Department for
Business, Energy
& Industrial Strategy

DIGEST OF UNITED KINGDOM ENERGY STATISTICS 2017

July 2017

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Digest of United Kingdom Energy Statistics

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This is a National Statistics publication

The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the UK Statistics Authority: Code of Practice for Official Statistics.

Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs
- are well explained and readily accessible
- are produced according to sound methods, and
- are managed impartially and objectively in the public interest

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed

Any enquiries regarding this publication should be sent to us at energy.stats@beis.gov.uk

This publication is available for download at www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

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Monthly and quarterly data are also available for Energy, Solid fuels and derived gases, Petroleum, Gas, Electricity and Renewables at:
www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics

Information on Energy Prices is also available at:
www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics

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Introduction

I This issue of the Digest of United Kingdom Energy Statistics (DUKES) continues a series which commenced with the Ministry of Fuel and Power Statistical Digest for the years 1948 and 1949, published in 1950. The Ministry of Fuel and Power Statistical Digest was previously published as a Command Paper, the first being that for the years 1938 to 1943, published in July 1944 (Cmd. 6538). A publication tracing the history of energy production and use over the past 60 years was produced in 2009 to mark the 60th anniversary of DUKES. The publication is available at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

II The current issue updates the figures given in the Department for Business, Energy and Industrial Strategy's (BEIS) *Digest of United Kingdom Energy Statistics 2016*, published in July 2016.

III This publication consists of seven chapters and four annexes. The first chapter deals with overall energy. The other chapters cover the specific fuels, renewable sources of energy and combined heat and power. The annexes cover conversion factors and calorific values, a glossary of terms, further sources of information and major events in the energy industries.

IV Some additional information appears on the internet. The tables on the internet are provided in Microsoft Excel format. Most internet versions of the tables include data for earlier years, which are not provided in this publication. For example commodity and energy balances (see VII and VIII, below) for 1998 to 2013 are included on the internet, and tables that show five years in this publication show nineteen years in their internet form because page sizes are not a limiting factor. In addition, the following appear on the internet:

Long term trends tables
Major events from 1990 to 2017 - Annex D
(only Major events for 2015 to 2017 appear in this publication)
Energy and the environment – Annex E
UK oil and gas resources - Annex F
Foreign trade – Annex G
Flow charts – Annex H
Energy balance: net calorific values – Annex I
Heat reconciliation – Annex J

V Annual information on prices is included in the publication *Energy Prices*. The data are also available on the Department for Business, Energy and Industrial Strategy (BEIS) section of the GOV.UK website. Further information on these publications can be found in Annex C.

VI Where necessary, data have been converted or adjusted to provide consistent series. However, in some cases changes in methods of data collection have affected the continuity of the series. The presence of remaining discontinuities is indicated in the chapter text or in footnotes to the tables.

VII Chapters 2, 3, 4, 5 and 6 contain production and consumption of individual fuels and are presented using *commodity balances*. A commodity balance illustrates the flows of an individual fuel through from production to final consumption, showing its use in transformation (including heat generation) and energy industry own use. Further details of commodity balances and their use are given in Annex A, paragraphs A.7 to A.42.

VIII The individual commodity balances are combined in an *energy balance,* presented in Chapter 1, *Energy*. The energy balance differs from a commodity balance in that it shows the interactions between different fuels in addition to illustrating their consumption. The energy balance thus gives a fuller picture of the production, transformation and use of energy showing all the flows. Expenditure on energy is also presented in energy balance format in Chapter 1. Further details of the energy balance and its use, including the methodology introduced in the 2003 Digest for heat, are given in Annex A, paragraphs A.43 to A.58.

IX Chapter 1 also covers general energy statistics and includes tables showing energy consumption by final users and an analysis of energy consumption by main industrial groups. Fuel production and consumption statistics are derived mainly from the records of fuel producers and suppliers.

X Chapters 6 and 7 summarise the results of surveys conducted by Ricardo Energy & Environment on behalf of BEIS which complement work undertaken by BEIS. These chapters estimate the contribution made by renewable energy sources to energy and combined heat and power (CHP) production and consumption in the United Kingdom.

XI Some of the data shown in this Digest may contain previously unpublished revisions and estimates of trade from HM Revenue and Customs and the Office for National Statistics. These data are included in Annex G.

Definitions

XII The text at the beginning of each chapter explains the main features of the tables. Technical notes and definitions, given at the end of this text, provide detailed explanations of the figures in the tables and how they are derived. Further information on methodologies are also provided on the BEIS section of the GOV.UK website for each fuel

XIII Most chapters contain some information on 'oil' or 'petroleum'; these terms are used in a general sense and vary according to usage in the field examined. In their widest sense they are used to include all mineral oil and related hydrocarbons (except methane) and any derived products.

XIV An explanation of the terms used to describe electricity generating companies is given in Chapter 5, paragraphs 5.62 to 5.69.

XV Data in this issue have been prepared on the basis of the Standard Industrial Classification (SIC 2007) as far as is practicable. For further details of classification of consumers see Chapter 1, paragraphs 1.57 to 1.61.

XVI Where appropriate, further explanations and qualifications are given in footnotes to the tables.

Proposed change to use net calorific values when producing energy statistics

XVII A consultation was launched in the 2005 edition of the Digest seeking views of users as to whether Net Calorific Values (NCVs) should be used in place of Gross Calorific Values (GCVs). As a result of this consultation, it was recognised that there are good arguments both for and against moving from GCV to NCV. However it was concluded that there would be no demonstrable advantage to changing the method of presenting UK Energy statistics, and so GCVs continue to be used in this edition and will be used in future editions of the Digest. The fuel specific NCVs will continue to be published, and are shown in Annex A. The total energy balances on a net calorifc basis are now produced as part of the additional internet content of the Digest, Annex I.

Geographical coverage

XVIII The geographical coverage of the statistics is the United Kingdom. However, within UK trade statistics, shipments to the Channel Islands and the Isle of Man from the United Kingdom are not classed as exports. Supplies of solid fuel and petroleum to these islands, from the UK, are therefore included as part of United Kingdom inland consumption or deliveries.

Periods

XIX Data in this Digest are for calendar years or periods of 52 weeks, depending on the reporting procedures within the fuel industry concerned. Actual periods covered are given in the notes to the individual fuel chapters

Revisions

XX The tables contain revisions to some of the previously published figures, and where practicable the revised data have been indicated by an 'r'. The 'r' marker is used whenever the figure has been revised from that published in the 2016 Digest, even though some figures may have been amended on the internet version of the tables. A table showing the size of revisions to key aggregates is available

(Chapter 1, table 1J). Statistics on energy in this Digest are classified as National Statistics. This means that they are produced to high professional standards as set out in the UK Statistics Authority's Code of Practice for Official Statistics. The Code of Practice requires that all the public bodies that produce official statistics "Publish a revisions policy for those outputs that are subject to scheduled revisions, and provide a statement explaining the nature and extent of revisions at the same time that they are released". The following statement outlines the policy on revisions for energy statistics.

Revisions to data published in the *Digest of UK Energy Statistics*.
It is intended that any revisions should be made to previous years' data only at the time of the publication of the Digest (i.e. in July 2017 when this Digest is published, revisions can be made to 2015 and earlier years). In exceptional circumstances previous years' data can be amended between Digest publication dates, but this will only take place when quarterly *Energy Trends* is published. The reasons for substantial revisions will be explained in the 'Highlights' sheet of the internet version of the table concerned. Valid reasons for revisions of Digest data include:

- revised and validated data received from a data supplier;
- the figure in the Digest was wrong because of a typographical or similar error.

In addition, when provisional annual data for a new calendar year (e.g. 2017) are published in *Energy Trends* in March of the following year (e.g. March 2018), percentage growth rates are liable to be distorted if the prior year (i.e. 2016) data are constrained to the Digest total, when revisions are known to be required. In these circumstances the prior year (i.e. 2016) data will be amended for all affected tables in *Energy Trends* and all affected Digest tables will be clearly annotated to show that the data has been up-dated in *Energy Trends*.

Revisions to 2017 data published in *Energy Trends* prior to publication in the 2018 edition of the *Digest of UK Energy Statistics.*

- All validated amendments from data suppliers will be updated when received and published in the next statistical release.
- All errors will be amended as soon as identified and published in the next statistical release.
- Data in energy and commodity balances format will be revised on a quarterly basis, to coincide with the publication of *Energy Trends*.

Further details on the UK Statistics Authority's Code of Practice for Official Statistics can be found at: www.statisticsauthority.gov.uk/monitoring-and-assessment/code-of-practice/. BEIS's statements of compliance with the Code are available at: www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics. The UK Statistics Authority undertake regular assessments of BEIS's energy statistics and their reports can be accessed at: www.statisticsauthority.gov.uk/publications-list/?keyword=&type=assessment-report.
The authority's recommendations have been incorporated into this publication and other BEIS energy statistical publications and outputs.

Energy data on the internet

XXI Energy data are held on the BEIS section of the GOV.UK website, under "statistics". The Digest is available at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes. Information on further BEIS energy publications is given in Annex C.

XXII The Department for Business, Energy and Industrial Strategy was created on 14 July 2016. This Department took over energy policy from the former Department of Energy and Climate Change. Within this publication references to BEIS's predecessor Department refer to DECC.

XXIII Short term statistics are published:

- monthly, by BEIS;
- quarterly, by BEIS in *Energy Trends,* and *Energy Prices;*
- quarterly, by BEIS in a Statistical Press Release which provides a summary of information published in *Energy Trends* and *Energy Prices*;

Table numbering

XXIV Page 10 contains a list showing the tables in the order in which they appear in this issue, and their corresponding numbers in previous issues.

Symbols used

XXV The following symbols are used in this Digest:

..	not available
-	nil or not separately available
r	revised since the previous edition

Rounding convention

XXVI Individual entries in the tables are rounded independently and this can result in totals, which are different from the sum of their constituent items.

Acknowledgements

XXVII Acknowledgement is made to the main coal producing companies, the electricity companies, the oil companies, the gas pipeline operators, the gas suppliers, National Grid, the Institute of Petroleum, the Coal Authority, the United Kingdom International Steel Statistics Bureau, Ricardo Energy & Environment, the Department for Environment, Food and Rural Affairs, the Department for Transport, OFGEM, Building Research Establishment, HM Revenue and Customs, the Office for National Statistics, and other contributors to the enquiries used in producing this publication.

Contacts

XXVIII For general enquiries on energy statistics contact:

BEIS Energy Statistics
(e-mail:energy.stats@beis.gov.uk)

Department for Business, Energy and Industrial Strategy
Energy Statistics Team
1st Floor – Abbey 2,
1 Victoria Street,
London SW1H 0ET

XXIX For enquiries concerning particular data series or chapters contact those named on page 9 or at the end of the relevant chapter.

Contact List

The following people in the Department for Business, Energy and Industrial Strategy may be contacted for further information about the topics listed:

Topic	Contact	Telephone 0300 068	E-mail
Total energy	Warren Evans	5059	Warren.Evans@beis.gov.uk
Solid fuels and derived gases	Chris Michaels	5050	coalstatistics@beis.gov.uk
Oil and upstream gas resources	Matthew Curds	8414	Matthew.Curds@beis.gov.uk
Petroleum (downstream)	Natalie Cartwright	5260	Natalie.Cartwright@beis.gov.uk
Gas supply (downstream)	James Halliwell	8121	James.Halliwell@beis.gov.uk
Electricity	Stephen Ashcroft	2928	electricitystatistics@beis.gov.uk
Renewable sources of energy	James Hemingway	5042	renewablesstatistics@beis.gov.uk
Combined heat and power	Liz Waters	5735	Elizabeth.Waters@beis.gov.uk
Prices and values, industrial, international and oil prices	Anwar Annut	5060	Anwar.Annut@beis.gov.uk
Regional and Local Authority Energy	Greg Haigh	6093	EnergyEfficiency.Stats@beis.gov.uk
Calorific values and conversion factors	Iain MacLeay	5048	Iain.MacLeay@beis.gov.uk
General enquiries	BEIS Energy Statistics		energy.stats@beis.gov.uk

Tables as they appear in this issue and their corresponding numbers in the previous three issues

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Chapter 1
Energy

Key points

- **In 2016, UK energy production was up 1.2 per cent on a year earlier**. The rise was driven by growth in UK Continental Shelf output with both oil and gas output up. There was also growth in biofuels. **However, coal output decreased to record low levels**. (Tables 1.1 and 1.2).

- Imports and exports in 2016 were both down; **overall net imports decreased though they still accounted for 36 per cent of energy used in the UK**.

- **Primary energy consumption was down 1.4 per cent; and on a temperature adjusted basis primary energy consumption was down 2.3 per cent** continuing the downward trend of the last ten years. UK temperatures were above normal, but there was a small increase in heating degree days than in 2015. (Table 1.1.7).

- **Final energy consumption rose by 1.6 per cent** as demand for heating increased with temperature adjusted final energy consumption up by 0.9 per cent on 2015 levels, mainly due to increased energy use in transport . (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 accounts for 81.5 per cent,** a record low level. Supply from renewables increased, with their contribution accounting for 8.9 per cent of final consumption on the EU agreed basis (see Chapter 6).

- In 2016, there was a switch in the main sources of electricity generation away from coal to gas generation. **Generation from coal fell by 60 per cent, as a number of plants closed or switched to burning biomass; gas rose by 46 per cent**. Renewables' share of generation was stable at 25 per cent in 2016, the same as in 2015. **Increased renewables generation capacity was balanced by less favourable weather conditions for solar and wind generation (see chapters 5 and 6).**

- Provisional BEIS estimates suggest that **overall emissions fell by nearly 30 million tonnes of carbon dioxide ($MtCO_2$) (7.4 per cent) to 374.1 $MtCO_2$** between 2015 and 2016, driven by the changes in 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, 2016, 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 web site at:
www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Aggregate energy balance (Tables 1.1, 1.2 and 1.3)

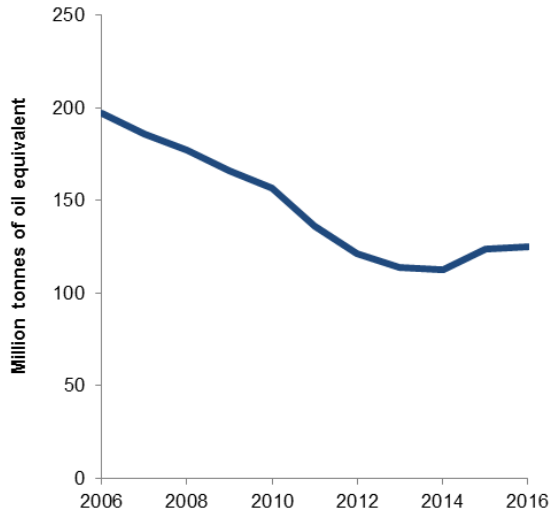
1.3 These tables show the flows of energy in the United Kingdom from production to final consumption through conversion into secondary fuels such as coke, petroleum products, secondary electricity and heat sold. The figures are presented on an energy supplied basis, in tonnes of oil equivalent (toe), 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

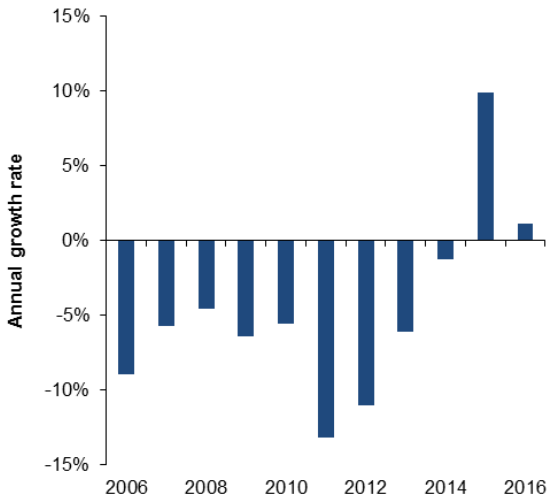
1.4 Indigenous **production in 2016 was 1.2 per cent higher than in 2015** (Chart 1.1). This small increase is the second rise in UK energy production since 1999. Production had fallen in each of the years between 2000 and 2014, mainly due to declines in output from the UK Continental Shelf (UKCS). However, despite the recent rise in output, production is 58 per cent below its peak in 1999. The rise in 2016 was mainly due to increased output from the UKCS, with crude oil production up 4.9 per cent, and with gas production up 2.4 per cent. This growth was mainly down to new fields commencing production. The other source of growth was from increased bioenergy production.

