sectors as space and water heating account for in the region of 80 per cent of final energy consumption. In addition, the majority of space and water heating are provided by gas resulting in gas consumption in the domestic sector being the most responsive to temperature variations (see chart 1.02).

Chart 3.01 below shows the long term trend in domestic consumption showing the contribution by each fuel type. It also shows mean air temperature (right hand axis).

Chart 3.01: Final consumption by fuel compared to mean air temperature



Note; "Other" includes petroleum, bioenergy, and heat sold. Source; BEIS ECUK Table 3.01

Whilst overall consumption has fluctuated since 1970, consumption is 12 per cent higher in 2016 compared to 1970. Short term changes in consumption have generally shown the effects of mean air temperature fluctuations year on year. For example, the peaks occurring in 1979, 1996, and 2010 were all colder than the years preceding and following. Correspondingly, troughs have occurred such as in 2011 when the mean temperature was 10.7 degrees celsius, 1.7 degrees warmer than in 2010 when temperatures were lower than usual for that period.

The fuel mix has changed significantly since 1970 when 49 per cent of final energy consumption was provided by solid fuels and 24 per cent gas. With declining coal production (particularly from 1989 onwards), combined with North Sea gas coming on line, this share had fallen to just 2 per cent by 2004, by which time natural gas comprised 69 per cent. The balance between the two fuels has remained fairly constant since then with solid fuels accounting for an average of 1.6 per cent and gas 66 per cent.

In addition to weather factors, domestic fuel consumption is dominated by a number of other factors;

- Household characteristics; the number of households, disposable income and energy prices
- Efficiency measures such as installing a more efficient boiler and improving home insulation (for example adding cavity wall insulation, and double glazing), and the age of the housing stock (older homes tend to have poorer insulation properties)
- In the case of electricity consumption, the number and usage of appliances along with appliance efficiencies

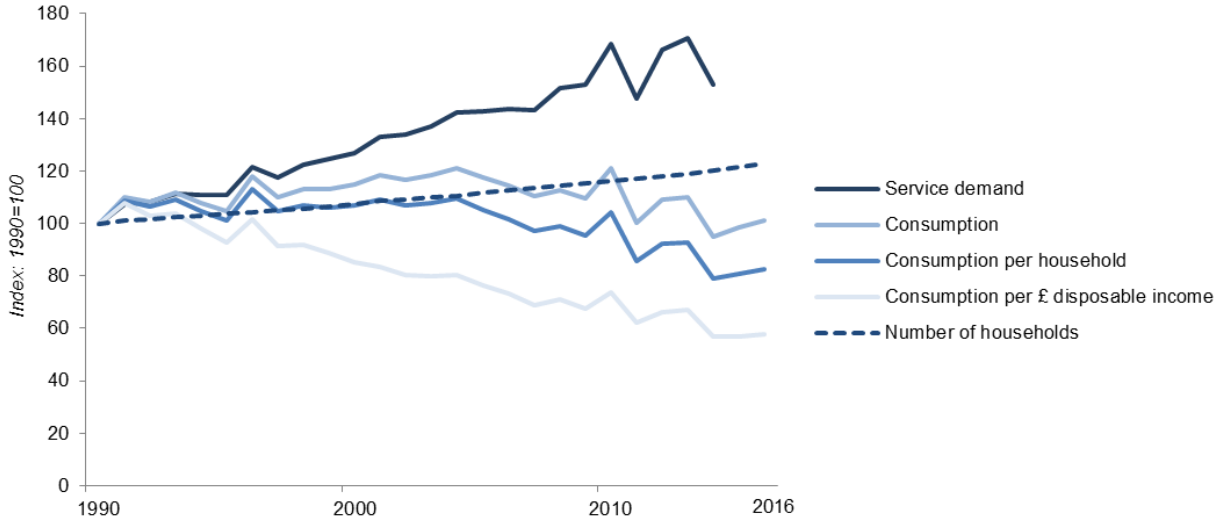
On a temperature corrected basis (only available from 2002) final energy consumption has fallen steadily; from 52,229 ktoe in 2002 to 42,486 ktoe in 2016, a fall of 19 per cent. Over this period, just three years saw an increase; 2004, 2012, and 2016. However, the long term trend is downward and this is likely to be due to a combination of the above factors and the following section discusses each one in turn.

Household characteristics

- Consumption per household increased between 2015 and 2016 by 2.1 per cent
- Consumption per person increased by 2.3 per cent from 2015 to 2016

The number of households in the UK has grown steadily since 1970 from 18.8 million to 27.8 million in 2016, an increase of 48 per cent. During this time, the population has also risen, although to a lesser extent - by 18 per cent - resulting in a reduction in the number of residents per household. A household with fewer occupants will generally result in lower consumption per household, but an increasing number of households will tend to increase consumption as a whole. Between 2015 and 2016, although the number of occupants per household fell slightly, by 0.2 per cent, consumption per household increased, by 2.1 per cent. An additional factor to be considered is the level of comfort required, i.e. the expectation of what is considered to be a reasonable level of warmth, which varies over time. This has increased over recent years resulting in additional energy demand. Chart 3.02 below shows, on an indexed basis the effects of these factors and how they may have influenced consumption.

Chart 3.02: Factors impacting on domestic consumption

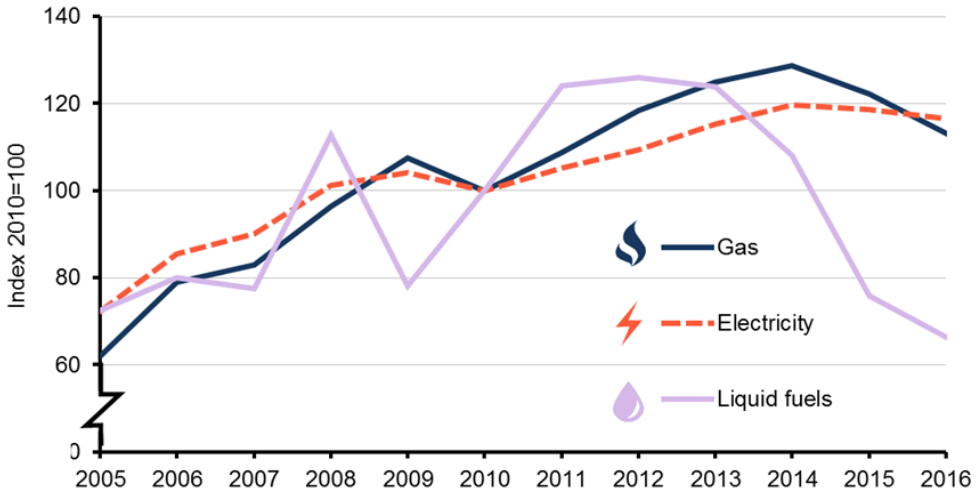


Source; BEIS ECUK Tables 3.01 3.04, and 3.05

The factors displaying a downward trend on consumption are; consumption per household and consumption per unit of disposable income. Upward pressures are the increasing number of households and also the service demand.

