Chapter 1
Energy

Key points

- In 2018, UK energy production was up 2.9 per cent on a year earlier. The rise was driven by growth from primary oil, wind, solar and bioenergy and waste. Overall fossil fuel production increased, but with coal reaching a record low. (Tables 1.1 and 1.2).

- Imports and exports in 2018 were both up; overall net imports decreased and accounted for 36.0 per cent of energy used in the UK.

- Primary energy consumption was nearly unchanged on 2017 but on a temperature adjusted basis primary energy consumption was down 1.1 per cent continuing the downward trend of the last ten years. UK temperatures were broadly similar, whilst there was an increase in heating degree days compared to 2017. (Tables 1.1.7 and 1.1.8).

- Final energy consumption rose by 1.1 per cent as demand for heating increased during February and March 2018 with temperature adjusted final energy consumption up by 0.2 per cent on 2017 levels. (More details are available in Energy Consumption in the UK www.gov.uk/government/collections/energy-consumption-in-the-uk)

- Fossil fuels remain the dominant source of energy supply, but now account for 79.4 per cent, a record low level. Supply from renewables increased, with their contribution accounting for 11.0 per cent of final consumption on the EU agreed basis (see Chapter 6).

- In 2018, there was a continuation of the switch in the main sources of electricity generation away from coal and gas to renewables. Generation from coal fell by 25 per cent, gas fell by 3.8 per cent, whilst renewables rose by 12 per cent. Renewables’ share of generation was at a record high level of 33.0 per cent in 2018, up from 29.2 per cent in 2017, due to increased wind, solar and plant biomass capacity (see chapters 5 and 6).

- Provisional BEIS estimates suggest that overall emissions fell by 9.1 million tonnes of carbon dioxide (MtCO₂) (2.4 per cent) to 364.1 MtCO₂ between 2017 and 2018, mainly due to the changes in the fuel mix used for electricity generation.

Introduction

1.1 This chapter presents figures on overall energy production and consumption. Figures showing the flow of energy from production, transformation and energy industry use through to final consumption are presented in the format of an energy balance based on the individual commodity balances in Chapters 2 to 6.

1.2 The chapter begins with aggregate energy balances covering the last three years (Tables 1.1 to 1.3) starting with the latest year, 2018, compiled using Gross Calorific Values (see paragraph 1.29). Energy value balances then follow this for the same years (Tables 1.4 to 1.6) and Table 1.7 shows sales of electricity and gas by sector in value terms. The explanation of the principles behind the energy balance and commodity balance presentations, and how this links with the figures presented in other chapters, is set out in Annex A. Information on long term trends (Tables 1.1.1 to 1.1.9) are available on BEIS’s energy statistics website at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes
Aggregate energy balance (Tables 1.1, 1.2 and 1.3)

1.3 These tables show the flows of energy in the United Kingdom from production to final consumption through conversion into secondary fuels such as coke, petroleum products, secondary electricity and heat sold. The figures are presented on an energy supplied basis, in tonnes of oil equivalent (toe), a unit of energy where 1 toe = 41.868 GJ, see also paragraph 1.28 for other energy units. The basic principles of energy balances and guidance on what is included in each row is detailed in Annex A of this publication.

Energy production and supply

1.4 Indigenous production in 2018 was 2.9 per cent higher than in 2017 (Chart 1.1). This increase is the fourth consecutive rise since UK energy production peaked in 1999 but is now 56 per cent below that peak with production falling in each of the years between 2000 and 2014 due to declines in output from the UK Continental Shelf (UKCS). The rise in 2018 was due to an increase in primary oil and renewable fuel production. Primary oil production rose by 9.0 per cent due to new fields opening as well as the closure of the Forties pipeline for maintenance in December 2017. The combined output of wind, hydro and solar photovoltaics rose by 12 per cent, mainly due to increases in wind and solar capacity. This was matched with strong growth in bioenergy production, up 7.7 per cent on last year, driven by the conversions from coal to biomass at the Drax and Lynemouth power stations. Gas production fell by 3.3 per cent due to the closure of the Theddlethorpe gas terminal in August 2018; overall fossil fuel production increased due to the growth in primary oil, however coal production was at a record low level.

Chart 1.1: UK energy production level

<table>
<thead>
<tr>
<th>Year</th>
<th>Million tonnes of oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>180</td>
</tr>
<tr>
<td>2010</td>
<td>160</td>
</tr>
<tr>
<td>2012</td>
<td>140</td>
</tr>
<tr>
<td>2014</td>
<td>120</td>
</tr>
<tr>
<td>2016</td>
<td>100</td>
</tr>
<tr>
<td>2018</td>
<td>80</td>
</tr>
</tbody>
</table>

Annual growth rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>-15%</td>
</tr>
<tr>
<td>2010</td>
<td>-10%</td>
</tr>
<tr>
<td>2012</td>
<td>-5%</td>
</tr>
<tr>
<td>2014</td>
<td>5%</td>
</tr>
<tr>
<td>2016</td>
<td>10%</td>
</tr>
<tr>
<td>2018</td>
<td>15%</td>
</tr>
</tbody>
</table>

1.5 The reduction in coal output, down 15 per cent to a record low level, is due to reduced demand from electricity generators coupled with mine closures. Nuclear output was down 7.0 per cent due to outages at Dungeness B and Hunterston B towards the end of 2018, resulting in primary electricity (nuclear plus wind, solar and hydro) output being down 1.7 per cent. More details on these changes are given in the later fuel specific chapters.