Chart 1.1: UK energy production

Level



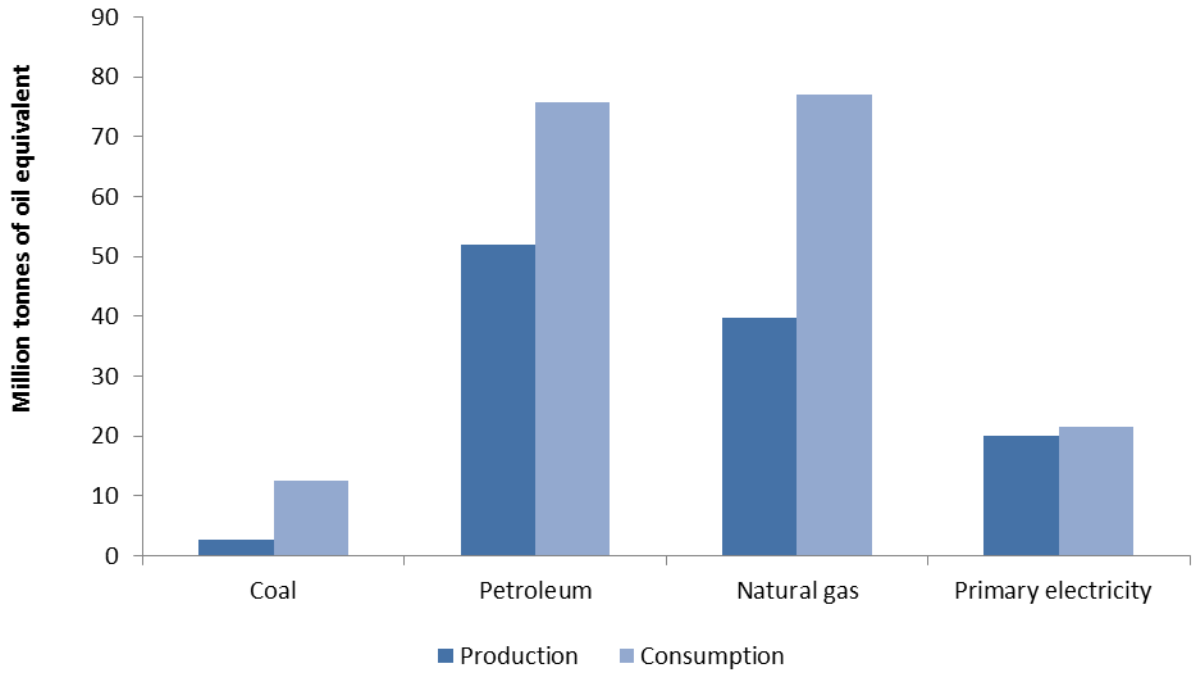
Annual growth rate



1.5 There was a sharp reduction in coal output, down by over 50 per cent on the low output levels in 2015. The decrease is due to the last large deep mines closing in 2015 and a sharp reduction in demand from electricity generators. **There was a fall in primary electricity production, with the combined output from wind, hydro and solar photovoltaics down by 1.8 per cent as adverse weather conditions (less wind, rain and sunshine) more than offset the increases in capacity**. Nuclear output was down marginally by 0.4 per cent. More details on these changes are given in the later fuel specific chapters.

1.6 **In 2016, the primary supply of fuels was 201.1 million tonnes of oil equivalent (mtoe), a 1.1 per cent decrease compared to 2015**. Chart 1.2 illustrates the figures for the production and consumption of individual primary fuels in 2016. In 2016, aggregate primary fuel 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.

Chart 1.2: Production and consumption of primary fuels 2016



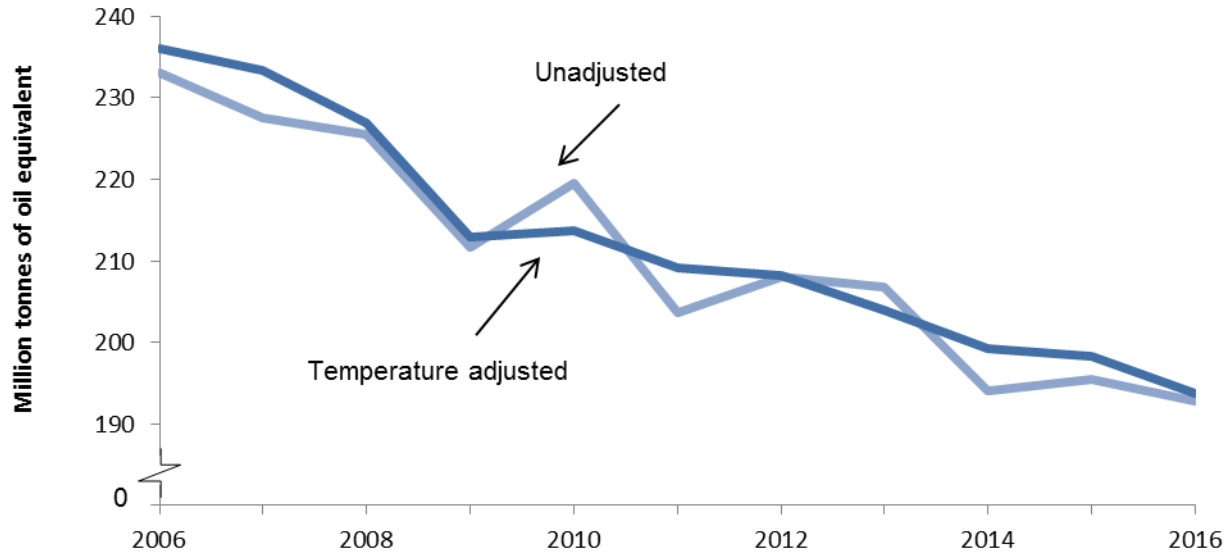
1.7 As explained in subsequent chapters, the UK has traded fuels such as oil and gas regardless of whether it has been a net exporter or importer. Imports in 2016 at 149.7 million toe fell back by 3.5 per cent from 2015 and are down 17 per cent from their peak in 2013. Exports at 75.8 million toe were down 1.1 per cent with the decrease in gas exports more than offsetting the increase in oil exports. The UK remained a net importer of all main fuel types in 2016. In 2016 the UK net import gap fell back to 73.9 million toe from the 2013 peak of 104 million toe. **Net imports accounted for 36 per cent of energy used in the UK in 2016, down from their share of 48 per cent in 2013.**

Energy demand and final consumption

1.8 **Total primary energy demand was 1.1 per cent lower in 2016 than in 2015 at 201.1 mtoe**. The slight fall in demand compared to a year earlier was mainly due to reduced losses in transformation, as more gas replaced coal in generation. Average temperatures overall in 2016 were broadly similar to those in 2015, though it is estimated that heating demand was up with the average number of heating degree days up from 5.3 to 5.5 (Summer 2016 was warmer whilst November and December were colder than in 2015).

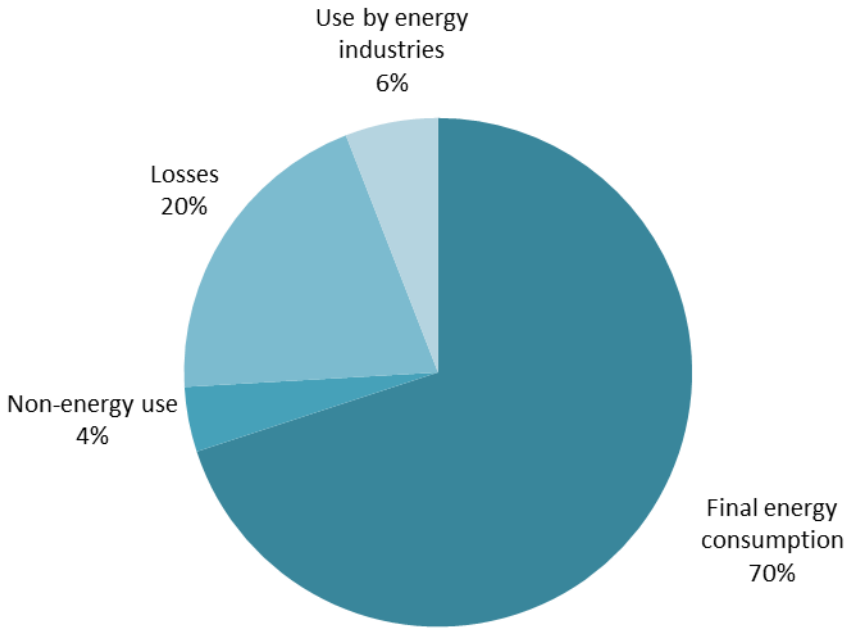
1.9 Primary energy consumption (primary supply less non-energy use) was down by 1.4 per cent in 2016**. On a temperature corrected basis, primary energy consumption was estimated to have fallen by 2.3 per cent.** A table showing temperature corrected demand is shown in Table 1.1.4 in the annex on long term trends, while Chart 1.3, shows the continued fall in primary energy consumption.

Chart 1.3: Primary energy consumption



1.10 In 2016, gas accounted for 42 per cent of UK generation up from 29 per cent in 2015. **Coal's share declined further, accounting for only 9.0 per cent share in 2016; this is down sharply from a share of just under 40 per cent in 2012 and a share of 22 per cent in 2015**. This decline is due to the closure of several power stations and the conversion of others to using biomass. Nuclear accounted for 21 per cent of generation, with thermal renewables accounting for 8.9 per cent, both shares broadly unchanged from last year. Generation from wind, hydro and solar photovoltaics fell by 1.8 per cent due to poorer weather conditions and accounted for just under 16 per cent of generation. Overall renewables' share of generation was stable at 25.4 per cent in 2016. More details on electricity are available in Chapter 5, with further information on renewable generation available in Chapter 6.

Chart 1.4: Primary demand 2016

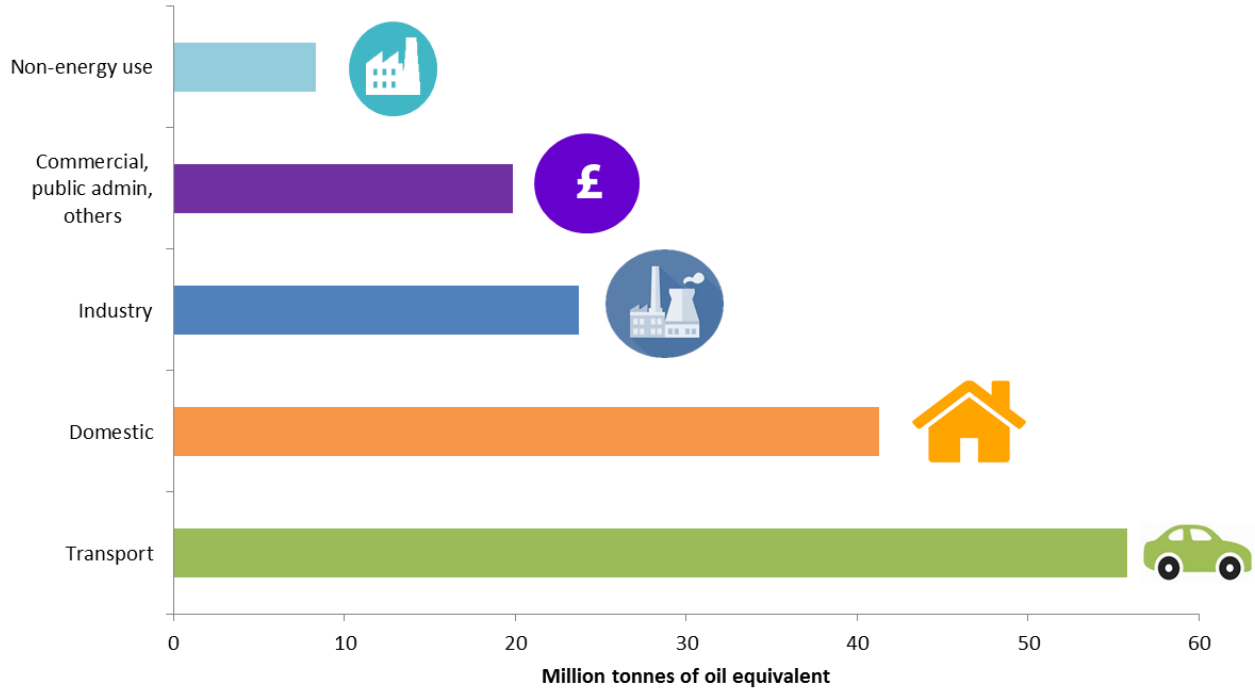


Primary demand: 201.1 million tonnes of oil equivalent

1.11 This switch from coal to gas for generation has resulted in a **sharp decrease in carbon dioxide emissions between 2015 and 2016**. Provisional BEIS estimates suggest that overall emissions fell by 29.8 million tonnes of carbon dioxide ($MtCO_2$) (7.4 per cent) to 374.1 $MtCO_2$ between 2015 and 2016. More details of carbon dioxide emissions are available in a Statistical Release, published in March, which is available on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics.

1.12 Total **final consumption**, which includes non-energy use of fuels, was 149.0 million tonnes of oil equivalent in 2016. 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 2016



1.13 Final consumption (including Non Energy Use) increased by 2.6 million tonnes of oil equivalent, **1.8 per cent up, on the consumption in 2015.** The increase comes mainly from the domestic and transport sectors. The domestic rise in consumption was mainly due to the cooler winter weather in 2016 compared to 2015. On a temperature adjusted basis domestic consumption is estimated to have increased by 1.4 per cent in 2016, though is down 13 per cent over the last 10 years.

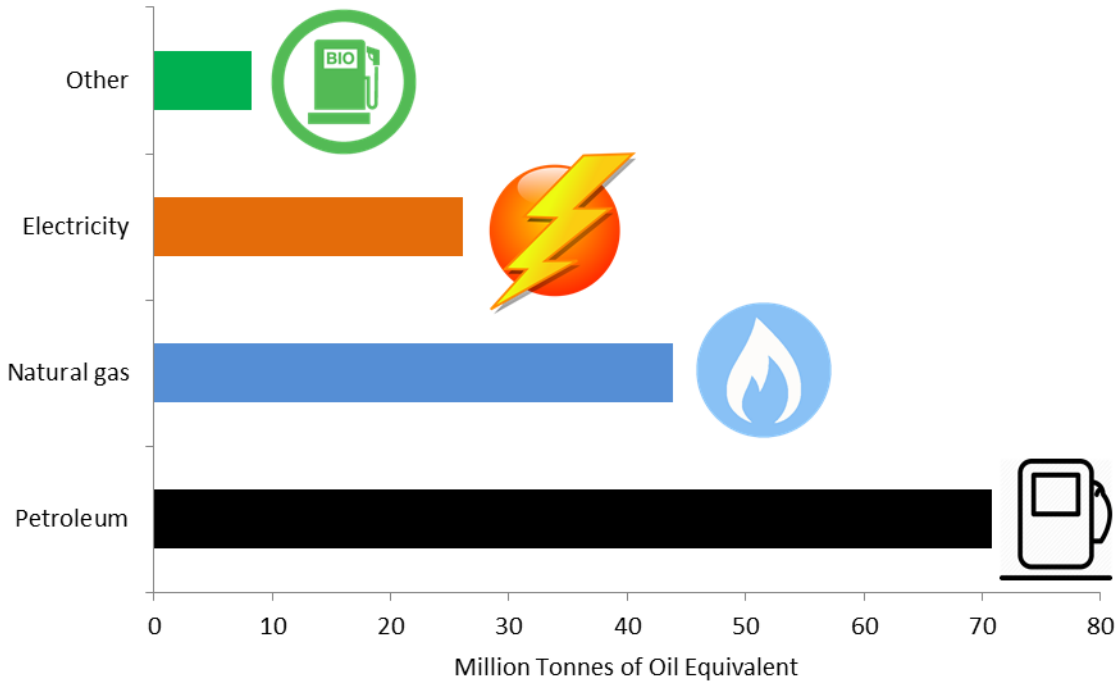
1.14 **Consumption in the transport sector rose by 1.9 per cent; this rise taking consumption to its highest level since 2008 is likely due to increased demand resulting from lower prices as petroleum product prices again fell during the year**. More details on these are published in Quarterly Energy Prices[1]. Consumption in the service sector increased by 2.7 per cent on increased heating demand, whilst consumption in the industrial sector fell by 2.6 per cent. There was also a second successive rise in non-energy use; this is discussed in Chapter 3.

1.15 **Final energy consumption (where non-energy use is excluded) was up by 1.6 per cent on the year**. On a temperature corrected basis final energy consumption was estimated to be up 0.9 per cent in 2016 compared to 2015, but is down by an average of 1.2 per cent per annum over the last 10 years.

[1] www.gov.uk/government/collections/quarterly-energy-prices

1.16 The main fuels used by final consumers in 2016 were petroleum products (47.5 per cent), natural gas (29.4 per cent) and electricity (17.5 per cent). Biofuels accounted for 3.4 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.

Chart 1.6: Final consumption by fuel



1.17 Of the petroleum products consumed by final users 11 per cent was for non-energy purposes; for natural gas 1.1 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 2016 is shown in Table 1A. Further details of non-energy use are given in Chapter 2 paragraph 2.29, Chapter 3, paragraph 3.20 and Chapter 4, paragraph 4.27.