Chart 3.03 below shows the consumer price index for the domestic sector over the same period for gas and electricity, the two key fuels used in households;

Chart 3.03: Consumer Price Index for gas and electricity



Source; BEIS Domestic energy price indices, QEP 2.1.1 and 2.1.2
https://www.gov.uk/government/statistical-data-sets/monthly-domestic-energy-price-stastics

Since 2002, gas and electricity prices have more than doubled over the period (though there was a decrease in 2015). It is likely that this significant increase in fuel prices, combined with the economic downturn will have had a negative impact on consumption as consumers became more conscious of their household budgets. In Wave 21[18] (May 2017) of The Public Attitudes Tracker[19] 30 per cent of households were worried or very worried about paying for their energy bills up from 28 per cent in wave 17 as reported in ECUK 2016.

Energy Efficiency Measures

The UK housing stock is old relative to most European countries with many houses dating from the Victorian era. As a result, many houses have poor insulation with properties resulting in additional consumption to maintain a given level of comfort. However, as older housing stock is gradually replaced with newer, more energy efficient homes, this will tend to lower consumption. This is a long term trend; houses built prior to 1918 represented 25

[18] https://www.gov.uk/government/collections/public-attitudes-tracking-survey
[19] A survey conducted by BEIS to understand and monitor public attitudes to the department's main business activities

per cent of the housing stock in 1970 compared to 17 per cent built prior to 1919[20] in 2015 (the latest year for which data are available).

There have been some key changes to various characteristics in households which have put downward pressure on consumption; in 1976, 87 per cent of households had a hot water tank of which 74 per cent were insulated. With the increasing prevalence of more energy efficient boilers such as combination and condensing boilers, which do not require a tank, the proportion of households with a hot water tank had declined to around half of households and of these 99 per cent were insulated (table 3.21). Installing a condensing boiler can reduce consumption by 8.3 per cent[21].

Installed **double glazing** is another measure which has increased dramatically; in 1983, just 9.5 per cent of households had double glazing in 80 per cent of the property[20]. By 2008, 71 per cent of homes had double glazing throughout and in 2015 the proportion was 81 per cent (table 3.22). Rates of **cavity wall insulation** (table 3.25), which can reduce consumption by 8.4 per cent[20], have also increased considerably since 1976 when just 3.8 per cent of homes known to have cavity walls had insulation compared to 69 per cent in 2016. This upward trend is still continuing; between 2015 and 2016, the proportion of properties with cavity wall insulation increased by 0.9 percentage points. For those homes without wall cavities, **solid wall insulation,** which can reduce consumption by 16 per cent[20], is an alternative to improving energy efficiency. Although the number of homes with solid wall insulation has increased since 2013[22] when 556,000 homes were known to have had solid wall insulation compared to 715,000 homes in 2016, the proportion of UK homes with this type of insulation is still relatively small; of those properties with no cavity walls, 8.8 per cent have solid wall insulation (tables 3.24 and 3.25).

Rates of **loft insulation**, which can reduce consumption by 2.1 per cent, have increased to the point where the majority of homes with a loft have insulation installed, and 66 per cent have insulation of 125 mm or more.

[20] There was a break in the series between 2000 and 2001 for the classification of date of construction. Source; table 3.14

[21] Source; National Energy Efficiency Data Framework; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/532535/National_Energy_Efficiency_Data-Framework__NEED__Main_Report.pdf

[22] There solid wall insulation data have been remodelled and there is a break in the series in 2013

Electrical appliance consumption

Key electrical appliances

- Lighting appliances include lightbulbs in the following categories; standard, halogen, fluorescent strip lighting, energy saving lightbulbs, and light emitting diodes (LEDs).
- Cold appliances; chest freezers, fridge-freezers, refrigerators, and upright freezers.
- Wet appliances; washing machines, washer-dryers, dishwashers, and tumble dryers.
- Consumer electronics; televisions, set top boxes, DVD/VCRs, games consoles, and power supply units.
- Home computing; desktop computers, laptops, monitors, printers, and multifunction devices.
- Cooking appliances; electric ovens, electric hobs, microwaves, and kettles.

- Electricity consumption increased marginally by 0.2 per cent between 2015 and 2016 to 9,284 ktoe
- Lighting and appliances account for approximately two thirds of electricity consumption with the remaining third being represented by space heating, hot water, and cooking.

Over the longer term, domestic electricity consumption increased to a peak of 10,809ktoe in 2005 then began decreasing, despite the continuing increase in the number of electrical appliances owned by households. Table 3.01 blow shows the average number of appliances per household;