1.6 In 2018, the primary supply of fuels was 200.0 million tonnes of oil equivalent (mtoe), a 0.1 per cent decrease compared to 2017. Chart 1.2 illustrates the figures for the production and consumption by fuels in 2018. In 2018, aggregate consumption was not met by indigenous production; this continues the trend since 2004 when the UK became a net importer of fuel. The differences between production and consumption are met mainly by trade but stock changes and the use of fuel in international shipping (marine bunkers) are also factors.
1.7 As explained in subsequent chapters, the UK has traded fuels such as oil and gas regardless of whether it has been a net exporter or importer. Imports in 2018 at 154.1 mtoe rose by 1.3 per cent from 2017 but were down 14 per cent from their peak in 2013. Imports of primary oil and gas fell, but these were more than offset by the rise in imports of petroleum products which were up by 2.0 per cent to meet UK refinery demand during an extended period of refinery maintenance in 2018. Exports at 81.3 million toe were up 2.6 per cent, as production from new oil fields was primarily exported to Asia, resulting in an increase of 16 per cent in crude oil exports. The UK remained a net importer of all main fuel types in 2018. In 2018 the UK net import gap fell back to 72.8 million toe from the 2013 peak of 104 million toe. **Net imports accounted for 36.0 per cent of energy used in the UK in 2018, down from their share of 47.9 per cent in 2013** (see table 1B and chart 1.7).

**Energy demand and final consumption**

1.8 Total primary energy demand was marginally lower in 2018 than in 2017 at 200.1 mtoe. The small fall in demand compared to a year earlier was mainly due to reduced losses in transformation, as renewables continued to displace coal in generation. Average temperatures overall in 2018 were broadly similar to 2017, whilst the average number of heating degree days was up from 5.2 to 5.5.

1.9 Primary energy consumption (primary supply less non-energy use) was down marginally in 2018. **On a temperature corrected basis, primary energy consumption was estimated to have fallen by 1.1 per cent.** A table showing temperature corrected demand is shown in Table 1.1.4 in the annex on long term trends, while Chart 1.3, shows the continued fall in primary energy consumption.
In 2018, gas accounted for 39.5 per cent of UK generation down from 40.4 per cent in 2017. Coal's share declined further, accounting for only 5.1 per cent in 2018. Nuclear accounted for 19.5 per cent of generation, down from 2017, with thermal renewables accounting for a record 10.4 per cent share. Generation from wind, hydro and solar photovoltaics rose by 12 per cent, to a record high level, due to increased wind and solar capacity and accounted for a record 22.6 per cent of generation. Overall renewables' share of generation was at a record high of 33.0 per cent in 2018. More details on electricity are available in Chapter 5, with further information on renewable generation available in Chapter 6.

Chart 1.4: Primary demand 2018

Primary demand: 200.1 million tonnes of oil equivalent
The continued switch from coal to renewables for generation has resulted in a sharp decrease in carbon dioxide emissions between 2017 and 2018. Provisional BEIS estimates suggest that overall emissions fell by 9.1 million tonnes of carbon dioxide (MtCO₂) (2.4 per cent) to 364.1 MtCO₂ between 2017 and 2018. More details of carbon dioxide emissions are available in a Statistical Release, published in March 2019, which is available on the BEIS section of the GOV.UK website at: www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2018

Total final consumption, which includes non-energy use of fuels, was 151.3 million tonnes of oil equivalent in 2018. Chart 1.5 shows consumption by category, with transport and domestic use accounting for nearly two thirds of final consumption.

Chart 1.5: Final consumption 2018

Final consumption (including Non-Energy Use) increased by 1.5 million tonnes of oil equivalent, up 1.0 per cent, on the consumption in 2017. The increase comes mainly from the domestic sector, which rose by 3.4 per cent. The domestic rise in consumption was mainly due to the colder weather in February and March 2018 during the ‘Beast from the East’ weather storm. On a temperature adjusted basis domestic consumption is estimated to have decreased by 0.1 per cent in 2018, and is down by 8.8 per cent over the last 10 years.

Consumption in the transport sector fell by 0.1 per cent, despite slightly increased demand in air transport consumption. Consumption in the service sector rose by 1.1 per cent on increased heating demand, whilst consumption in the industrial sector rose by 0.3 per cent. There was a fall in non-energy use of 0.9 per cent.

Final energy consumption (where non-energy use is excluded) was up by 1.1 per cent on the year. On a temperature corrected basis final energy consumption was estimated to be up 0.2 per cent in 2018 compared to 2017 but is down by 6.5 per cent since 2008.

The main fuels used by final consumers in 2018 were petroleum products (47.4 per cent), natural gas (29.2 per cent) and electricity (17.0 per cent). Biofuels accounted for 4.3 per cent of final consumption. The amount of heat that was bought for final consumption accounted for 0.8 per cent of the total final consumption.
1.17 Of the petroleum products consumed by final users 11 per cent was for non-energy purposes; for natural gas 0.9 per cent was consumed for non-energy purposes. Non-energy use of fuels includes use as chemical feedstocks and other uses such as lubricants. Non-energy use of fuels for 2018 is shown in Table 1A. Further details of non-energy use are given in Chapter 2 paragraph 2.31, Chapter 3, paragraph 3.23 and Chapter 4, paragraph 4.26.

### Table 1A: Non-energy use of fuels 2018

<table>
<thead>
<tr>
<th></th>
<th>Thousand tonnes of oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Petroleum</td>
</tr>
<tr>
<td>Petrochemical feedstocks</td>
<td>5,321</td>
</tr>
<tr>
<td>Other</td>
<td>2,758</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,079</strong></td>
</tr>
</tbody>
</table>

1.18 The data in the energy balances (Table 1.1) can be viewed in a number of ways, with a number of other statistics derived to produce different descriptions of the UK energy market. Recently greater focus has been given to looking at import dependency and also at fossil fuel dependency. Import dependency (Table 1B) is calculated by dividing net imports by primary supply, including an addition for the energy supplied to marine bunkers. Chart 1.7 shows this on a longer time frame.