Table 1A: Non-energy use of fuels 2016

Thousand tonnes of oil equivalent

	Petroleum	Natural gas	Manufactured fuel
Petrochemical feedstocks	5,013	439	46
Other	2,805	-	-
Total	**7,818**	**439**	**46**

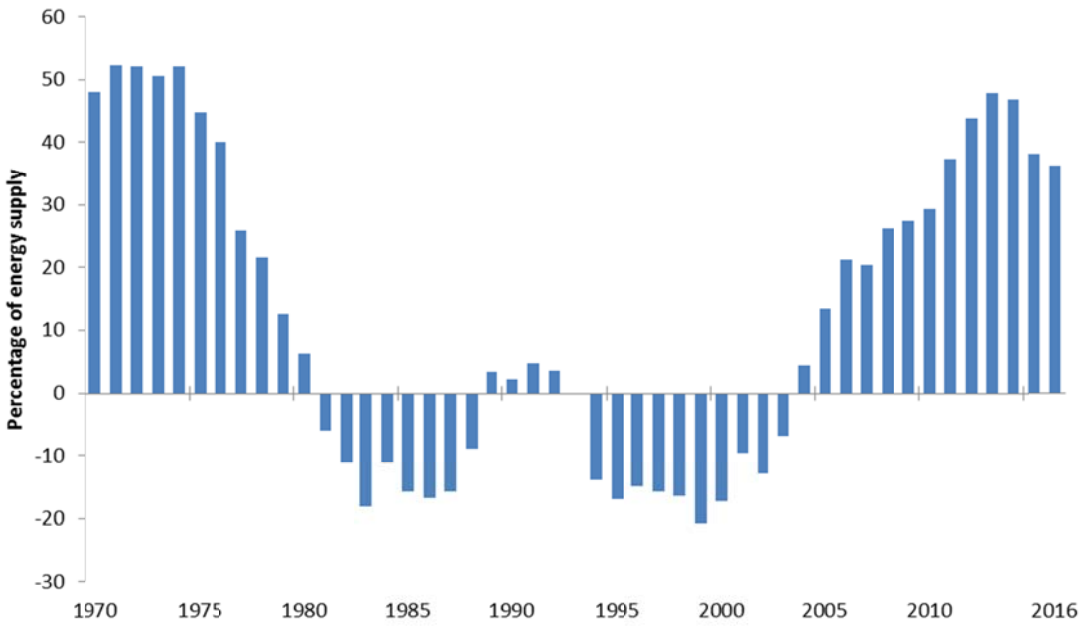
1.18 The data in the energy balances (Table 1.1) can be viewed in a number of ways, with a number of other statistics derived to produce different descriptions of the UK energy market. Recently greater focus has been given to looking at import dependency and also at fossil fuel dependency. Import dependency (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 2014 to 2016

Thousand tonnes of oil equivalent

	2014	2015	2016
Net imports	95,702	78,490	73,924
Primary energy supply + bunkers	204,199	206,070	203,965
Net import dependency	46.9%	38.1%	36.2%

Chart 1.7: Net import dependency, 1970 to 2016



1.19 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 2016, the share of energy from fossil fuels decreased further to a record low of 81.5 per cent**, whilst that from low-carbon sources increased from having a 16.4 per cent to a 17.0 per cent share.

1.20 The largest component of this series is currently nuclear; its share of energy supplied remained broadly unchanged at 8.0 per cent in 2016. 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" 8.9 per cent share of final energy consumption in 2016 (the normalisation process takes out weather effects from this statistic; see paragraph 6.45). There are other ways to measure renewables contribution to energy, and these are discussed in more detail in Chapter 6.

Table 1C: Fossil fuel and low carbon dependencies 2014 to 2016

Per cent

	2014	2015	2016
Fossil fuel	84.3%	82.1%	81.5%
Low-carbon	14.3%	16.4%	17.0%
Other	1.4%	1.5%	1.5%

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

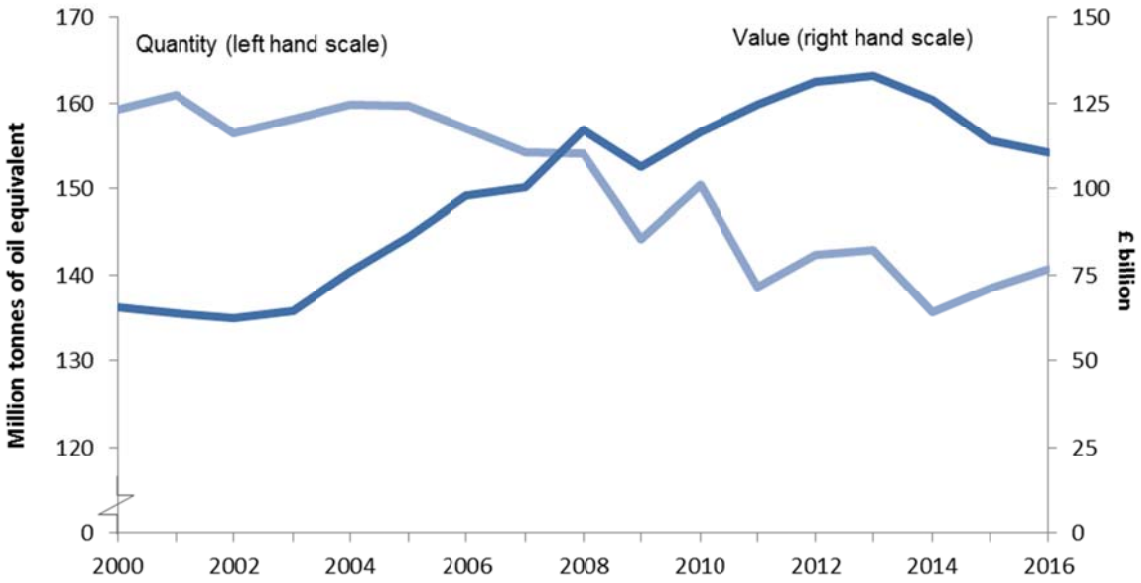
1.21 Tables 1.4 to 1.6 present the value of traded energy in a similar format to the energy balances. The balance shows how the value of inland energy supply is made up from the value of indigenous production, trade, tax and margins (profit and distribution costs). The lower half of the tables show how 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.

1.22 **Total expenditure by final consumers** in 2016 is estimated at £110,835 million, (£110,660 million shown as actual final consumption and £175 million of coal consumed by the iron and steel sector in producing coke for their own consumption), **down by 2.9 per cent on the 2015 level.**

1.23 **Expenditure though is down by 17 per cent (down 20 per cent in real terms when adjusted for inflation) from the peak in 2013**, with the most significant changes from then being the reduced price for crude and petroleum products. In 2016, crude oil prices averaged around $45 per barrel, down from $54 per barrel in 2015 and much lower compared to the average 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



1.24 Of the total final expenditure on energy in 2016 (£111 billion), the biggest share, 50 per cent, fell to the transport sector. Industry purchased 9.5 per cent (£11 billion), the domestic sector purchased 28 per cent (£31 billion), with the remaining 13 per cent (£14 billion) purchased by 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

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 2016, based on the latest available data from the Office for National Statistics (ONS):

- 2.3 per cent of GDP;
- 10 per cent of total investment;
- 34 per cent of industrial investment;
- 178,000 people directly employed (6.3 per cent of industrial employment);
- Many others indirectly employed (e.g. an estimated 152,000 in support of UK Continental Shelf activities).

1.27 The share of GDP at 2.3 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 2000, with the latest fall taking energy's share of the UK economy to its lowest level for over 40 years**. The latest fall is largely due to the further decline in the price of oil; which fell by around 17 per cent in 2016[2]. In 2016 investment in the energy industries fell back from the recent high levels with reduced spending for oil and gas extraction. Employment has remained broadly unchanged in the last seven years, but up from 10 years ago.

[2] www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/oil/oil-prices.html

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 tonne of oil equivalent = 10^7 kilocalories
= 396.83 therms
= 41.868 Gigajoules (GJ)
= 11,630 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 2016 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 Table 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:

$GJ = 51.83 - 8.78 \times d^2$, where *d* 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 flap inside the back cover 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 flap inside the back cover 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 (40.0 per cent in 2016). (See Chapter 5, paragraphs 5.71 and 5.79).

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 3.20.

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 paragraphs 7.36 to 7.41. 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 is defined as heat that is produced and sold under the provision of a contract. The heat sold figures have been derived from two sources covering CHP plants and community heating schemes without CHP plants. Data for heat sold were supplied by CHP plants to the Combined Heat and Power Quality Assurance Programme and were processed by Ricardo-AEA. Data for heat consumption from community heating schemes were derived from the Building Research Establishment's (BRE) 'Nationwide Survey of Community Heating' that was carried out in 1997, a database of community heating schemes in social housing in 2000, and Community Heating Sales Surveys undertaken between 2003 and 2005. The estimates from these sources have been used to derive heat sold figures since 1999. When information about where the heat was generated was not available from the BRE sources, it was assumed that domestic sector heat consumption was provided by the commercial sector, public sector heat consumption was provided by the public administration and industrial sectors (using proportions derived from CHP statistics) and that industrial sector heat consumption was provided by the industrial sector. The introduction of heat sold into the energy balances has not affected the individual fuel totals, since the energy used to generate the heat has been deducted from the final consumption section of the energy balance and transferred to the transformation section. The figures that are included in the balances should be treated as indicative of the amount of heat sold. Annex J of the Digest, at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes shows the quantity of fuel by consuming sector used to produce heat that is subsequently sold.

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, 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 2016, £12,790 million of crude oil was indigenously produced, of which £8,375 million was exported; and £11,675 million of crude oil was imported. Allowing for stock changes, this provides a total value of UK inland crude oil supply of £16,060 million. This fuel was then completely consumed within the petroleum industry in the process of producing £21,890 million of petroleum products. Again, some external trade and stock changes took place before arriving at a basic value of petroleum products of £24,340 million. In supplying the fuel to final consumers, distribution costs were incurred and some profit was made amounting to £2,045 million, whilst duty and tax meant a further £33,585 million was added to the basic price to arrive at the final market value of £60,075 million. This was the value of petroleum products purchased, of which industry purchased £1,545 million, domestic consumers for heating purposes purchased £910 million, with the vast majority £52,925 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 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 significant 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 (which can be found on the Internet at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes). 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.6. **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 2016 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 2016 – energy supplied basis

	Percentage of each fuel						Percentage of each sector					
	Industry	Transport	Domestic	Others	Total		Solid fuels	Petr-oleum	Gas	Electricity	Bio-energy	Total
Solid fuels	69	1	29	1	100	Industry	6	18	36	34	6	100
Petroleum	6	86	4	3	100	Transport	0	97	-	1	2	100
Gas	19	-	62	19	100	Domestic	1	6	65	23	5	100
Electricity	30	2	36	33	100	Others	0	10	42	44	3	100
Bioenergy	26	20	41	12	100							
All fuels	**17**	**40**	**30**	**14**	**100**	**All users**	**1**	**45**	**31**	**19**	**4**	**100**

Table 1E: Total primary fuel consumption by final users in 2016 - primary input basis

	Percentage of each fuel						Percentage of each sector					
	Industry	Transport	Domestic	Others	Total		Coal	Petr-oleum	Gas	Primary electricity	Bio-energy	Total
Coal	38	1	34	27	100	Industry	14	12	48	17	11	100
Petroleum	7	85	4	4	100	Transport	0	97	1	1	2	100
Gas	24	1	51	25	100	Domestic	8	5	65	13	9	100
Primary electricity	30	2	36	33	100	Others	10	7	53	20	10	100
Bioenergy	29	8	37	25	100							
All fuels	**20**	**31**	**30**	**18**	**100**	**All users**	**7**	**35**	**39**	**11**	**7**	**100**

1.52 In 2016, every 1 toe of secondary electricity consumed by final users required, on average, 0.3 toe of coal, 1.1 toe of natural gas, 0.6 toe of primary electricity (nuclear) and 0.4 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 1F: Value of fuels purchased by final users in 2016

	Percentage of each sector						
	Solid fuels	Petroleum	Gas	Secondary electricity	Heat	Biofuels	Total
Industry	5	15	15	63	1	1	100
Transport	-	96	-	1	-	3	100
Domestic	1	3	43	50	-	2	100
Others	-	7	16	76	1	-	100
All users	**1**	**51**	**16**	**30**	**0**	**2**	**100**

Systems of measurement - international statistics

1.54 The systems of energy 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 16 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 an annex to DUKES available via the internet.

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 (C_5 or heavier) and petroleum gases other than methane C_1, that is ethane C_2, propane C_3 and butane C_4, 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 C_1 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. See Chapter 5, paragraphs 5.62 to 5.69.

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* (www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/standard-industrial-classification/index.html). 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 1.58
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
Commercial	45-47, 49-51 (part*), 52-53, 55-56, 58-66, 68-75, 77-82
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 below 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 2008. Next year revisions for earlier years are likely to be restricted to two years only, though this is subject to change. Key data changes this year include moving some indigenous gas production to imports based on revised data from terminal operators; and a reassessment of gas consumption with some use reassigned to industry from the services sector.

Table 1J: Revisions since DUKES 2016

Thousand tonnes of oil equivalent

	2008	2009	2010	2011	2012	2013	2014	2015	Percentage revisions to 2015 data
Production	-156	-1,256	-1,674	-1,055	-1,313	-1,172	-1,092	-874	-0.7%
Primary supply	-64	-77	155	217	161	-141	183	385	0.2%
Primary demand	-358	143	9	304	-292	-3	427	796	0.4%
Transformation	-1	-1	-48	-49	50	-3	10	-117	0.3%
Energy industry use	3	-1	142	93	-143	-57	17	-1	0.0%
Final consumption	-294	202	-124	217	-100	51	531	706	0.5%
Industry	1,167	1,298	913	910	997	1,029	584	767	3.3%
Transport	0	0	-16	-4	19	0	20	-61	-0.1%
Other	-1,461	-1,096	-1,022	-689	-1,116	-978	-134	364	0.6%
Non energy use	0	0	0	0	0	0	61	-364	-4.4%

Contact: *Warren Evans*
Energy Statistics Team
warren.evans@beis.gov.uk
0300 068 5059

1.1 Aggregate energy balance 2016
Gross calorific values

Thousand tonnes of oil equivalent

	Coal	Manufactured fuel*(1)*	Primary oils	Petroleum products	Natural gas*(2)*	Bioenergy & waste*(3)*	Primary electricity	Electricity	Heat sold	Total
Supply										
Production	2,633	-	51,952	-	39,789	10,774	19,987	-	-	125,135
Imports	5,747	890	53,380	38,254	45,979	3,743	-	1,694	-	149,687
Exports	-333	-16	-38,180	-26,663	-10,048	-338	-	-185	-	-75,763
Marine bunkers	-	-	-	-2,840	-	-	-	-	-	-2,840
Stock change*(4)*	+3,658	-89	-135	+77	+1,397	-	-	-	-	+4,907
Primary supply	**11,705**	**785**	**67,016**	**8,828**	**77,117**	**14,180**	**19,987**	**1,509**	**-**	**201,125**
Statistical difference*(5)*	-58	+1	-86	+32	+127	-	-	+17	-	+32
Primary demand	**11,763**	**784**	**67,102**	**8,796**	**76,990**	**14,180**	**19,987**	**1,492**	**-**	**201,093**
Transfers	-	+27	-1,640	+1,629	+135	-165	-4,573	+4,573	-	-14
Transformation	**-10,243**	**231**	**-65,462**	**64,560**	**-27,876**	**-8,964**	**-15,414**	**24,356**	**1,409**	**-37,404**
Electricity generation	-7,533	-540	-	-559	-25,630	-8,894	-15,414	24,356	-	-34,214
Major power producers	-7,521	-	-	-194	-23,350	-4,233	-15,414	21,778	-	-28,934
Autogenerators	-12	-540	-	-365	-2,280	-4,661	-	2,577	-	-5,280
Heat generation	-132	-51	-	-62	-2,246	-70	-	-	1,409	-1,152
Petroleum refineries	-	-	-65,931	65,776	-	-	-	-	-	-155
Coke manufacture	-1,384	1,303	-	-	-	-	-	-	-	-81
Blast furnaces	-1,037	-656	-	-	-	-	-	-	-	-1,692
Patent fuel manufacture	-157	175	-	-81	-	-	-	-	-	-64
Other(7)	-	-	469	-515	-	-	-	-	-	-46
Energy industry use	**-**	**417**	**-**	**4,188**	**4,968**	**-**	**-**	**2,035**	**273**	**11,881**
Electricity generation	-	-	-	-	-	-	-	1,313	-	1,313
Oil and gas extraction	-	-	-	715	4,306	-	-	51	-	5,072
Petroleum refineries	-	-	-	3,473	93	-	-	379	273	4,218
Coal extraction	-	-	-	-	5	-	-	40	-	46
Coke manufacture	-	145	-	-	-	-	-	1	-	146
Blast furnaces	-	272	-	-	25	-	-	18	-	315
Patent fuel manufacture	-	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	91	-	91
Other	-	-	-	-	539	-	-	142	-	680
Losses	**-**	**96**	**-**	**-**	**464**	**-**	**-**	**2,263**	**-**	**2,823**
Final consumption	**1,520**	**529**	**-**	**70,797**	**43,818**	**5,050**	**-**	**26,122**	**1,136**	**148,971**
Industry	**1,072**	**316**	**-**	**4,074**	**8,427**	**1,337**	**-**	**7,894**	**610**	**23,730**
Unclassified	-	-	-	3,114	1	134	-	-	-	3,249
Iron and steel	25	316	-	4	357	-	-	245	-	946
Non-ferrous metals	11	-	-	0	162	-	-	370	-	542
Mineral products	542	-	-	192	1,007	185	-	517	-	2,443
Chemicals	42	-	-	117	1,686	26	-	1,328	202	3,401
Mechanical engineering etc	8	-	-	-	523	2	-	536	-	1,068
Electrical engineering etc	3	-	-	1	293	-	-	502	-	799
Vehicles	37	-	-	200	783	-	-	402	-	1,423
Food, beverages etc	31	-	-	140	1,704	37	-	923	0	2,835
Textiles, leather etc	48	-	-	44	356	-	-	227	-	675
Paper, printing etc	75	-	-	32	716	599	-	911	-	2,333
Other industries	247	-	-	37	562	355	-	1,818	408	3,426
Construction	4	-	-	193	278	-	-	115	-	590
Transport *(6)*	**11**	**-**	**-**	**54,345**	**-**	**1,010**	**-**	**401**	**-**	**55,767**
Air	-	-	-	12,635	-	-	-	-	-	12,635
Rail	11	-	-	627	-	-	-	390	-	1,028
Road	-	-	-	40,429	-	1,010	-	11	-	41,450
National navigation	-	-	-	654	-	-	-	-	-	654
Pipelines	-	-	-	-	-	-	-	-	-	-
Other	**437**	**168**	**-**	**4,559**	**34,952**	**2,704**	**-**	**17,826**	**526**	**61,170**
Domestic	414	168	-	2,525	26,773	2,079	-	9,284	52	41,295
Public administration	14	-	-	377	3,203	38	-	1,705	471	5,807
Commercial	4	-	-	872	3,995	299	-	6,457	3	11,629
Agriculture	-	-	-	488	81	288	-	380	-	1,237
Miscellaneous	5	-	-	297	900	-	-	-	-	1,201
Non energy use	-	**46**	-	**7,818**	**439**	-	-	-	-	**8,303**

(1) Includes all manufactured solid fuels, benzole, tars, coke oven gas and blast furnace gas.
(2) Includes colliery methane.
(3) Includes geothermal and solar heat.
(4) Stock fall (+), stock rise (-).
(5) Primary supply minus primary demand.
(6) See paragraphs 5.42 regarding electricity use in transport and 6.66 regarding renewables use in transport.
(7) Back-flows from the petrochemical industry.