Table 3.01; Average number of appliances per household

Average number of appliances per household

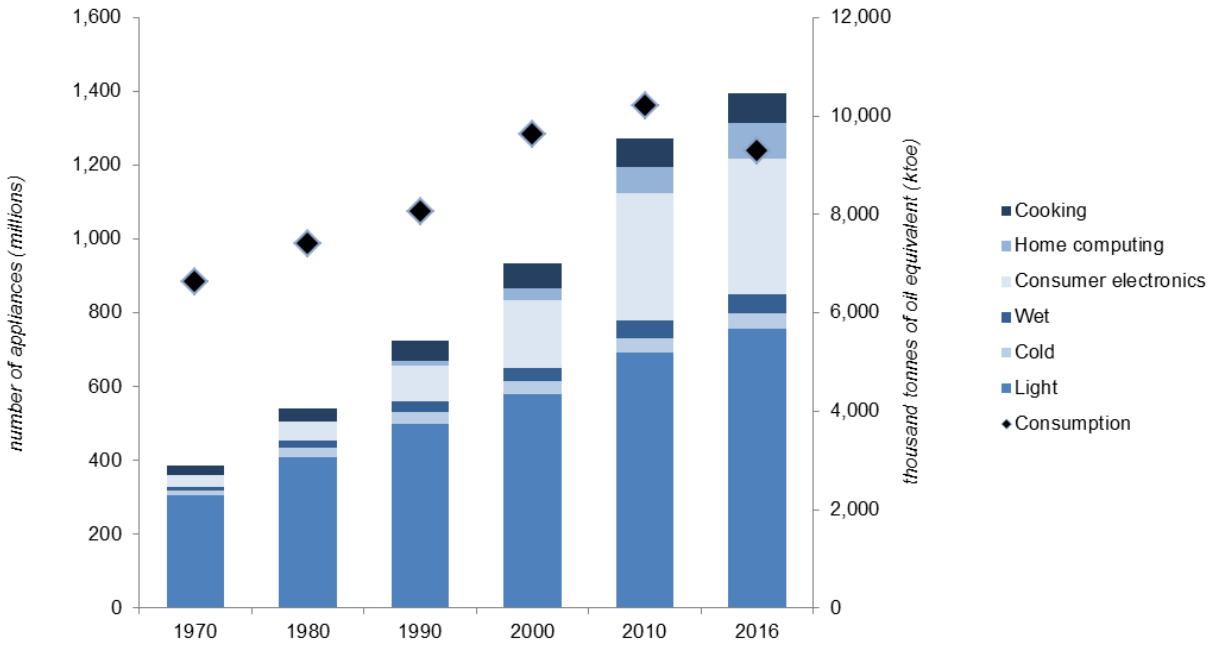
Year	Lighting	Cold Appliances	Wet Appliances	Consumer electronics	Home computing	Cooking
1970	16	1	1	2	0	1
1980	20	1	1	2	0	2
1990	22	1	1	4	1	2
2000	24	1	2	8	1	3
2010	26	2	2	13	3	3
2015	27	2	2	13	3	3
2016	27	2	2	13	3	3

Source; BEIS ECUK Table 3.12

The average number of appliances per household has increased for all appliance types but the most dramatic increase is for consumer electronics which has increased from an average of 2 appliances in 1970 to 13 in 2016.

Chart 3.04 below shows electricity consumption (right hand axis) together with the number of appliances;

Chart 3.04: Total number of electrical appliances owned by households and total domestic electricity consumption (right hand axis)



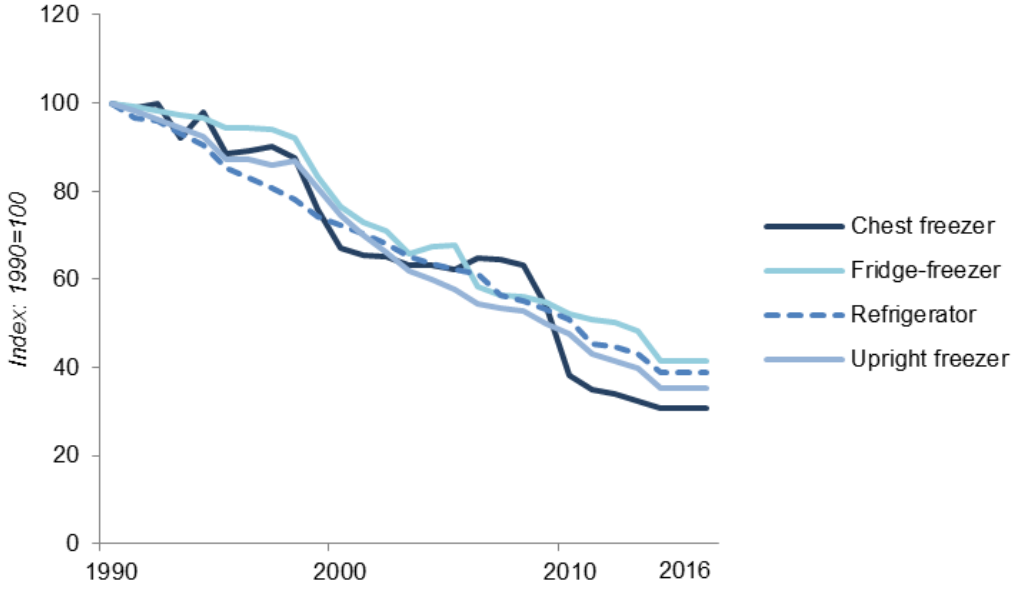
Source; BEIS ECUK table 3.01

The growth in consumer appliances is particularly notable from the mid 1990s, particularly for consumer electronics and lighting.

The recent decrease in electricity consumption (despite the increasing number of appliances) can be partially explained by increasing efficiencies.

Average consumption for **new cold appliances** has decreased dramatically since 1990 for all appliance types (Chart 3.05) particularly for chest freezers which saw notable improvements between 2008 and 2010 when average consumption fell by 39 per cent over the two year period. There were also notable improvements in average consumption during the late 1990s for all freezer types. Improvements in refrigerator consumption were more stable over the period (1990 to 2016) but all types of cold appliance improved by between 58 per cent (fridge-freezers) and 69 per cent for chest freezers.

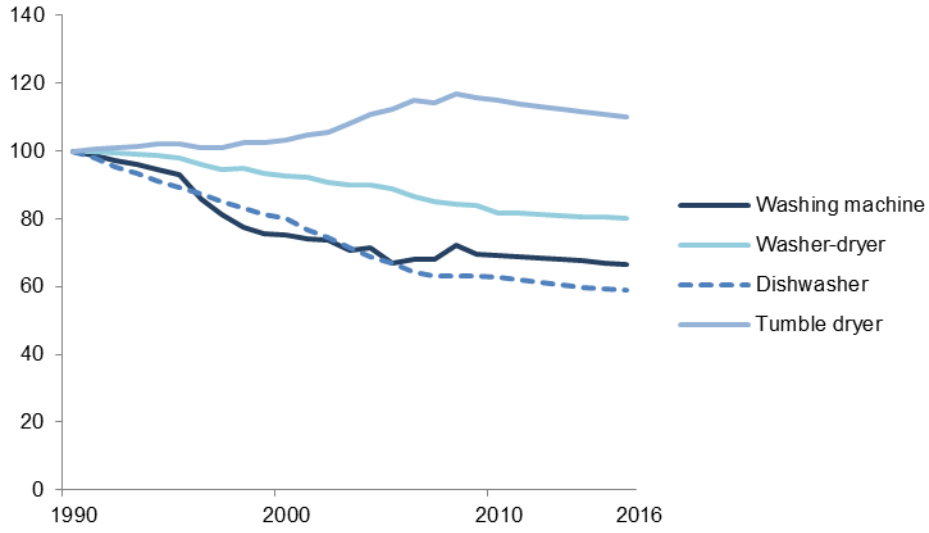
Chart 3.05: Average energy consumption of new cold appliances 1990 to 2016 (index 1990)



Source; BEIS ECUK Table 3.09

Improvements in average consumption for wet appliances were less dramatic compared to cold appliances with an increase of 10 per cent for tumble dryers, reflecting bigger demand. Average consumption for dishwashers fell most significantly, by 41 per cent between 1990 and 2016, washing machines by 34 per cent, and washer dryers by 20 per cent over the same period.