### Table 1B: Net import dependency 2016 to 2018

<table>
<thead>
<tr>
<th></th>
<th>Thousand tonnes of oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Net imports</td>
<td>74,045</td>
</tr>
<tr>
<td>Primary energy supply + bunkers</td>
<td>204,768</td>
</tr>
<tr>
<td><strong>Net import dependency</strong></td>
<td><strong>36.2%</strong></td>
</tr>
</tbody>
</table>
The energy used in the UK can also be classified by whether its source was from fossil fuels, low-carbon sources or other (Table 1C). The main fossil fuel sources in the UK are coal, gas and oil. The low carbon sources include nuclear and renewables such as wind; hydro; solar photovoltaics (pv) and biofuels. In 2018, the share of primary energy consumption from fossil fuels decreased further to a record low of 79.4 per cent, whilst that from low-carbon sources increased from 18.3 per cent to a record 19.0 per cent share.

The largest component of the low carbon series is currently nuclear; though its share of energy supplied fell slightly to 7.3 per cent in 2018. There was a rise in the share from renewables; with an increase in bioenergy use. The ‘other’ category, shown for completeness, includes net imports of electricity, as imports and exports could come from either of the previous categories, and non-biodegradable wastes. Headline data, taken from Table 6.7 later in this publication, show that renewables had a “normalised” 11.0 per cent share of final energy consumption in 2018 (the normalisation process takes out weather effects from this statistic). There are other ways to measure renewables contribution to energy, and these are discussed in more detail in Chapter 6.

<table>
<thead>
<tr>
<th>Table 1C: Fossil fuel and low carbon dependencies 2016 to 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per cent</td>
</tr>
<tr>
<td>Fossil fuel</td>
</tr>
<tr>
<td>Low carbon</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

Value balance of traded energy (Tables 1.4, 1.5 and 1.6)

Tables 1.4 to 1.6 present the value of traded energy in a similar format to the energy balances. The balance shows how the value of inland energy supply is made up from the value of indigenous production, trade, tax and margins (profit and distribution costs). The lower half of the tables show how this value is generated from the final expenditure on energy (from the industrial and domestic sectors) through transformation processes and other energy sector users. The balances only contain values of energy which are traded, i.e. where a transparent market price is applicable. Further technical notes are given in paragraphs 1.39 to 1.45.

Total expenditure by final consumers in 2018 is estimated at £128,320 million, (£128,065 million shown as actual final consumption and £255 million of coal consumed by the iron and steel sector in producing coke for their own consumption), up by 8.2 per cent on the 2017 level.
1.23 Total expenditure by final consumers in 2018 is down by 3.7 per cent (down 9.4 per cent in real terms when adjusted for inflation) from the peak in 2013. The most significant changes from then being the reduced prices in crude and petroleum products. In 2018, crude oil prices averaged around $71 per barrel which is 35 per cent lower compared to the average price of just under $109 per barrel in 2013. Chart 1.8 shows energy consumption and expenditure by final users.

**Chart 1.8: Energy consumption and estimated expenditure on energy by final users 2000 - 2018**

1.24 Of the total final expenditure on energy in 2018 (£128 billion), the biggest share of 51 per cent fell to the transport sector. Industry purchase was 10 per cent (£13 billion), the domestic sector purchase was 26 per cent (£33 billion) and the remaining 13 per cent (£16 billion) were in the service sector.

**Sales of electricity and gas by sector (Table 1.7)**

1.25 Table 1.7 shows broad estimates for the total value of electricity and gas to final consumption. Net selling values provide some indication of typical prices paid in broad sectors and can be of use to supplement more detailed and accurate information contained in the rest of this chapter. More detailed information on energy prices is available in *Energy Prices*, available on BEIS’s energy statistics website at: [www.gov.uk/government/collections/quarterly-energy-prices](http://www.gov.uk/government/collections/quarterly-energy-prices)
The energy industries

1.26 The energy industries in the UK play a central role in the economy by producing, transforming and supplying energy in its various forms to all sectors. They are also major contributors to the UK’s Balance of Payments through the exports of crude oil and oil products. The box below summarises the energy industries’ contribution to the economy in 2018, based on the latest available data from the Office for National Statistics (ONS):

- 3.2 per cent of GDP;
- 9.7 per cent of total investment;
- 32.6 per cent of industrial investment;
- 179,000 people directly employed (6.2 per cent of industrial employment);
- Many others indirectly employed (e.g. an estimated 126,700 in support of UK Continental Shelf production).

1.27 The share of GDP at 3.2 per cent compares to a peak level of 10.4 per cent in 1982. The share fell to below 4 per cent in most years since 1997, with energy’s share of the UK economy falling to a low of 2.8 per cent in 2016 before rising marginally in 2017 and 2018. The rise between 2017 and 2018 is largely due to the increase in the price of oil; which rose by around 28 per cent in 2018. In 2018 investment in the energy industries rose slightly with increased spending for electricity and gas. Employment has remained broadly unchanged in the last nine years, but is up from 10 years ago.
Technical notes and definitions

I Units and measurement of energy

Units of measurement

1.28 The original units of measurement appropriate to each fuel are used in the individual fuel chapters. A common unit of measurement, the tonne of oil equivalent (toe), which enables different fuels to be compared and aggregated, is used in Chapter 1. In common with the International Energy Agency and with the Statistical Office of the European Communities, the tonne of oil equivalent is defined as follows:

\[
1 \text{ tonne of oil equivalent} = 10^7 \text{ kilocalories} = 396.83 \text{ therms} = 41.868 \text{ Gigajoules (GJ)} = 11,630 \text{ Kilowatt hours (kWh)}
\]

This unit should be regarded as a measure of energy content rather than a physical quantity. One tonne of oil is not equal to one tonne of oil equivalent.

Calorific values when producing energy statistics

1.29 In this publication Gross Calorific Values (GCVs) are used to convert fuel from their original units to tonnes of oil equivalent (toe). An alternative is to use Net Calorific Values (NCVs) as detailed in paragraph XVII of the introduction. The fuel specific GCVs and NCVs are shown at Annex A. However, as some EU targets are calculated on data converted using net calorific values, aggregate energy balances for the most recent years have been calculated using NCVs; these are used in Table 6.7, and are available on the internet version, Annex I, of this publication at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes.