1.2 Aggregate energy balance 2015
Gross calorific values

Thousand tonnes of oil equivalent

	Coal	Manufactured fuel*(1)*	Primary oils	Petroleum products	Natural gas*(2)*	Bioenergy & waste*(3)*	Primary electricity	Electricity	Heat sold	Total
Supply										
Production	5,384r	-	49,544	-	38,847r	9,761r	20,137r	-	-	123,673r
Imports	14,885r	806	55,413r	35,238r	43,127r	3,712r	-	1,953	-	155,134r
Exports	-290	-79	-36,867r	-25,173r	-13,716r	-366r	-	-153	-	-76,644r
Marine bunkers	-	-	-	-2,684r	-	-	-	-	-	-2,684r
Stock change*(4)*	4,463r	46	-105r	-800r	302r	-	-	-	-	3,907r
Primary supply	**24,443r**	**772**	**67,985r**	**6,581r**	**68,560r**	**13,108r**	**20,137r**	**1,800**	**-**	**203,386r**
Statistical difference*(5)*	58r	4	-74r	-43r	67r	-	-	103r	-	113r
Primary demand	**24,386r**	**769**	**68,059r**	**6,625r**	**68,493r**	**13,108r**	**20,137r**	**1,698r**	**-**	**203,273r**
Transfers	-	34	-1,477r	1,511r	48r	-84r	-4,657r	4,657r	-	32r
Transformation	**-22,588r**	**863**	**-66,582r**	**65,645r**	**-20,466r**	**-8,382r**	**-15,479**	**24,249r**	**1,412r**	**-41,329r**
Electricity generation	-18,328r	-783	-	-608r	-18,283r	-8,311r	-15,479	24,249r	-	-37,544r
Major power producers	-18,316r	-	-	-213r	-15,989	-4,060	-15,479	21,813r	-	-32,245r
Autogenerators	-12r	-783	-	-394r	-2,294r	-4,251r	-	2,436r	-	-5,298r
Heat generation	-132r	-51	-	-62r	-2,183r	-71r	-	-	1,412r	-1,088r
Petroleum refineries	-	-	-67,032r	66,880r	-	-	-	-	-	-152r
Coke manufacture	-2,792r	2,636	-	-	-	-	-	-	-	-156r
Blast furnaces	-1,174r	-1,103	-	-	-	-	-	-	-	-2,277r
Patent fuel manufacture	-161r	164	-	-71	-	-	-	-	-	-68r
Other(7)	-	-	450	-494	-	-	-	-	-	-44
Energy industry use	**-**	**716**	**-**	**4,293r**	**5,043r**	**-**	**-**	**2,163r**	**270**	**12,485r**
Electricity generation	-	-	-	-	-	-	-	1,432r	-	1,432r
Oil and gas extraction	-	-	-	756	4,387r	-	-	52r	-	5,196r
Petroleum refineries	-	-	-	3,536r	103r	-	-	390r	270	4,300r
Coal extraction	-	-	-	-	7r	-	-	43r	-	50r
Coke manufacture	-	329	-	-	-	-	-	4	-	333
Blast furnaces	-	387	-	-	28	-	-	30	-	445
Patent fuel manufacture	-	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	84	-	84
Other	-	-	-	-	517r	-	-	129r	-	646r
Losses	**-**	**228**	**-**	**-**	**556r**	**-**	**-**	**2,349r**	**-**	**3,133r**
Final consumption	**1,798r**	**722**	**-**	**69,488r**	**42,476r**	**4,641r**	**-**	**26,092r**	**1,142r**	**146,359r**
Industry	**1,360r**	**457**	**-**	**4,298r**	**8,531r**	**1,121r**	**-**	**7,989r**	**607r**	**24,362r**
Unclassified	-	12	-	3,351r	1	99r	-	-	-	3,462r
Iron and steel	31r	446	-	6r	462	-	-	317	-	1,262r
Non-ferrous metals	13r	-	-	0r	158r	-	-	380r	-	551r
Mineral products	698r	-	-	185r	959r	202r	-	524r	-	2,569r
Chemicals	47r	-	-	119r	1,679r	16r	-	1,342r	182r	3,385r
Mechanical engineering etc	8r	-	-	-	521r	2r	-	536r	-	1,066r
Electrical engineering etc	4r	-	-	1r	266r	-	-	515r	-	786r
Vehicles	42r	-	-	197r	748r	-	-	419r	-	1,406r
Food, beverages etc	38r	-	-	136r	1,686r	27r	-	926r	-	2,814r
Textiles, leather etc	46r	-	-	46r	384r	-	-	231r	-	708r
Paper, printing etc	77r	-	-	32r	818r	411r	-	911r	-	2,250r
Other industries	351r	-	-	35r	580r	365r	-	1,768r	425r	3,524r
Construction	5	-	-	189r	269r	-	-	117r	-	579r
Transport *(6)*	**9r**	**-**	**-**	**53,354r**	**-**	**998r**	-	**388r**	**-**	**54,749r**
Air	-	-	-	12,529r	-	-	-	-	-	12,529r
Rail	9r	-	-	633r	-	-	-	380r	-	1,023r
Road	-	-	-	39,510	-	998r	-	8	-	40,516r
National navigation	-	-	-	682r	-	-	-	-	-	682r
Pipelines	-	-	-	-	-	-	-	-	-	-
Other	**429r**	**167**	-	**4,528r**	**33,492r**	**2,523r**	-	**17,715r**	**535r**	**59,390r**
Domestic	418r	167	-	2,522r	25,587r	2,033r	-	9,266r	52	40,046r
Public administration	3r	-	-	369r	3,142r	38r	-	1,666r	475r	5,693r
Commercial	4	-	-	869r	3,792r	246r	-	6,429r	8r	11,347r
Agriculture	-	-	-	467r	84r	205r	-	354r	-	1,111r
Miscellaneous	5r	-	-	301r	887r	-	-	-	-	1,193r
Non energy use	**-**	**98**	**-**	**7,308r**	**453**	**-**	**-**	**-**	**-**	**7,859r**

(1) Includes all manufactured solid fuels, benzole, tars, coke oven gas and blast furnace gas.
(2) Includes colliery methane.
(3) Includes geothermal and solar heat.
(4) Stock fall (+), stock rise (-).
(5) Primary supply minus primary demand.
(6) See paragraphs 5.42 regarding electricity use in transport and 6.66 regarding renewables use in transport.
(7) Back-flows from the petrochemical industry.

1.3 Aggregate energy balance 2014
Gross calorific values

Thousand tonnes of oil equivalent

	Coal	Manufactured fuel*(1)*	Primary oils	Petroleum products	Natural gas*(2)*	Bioenergy & waste*(3)*	Primary electricity	Electricity	Heat sold	Total
Supply										
Production	7,289r	-	43,705	-	35,761r	8,324r	17,453r	-	-	112,534r
Imports	27,581	669	58,676	32,148r	42,041r	3,203	-	1,999	-	166,316r
Exports	-319	-80	-33,774	-24,848	-10,998r	-361	-	-234	-	-70,614r
Marine bunkers	-	-	-	-3,004r	-	-	-	-	-	-3,004r
Stock change*(4)*	-3,342r	-151	-648	309	-205r	-	-	-	-	-4,036r
Primary supply	**31,208r**	**439**	**67,960**	**4,605r**	**66,600r**	**11,166r**	**17,453r**	**1,764**	**-**	**201,195r**
Statistical difference*(5)*	-103r	-4	-56	-33r	-331r	-	-	-92r	-	-619r
Primary demand	**31,311r**	**442**	**68,016**	**4,638r**	**66,930r**	**11,166r**	**17,453r**	**1,856r**	**-**	**201,814r**
Transfers	-	9	-1,778	1,877r	-0r	-12r	-3,603r	3,603r	-	96r
Transformation	**-29,234r**	**1,451**	**-66,238**	**65,001r**	**-20,934r**	**-6,855r**	**-13,850**	**25,220r**	**1,440r**	**-44,000r**
Electricity generation	-23,948r	-914	-	-547r	-18,731r	-6,795r	-13,850	25,220r	-	-39,564r
Major power producers	-23,936r	-	-	-176r	-16,330	-3,156	-13,850	22,918	-	-34,531
Autogenerators	-12r	-914	-	-371r	-2,401r	-3,639r	-	2,302r	-	-5,034r
Heat generation	-169r	-51	-	-64r	-2,204	-60r	-	-	1,440r	-1,108r
Petroleum refineries	-	-	-66,677	66,172	-	-	-	-	-	-505
Coke manufacture	-3,784r	3,450	-	-	-	-	-	-	-	-334r
Blast furnaces	-1,150	-1,229	-	-	-	-	-	-	-	-2,379
Patent fuel manufacture	-183r	195	-	-78	-	-	-	-	-	-66r
Other(7)	-	-	439	-482r	-	-	-	-	-	-44r
Energy industry use	**0r**	**802**	**-**	**4,097**	**4,512r**	**-**	**-**	**2,192r**	**285**	**11,889r**
Electricity generation	-	-	-	-	-	-	-	1,417r	-	1,417r
Oil and gas extraction	-	-	-	717	3,903	-	-	46	-	4,666
Petroleum refineries	-	-	-	3,380r	103r	-	-	419r	285	4,188r
Coal extraction	0r	-	-	-	9r	-	-	57	-	66r
Coke manufacture	-	381	-	-	-	-	-	7	-	388
Blast furnaces	-	421	-	-	29	-	-	38	-	488
Patent fuel manufacture	-	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	86	-	86
Other	-	-	-	-	468r	-	-	123r	-	591r
Losses	**-**	**216**	**-**	**-**	**590r**	**-**	**-**	**2,452r**	**-**	**3,258r**
Final consumption	**2,077r**	**884**	**-**	**67,419r**	**40,894r**	**4,299r**	**-**	**26,035r**	**1,155r**	**142,762r**
Industry	**1,627r**	**566**	**-**	**4,238r**	**8,653r**	**594r**	**-**	**7,997r**	**627r**	**24,302r**
Unclassified	-	46	-	3,344r	1	594r	-	-	-	3,985r
Iron and steel	38r	520	-	7r	469	-	-	326	-	1,360r
Non-ferrous metals	15	-	-	0r	178r	-	-	385r	-	578r
Mineral products	825r	-	-	174r	955r	-	-	539r	-	2,493r
Chemicals	68r	-	-	110r	1,682r	-	-	1,331r	219r	3,409r
Mechanical engineering etc	10r	-	-	-	511r	-	-	594r	-	1,115r
Electrical engineering etc	5r	-	-	1r	239r	-	-	491r	-	736r
Vehicles	49	-	-	186r	716r	-	-	415r	-	1,366r
Food, beverages etc	44r	-	-	135r	1,754r	-	-	915r	-	2,848r
Textiles, leather etc	52	-	-	44r	394r	-	-	234r	-	723r
Paper, printing etc	96r	-	-	31r	898r	-	-	922r	-	1,947r
Other industries	418r	-	-	35r	604r	-	-	1,725r	408r	3,189r
Construction	5r	-	-	173r	254r	-	-	120	-	553r
Transport *(6)*	**9**	**-**	**-**	**52,506r**	**-**	**1,243**	**-**	**387**	**-**	**54,146r**
Air	-	-	-	12,419	-	-	-	-	-	12,419
Rail	9	-	-	676	-	-	-	381	-	1,067
Road	-	-	-	38,713	-	1,243	-	6	-	39,962
National navigation	-	-	-	699r	-	-	-	-	-	699r
Pipelines	-	-	-	-	-	-	-	-	-	-
Other	**441r**	**182**	**-**	**4,124r**	**31,774r**	**2,462r**	**-**	**17,651r**	**528r**	**57,161r**
Domestic	415r	182	-	2,508r	24,393r	1,837r	-	9,293r	52	38,680r
Public administration	17r	-	-	334r	3,007r	119r	-	1,591r	470r	5,538r
Commercial	4	-	-	616r	3,456r	47r	-	6,436r	6r	10,564r
Agriculture	-	-	-	400r	92r	459r	-	331	-	1,282r
Miscellaneous	5r	-	-	266r	826r	-	-	-	-	1,097r
Non energy use	**-**	**136**	**-**	**6,550r**	**467**	**-**	**-**	**-**	**-**	**7,153r**

(1) Includes all manufactured solid fuels, benzole, tars, coke oven gas and blast furnace gas.
(2) Includes colliery methane.
(3) Includes geothermal and solar heat.
(4) Stock fall (+), stock rise (-).
(5) Primary supply minus primary demand.
(6) See paragraphs 5.42 regarding electricity use in transport and 6.66 regarding renewables use in transport.
(7) Back-flows from the petrochemical industry.