Chart 3.06: Average energy consumption of new wet appliances 1990 to 2016 (index 1990)



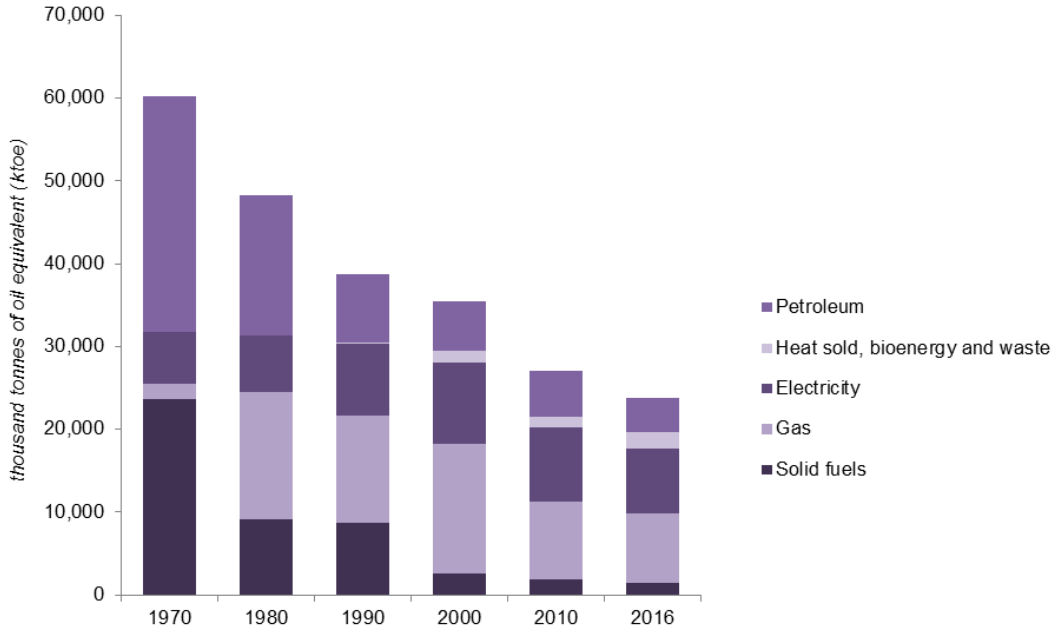
Source; BEIS ECUK Table 3.09

Industry Sector

- Final consumption in the industry sector fell by 631 ktoe (2.6 per cent) between 2015 and 2016 to 23,730, the lowest level since 1970
- In 2016, the industry sector accounted for 17 per cent of total final energy consumption
- By fuel, the largest fall in absolute terms was in solid fuels which fell by 458 (26 per cent) to 1,297 in 2016
- The sub-sectors with the largest decreases were iron and steel, by 316 ktoe (25 per cent) and mineral products, by 126 ktoe (4.9 per cent)
- Sub-sectors showing an increase are; paper, printing and publishing, by 83 ktoe (3.7 per cent); food, drink and tobacco, by 21 ktoe (0.8 per cent), vehicles, by 17 ktoe (1.2 per cent), and chemicals, by 16 ktoe (0.5 per cent)
- Energy intensity fell by 3.7 per cent between 2015 and 2016

Chart 4.01 below shows **total final consumption in the industry sector since 1970**. The general fall in consumption reflects the shift away from heavy industry to more energy light industries such as within the service sector (see section 5).

Chart 4.01: Total industrial consumption by fuel mix

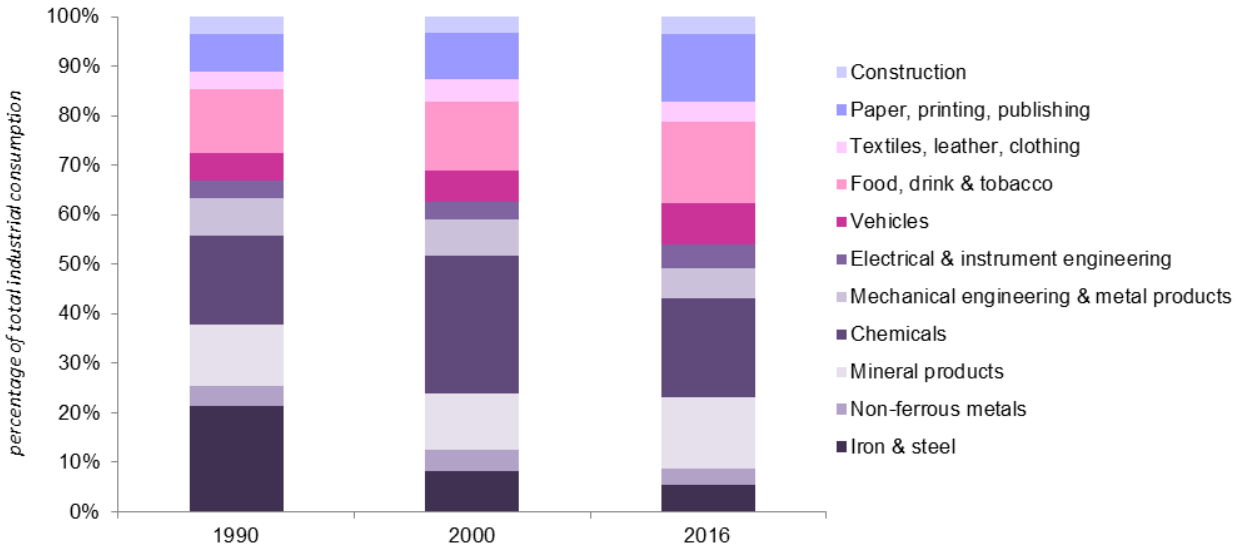


Source; BEIS ECUK Table 4.01
Note: Other includes heat sold and bioenergy. Renewable electricity is included in electricity
Solid fuels include coal, coal, manufactured solid fuels, benzole, tars, coke, oven gas and blast furnace gas.
Wood and wood waste is included in renewable fuels and waste

The fuel mix used in industry has changed over the period reflecting the shift away from solid fuels and petroleum to gas and, more recently, an increasing proportion of demand is being satisfied by bioenergy. In 1970, 82 per cent of consumption was provided by solid fuels and petroleum. By 2016, this had fallen to 23 per cent with gas and electricity accounting for 36 per cent and 33 per cent respectively.