Thermal content - energy supplied basis of measurement

1.30 Tables 1.1 to 1.3 and 1.1.1 to 1.1.5 (available on the BEIS section of GOV.UK at: www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes) are compiled on an energy-supplied basis. Detailed data for individual fuels are converted from original units to tonnes of oil equivalent using gross calorific values and conversion factors appropriate to each category of fuel. The results are then aggregated according to the categories used in the tables. Gross calorific values represent the total energy content of the fuel, including the energy needed to evaporate the water present in the fuel (see also paragraph 1.55).

1.31 Estimated gross and net calorific values for 2018 are given in Table A.1 in Annex A. Calorific values are reviewed each year in collaboration with the fuel industries, and figures for earlier years can be found in Tables A.2 and A.3. To construct energy balances on an energy supplied basis calorific values are required for production, trade, and stocks, as follows:

**Coal** The weighted average gross calorific value of all indigenous coal consumed is used to derive the thermal content of coal production and undistributed stocks. Thermal contents of imports and exports allow for the quality of coal. Thermal contents of changes in coal stocks at secondary fuel producers are the average calorific values of indigenous coal consumed.

**Petroleum** Work carried out in 1997 to revise calorific values for petroleum products did not find any recent work on the subject. In the absence of such work, the gross calorific values, included in Annex A and used in the construction of these energy balances from 1990 onwards, have been calculated using a formula derived by the US Bureau of Standards. This formula estimates the gross calorific value of products according to their density as follows:

\[
GJ = 51.83 - 8.78 \times d^2, \text{ where } d \text{ is the density of the product in terms of kilograms per litre}
\]

For crude petroleum and refinery losses, the weighted average calorific value for all petroleum products from UK refineries is used. A notional figure of 42.9 GJ per tonne is used for non-energy petroleum products (industrial and white spirits, lubricants, bitumen, petroleum coke, waxes and miscellaneous products).
Gases Although the original unit for gases is the cubic metre, figures for gases are generally presented in the fuel sections of this Digest in gigawatt hours (GWh), having been converted from cubic metres using gross calorific values provided by the industries concerned. Conversion factors between units of energy are given on the inside back page and in Annex A.

Electricity and heat Unlike other fuels, the original unit used to measure electricity and heat is a measure of energy. The figures for electricity and heat can therefore be converted directly to toe using the conversion factors on the inside back page and in Annex A.

Primary electricity Hydro electricity and net imports of electricity are presented in terms of the energy content of the electricity produced (the energy supplied basis). This is consistent with international practice. Primary inputs for nuclear electricity assume the thermal efficiencies at nuclear stations given in Chapter 5, Table 5.10 (39.8 per cent in 2018).

Non-energy uses of fuel
1.32 Energy use of fuel mainly comprises use for lighting, heating, motive power and power for appliances. Non-energy use includes use as chemical feedstocks, solvents, lubricants and road making material. It should be noted that the amounts of non-energy use of natural gas included in the Digest are approximate. Further discussion of non-energy uses of lubricating oils and petroleum coke appears in Chapter 3, paragraph 3.23.

Autogeneration of electricity
1.33 Autogeneration is defined as the generation of electricity by companies whose main business is not electricity generation, the electricity being produced mainly for that company’s own use. Estimated amounts of fuel used for thermal generation of electricity by such companies, the output of electricity and the thermal losses incurred in generation are included within the Transformation section in the energy balances shown in Tables 1.1 to 1.3. Electricity used in the power generation process by autogenerators is shown within the Energy Industry Use section. Electricity consumed by industry and commerce from its own generation is included as part of final consumption. This treatment is in line with the practice in international energy statistics.

1.34 Figures on total amount of fuel used and electricity generated by autogenerators, and the amount of electricity for own consumption is shown in Tables 5.1 to 5.6. Table 5.4 summarises the figures by broad industrial groups. Much of the power generated is from combined heat and power (CHP) plants and data from Chapter 7 are included within Table 5.4. Differences will occur where CHP plants are classified to major power producers, and this mainly affects the chemicals sector. The method of allocating fuel used in CHP plants between electricity production and heat production is described in Chapter 7. This method can give rise to high implied conversion efficiencies in some sectors, most notably in the iron and steel sector.

Final consumption, deliveries, stock changes
1.35 Figures for final consumption relate to deliveries, if fuels can be stored by users and data on actual consumption are not available. Final consumption of petroleum and solid fuels is on a deliveries basis throughout, except for the use of solid fuels by the iron and steel industry. Figures for domestic use of coal are based on deliveries to merchants. Figures for stock changes in Tables 1.1 to 1.3 cover stocks held by primary and secondary fuel producers, major distributors of petroleum products, and stocks of coke and breeze held by the iron and steel industry; for coal they also include an estimate of volumes in transit. Figures for stock changes in natural gas represent the net amount put into storage by gas companies operating pipelines.

1.36 Figures for final consumption of electricity include sales by the public distribution system and consumption of electricity produced by generators other than the major electricity producing companies. Thus, electricity consumption includes that produced by industry and figures for deliveries of other fuels to industry exclude amounts used to generate electricity (except for years prior to 1987, shown in tables giving long term trends).
Heat sold
1.37 Heat sold has been separately identified in the energy balances since 1999. It is defined as heat that is produced and sold under the provision of a contract. The introduction of heat sold into the energy and commodity balances did not affect the individual fuel totals, since the energy used to generate the heat has been deducted from the final consumption section of the energy balances and transferred to the transformation section. Details of the methodology used and tables that show the detailed analysis of the heat generation row of the main energy balances, by sector generating the heat, are available at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes. To make the heat sold information more transparent, data on the quantity of fuel by consuming sector used to produce heat that is subsequently sold are also available in Annex J.