1.4 Value balance of traded energy in 2016[(1)]

£million

	Coal	Manufactured fuels	Crude oil	Petroleum products	Natural gas	Electricity	Heat sold	Other fuels	Total
Supply									
Indigenous production	135	95	12,790	21,890	4,850	16,485	325	2,825	59,400
Imports	565	80	11,675	11,335	6,300	780	-	310	31,050
Exports	-50	-5	-8,375	-8,050	-1,350	-105	-	-	-17,930
Marine bunkers	-	-	-	-835	-	-	-	-	-835
Stock change	290	-5	-35	-	205	-	-	-	455
Basic value of inland consumption	**945**	**165**	**16,060**	**24,340**	**10,005**	**17,165**	**325**	**3,135**	**72,140**
Tax and margins									
Distribution costs and margins	**235**	**30**	**-**	**2,045**	**10,715**	**16,060**	**-**	**80**	**29,160**
Electricity generation	15	-	-	5	-	-	-	-	20
Solid fuel manufacture	50	-	-	-	-	-	-	-	50
of which iron & steel sector	40	-	-	-	-	-	-	-	40
Iron & steel final use	30	20	-	-	-	-	-	-	50
Other industry	35	-	-	325	-	-	-	-	355
Air transport	-	-	-	105	-	-	-	-	105
Rail and national navigation	-	-	-	20	-	-	-	-	20
Road transport	-	-	-	965	-	-	-	80	1,045
Domestic	100	10	-	85	-	-	-	-	195
Agriculture	-	-	-	40	-	-	-	-	40
Commercial and other services	5	-	-	115	-	-	-	-	120
Non energy use	-	-	-	390	85	-	-	-	475
VAT and duties	**10**	**5**	**-**	**33,585**	**650**	**750**	**-**	**1,155**	**36,150**
Electricity generation	-	-	-	30	-	-	-	-	30
Iron & steel final use	-	-	-	-	-	-	-	-	-
Other industry	-	-	-	225	-	-	-	-	225
Air transport	-	-	-	5	-	-	-	-	5
Rail and national navigation	-	-	-	155	-	-	-	-	155
Road transport	-	-	-	32,925	-	-	-	1,115	34,040
Domestic	10	5	-	60	650	750	-	35	1,510
Agriculture	-	-	-	45	-	-	-	-	45
Commercial and other services	-	-	-	135	-	-	-	-	135
Climate Change Levy/Carbon Price Support	**180**	**-**	**-**	**105**	**1,030**	**585**	**-**	**-**	**1,895**
Total tax and margins	**425**	**35**	**-**	**35,735**	**12,390**	**17,390**	**-**	**1,235**	**67,205**
Market value of inland consumption	**1,365**	**200**	**16,060**	**60,075**	**22,400**	**34,550**	**325**	**4,370**	**139,345**
Energy end use	-	-	-	-	-	-	-	-	-
Total energy sector	**875**	**-**	**16,060**	**985**	**4,865**	**1,170**	**65**	**1,855**	**25,870**
Transformation	875	-	16,060	150	4,130	840	-	1,855	23,910
Electricity generation	655	-	-	135	3,800	840	-	1,855	7,280
of which from stocks	35	-	-	-	-	-	-	-	35
Heat Generation	10	-	-	20	335	-	-	-	365
Petroleum refineries	-	-	16,060	-	-	-	-	-	16,060
Solid fuel manufacture	210	-	-	-	-	-	-	-	210
of which iron & steel sector	175	-	-	-	-	-	-	-	175
Other energy sector use	**-**	**-**	**-**	**835**	**735**	**330**	**65**	**-**	**1,960**
Oil & gas extraction	-	-	-	190	640	50	-	-	880
Petroleum refineries	-	-	-	645	15	235	65	-	960
Coal extraction	-	-	-	-	-	40	-	-	40
Other energy sector	-	-	-	-	80	-	-	-	80
Total non energy sector use	**490**	**185**	**-**	**56,375**	**17,450**	**33,385**	**265**	**2,515**	**110,660**
Industry	**275**	**85**	**-**	**1,545**	**1,610**	**6,595**	**140**	**110**	**10,360**
Iron & steel final use	145	85	-	-	65	170	-	15	485
Other industry	130	-	-	1,540	1,545	6,420	140	95	9,875
Transport	**5**	**-**	**-**	**52,925**	**-**	**460**	**-**	**1,605**	**54,990**
Air	-	-	-	3,965	-	-	-	-	3,965
Rail and national navigation	5	-	-	565	-	450	-	-	1,020
Road	-	-	-	48,395	-	5	-	1,605	50,005
Other final users	**210**	**100**	**-**	**1,905**	**15,840**	**26,330**	**120**	**800**	**45,310**
Domestic	205	100	-	910	13,605	15,705	10	780	31,315
Agriculture	-	-	-	245	25	535	-	20	825
Commercial and other services	5	-	-	755	2,205	10,095	110	-	13,170
Total value of energy end use	**1,365**	**185**	**16,060**	**57,360**	**22,315**	**34,550**	**325**	**4,370**	**136,530**
Value of non energy end use	**-**	**20**	**-**	**2,715**	**85**	**-**	**-**	**-**	**2,820**
Market value of inland consumption	**1,365**	**200**	**16,060**	**60,075**	**22,400**	**34,550**	**325**	**4,370**	**139,345**

(1) For further information see paragraphs 1.39 to 1.45.

1.5 Value balance of traded energy in 2015[(1)]

£million

	Coal	Manufactured fuels	Crude oil	Petroleum products	Natural gas	Electricity	Heat sold	Other fuels	Total
Supply									
Indigenous production	255r	205	12,985r	23,180r	6,380r	17,605r	395	2,675r	63,675r
Imports	985r	70	12,645r	12,405	6,990r	950	-	340r	34,385r
Exports	-45	-20	-9,915r	-8,675	-2,310r	-80	-	-	-21,045r
Marine bunkers	-	-	-	-855r	-	-	-	-	-855r
Stock change	320r	-20	-15r	-250	55	-	-	-	90r
Basic value of inland consumption	**1,510r**	**230**	**15,695r**	**25,810r**	**11,115r**	**18,475r**	**395**	**3,015r**	**76,245r**
Tax and margins									
Distribution costs and margins	**375r**	**20**	**-**	**2,040r**	**11,035r**	**15,720r**	**-**	**85r**	**29,275r**
Electricity generation	105	-	-	5	-	-	-	-	105
Solid fuel manufacture	85	-	-	-	-	-	-	-	85
of which iron & steel sector	75r	-	-	-	-	-	-	-	75
Iron & steel final use	35r	10	-	-	-	-	-	-	40
Other industry	65	-	-	355r	-	-	-	-	420r
Air transport	-	-	-	110	-	-	-	-	110
Rail and national navigation	-	-	-	20	-	-	-	-	20
Road transport	-	-	-	975r	-	-	-	85r	1,060
Domestic	85	10	-	100	-	-	-	-	195
Agriculture	-	-	-	30r	-	-	-	-	30r
Commercial and other services	-	-	-	85r	-	-	-	-	85r
Non energy use	-	-	-	360r	105	-	-	-	465r
VAT and duties	**10**	**5**	**-**	**33,030r**	**685r**	**765r**	**-**	**1,160r**	**35,655r**
Electricity generation	-	-	-	30	-	-	-	-	30
Iron & steel final use	-	-	-	-	-	-	-	-	-
Other industry	-	-	-	250r	-	-	-	-	250r
Air transport	-	-	-	5	-	-	-	-	5
Rail and national navigation	-	-	-	160	-	-	-	-	160
Road transport	-	-	-	32,345r	-	-	-	1,125r	33,470r
Domestic	10	5	-	65	685r	765	-	35	1,560r
Agriculture	-	-	-	45r	-	-	-	-	45r
Commercial and other services	-	-	-	135r	-	-	-	-	135r
Climate Change Levy/Carbon Price Support	**465**	**-**	**-**	**270**	**700**	**325**	**-**	**-**	**1,760**
Total tax and margins	**850r**	**25**	**-**	**35,340r**	**12,420**	**16,810**	**-**	**1,240r**	**66,690r**
Market value of inland consumption	**2,365r**	**255**	**15,695r**	**61,150r**	**23,535**	**35,285**	**395**	**4,255r**	**142,935r**
Energy end use	-	-	-	-	-	-	-	-	-
Total energy sector	**1,810r**	**-**	**15,695r**	**1,060r**	**4,695r**	**1,245r**	**75**	**1,790r**	**26,370r**
Transformation	1,810r	-	15,695r	180r	3,770r	915	-	1,790r	24,155r
Electricity generation	1,430r	-	-	155	3,365r	915	-	1,790r	7,655r
of which from stocks	25r	-	-	-	-	-	-	-	25r
Heat Generation	10	-	-	20	405	-	-	-	435
Petroleum refineries	-	-	15,695r	-	-	-	-	-	15,695r
Solid fuel manufacture	370r	-	-	-	-	-	-	-	370r
of which iron & steel sector	335	-	-	-	-	-	-	-	335
Other energy sector use	**-**	**-**	**-**	**880r**	**925r**	**335r**	**75**	**-**	**2,215r**
Oil & gas extraction	-	-	-	220	810r	50	-	-	1,085r
Petroleum refineries	-	-	-	660r	20	235r	75	-	985r
Coal extraction	-	-	-	-	-	45	-	-	45
Other energy sector	-	-	-	-	95	5	-	-	100
Total non energy sector use	**555r**	**215**	**-**	**57,490r**	**18,735r**	**34,040r**	**320**	**2,470r**	**113,820r**
Industry	**345r**	**115**	**-**	**1,740r**	**1,980r**	**6,895r**	**170r**	**95r**	**11,340r**
Iron & steel final use	150r	115	-	-	105	240	-	15	625r
Other industry	195r	5	-	1,740r	1,875r	6,655r	170r	80r	10,715r
Transport	**5**	**-**	**-**	**53,745r**	**-**	**440**	**-**	**1,655r**	**55,845r**
Air	-	-	-	4,215r	-	-	-	-	4,215r
Rail and national navigation	5	-	-	625r	-	430r	-	-	1,060r
Road	-	-	-	48,905r	-	5	-	1,655r	50,570r
Other final users	**205**	**95**	**-**	**2,000r**	**16,755r**	**26,705r**	**150r**	**720r**	**46,635r**
Domestic	205	95	-	1,005r	14,350r	16,050r	15	705	32,425r
Agriculture	-	-	-	235r	30r	505r	-	15r	785r
Commercial and other services	-	-	-	760r	2,375r	10,155r	135r	-	13,425r
Total value of energy end use	**2,365r**	**215**	**15,695r**	**58,545r**	**23,430r**	**35,285r**	**395**	**4,255r**	**140,185r**
Value of non energy end use	**-**	**40**	**-**	**2,605r**	**105**	**-**	**-**	**-**	**2,750r**
Market value of inland consumption	**2,365r**	**255**	**15,695r**	**61,150r**	**23,535r**	**35,285r**	**395**	**4,255r**	**142,935r**

(1) For further information see paragraphs 1.39 to 1.45.

1.6 Value balance of traded energy in 2014[(1)]

£million

	Coal	Manufactured fuels	Crude oil	Petroleum products	Natural gas	Electricity	Heat sold	Other fuels	Total
Supply									
Indigenous production	390r	265r	18,135r	34,455r	6,315r	17,715r	470	2,210r	79,950r
Imports	2,260	70r	24,335r	16,415r	7,635r	955r	-	610	52,275r
Exports	-55	-20	-14,625r	-14,060r	-2,000r	-130r	-	-	-30,895r
Marine bunkers	-	-	-	-1,405	-	-	-	-	-1,405
Stock change	-370r	-30	-275	135	-40	-	-	-	-580r
Basic value of inland consumption	**2,220r**	**285**	**27,565r**	**35,540r**	**11,905**	**18,540**	**470**	**2,815r**	**99,345r**
Tax and margins									
Distribution costs and margins	**640r**	**25**	**-**	**2,285r**	**11,965r**	**15,835r**	**-**	**115**	**30,870r**
Electricity generation	225	-	-	5	-	-	-	-	230
Solid fuel manufacture	120	-	-	-	-	-	-	-	120
of which iron & steel sector	105	-	-	-	-	-	-	-	105
Iron & steel final use	35	10	-	-	-	-	-	-	45
Other industry	150r	-	-	360r	-	-	-	-	515r
Air transport	-	-	-	175	-	-	-	-	175
Rail and national navigation	-	-	-	30	-	-	-	-	30
Road transport	-	-	-	1,105r	-	-	-	115	1,220r
Domestic	105r	10	-	130r	-	-	-	-	245r
Agriculture	-	-	-	35r	-	-	-	-	35r
Commercial and other services	5	-	-	100r	-	-	-	-	110r
Non energy use	-	-	-	345r	125	-	-	-	470r
VAT and duties	**10**	**5**	**-**	**33,410r**	**690r**	**785r**	**-**	**1,440**	**36,340r**
Electricity generation	-	-	-	30	-	-	-	-	30
Iron & steel final use	-	-	-	-	-	-	-	-	-
Other industry	-	-	-	225	-	-	-	-	225
Air transport	-	-	-	10	-	-	-	-	10
Rail and national navigation	-	-	-	165	-	-	-	-	165
Road transport	-	-	-	32,735r	-	-	-	1,410	34,145r
Domestic	10	5	-	85	690r	785r	-	30	1,605
Agriculture	-	-	-	35r	-	-	-	-	35r
Commercial and other services	-	-	-	120	-	-	-	-	120
Climate Change Levy/Carbon Price Support	**485**	**-**	**-**	**280**	**475**	**260r**	**-**	**-**	**1,495**
Total tax and margins	**1,130r**	**30**	**-**	**35,975r**	**13,130r**	**16,880**	**-**	**1,555**	**68,705r**
Market value of inland consumption	**3,350**	**315**	**27,565r**	**71,515r**	**25,040r**	**35,420r**	**470**	**4,370r**	**168,050r**
Energy end use									
Total energy sector	**2,715**	**-**	**27,565r**	**1,210r**	**5,580r**	**1,225r**	**95**	**1,335r**	**39,720r**
Transformation	2,715	-	27,565r	225r	4,595r	905	-	1,335r	37,335r
Electricity generation	2,170	-	-	195r	4,110	905	-	1,335r	8,710r
of which from stocks	45	-	-	-	-	-	-	-	45
Heat Generation	15	-	-	30	485	-	-	-	530
Petroleum refineries	-	-	27,565r	-	-	-	-	-	27,565r
Solid fuel manufacture	530	-	-	-	-	-	-	-	530
of which iron & steel sector	460	-	-	-	-	-	-	-	460
Other energy sector use	**-**	**-**	**-**	**985**	**985r**	**320r**	**95**	**-**	**2,385r**
Oil & gas extraction	-	-	-	345	860	45	-	-	1,250
Petroleum refineries	-	-	-	645	25r	210	95	-	970
Coal extraction	-	-	-	-	-	55	-	-	60
Other energy sector	-	-	-	-	105r	5	-	-	110r
Total non energy sector use	640r	**260**	**-**	**67,625r**	**19,335r**	**34,195r**	**375**	**3,035r**	**125,465r**
Industry	425r	**155**	**-**	**2,245r**	**2,330r**	**6,825r**	**205r**	**65r**	**12,250r**
Iron & steel final use	160	140	-	5	125	235	-	20	685
Other industry	265	15	-	2,240r	2,205r	6,585r	205r	50r	11,565r
Transport	**5**	**-**	**-**	62,905r	**-**	**430r**	**-**	**2,310**	**65,650r**
Air	-	-	-	6,580	-	-	-	-	6,580
Rail and national navigation	5	-	-	870r	-	425r	-	-	1,295r
Road	-	-	-	55,460r	-	5r	-	2,310	57,775r
Other final users	**210**	**105**	**-**	**2,475r**	**17,005r**	**26,940r**	**170r**	**660r**	**47,565r**
Domestic	205	105	-	1,425r	14,525r	16,505r	15	610r	33,395r
Agriculture	-	-	-	255r	40r	455r	-	40r	790r
Commercial and other services	5	-	-	790r	2,440r	9,980r	155r	10	13,385r
Total value of energy end use	**3,350**	**260**	**27,565r**	**68,830r**	**24,915r**	**35,420r**	**470**	**4,370r**	**165,190r**
Value of non energy end use	**-**	**55**	**-**	**2,680r**	**125**	**-**	**-**	**-**	**2,865r**
Market value of inland consumption	**3,350**	**315**	**27,565r**	**71,515r**	**25,040r**	**35,420r**	**470**	**4,370r**	**168,050r**

(1) For further information see paragraphs 1.39 to 1.45.

1.7 Sales of electricity and gas by sector

United Kingdom

	2012	2013	2014	2015	2016
Total selling value (£ million)[1]					
Electricity generation - Gas	4,614	4,722	4,109r	3,366r	3,798
Industrial - Gas[2]	2,173	2,457	2,325r	1,974r	1,608
- Electricity	7,092	7,462	7,143	7,227r	6,924
of which:					
Fuel industries	337	334	320	333r	330
Industrial sector	6,755	7,129	6,823	6,894	6,594
Domestic sector - Gas	14,970	15,822	13,833r	13,668r	12,959
- Electricity	14,942	15,809	15,720r	15,285r	14,956
Other - Gas	3,122	3,488	2,583r	2,506r	2,327
- Electricity	10,363	10,918	10,867	11,178r	11,142
of which:					
Agricultural sector	416	437	455	503r	534
Commercial sector	8,162	8,613	8,504	8,664r	8,600
Transport sector	357	398	431	442r	459
Public lighting	164	170	178	190	194
Public admin. and other services	1,264	1,300	1,299	1,378r	1,355
Total, all consumers	**57,276**	**60,678**	**56,580r**	**55,203r**	**53,713**
of which gas	**24,879**	**26,489**	**22,850r**	**21,514r**	**20,692**
of which electricity	**32,397**	**34,189**	**33,730r**	**33,689r**	**33,021**
Average net selling value per kWh sold (pence)[1]					
Electricity generation - Gas	2.135	2.299	1.890	1.586	1.276
Industrial - Gas	2.375	2.616	2.310	1.990	1.641
- Electricity	7.585	7.992	8.073	8.191	8.074
of which:					
Fuel industries	8.048	8.219	8.645	8.652	8.648
Industrial sector	7.563	7.981	8.048	8.170	8.047
Domestic sector - Gas	4.338	4.606	4.876r	4.593r	4.162
- Electricity	13.089	14.017	14.666r	14.334r	14.028
Other - Gas	2.800	3.023	3.009	2.726	2.446
- Electricity	10.286	10.854	11.380	11.747r	11.635
of which:					
Agricultural sector	10.740	11.284	11.846	12.221	12.079
Commercial sector	10.740	11.284	11.846	12.221	12.079
Transport sector	8.385	9.142	9.558	9.779	9.829
Public lighting	8.590	9.166	9.622	10.041	10.012
Public admin. and other services	8.590	9.166	9.622	10.041	10.012
Average, all consumers	**5.340**	**5.698**	**5.781r**	**5.570r**	**4.927**
of which gas	**3.256**	**3.494**	**3.323r**	**3.069r**	**2.580**
of which electricity	**10.505**	**11.146**	**11.585r**	**11.617r**	**11.461**

(1) Excludes VAT where payable - see paragraph 1.46 for a definition of average net selling value.