Consumption by sub-sector has also changed over the long term. In 1990, the heavy industry sub-sectors; iron & steel, non-ferrous metals, mineral products, chemicals, and engineering together accounted for 56 per cent of industrial final consumption compared to 39 per cent in 2016. Chart 4.02 below shows the mix between the subsectors;

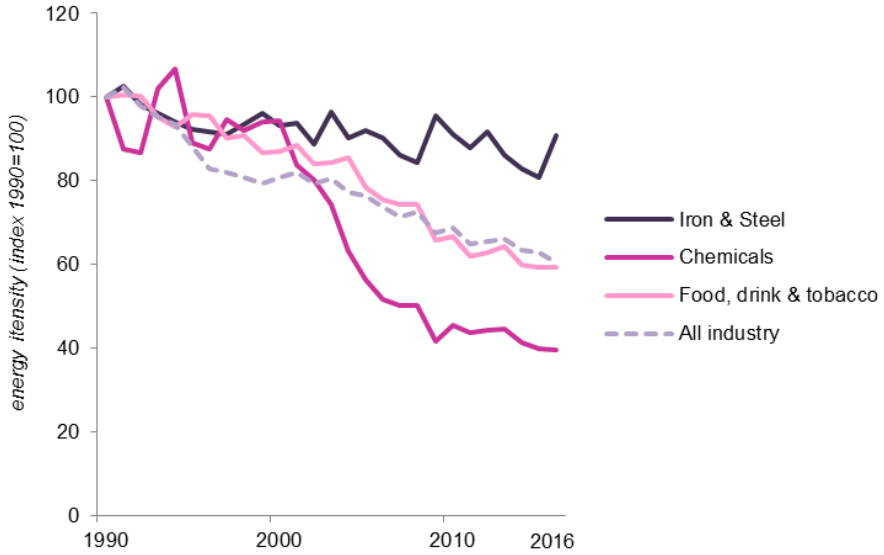
Chart 4.02: Industrial consumption by sub-sector, 1990, 2000, and 2015



Source: Table 4.02
Note the above chart excludes other industry and unclassified. Unclassified has accounted for an increasing proportion since 1990 so may give a slightly distorted picture of the changing share of sub-sectors

Across the industry sector as a whole, **energy intensity** (energy consumed per unit output) has decreased by 39 per cent between 1990 and 2016 with the chemicals industry improving by a significant proportion (61 per cent) reflecting a structural change within the industry. Chart 4.03 below shows the trend for three key sectors; Iron & steel, chemicals, and food, drink & tobacco.

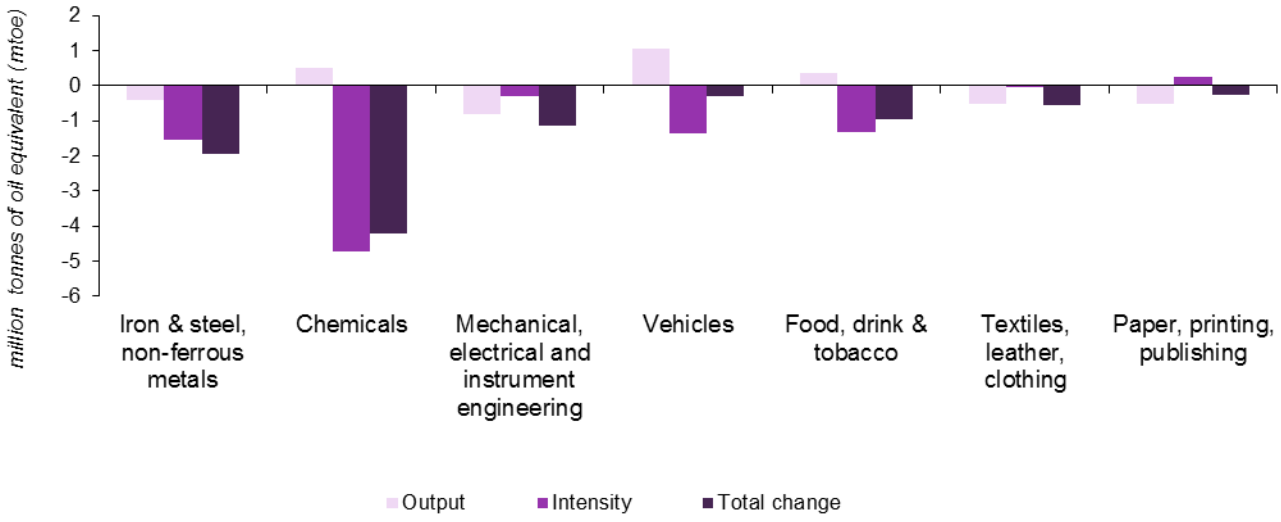
Chart 4.03; Energy intensity for the industry sector and three key sub-sectors