II Energy balances (Tables 1.1, 1.2 and 1.3)
1.38 Tables 1.1, 1.2 and 1.3 show the energy flows as the primary fuels are processed (or used) and as the consequent secondary fuels are used. The net inputs to transformation are shown in the transformation rows and hence outputs from transformation processes into which primary fuels are input (such as electricity generation, heat generation or petroleum refining) appear as positive figures under the secondary product’s heading in the tables. Similarly, the net inputs are shown as negative figures under the primary fuel headings.

III Value balances (Tables 1.4, 1.5 and 1.6)
Valuation of energy purchases
1.39 In common with the rest of the chapter, these tables covering energy expenditure follow a balance format. While a user may derive data on a similar basis as that previously published, the balance tables allow for more varied use and interpretation of traded energy value data. That said, the tables continue to only show values for energy that has to be purchased and therefore do not include estimated values of a sector’s internal consumption, such as coal used in the process of coal extraction.

The value balance
1.40 The tables balances around market value of inland consumption, with the lower half of the tables showing the total value of consumption by end users, sub divided into energy sector users and final users both for energy and non-energy use. The top half of the tables show the supply components that go to make up the final market value of inland consumption, namely upstream cost of production, imports, taxes and the margins and costs of delivering and packaging the fuel for the final consumer. The total final consumers’ value of energy consumption is represented by the lines ‘total non-energy sector use’ and iron and steel sectors’ purchases of coal for use in solid fuel manufacture. All figures are estimates and have been rounded to the nearest £5 million.

1.41 In keeping with the energy balances, the value balances, since 2000, have included data on heat generation and heat sold. Additionally, an estimate of the amount of Climate Change Levy (CCL) and the Carbon Price Support (CPS) paid is included in Tables 1.4, 1.5 and 1.6. The CCL was introduced in April 2001 and is payable by non-domestic final consumers of gas, electricity, coal, coke and LPG, with the Carbon Price Support (CPS), a tax on fossil fuel used to generate electricity, was introduced in April 2013.

1.42 The value balance demonstrates how the value chain works in the production and consumption of energy. For example, in 2018, £21,285 million of crude oil was indigenously produced, of which £18,605 million was exported; and £20,580 million of crude oil was imported. Allowing for stock changes, this provides a total value of UK inland crude oil supply of £23,375 million. This fuel was then completely consumed within the petroleum industry in the process of producing £31,915 million of petroleum products. Again, some external trade and stock changes took place before arriving at a basic value of petroleum products of £35,635 million. In supplying the fuel to final consumers, distribution costs were incurred, and some profit was made amounting to £2,495 million, whilst duty and tax meant a further £34,220 million was added to the basic price to arrive at the final market value of £72,430 million. This was the value of petroleum products purchased, of which industry purchased
£1,220 million, domestic consumers for heating purposes purchased £1,350 million, with the vast majority £63,085 million, purchased by the transport sector.

**Fuel definitions in value balances**

1.43 **Crude oil** includes Natural Gas Liquids (NGLs) and refinery feedstocks. **Natural gas** does not include colliery methane. **Electricity** only includes electricity delivered via the public distribution system and therefore does not value electricity produced and consumed by autogenerators; however, the fuels used by autogenerators are included under Transformation. **Manufactured solid fuels** include coke, breeze and other solid manufactured fuels, mainly products from patent fuel and carbonisation plants. **Other fuels** include all other fuels not separately listed, where they can be clearly considered as traded and some reasonable valuation can be made. Fuels mainly contributing to this year’s values are wood, coke oven and colliery methane gases sold on to other industrial users and some use of waste products such as poultry litter.

**Energy end use**

1.44 Values represent the cost to the final user including transportation of the fuel. They are derived, except where actual values are available, from the traded element of the volumes presented in aggregate energy balance and end user prices collected from information supplied by users or energy suppliers. The **energy sector** consists of those industries engaged in the production and sale of energy products, but values are not given for consumption of self-generated fuels e.g. coke oven gas used by coke producers. Many of the processes in the **iron and steel** industry are considered to be part of the energy sector in the energy balances, but for the purposes of this economic balance their genuine purchases are treated as those of final consumers, except for purchases of coal directly used in coke manufacture, which is shown separately as part of the manufacture of solid fuel. Coal used directly in or to heat blast furnaces is shown as iron and steel final use. **Transformation** includes those fuels used directly in producing other fuels e.g. crude oil in petroleum products. **Electricity generators** keep and use stocks of coal, and the stocks used in consumption each year are shown separately. The value and margins for these being assumed to be the same as other coal purchased in the year. **Road transport** includes all motor spirit and DERV (diesel-engined road vehicle) use. **Commercial and other users** include public administration and miscellaneous uses not classified to the industrial sector.

**Supply**

1.45 The supply side money chain is derived using various methods. **Indigenous production** represents the estimated basic value of in-year sales by the upstream producers. This value is gross of any taxes or cost they must meet. The valuation problems in attributing network losses in gas and electricity between upstream and downstream within this value chain means any costs borne are included in the production value. **Imports and exports** are valued in accordance with data published by HM Revenue and Customs, contained in Annex G. However, crude oil is treated differently, where the value is formed from price data taken from a census survey of refiners and volume data taken from Table 3.1. These values are considered to reflect the complete money chain more accurately than Tables G.1 to G.7. **Stock changes** are those for undistributed stocks except for coal where coke oven and generators’ stocks are included. A stock increase takes money out of the money chain and is therefore represented as a negative. **Distribution costs** are arrived at by removing an estimate of producers’ value along with any taxes from the end user values shown. For most fuels, the estimate of producer value is derived from the consumption used for end use and the producer price taken from survey of producers. No sector breakdown is given for gas and electricity margins because it is not possible to accurately measure delivery costs for each sector. **Taxes** include VAT where not refundable and duties paid on downstream sales. Excluded are the gas and fossil fuel levies, petroleum revenue tax and production royalties and licence fees. The proceeds from the fossil fuel levy are redistributed across the electricity industry, whilst the rest are treated as part of the production costs.
Sales of electricity and gas by sector (Table 1.7)

1.46 This table provides data on the total value of gas and electricity sold to final consumers. The data are collected from the energy supply companies. The data are useful in indicating relative total expenditure between sectors, but the quality of data provided in terms of industrial classification has been worsening in recent years. Net selling values provide an indication of typical prices paid in broad sectors.