(2) Excludes Fuel Industry use

Chapter 2
Solid fuels and derived gases

Key points

- **Coal production fell more than half compared to last year**, down to an all-time low of 4 million tonnes (Table 2.4). This is the largest ever year-on-year reduction and is a marked step down from the 30 million tonnes produced at the start of the century. The decrease is due to the closure of the last large deep mines in 2015, combined with a steep reduction in demand) as government policy and market forces reduced the use of coal for electricity generation.

- Similarly, **demand for coal halved**, falling from 38 million tonnes in 2015 to 18 million tonnes in 2016 (Table 2.4), with a 59 per cent decrease in the use of coal for electricity generation. Demand last year was around quarter of that seen at the start of the century.

- In 2016 around 67 per cent of demand for coal was from major power producers for electricity generation with around a further 15 per cent used for the manufacture of coke (Table 2.4).

- In 2016 **UK imports were 8.5 million tonnes (the lowest value for 15 years)**, a decrease of 62 per cent on 2015 due to lower demand from generators (Table 2.4).

- In 2016 Columbia was the UK's largest supplier of coal imports with a share of 31 per cent. The other main suppliers were Russia with a 27 per cent share and USA with a 17 per cent share (Table 2B).

- Total stock levels decreased in 2016 to 8 million tonnes, which was 5.7 million tonnes lower than in 2015, due to generators using more stocks for electricity generation. (Table 2.4).

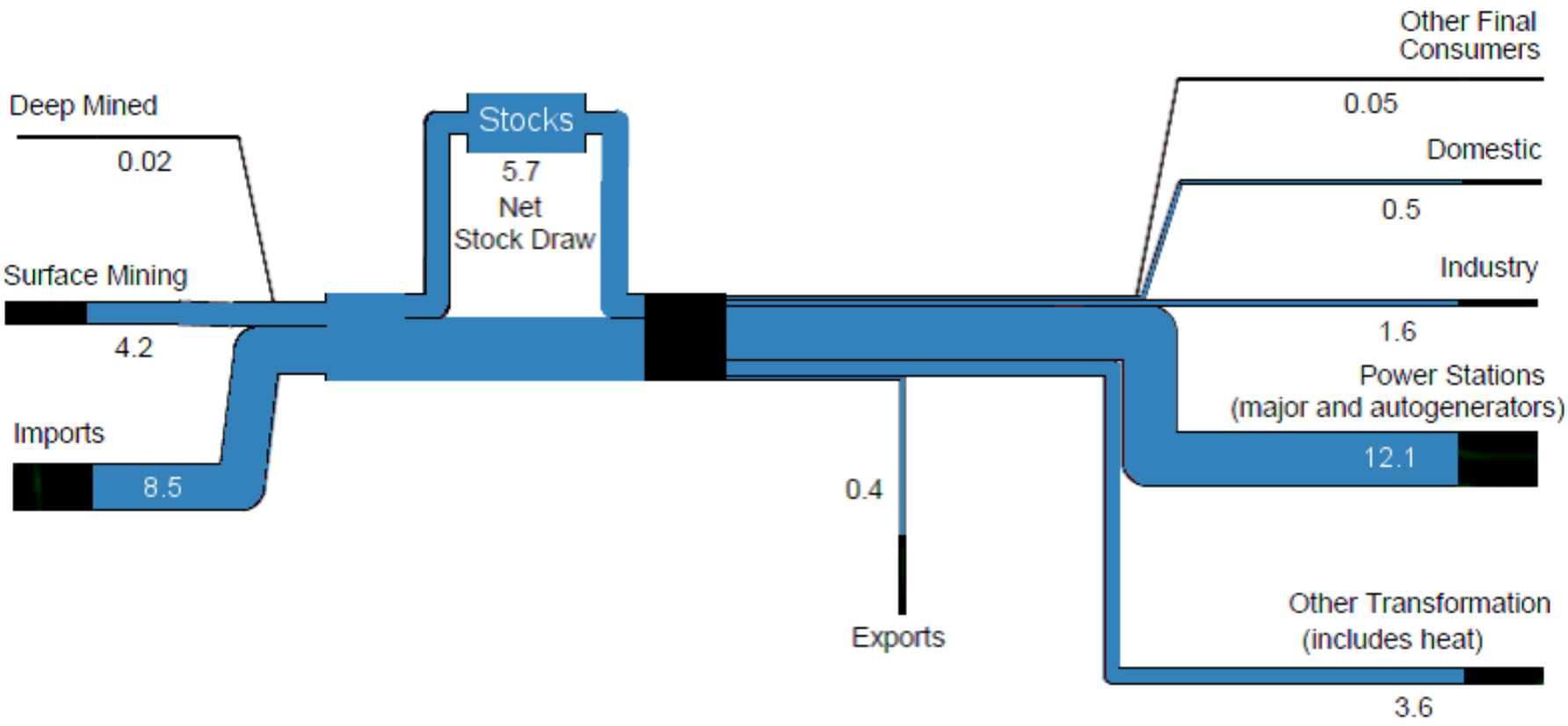
Introduction

2.1 This chapter presents statistics on supply and demand for coal (tables 2.1 - 2.4) and manufactured solid fuels, including coke oven coke, coke breeze, patent fuel, coke oven gas, blast furnace gas, benzole and tar (tables 2.5 and 2.6). A full list of tables is available at the end of the chapter.

2.2 **In 2016, coal comprised 5.8 per cent of UK primary energy demand, half that of the previous year** and under a third of its recent peak of 19 per cent in 2012. Most coal is used for electricity generation, coke manufacture, or in blast furnaces in the steel industry.

2.3 Overleaf, an energy flow chart for 2016 shows the flows of coal from production and imports through to consumption. It is a way of simplifying the figures that can be found in the commodity balance for coal in Table 2.4. The chart illustrates the flow of coal from the point of supply (on the left) to its eventual final use (on the right).

Coal flow chart 2016 (million tonnes of coal)

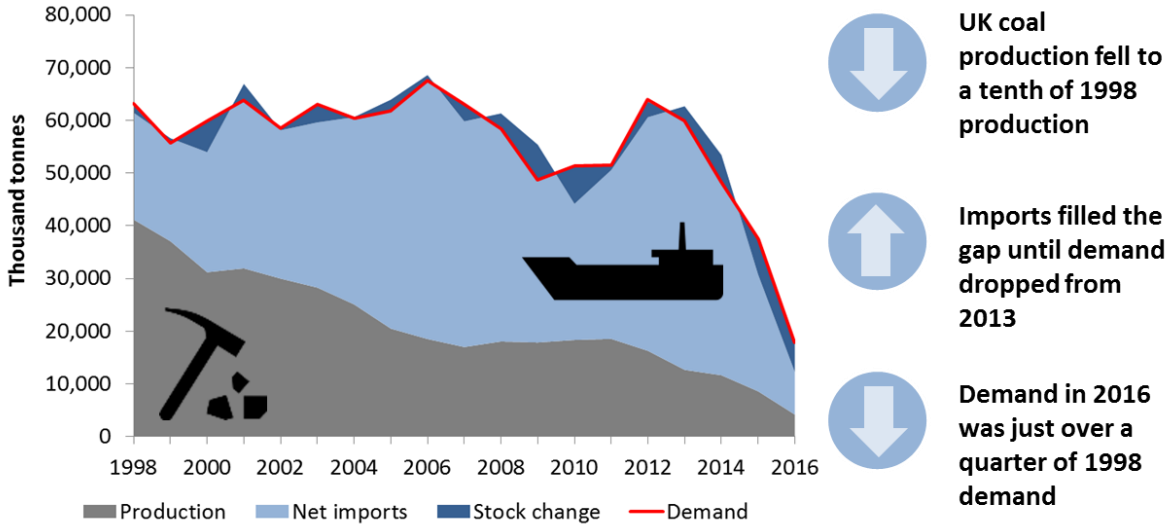


Notes: This flow chart is based on the data that appear in Tables 2.1 and 2.4.

Coal supply and demand (Table 2.1)

2.4 **In 2016, coal production halved (-51 per cent) compared to 2015 to an all-time low of 4.2 million tonnes.** Net imports fell 64 per cent to 8.0 million tonnes (Chart 2.1).

Chart 2.1: UK coal supply and demand to 2016



2.5 **Deep mined** production fell to just 0.02 million tonnes in 2016, from 2.8 million tonnes in 2015. Kellingley, the last remaining large deep mine, closed in December 2015 and there are only seven small deep mines left in the UK. Similarly, **surface mine** production decreased by 29 per cent to a new record low of 4.2 million tonnes. This was due to the closure of a number of mines in 2015 and some other mines producing less coal as they are coming to the end of operation. Production from deep mines and surface mines accounted for 23 per cent of UK coal supply, with 45 per cent from net imports and the remaining 32 per cent drawn from stocks held by coal power plants and coke ovens.

2.6 **Steam coal**, mainly used by power stations, accounted for 88 per cent of total coal production in 2016, with 11 per cent **anthracite** and the remainder **coking coal** (Table 2.1). No coal slurry has been produced since the last UK sites closed in 2013.

2.7 Table 2A shows how production of coal is divided between England, Wales and Scotland. In 2016, 59 per cent of coal output was in Wales, 21 per cent in England and 20 per cent in Scotland. Wales overtook England as the main producer of coal as the last remaining large deep mines, which were in England, closed in 2015. There is no longer any deep mining of coal in Scotland (Map 2A).

Table 2A: Output from UK coal mines and employment in UK coal mines [1, 2]

		Million tonnes			Number		
		Output			Employment		
		2014	2015	2016	2014	2015	2016
Deep mined	England	3.6	2.8	0.02	1,650	427	42
	Wales	0.04	0.03	0.01	116	50	6
	Total	3.7	2.8	0.02	1,766	477	48
Surface mining	England	2.9	2.2	0.9	505	388	192
	Scotland	2.5	1.3	0.8	647	421	176
	Wales	2.5	2.3	2.4	683	689	415
	Total	7.9	5.7	4.2	1,835	1,498	783
Total	England	6.5	4.9	0.9	2,155	815	234
	Scotland	2.5	1.3	0.8	647	421	176
	Wales	2.5	2.3	2.5	799	739	421
	Total	11.5	8.5	4.2	3,601	1,975	831

Source: The Coal Authority

1. *Output is the tonnage declared by operators to the Coal Authority, including estimated tonnages. It excludes estimates of slurry recovered from dumps, ponds, rivers, etc.*
2. *Employment includes contractors and is as declared by licensees to the Coal Authority at 31 December each year.*

2.8 Employment in the coal industry has followed a similar pattern to UK production levels. Table 2A also shows how numbers employed in the production of coal have changed over the last three years. **During 2016 total employment, including contractors, was 58 per cent lower than in 2015**. At 31 December 2016, 51 per cent of the 831 people employed in UK coal mining worked in Wales, while 28 per cent were employed in England and 21 per cent in Scotland.

2.9 **In 2016 UK imports were 8.5 million tonnes, a decrease of 62 per cent on 2015** (23 million tonnes). This was the lowest value for 20 years.

2.10 The majority of UK coal imports came from just three countries, as shown by the map below. In 2016, 75 per cent of the UK's total coal imports came from Colombia (2.7 million tonnes), 27 per cent (2.3 million tonnes) came from Russia and 17 per cent (1.4 million tonnes) came from the USA.

Chart 2.2: UK Coal Imports in 2016

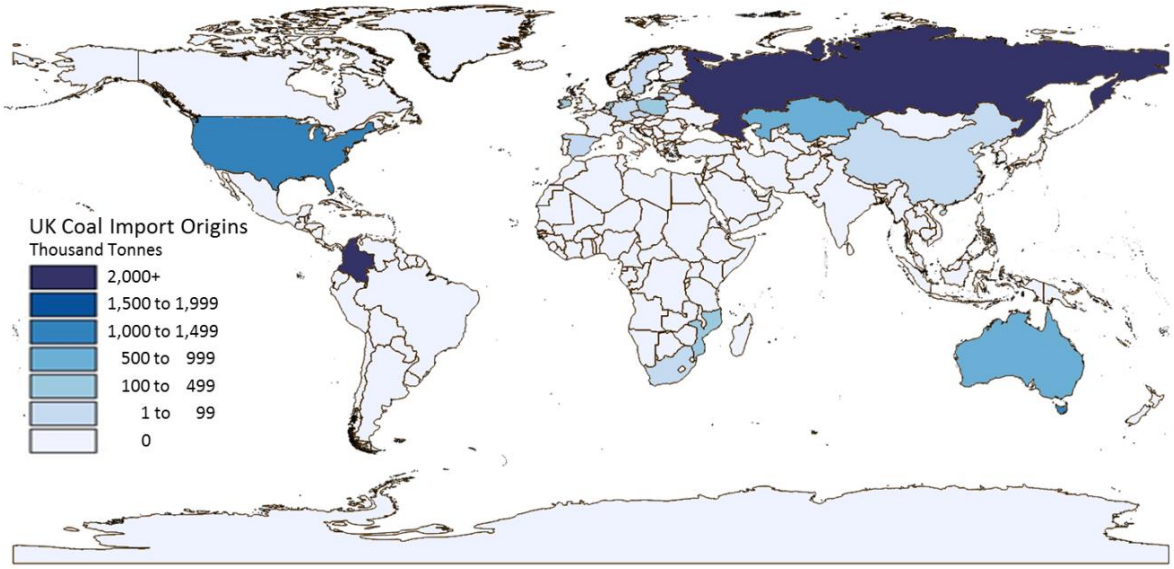


Table 2B: Imports of coal in 2016[1]

Thousand tonnes

	Steam coal	Coking coal	Anthracite	Total
Colombia	2,667	-	-	2,667
Russia	1,554	730	8	2,292
United States of America	373	1,044	3	1,420
Australia	-	778	-	778
European Union[2]	337	43	60	439
Republic of South Africa	98	-	-	98
Other countries	589	187	23	799
Total all countries	5,619	2,781	94	8,494

Source: HM Revenue and Customs, ISSB

1. *Country of origin basis.*
2. *Includes non-EU coal routed through the Netherlands.*

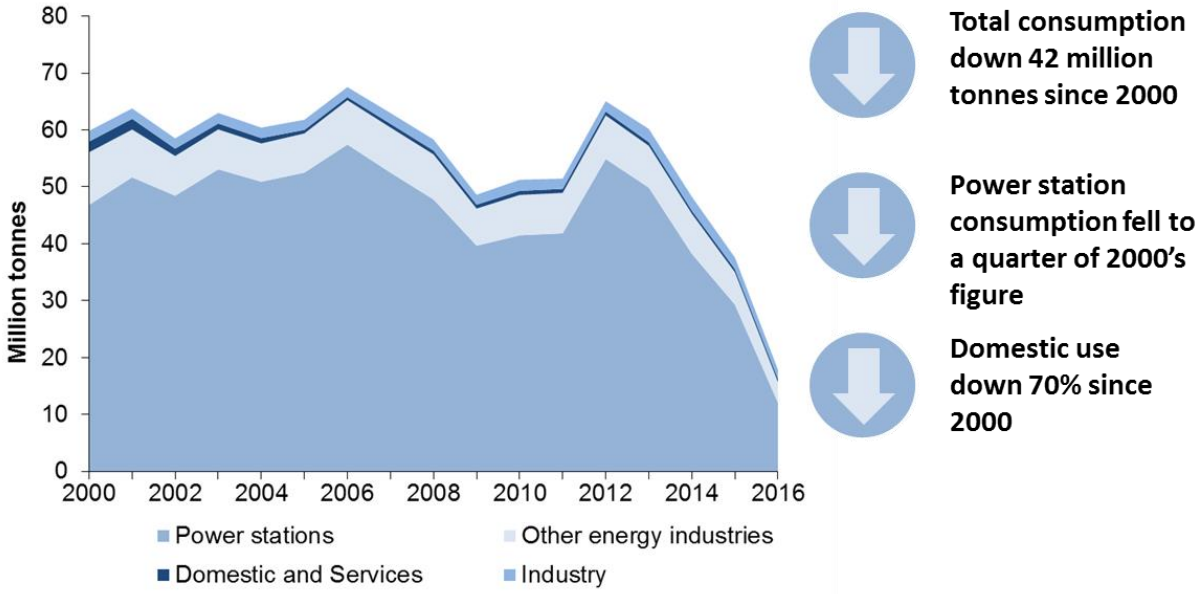
2.11 Steam coal accounted for 66 per cent of the total imports, of the rest, 33 per cent was coking coal, with anthracite accounting for the remainder. Imports from Colombia decreased by 59 per cent in 2016 compared to 2015, from 7 million tonnes to 3 million tonnes. In 2016, Colombia accounted for 47 per cent of total steam coal imports. A further 28 per cent came from Russia. The UK imported 38 per cent of coking coal from the USA with a further 28 per cent from Australia and 26 per cent from Russia. The small volume of imported anthracite was mainly from the European Union (64 per cent) and Canada (12 per cent).

2.12 In 2015, the latest year for which data is available, the UK was the fourth largest importing country in the EU and accounted for 11 per cent of total EU imports (230 million tonnes), after being overtaken by Turkey. The Netherlands was the top importing country in the EU accounting for 25 per cent, followed by Germany with a 24 per cent share and Turkey with a 15 per cent share of the total[1].