Source; BEIS ECUK Table 4.08

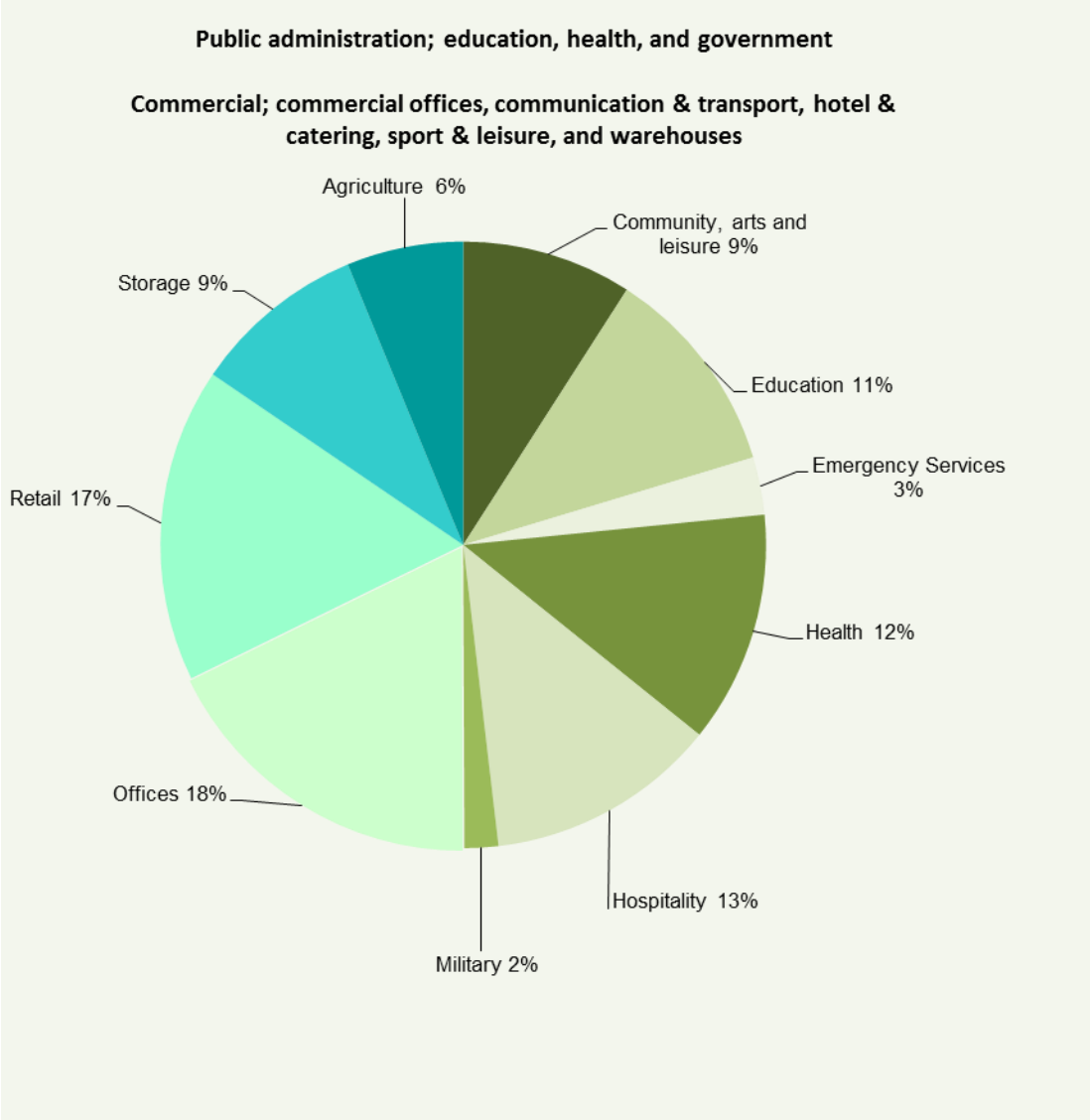
Comparing output changes and energy intensity from 2000 to 2016, chart 4.04 shows that all sub-sectors' consumption fell and most were due to a combination of a fall in output and improvements in intensity. The exceptions were the chemicals and food, drink and tobacco sub-sectors which both saw an increase in output effects but the improvement in intensity consumption resulted in an overall decrease.

Chart 4.04: Output and Intensity effects for industry subsectors 2000 to 2016



Source; BEIS ECUK Table 4.07

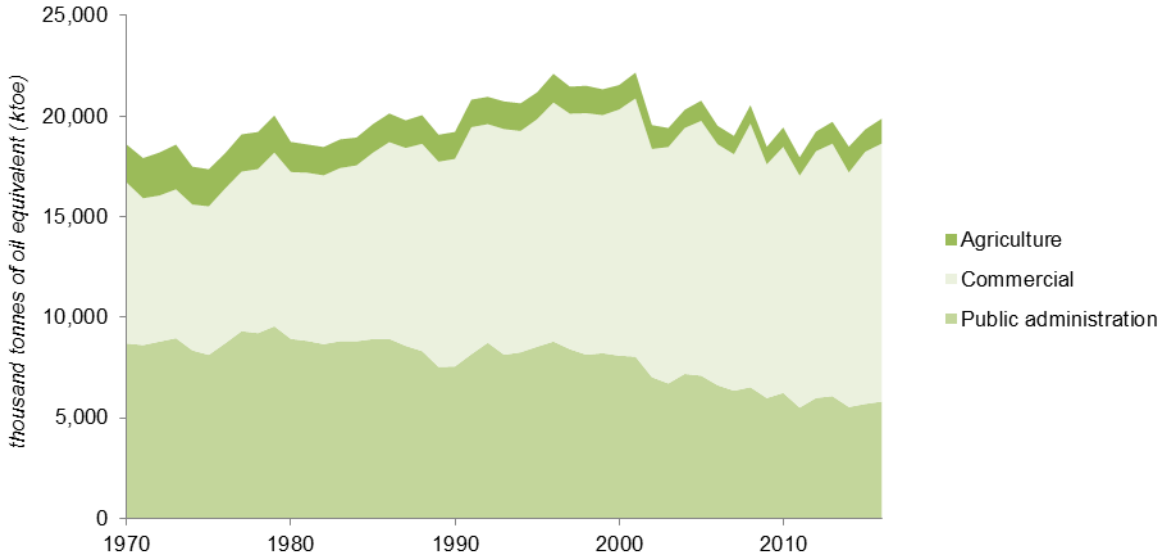
Services Sector



- Consumption increased by 532 ktoe (2.7 per cent) between 2015 and 2016 to 19,875
- The majority of the increase was from gas (273 ktoe) and bioenergy and waste (135 ktoe)
- The service sector accounted for 14 per cent of total final consumption in 2016
- The commercial sector accounted for 65 per cent of services consumption in 2015, public administration 29 per cent, and the agriculture sector 6.2 per cent
- Energy intensity fell by 1.2 per cent between 2015 and 2016

Over the longer term, **final consumption in the services sector** has fluctuated but the underlying trend has been relatively stable since 1970 (chart 5.01); consumption in 2016 was 6.9 per cent higher than in 1970 despite a 63 per cent increase in the number of employees (from 1978, the earliest year for which employee data are available). Floor space dedicated to the services sector also increased though only a shorter time series is available[23]; floor area in retail increased by 9.6 per cent from 2000 to 2015 and office space by 13 per cent. The shift away from an industry intensive economy to a services based economy, putting upward pressure on consumption in this sector, has been accompanied by an improvement in energy intensity which fell by 67 per cent (excluding agriculture) from 1970.