IV Measurement of energy consumption

Primary fuel input basis

1.47 Energy consumption is usually measured in one of three different ways. The first, known as the primary fuel input basis, assesses the total input of primary fuels and their equivalents. This measure includes energy used or lost in the conversion of primary fuels to secondary fuels (for example in power stations and oil refineries), energy lost in the distribution of fuels (for example in transmission lines) and energy conversion losses by final users. Primary demands as in Table 1.1, 1.2 and 1.3 are on this basis.

Final consumption - energy supplied basis

1.48 The second method, known as the energy supplied basis, measures the energy content of the fuels, both primary and secondary, supplied to final users. Thus, it is net of fuel industry own use and conversion, transmission and distribution losses, but it includes conversion losses by final users. Table 1D presents shares of final consumption on this basis. The final consumption figures are presented on this basis throughout Chapter 1.

1.49 Although this is the usual and most direct way to measure final energy consumption, it is also possible to present final consumption on a primary fuel input basis. This can be done by allocating the conversion losses, distribution losses and energy industry use to final users. This approach can be used to compare the total primary fuel use which each sector of the economy accounts for. Table 1E presents shares of final consumption on this basis.

Final consumption - useful energy basis

1.50 Thirdly, final consumption may be expressed in the form of useful energy available after deduction of the losses incurred when final users convert energy supplied into space or process heat, motive power or light. Such losses depend on the type and quality of fuel and the equipment used and on the purpose, conditions, duration and intensity of use. Statistics on useful energy are not sufficiently reliable to be given in this Digest; there is a lack of data on utilisation efficiencies and on the purposes for which fuels are used.

Shares of each fuel in energy supply and demand

1.51 The relative importance of the energy consumption of each sector of the economy depends on the method used to measure consumption. Shares of final consumption on an energy supplied basis (that is in terms of the primary and secondary fuels directly consumed) in 2018 are presented in Table 1D. For comparison, Table 1E presents shares of final consumption on a primary fuel input basis.
Table 1D: Primary and secondary fuels consumed by final users in 2018 – energy supplied basis

<table>
<thead>
<tr>
<th>Percentage of each fuel</th>
<th>Industry</th>
<th>Transport</th>
<th>Domestic</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid fuels</td>
<td>70</td>
<td>1</td>
<td>28</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>Petroleum</td>
<td>4</td>
<td>87</td>
<td>4</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Gas</td>
<td>21</td>
<td>-</td>
<td>61</td>
<td>19</td>
<td>100</td>
</tr>
<tr>
<td>Electricity</td>
<td>31</td>
<td>2</td>
<td>35</td>
<td>32</td>
<td>100</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>22</td>
<td>21</td>
<td>37</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of each sector</th>
<th>Solid fuels</th>
<th>Petroleum</th>
<th>Gas</th>
<th>Electricity</th>
<th>Bioenergy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>6</td>
<td>10</td>
<td>41</td>
<td>36</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Transport</td>
<td>0</td>
<td>97</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Domestic</td>
<td>1</td>
<td>6</td>
<td>65</td>
<td>22</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Others</td>
<td>0</td>
<td>17</td>
<td>38</td>
<td>39</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

All fuels: 16 40 29 15 100
All users: 1 45 31 18 5 100

1.52 In 2018, every 1 toe of secondary electricity consumed by final users required, on average, 0.2 toe of coal, 1.1 toe of natural gas, 0.6 toe of primary electricity (nuclear) and 0.5 toe of oil and bioenergy combined. The extent of this primary consumption is hidden in Table 1D, which presents final consumption only in terms of the fuels directly consumed. When all such primary consumption is allocated to final users, as in Table 1E, the relative importance of fuels and sectors changes; the transport sector, which uses very little electricity, declines in importance, whilst the true cost of final consumption in terms of coal use can now be seen.

1.53 Another view comes from shares of users’ expenditure on each fuel (Table 1F based on Table 1.4). In this case the importance of fuels which require most handling by the user (solids and liquid fuels) is slightly understated, and the importance of uses taxed at higher rates (transport) is overstated in the “All users” line.

Table 1E: Total primary fuel consumption by final users in 2018 - primary input basis

<table>
<thead>
<tr>
<th>Percentage of each fuel</th>
<th>Industry</th>
<th>Transport</th>
<th>Domestic</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>42</td>
<td>1</td>
<td>33</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>Petroleum</td>
<td>4</td>
<td>86</td>
<td>4</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Gas</td>
<td>25</td>
<td>1</td>
<td>51</td>
<td>23</td>
<td>100</td>
</tr>
<tr>
<td>Primary electricity</td>
<td>31</td>
<td>2</td>
<td>35</td>
<td>32</td>
<td>100</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>28</td>
<td>9</td>
<td>35</td>
<td>27</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of each sector</th>
<th>Coal</th>
<th>Petroleum</th>
<th>Gas</th>
<th>Primary electricity</th>
<th>Bioenergy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>11</td>
<td>7</td>
<td>51</td>
<td>18</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>Transport</td>
<td>0</td>
<td>96</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Domestic</td>
<td>6</td>
<td>5</td>
<td>66</td>
<td>13</td>
<td>11</td>
<td>100</td>
</tr>
<tr>
<td>Others</td>
<td>6</td>
<td>12</td>
<td>49</td>
<td>20</td>
<td>13</td>
<td>100</td>
</tr>
</tbody>
</table>