Coal Consumption

2.13 **The main development this year was yet another significant fall in demand, as coal for electricity generation continued to fall sharply** (Chart 2.3). Consumption by electricity generators was down by 59 per cent to 12 million tonnes (a new record low). The decline was due to reduced coal-fired capacity due to the conversion of a third unit at Drax from coal to high-range co-firing (85 % to <100% biomass) in July 2015 and an increase in the carbon price floor, which made coal-fired generation more expensive relative to gas-fired generation (from April 2015). The price of gas relative to coal was also a key reason for the decline; the price of coal purchased by major power producers rose by 12 per cent in 2016, while the price of gas fell by 20 per cent.[1] Seventy-eight per cent (13 million tonnes) of demand for all coal was for steam coal, 18 per cent (3.2 million tonnes) was for coking coal and the remaining 4 per cent (0.8 million tonnes) was for anthracite. The proportion of steam coal fell from 83 per cent in 2015, and coking coal rose from 14 per cent as use by the iron and steel industry fell less steeply than for electricity generation.

Chart 2.3: Coal consumption, 2000 to 2016



2.14 **The transformation sector represented 88 per cent (16 million tonnes) of overall demand for coal in 2016.** Electricity generation accounted for 67 per cent of demand for all types of coal and 86 per cent of demand for steam coal. Most coking coal was used in coke ovens (57 per cent) and the rest in blast furnaces (43 per cent) in the UK iron and steel industry. Coking coal used in blast furnaces decreased by 12 per cent from 1.5 million tonnes in 2015 to 1.4 million tonnes in 2016. An energy balance flow chart for manufactured fuel, similar to that at the start of this chapter, is included in annex H.

2.15 Electricity generation use of coal by major power producers fell by 59 per cent from 29 million tonnes in 2015 to 12 million tonnes (a new record low) in 2016. Coal use by autogenerators was 19 thousand tonnes, which was unchanged from 2015.

2.16 **Coal consumption by final consumers fell 16 per cent compared to 2015, to 2.2 million tonnes. This comprised 12 per cent of total demand.** Final consumption mainly covers steam raising, space or hot water heating, or heat for processing. Steam coal accounted for 81 per cent of this final consumption (down 14 per cent from 2015).

2.17 The industrial sector is the largest final consumer (accounting for 73 per cent of total final consumption in 2016). Eighty six per cent of the coal used in the industrial sector was steam coal and manufacturers of mineral products (e.g. cement, glass and brick) were the largest users.

[1] *Quarterly Energy Prices – table 3.2.1, which can be accessed at www.gov.uk/government/collections/industrial-energy-prices*

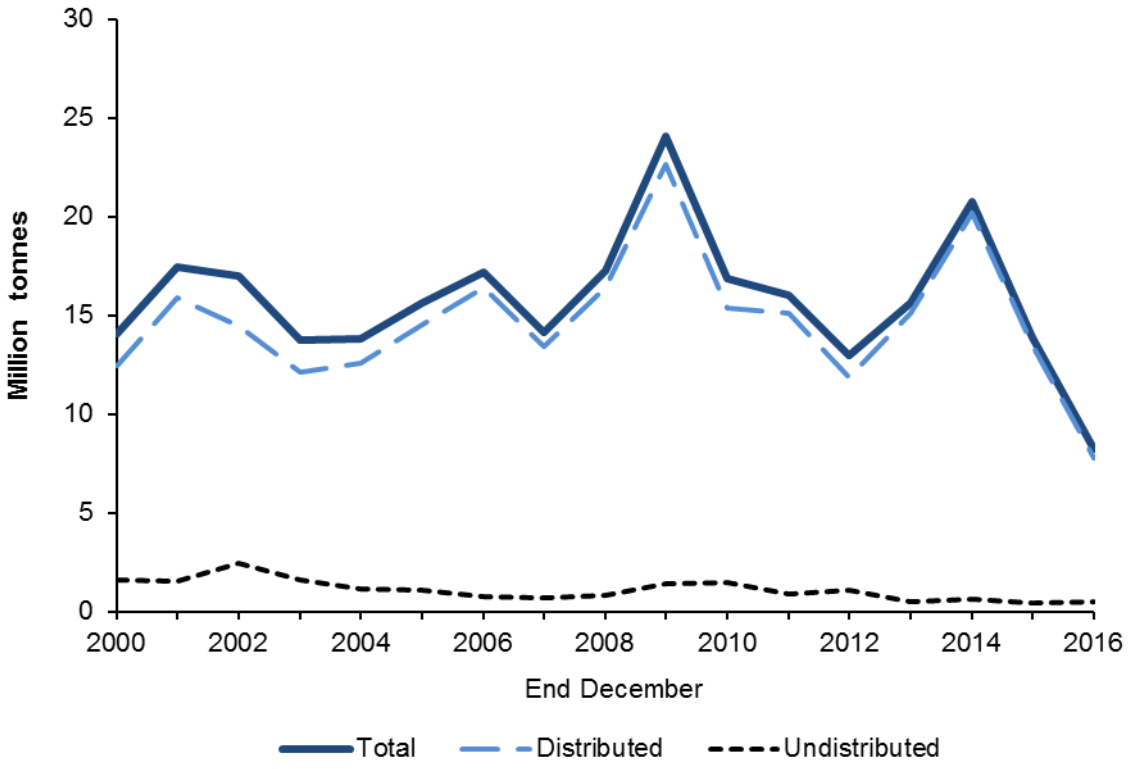
2.18 The domestic sector accounted for 25 per cent of the final consumption of coal, with 66 per cent of this demand being for steam coal and the remainder for anthracite. Domestic consumption fell slightly, by 0.4 per cent in 2016 compared with 2015.

2.19 **In 2015, the UK was the third largest consumer of coal among the EU countries**, accounting for 13 per cent (39 million tonnes) of total coal consumption in the EU (289 million tonnes). The top consumer was Poland accounting for 23 per cent (65 million tonnes) of total EU consumption, while Germany was second accounting for 22 per cent (64 million tonnes)[1].

Coal Stocks

2.20 Coal stocks fell 41 per cent in 2016 to 8.3 million tonnes, compared to 13.9 million tonnes in 2015. (Chart 2.4). The fall was due to major power stations depleting their stocks whilst purchasing less coal from the UK and overseas. Stocks at major power stations fell 45% from 12.6 million tonnes to 7.0 million tonnes. Stocks held by coke ovens increased 11 per cent to 0.6 million tonnes. Undistributed stocks (stocks held at collieries and surface mine sites) of 0.49 million tonnes at the end of 2016 were slightly higher than 0.44 million tonnes a year earlier.

Chart 2.4: Coal stocks in the UK 2000 to 2016



Coal Resources

2.21 **The Coal Authority estimates that overall there are 3,365 million tonnes of coal resources, including prospects** (Table 2C), down from 3,560 million tonnes assessed in June 2016. Of the economically recoverable and minable coal resource in current operations (including those in the planning or pre-planning process) 471 million tonnes is in underground mines and 67 million tonnes in surface mines. Overall England had a 66 per cent share of UK current mines and licenced resources, followed by Scotland with 28 per cent and Wales 7 per cent.

2.22 In prospects, there were 2,000 million tonnes suitable for underground mining and 777 million tonnes suitable for surface mining. Table 2C gives details of the resource assessment by England, Scotland and Wales as at 14 June 2017.

Table 2C: Identified GB coal resource assessment at 14 June 2017

UNDERGROUND MINING

Million tonnes

	England	Scotland	Wales	Total
Operational mines	1	0	25	26
Planning granted	5	0	0	5
In planning process	340	0	0	340
Pre-planning	0	100	0	100
Prospects	2,000	0	50	2,050
Closed mines still in licence	0	0	0	0
Total	**2,346**	**100**	**75**	**2,521**

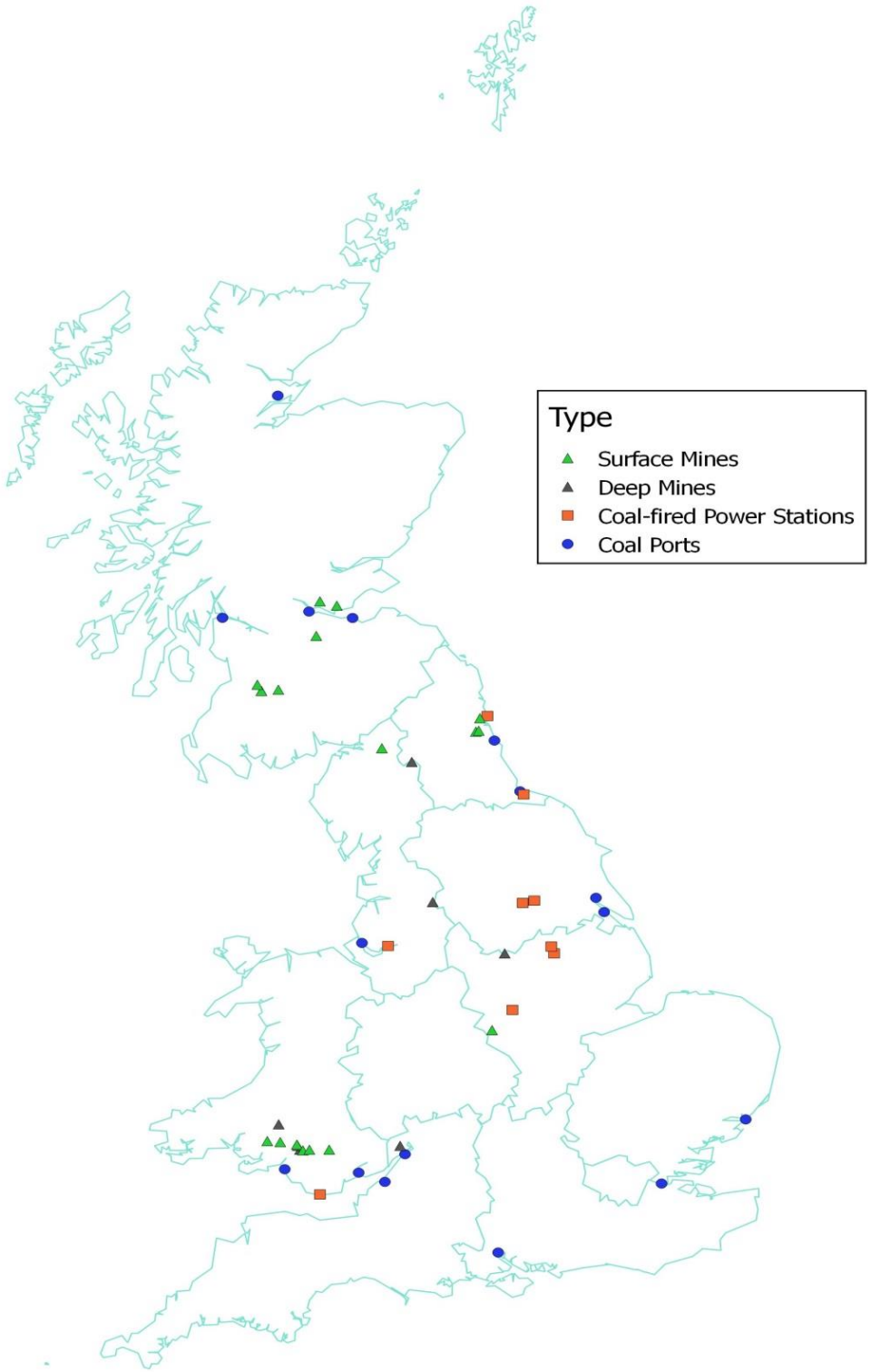
SURFACE MINING

Million tonnes

	England	Scotland	Wales	Total
Operational mines	1	3	9	13
Planning granted	3	5	1	9
In planning process	3	1	1	5
Pre-planning	0	40	0	40
Prospects	516	115	147	777
Total	**523**	**164**	**158**	**844**

Source: Coal Authority

Map 2A: UK coal production sites and ports as at the end of December 2016[2]



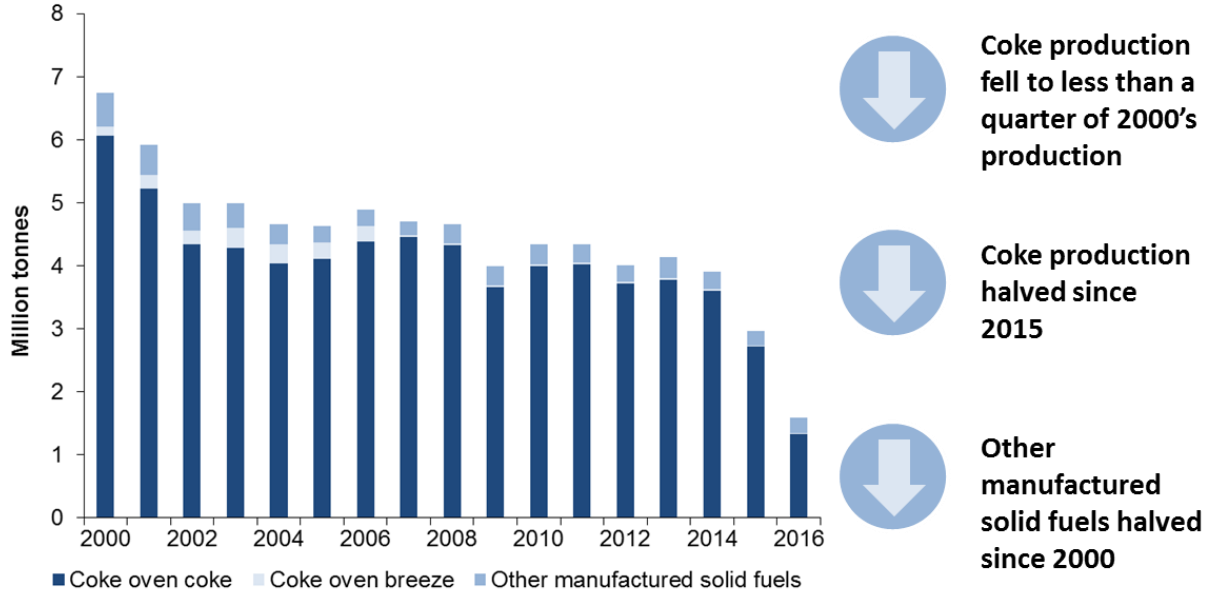
[2] *Includes non-coastal ports: Immingham (River Humber), Avonmouth (River Avon) and Tilbury (River Thames)*

Manufactured Solid Fuels (Tables 2.5 and 2.6)

Production, Trade and Consumption

2.23 Between 2015 and 2016, home produced coke oven coke decreased by 51 per cent to 1.3 million tonnes (Chart 2.5). Monckton Coke and Chemicals, the only dedicated coke plant in the UK closed in December 2014. However, coke is still being produced and used at steelworks, mainly Port Talbot and Scunthorpe. In 2016, 71 per cent of the UK's supply of coke oven coke was home produced, with the remainder being imported.

Chart 2.5: Total manufactured solid fuels production in the UK 2000 to 2016



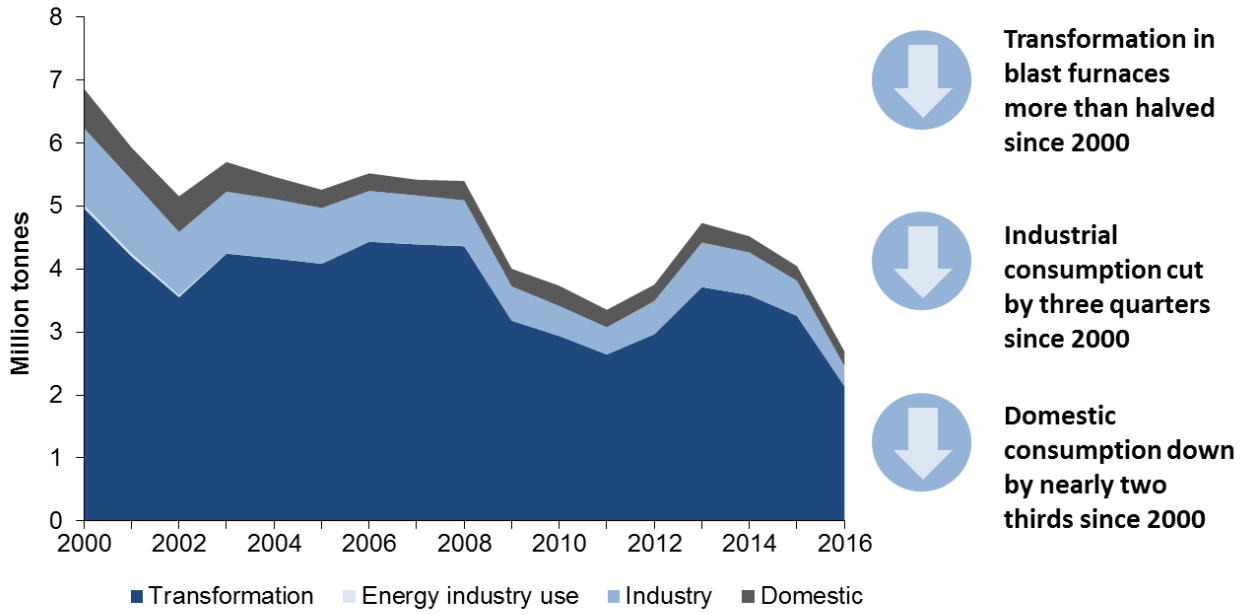
2.24 The main purpose of coke oven coke is for use in blast furnaces in the UK iron and steel industry. In 2016, blast furnace use had fallen to 1.9 million tonnes, down 34 per cent from 2015. The fall in blast furnace use was due to reduced steel production in the UK. Notably, SSI steelworks at Redcar ceased production in mid-September 2015 (with the subsequent closure in October).