Chart 5.01: Energy consumption in the services sector



Source; Tables 5.01, 5.02, 5.03, and 5.04

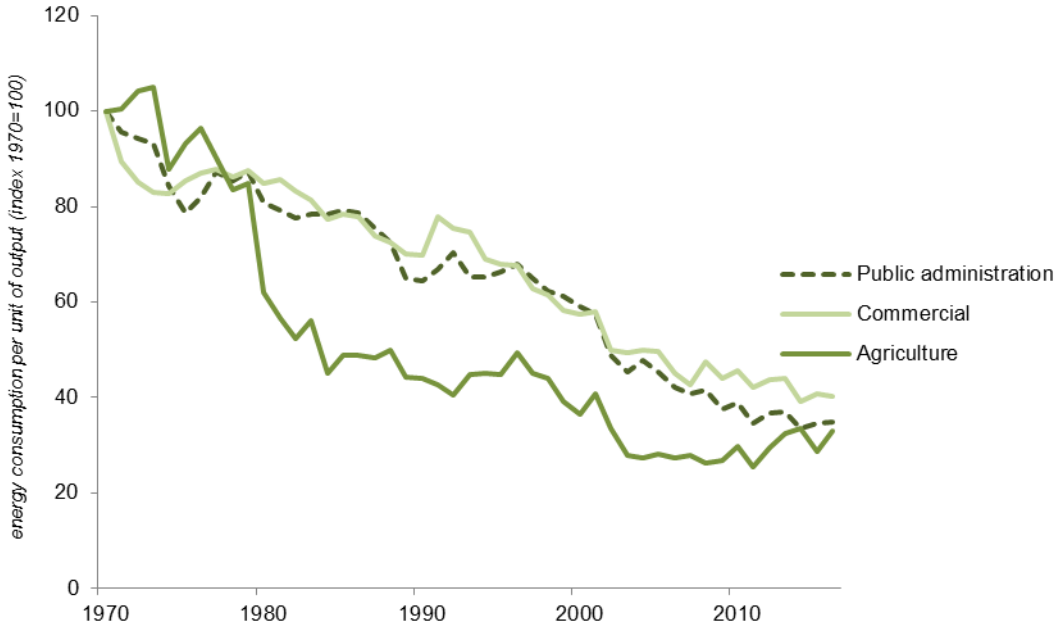
Consumption peaked in 2001 and has since fallen by 10 per cent.

There has also been a shift in the share of consumption by the three key sectors; in 1970, public administration accounted for 47 per cent of services in consumption and the commercial sector 43 per cent. By 2016, public administration consumed 29 per cent and commercial's share had increased to 65 per cent. Agricultural's share decreased between 1970 and 2016 from 10 per cent to 6.2 per cent.

[23] Source; table 5.01. Valuation Office Agency experimental statistics covering England and Wales only

Energy intensity in the services sector overall[24] has improved since 1970, falling by 66 per cent since then. It reached a minimum in 2014 and has risen by 1.5 per cent since then, (though it fell by 1.2 per cent between 2015 and 2016). Chart 5.02 shows the long term trends in public administration, commercial and agriculture and the services sector as a whole.

Chart 5.02: Energy Intensity in the services sector



Source; BEIS ECUK Tables 5.01, 5.02, 5.03, and 5.04

Within the services sector, **energy intensity for public administration has fallen since its maximum in 1970, by 65 per cent.** It reached a minimum in 2014 and has increased again in 2015 and 2016 by 2.6 per cent and 1.2 per cent respectively.

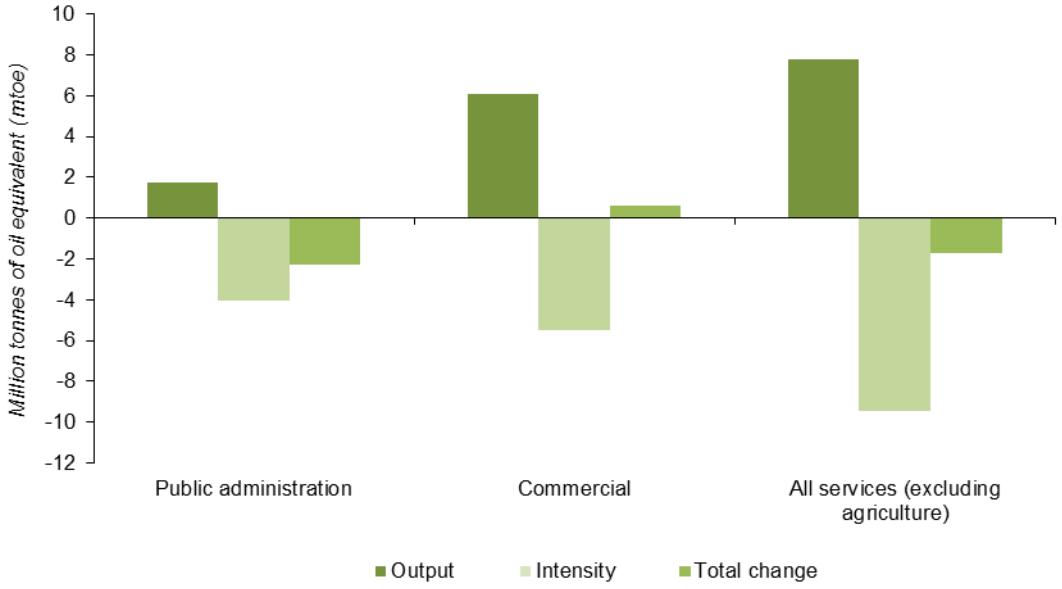
In the commercial sector, energy intensity has fallen by 60 per cent since 1970 but reached a minimum in 2014. Although it increased in 2015 (by 4.1 per cent), it fell in 2016 (by 1.1 per cent).

Since 1970, **energy intensity in the agricultural sector peaked in 1973 and has since fallen (by 76 per cent)** to a minimum in 2011. Since 2011, intensity has increased by 30 per cent.

[24] Energy intensity in the services sector is the energy required to produce a unit of output. Output is measured using ONS GVA statistics which measures the contribution to the economy of each individual producer, industry, or sector in the UK.

Chart 5.03 shows the effect of output changes in the services sector compared with intensity effects between 2000 and 2016.