All fuels: 19 32 30 19 100
All users: 5 36 39 12 9 100

1.54 The systems of measurement used in various international statistics differ slightly from the methods of the Digest. The key difference is the conversion factors used in BEIS’s headline data that change the units for fuels for a volume or weight measure to an energy basis, as discussed in the paragraph below. However, in line with the International Recommendations for Energy Statistics (IRES) the UK does make data available on both bases. Other differences are that both the International Energy Agency (IEA) as well as the United Nations’ IRES have International Aviation Bunkers as well as International Marine Bunkers shown together and not included in the country’s
energy supply. The UK in its energy balances continues to show fuel used for international marine bunkers in this manner but has maintained its practice of showing fuel for international aviation as part of final consumption - this practice is also followed by Eurostat.

**Net calorific values**

1.55 Calorific values (thermal contents) used internationally are net rather than gross. The difference between the net and gross thermal content is the amount of energy necessary to evaporate the water present in the fuel or formed during the combustion process. The differences between gross and net values are generally taken to be 5 per cent for liquid and solid fuels (except for coke and coke breeze where there is no difference), 10 per cent for gases (except for blast furnace gas, 1 per cent), 15 per cent for straw, and 20 per cent for poultry litter. The calorific value of wood is highly dependent on its moisture content. In Annex A, the gross calorific value is given as 16.3 GJ at 20 per cent moisture content and 20.3 GJ for dry wood. Both gross and net calorific values are shown in Annex A. Energy balances on a net calorific basis are published in Annex I of DUKES available at: www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

**V Definitions of fuels**

1.56 The following paragraphs explain what is covered under the terms “primary” and “secondary” fuels.

**Primary fuels**

- **Coal** - Production comprises all grades of coal, including slurry.
- **Primary oils** - This includes crude oil, natural gas liquids (NGLs) and feedstock.
- **Natural gas liquids** - Natural gas liquids (NGLs) consist of condensates (C5 or heavier) and petroleum gases other than methane C1, that is ethane C2, propane C3 and butane C4, obtained from the onshore processing of associated and non-associated gas. These are treated as primary fuels when looking at primary supply but in the consumption data presented in this chapter these fuels are treated as secondary fuels, being transferred from the primary oils column in Tables 1.1, 1.2 and 1.3.
- **Natural gas** - Production relates to associated or non-associated methane C1 from land and the United Kingdom sector of the Continental Shelf. It includes that used for drilling production and pumping operations, but excludes gas flared or re-injected. It also includes colliery methane piped to the surface and consumed by collieries or others.
- **Nuclear electricity** - Electricity generated by nuclear power stations belonging to the major power producers.
- **Natural flow hydro-electricity** - Electricity generated by natural flow hydroelectric power stations, whether they belong to major power producers or other generators. Pumped storage stations are not included (see under secondary electricity below).
- **Renewable energy sources** - In this chapter figures are presented for renewables and waste in total. Further details, including a detailed breakdown of the commodities and technologies covered are in Chapter 6.

**Secondary fuels**

- **Manufactured fuel** - This heading includes manufactured solid fuels such as coke and breeze, other manufactured solid fuels, liquids such as benzole and tars and gases such as coke oven gas and blast furnace gas. Further details are given in Chapter 2, Tables 2.5 and 2.6.
- **Coke and breeze** – Coke, oven coke and hard coke breeze. Further details are given in Chapter 2, Table 2.5.
- **Other manufactured solid fuels** – Manufactured solid fuels produced at low temperature carbonisation plants and other manufactured fuel and briquetting plants. Further details are given in Chapter 2, Table 2.5.
- **Coke oven gas** - Gas produced at coke ovens, excluding low temperature carbonisation plants. Gas bled or burnt to waste is included in production and losses. Further details are given in Chapter 2, Table 2.6.
- **Blast furnace gas** - Blast furnace gas is mainly produced and consumed within the iron and steel industry. Further details are given in Chapter 2, Table 2.6.
- **Petroleum products** - Petroleum products produced mainly at refineries, together with inland deliveries of natural gas liquids.
Secondary electricity - Secondary electricity is that generated by the combustion of another fuel, usually coal, natural gas, biofuels or oil. The figure for outputs from transformation in the electricity column of Tables 1.1, 1.2 and 1.3 is the total of primary and secondary electricity, and the subsequent analysis of consumption is based on this total.

Heat sold – Heat sold is heat that is produced and sold under the provision of a contract.

VI Classification of consumers

1.57 The Digest has been prepared, as far as is practicable, on the basis of the Standard Industrial Classification (SIC) 2007, details of which are available at: www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicsactivities/uksic2007). Table 1G shows the categories of consumers together with their codes in SIC 2007. SIC(2007) replaced SIC(2003) on 1 January 2008, with energy statistics being compiled on the new basis from 2010. SIC(2003) was introduced at the start of 2003; the previous classification SIC(1992) was used from 1995. Between 1986 and 1994 data in the Digest were prepared on the basis of SIC(1980). The changes in classification between SIC(1992), SIC(2003) and SIC(2007) are mainly in the very detailed classifications at the four or five digit level. As such the classifications used for energy statistics are unaffected by these changes.

1.58 The coverage varies between tables (e.g. in some instances the ‘other’ category is split into major constituents, whereas elsewhere it may include transport). This is because the coverage is dictated by what data suppliers can provide. The table also shows the disaggregation available within industry. This disaggregation forms the basis of virtually all the tables that show a disaggregated industrial breakdown.