Chart 5.03: Output and intensity effects in services between 2000 and 2016

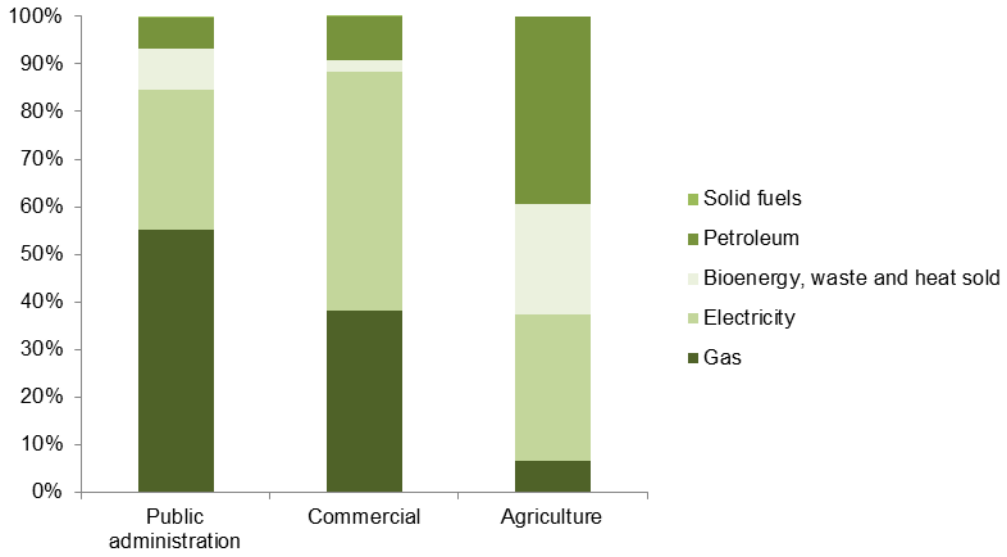


Source; BEIS ECUK Table 5.05

Increased output within public administration would have increased energy consumption by 1.7 mtoe (30 per cent) had there been no change in energy intensity. However, this was more than offset by a 4.0 mtoe (69 per cent) reduction in energy intensity. For the commercial sector, consumption due to output increases would have been 6.1 mtoe (47 per cent) higher but this was largely offset (though not totally) by a 5.5 mtoe (43 per cent) improvement in energy intensity.

Whilst the **fuel mix** in the services sector as a whole reflects the long term trend of increasing use of gas and lower solid fuel consumption, the pattern varies most notably in the agricultural sector where activity is less focussed on heating and lighting compared to office space. Chart 5.04 shows the fuel mix for 2016.

Chart 5.04: Fuel mix for public administration, commercial, and agriculture for 2016



Source; BEIS ECUK Tables 5.02, 5.03, 5.04

In the public sector, gas provides the largest proportion of fuel requirements at 55 per cent compared to the commercial sector where electricity is the main fuel accounting for 50 per cent of consumption. Just 6.6 per cent of fuel in agriculture is provided by gas; 39 per cent is petroleum, 31 per cent electricity, and 23 per cent is bioenergy and heat sold. More than half of bioenergy consumption in the agricultural sector is farm waste digestion (59 per cent) with the remainder being straw and short rotation crops (27 per cent) and wood (14 per cent)[25]. This reflects activities in that sector where petroleum is required to fuel farm machinery and bioenergy is often produced and consumed on site.

Building Energy Efficiency Survey (BEES)

This project was undertaken by The Department of Business, Energy, and Industrial Strategy to improve and update evidence of how energy is used within non-domestic premises across England and Wales. The full results are now available via the following link;

https://www.gov.uk/government/publications/building-energy-efficiency-survey-bees

Although preliminary results for the survey were included in table 5.05a in the initial July publication, this has now been updated and includes a breakdown for non-electricity fuel types. In addition, table 5.05 has been updated to incorporate the full results. Table 5.05

[25] Source; table 6.1 DUKES

provides detailed consumption by end use and, although the actual uses have remained the same compared to previous years, the sub-sectors have been amended to coincide with those sectors used in the survey.

The Building Energy Efficiency Survey (BEES) is based on modelled energy use. The model provided an estimated amount of electrical and non-electrical energy for each end use. The survey did collect the main fuel type for space heating. It is not possible to identify the main fuel for non-electrical energy uses for other end uses from BEES directly and assumptions have been made to enable this. All electrical energy is of course allocated to electricity.

Table 5.01: Allocation of non-electrical energy to fuel type by end use

	Main Heating fuel				
End Use	**Natural gas**	**Oil**	**LPG**	**District heating**	**Other**
Space heating	Natural gas	Oil	Oil	Heat sold	Bioenergy and waste
Water heating	Natural gas	Oil	Oil	Heat sold	Bioenergy and waste
Heating swimming pools	Natural gas	Oil	Oil	Heat sold	Bioenergy and waste
Catering	Natural gas	Oil	Oil	Oil	Oil
Cooling & humidification	Natural gas	Oil	Oil	Oil	Oil
Other	Natural gas	Oil	Oil	Oil	Oil

Some assumptions have been made for converting the BEES end use and fuel categories to fit the ECUK definitions. Liquid Petroleum Gas (LPG) will be treated as part of the ECUK oil category and District Heating as heat sold. For end uses it has been assumed that the ECUK cooling and ventilation category is equal to the BEES categories fans, cooling and ventilation. The BEES categories cold storage and small power have been added to the other category to match the ECUK other category.

Annex A: Related BEIS publications

The Digest of UK Energy Statistics (DUKES)

Much of the data contained in ECUK are based on estimates from DUKES. DUKES is an annual publication which includes tables, charts and commentary covering all the major aspects of energy. It provides a detailed and comprehensive picture of fuel production and consumption during the last three years. DUKES 2017 is published alongside ECUK and relates to 2015 data.

www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Energy Trends

A quarterly publication including tables, charts and commentary covering all major aspects of energy. It provides a comprehensive picture of energy production and use.

www.gov.uk/government/collections/energy-trends

Sub-national consumption statistics

The sub-national data contain estimates at regional, local authority and MSOA/LSOA (for electricity and gas consumption statistics) geographies. However, it is worth noting that the data are not comparable with DUKES and ECUK due to differing data sources.

A full summary of the sub-national consumption datasets available, along with links to relevant datasets is available from the following link:

https://www.gov.uk/government/collections/sub-national-electricity-consumption-data

National Energy Efficiency Data Framework (NEED)

The National Energy Efficiency Data-Framework (NEED) was set up by BEIS to provide a better understanding of energy use and energy efficiency in domestic and non-domestic buildings in Great Britain. The data framework matches gas and electricity consumption data with information on energy efficiency measures installed in homes. It also includes data about property attributes and household characteristics.

www.gov.uk/government/collections/national-energy-efficiency-data-need-framework