1.59 There is also an ‘unclassified’ category in the industry sector (see Table 1G). In cases where the data supplier has been unable to allocate an amount between categories, but the Department for Business, Energy and Industrial Strategy has additional information, from other data sources, with which to allocate between categories, then this has been done. Where such additional information is not available the data are included in the ‘unclassified’ category, enabling the reader to decide whether to accept a residual, pro-rate, or otherwise adjust the figures. The ‘miscellaneous’ category also contains some unallocated figures for the services sector.
Table 1G: SIC 2007 classifications

Fuel producers: 05-07, 09, 19, 24.46, 35

Final consumers:

**Industrial**
- Unclassified: See paragraph 1.59
- Iron and steel: 24, (excluding 24.4, 24.53, 24.54)
- Non-ferrous metals: 24.4, (excluding 24.46), 24.53, 24.54
- Mineral products: 08, 23
- Chemicals: 20-21
- Mechanical engineering and metal products: 25, 28
- Electrical and instrument engineering: 26-27
- Vehicles: 29-30
- Food, beverages & tobacco: 10-12
- Textiles, clothing, leather, & footwear: 13-15
- Paper, printing & publishing: 17-18
- Other industries: 16, 22, 31-33, 36-39
- Construction: 41-43

**Transport**
- 49-51 (part*)

**Other final users**
- Domestic: Not covered by SIC 2007
- Public administration: 84-88
- Agriculture: 01-03
- Miscellaneous: 90-99

* Note – transport sector includes only energy used for motion/traction purposes. Other energy used by transport companies is classified to the commercial sector.

1.60 In Tables 7.8 and 7.9 of Chapter 7 the following abbreviated grouping of industries (Table 1H), based on SIC 2007, is used in order to prevent disclosure of information about individual companies.

Table 1H: Abbreviated grouping of Industry

- Iron and steel and non-ferrous metal: 24
- Chemicals: 20-21
- Oil refineries: 19.2
- Paper, printing and publishing: 17-18
- Food, beverages and tobacco: 10-12
- Metal products, machinery and equipment: 25, 26, 27, 28, 29, 30
- Mineral products, extraction, mining and agglomeration of solid fuels: 05, 06, 08, 23
- Sewage Treatment: (parts of 36 and 37)
- Electricity supply: 35.1
- Other industrial branches: 07, 13, 14, 15,16, 19.1, 24.46, 22, 31, 32, 33, 35.2, 36 & 37 (remainder) 41, 42, 43
- Transport, commerce, and administration: 1, 2, 3, 45 to 99 (except 93)
- Other: 35.3, 93

1.61 In Table 5.4 the list above is further condensed and includes only manufacturing industry and construction as follows in Table 1I.

Table 1I: Abbreviated grouping of Industry for Table 5.4

- Iron and steel and non-ferrous metals: 24
- Chemicals: 20-21
- Paper, printing and publishing: 17-18
- Food, beverages and tobacco: 10-12
- Metal products, machinery and equipment: 25-30
- Other (including construction): 08, 13-16, 19, 22-23, 31-33, 36-39, 41-43
VII Monthly and quarterly data

1.62 Monthly and quarterly data on energy production and consumption (including on a seasonally adjusted and temperature corrected basis) split by fuel type are provided on the BEIS section of the GOV.UK website at: www.gov.uk/government/statistics/total-energy-section-1-energy-trends. Quarterly figures are also published in BEIS’s quarterly statistical bulletins Energy Trends and Energy Prices. See Annex C for more information about these bulletins.

VIII Statistical differences

1.63 Tables 1.1 to 1.3 each contain a statistical difference term covering the difference between recorded supply and recorded demand. These statistical differences arise for a number of reasons. The data within each table are taken from varied sources, as described above and in later chapters; for example, producers, intermediate consumers (such as electricity generators), final consumers and HM Revenue and Customs. Also, some of the figures are estimated either because data in the required detail are not readily available within the industry or because the methods of collecting the data do not cover the smallest members of the industry. Typically, the supply of fuels is easier to measure than demand, and thus greater reliance can be made of these numbers.
IX Revisions

1.64 Table 1J shows a summary of the revisions made to the major energy aggregates between this year’s edition of DUKES and the immediately preceding version. This year, the revisions window for DUKES has been opened back to 2015. Key data changes this year include revisions to oil sector estimates of demand, see Energy Trends article at: www.gov.uk/government/publications/energy-trends-june-2019-special-feature-article-change-to-method-of-estimating-sector-demand-for-oil-products, following an extensive programme of improvement that is ongoing, and a change of method to reporting actual shipments of Liquefied Natural Gas (LNG), see Energy Trends article at: www.gov.uk/government/publications/energy-trends-march-2019-special-feature-article-proposed-change-to-method-of-reporting-uk-liquified-natural-gas-imports, as they enter the terminals from tankers and are placed into storage.

1.65 There have been two main effects of the improvement work on estimates of oil demand by sector. The first has been re-allocation of over one million tonnes of oil from ‘unclassified’ to other sectors, including agriculture, public administration and commerce in 2016 and 2017 data. A second effect has been an increase in the amount of oil allocated to non-energy, particularly in 2017, following better data coverage of this sector. The increase has been primarily driven by re-balancing of liquefied petroleum gases (propane and butane) and naphtha, which has accounted for more than three-quarters of the increase to non-energy use of oil in 2017 data.

<table>
<thead>
<tr>
<th>Table 1J: Revisions since DUKES 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousand tonnes of oil equivalent</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Production</td>
</tr>
<tr>
<td>Primary supply</td>
</tr>
<tr>
<td>Primary demand</td>
</tr>
<tr>
<td>Transformation</td>
</tr>
<tr>
<td>Energy industry use</td>
</tr>
<tr>
<td>Final consumption</td>
</tr>
<tr>
<td>Industry</td>
</tr>
<tr>
<td>Transport</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Non energy use</td>
</tr>
</tbody>
</table>

Contacts: Warren Evans Energy Statistics Team Warren.Evans@beis.gov.uk 0300 068 5059 Kevin Harris Energy Statistics Team Kevin.Harris@beis.gov.uk 0300 068 5041