2.25 Most of the supply of **coke breeze** is from re-screened coke oven coke, with direct production accounting for only 2.7 per cent of total supply in 2016. In that year, 48 per cent of coke breeze was used in blast furnaces (0.3 million tonnes) for transformation and 52 per cent used for final consumption (Chart 2.5).

2.26 Other manufactured solid fuels (patent fuels) are manufactured smokeless fuels, produced mainly for the domestic market. A small amount of these fuels (only 12 per cent of total supply in 2016) was imported, but exports generally exceed this.

2.27 The carbonisation and gasification of solid fuels in coke ovens produces coke oven gas as a by-product. In 2016, production of coke oven gas was 3.5 TWh, 50 per cent lower than in 2014 (6.9 TWh). Some of this (27 per cent) was used to fuel the coke ovens themselves. Another 24 per cent was used for electricity generation, 36 per cent for iron and steel and other industrial processes (including heat production), 8 per cent in blast furnaces and 5 per cent was lost.

Chart 2.6: Total manufactured solid fuels consumption in the UK 2000 to 2016



2.28 Blast furnace gas is a by-product of iron smelting in a blast furnace. A similar product is obtained when steel is made in basic oxygen steel (BOS) converters and "BOS" gas is included in this category. Most of these gases are used in other parts of integrated steel works. Production decreased by 29 per cent in 2016 compared with 2015. The generation of electricity in 2016 used 53 per cent of total blast furnace gas and BOS gas, while 35 per cent was used in coke ovens and blast furnaces themselves, 1.8 per cent used in general heat production, 9.1 per cent was lost or burned as waste and a further 0.9 per cent was used in the iron and steel industry.

2.29 Demand for benzole and tars decreased by 53 per cent from 1,136 GWh in 2015 to 531 GWh in 2016, all of which was met by domestic production. From 2009, based on information from the EU-ETS, all consumption of these products has been allocated to non-energy use – see also paragraph 2.51 (d) and (e).

List of DUKES coal tables

Table	Description	Period
2.1-2.3	Commodity balances for coal – supply, demand & final consumption	1998-2016
2.4	Supply and consumption of coal	2016
2.5	Supply and consumption of coke oven coke, coke breeze and other manufactured solid fuels	1996-2016
2.6	Supply and consumption of coke oven gas, blast furnace gas, benzole and tars	1996-2016
2.7	Deep mines and surface mines in production, December 2016.	2016

2.1.1	Coal production and stocks	1970-2016
2.1.2	Inland consumption of solid fuels	1970-2016

2A	Output from UK coal mines and employment in UK coal mines	2014-2016
2B	Imports of coal in 2016, by grade and origin	2016
2C	Identified GB coal resource assessment at 6 June 2016	6th June 2016

Technical notes and definitions

2.30 These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1. Additional guidance on the compilation of the solid fuels and derived gases statistics can be found in the document 'Data Sources and Methodologies', available on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/coal-statistics. For notes on the commodity balances and definitions of the terms used in the row headings see Annex A. While the data in the printed and bound copy of this Digest cover only the most recent 5 years, these notes also cover data for earlier years that are available on the BEIS website.

Coal production

2.31 **Deep mined**: The statistics cover saleable output from deep mines including coal obtained from working on both revenue and capital accounts. All licensed collieries (and British Coal collieries prior to 1995) are included, even where coal is only a subsidiary product.

2.32 **Surface** mines: The figures cover saleable output and include the output of sites worked by operators under agency agreements and licences, as well as the output of sites licensed for the production of coal as a subsidiary to the production of other minerals. The term 'surface mining' has now replaced opencast production as defined in DUKES pre-2011. Opencast production is a particular type of surface mining technique.

2.33 **Other sources/Slurry**: Estimates of slurry etc recovered and disposed of from dumps, ponds, rivers, etc.

Steam coal, coking coal and anthracite

2.34 **Steam coal** is coal classified as such by UK coal producers and by importers of coal. It tends to have calorific values at the lower end of the range.

2.35 **Coking coal** is coal sold by producers for use in coke ovens and similar carbonising processes. The definition is not therefore determined by the calorific value or caking qualities of each batch of coal sold, although calorific values tend to be higher than for steam coal.

2.36 **Anthracite** is coal classified as such by UK coal producers and importers of coal. Typically it has a high heat content making it particularly suitable for certain industrial processes and for use as a domestic fuel. Some UK anthracite producers have found a market for their lower calorific value output at power stations.

Allocation of imported coal

2.37 Although data are available on consumption of home produced coal, and also on consumption of imported coal by secondary fuel producers, there is only very limited direct information on consumption of imported coal by final users. Guidance on how BEIS allocate imports to final users is outlined in paragraph 3.2.5 of the 'Data Sources and Methodologies' document. This guidance can be found on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/coal-statistics.

Coal consumption

2.38 Figures for actual consumption of coal are available for all fuels and power producers and for final use by the iron and steel industry. The remaining final users' consumption figures are based on information on disposals to consumers by producers and on imports.

2.39 Annex A of this Digest outlines the principles of energy and commodity balances and defines the activities that fall within these parts of the balances. However, the following additional notes relevant to solid fuels are given below:

Transformation: Blast furnaces: Coking coal injected into blast furnaces is shown separately within the balance tables.

Transformation: Low temperature carbonisation plants and patent fuel plants: Coal used at these plants for the manufacture of domestic coke such as Coalite and of briquetted fuels such as Phurnacite and Homefire.

Consumption: Industry: The statistics comprise sales of coal by the six main coal producers and a few small producers to the iron and steel industry (excluding those used at coke ovens and blast furnaces) and to other industrial sectors, estimated proportions of anthracite and steam coal imports, and submission made to the EU Emissions Trading Scheme. The figures exclude coal used for industries' own generation of electricity, which appear separately under transformation.

Consumption: Domestic: Some coal is supplied free of charge to retired miners and other retired eligible employees through the National Concessionary Fuel Scheme (NCFS). The concessionary fuel provided in 2015 is estimated at 34.9 thousand tonnes. This estimate is included in the domestic steam coal and domestic anthracite figures.

Stocks of coal

2.40 Undistributed stocks are those held at collieries and surface mine sites. It is not possible to distinguish these two locations in the stock figures. Distributed stocks are those held at power stations and stocking grounds of the major power producing companies (as defined in Chapter 5, paragraphs 5.62 and 5.63), coke ovens, low temperature carbonisation plants and patent fuel plants.

Coke oven coke (hard coke), hard coke breeze and other manufactured fuels

2.41 The statistics cover coke produced at coke ovens owned by Corus plc, Coal Products Ltd and other producers. Low temperature carbonisation plants are not included (see paragraph 2.39). Breeze (as defined in paragraph 2.42) is excluded from the figures for coke oven coke.

2.42 Breeze can generally be described as coke screened below 19 mm (¾ inch) with no fines removed, but the screen size may vary in different areas and to meet the requirements of particular markets. Coke that has been transported from one location to another is usually re-screened before use to remove smaller sizes, giving rise to further breeze.

2.43 The coke screened out by producers as breeze and fines appears as transfers in the coke breeze column of the balances. Transfers out of coke oven coke have not always been equal to transfers into coke oven breeze. This was due to differences arising from the timing, location of measurement and the practice adopted by the iron and steel works. Since 2000, however, the Iron

and Steel Statistics Bureau have been able to reconcile these data. Since 2007, most of the supply of coke breeze was reclassified to coke oven coke following better information received by the Iron and Steel Statistics Bureau.

2.44 Figures are derived from returns made to HM Revenue and Customs and are broken down in greater detail in Annex G on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes.

2.45 In Table 2.5, the export figures used for hard coke, coke breeze and other manufactured solid fuels for the years before 1998 (as reported on the BEIS web site) are quantities of fuel exported as reported to BEIS or its predecessor Departments by the companies concerned, rather than quantities recorded by HM Revenue and Customs in their Trade Statistics. A long-term trend commentary and tables on exports are on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes.

2.46 In 1998, an assessment using industry data showed that on average over the previous five years 91 per cent of imports had been coke and 9 per cent breeze and it is these proportions that have been used for 1998 and subsequent years in Table 2.5.

2.47 The calorific value for coke breeze has been set the same as for coke oven coke. This is following information from the iron and steel industry on the similarities between the two types of manufactured fuels.

2.48 Imports and exports of manufactured smokeless fuels can contain small quantities of non-smokeless fuels.

2.49 Other manufactured solid fuels are mainly solid smokeless fuels for the domestic market for use in both open fires and in boilers. A smaller quantity is exported (although exports are largely offset by similar quantities of imports in most years). Manufacture takes place in patented fuel plants and low-temperature carbonisation plants. The brand names used for these fuels include Homefire, Phurnacite, Ancit and Coalite.

2.50 Consumption of coke and other manufactured solid fuels: These are disposals from coke ovens to merchants. The figures also include estimated proportions of coke imports.

Blast furnace gas, coke oven gas, benzole and tars

2.51 The following definitions are used in the tables that include these fuels:

(a) Blast furnace gas: includes Basic Oxygen Steel furnace (BOS) gas. Blast furnace gas is the gas produced during iron ore smelting when hot air passes over coke within the blast ovens. It contains carbon monoxide, carbon dioxide, hydrogen and nitrogen. In a BOS furnace the aim is not to introduce nitrogen or hydrogen into the steel making process, so pure oxygen gas and suitable fluxes are used to remove the carbon and phosphorous from the molten pig iron and steel scrap. A similar fuel gas is thus produced.

(b) Coke oven gas: is a gas produced during the carbonisation of coal to form coke at coke ovens. In 2009, some coke oven gas was produced using a combination of gases other than natural gas and blast furnace gas. This total has been added to the production of coke oven gas rather than transfers because it is specifically defined as the mixture of natural gas, blast furnace gas and BOS gas. See the paragraph below on synthetic coke oven gas for a complete definition of this.

(c) Synthetic coke oven gas: is mainly natural gas that is mixed with smaller amounts of blast furnace and BOS gas to produce a gas with almost the same qualities as coke oven gas. The transfers row of Table 2.6 shows the quantities of blast furnace gas used for this purpose and the total input of gases to the synthetic coke oven gas process. There is a corresponding outward transfer from natural gas in Chapter 4, Table 4.1.

(d) Benzole: a colourless, liquid, flammable, aromatic hydrocarbon by-product of the iron and steel making process. It is used in the UK as a solvent in the manufacture of styrenes and phenols. All consumption of benzole has been allocated to non-energy use from 2009 onwards.

(e) Tars: viscous materials usually derived from the destructive distillation of coal, which are by-products of the coke and iron making processes. . All consumption of tars has been allocated to non-energy use from 2009 onwards.

Contact: Chris Michaels
Energy Statistics Team
coalstatistics@beis.gov.uk
0300 068 5050

2.1 Commodity balances 2016

Coal

Thousand tonnes

	Steam coal	Coking coal	Anthracite	Total
Supply				
Production	3,664	53	461	4,178
Other sources	-	-	-	-
Imports	5,619	2,781	94	8,494
Exports	-356	-1	-86	-443
Marine bunkers	-	-	-	-
Stock change *(1)*	+5,811	-58	-98	+5,655
Transfers	-	-	-	-
Total supply	**14,737**	**2,775**	**371**	**17,883**
Statistical difference *(2)*	+806	-409	-404	-6
Total demand	**13,930**	**3,184**	**775**	**17,889**
Transformation	**12,139**	**3,184**	**355**	**15,678**
Electricity generation	11,926	-	132	12,058
Major power producers	11,908	-	132	12,040
Autogenerators	19	-	-	19
Heat generation	213	-	-	213
Petroleum refineries	-	-	-	-
Coke manufacture	-	1,821	-	1,821
Blast furnaces	-	1,364	-	1,364
Patent fuel manufacture and low temperature carbonisation	-	-	223	223
Energy industry use	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-
Oil and gas extraction	-	-	-	-
Petroleum refineries	-	-	-	-
Coal extraction	-	-	-	-
Coke manufacture	-	-	-	-
Blast furnaces	-	-	-	-
Patent fuel manufacture	-	-	-	-
Pumped storage	-	-	-	-
Other	-	-	-	-
Losses	-	-	-	-
Final consumption	**1,791**	**-**	**420**	**2,211**
Industry	**1,383**	**-**	**232**	**1,615**
Unclassified	-	-	-	-
Iron and steel	2	-	33	35
Non-ferrous metals	18	-	-	18
Mineral products	813	-	0	813
Chemicals	67	-	-	67
Mechanical engineering etc.	11	-	-	11
Electrical engineering etc.	5	-	-	5
Vehicles	53	-	-	53
Food, beverages etc	30	-	14	44
Textiles, leather etc.	68	-	-	68
Paper, printing etc.	130	-	-	130
Other industries	182	-	185	367
Construction	5	-	-	5
Transport	**15**	**-**	**-**	**15**
Air	-	-	-	-
Rail *(3)*	15	-	-	15
Road	-	-	-	-
National navigation	-	-	-	-
Pipelines	-	-	-	-
Other	**394**	-	**188**	**581**
Domestic	362	-	188	550
Public administration	20	-	-	20
Commercial	5	-	-	5
Agriculture	-	-	-	-
Miscellaneous	7	-	-	7
Non energy use	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) Estimate revised following research carried out into heritage railways.

2.2 Commodity balances 2015

Coal

Thousand tonnes

	Steam coal	Coking coal	Anthracite	Total
Supply				
Production	7,668r	72r	858r	8,598r
Other sources	-	-	-	-
Imports	17,665r	4,750	102	22,518r
Exports	-303r	-1	-81r	-385r
Marine bunkers	-	-	-	-
Stock change *(1)*	6,590r	248r	25r	6,862r
Transfers	-	-	-	-
Total supply	**31,620r**	**5,069r**	**904r**	**37,593r**
Statistical difference *(2)*	467r	-148r	-337r	-18r
Total demand	**31,153r**	**5,217r**	**1,242r**	**37,612r**
Transformation	**29,070r**	**5,217r**	**701r**	**34,988r**
Electricity generation	28,857r	-	473r	29,330r
Major power producers	28,838r	-	473r	29,310r
Autogenerators	19r	-	-	19r
Heat generation	213r	-	-	213r
Petroleum refineries	-	-	-	-
Coke manufacture	-	3,673r	-	3,673r
Blast furnaces	-	1,544r	-	1,544r
Patent fuel manufacture and low temperature carbonisation	-	-	228r	228r
Energy industry use	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-
Oil and gas extraction	-	-	-	-
Petroleum refineries	-	-	-	-
Coal extraction	-	-	-	-
Coke manufacture	-	-	-	-
Blast furnaces	-	-	-	-
Patent fuel manufacture	-	-	-	-
Pumped storage	-	-	-	-
Other	-	-	-	-
Losses	-	-	-	-
Final consumption	**2,084r**	**-**	**541r**	**2,624r**
Industry	**1,707r**	**-**	**336r**	**2,043r**
Unclassified	-	-	-	-
Iron and steel	1r	-	43	44r
Non-ferrous metals	21r	-	-	21r
Mineral products	1,048r	-	0	1,048r
Chemicals	74r	-	-	74r
Mechanical engineering etc.	11r	-	-	11r
Electrical engineering etc.	5r	-	-	5r
Vehicles	60r	-	-	60r
Food, beverages etc.	33r	-	21	54r
Textiles, leather etc.	66r	-	-	66r
Paper, printing etc.	133r	-	-	133r
Other industries	248r	-	272r	520r
Construction	6	-	-	6
Transport	**13r**	**-**	**-**	**13r**
Air	-	-	-	-
Rail *(3)*	13r	-	-	13r
Road	-	-	-	-
National navigation	-	-	-	-
Pipelines	-	-	-	-
Other	**363r**	-	**205r**	**568r**
Domestic	347r	-	205r	552r
Public administration	4r	-	-	4r
Commercial	5	-	-	5
Agriculture	-	-	-	-
Miscellaneous	7r	-	-	7r
Non energy use	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) Estimate revised following research carried out into heritage railways.

2.3 Commodity balances 2014

Coal

Thousand tonnes

	Steam coal	Coking coal	Anthracite	Total
Supply				
Production	10,161r	99	1,388r	11,648r
Other sources	-	-	-	-
Imports	35,754	6,344	127	42,225
Exports	-343r	-1r	-81	-425r
Marine bunkers	-	-	-	-
Stock change *(1)*	-4,833r	-276	-22r	-5,131r
Transfers	-	-	-	-
Total supply	**40,739r**	**6,166**	**1,412r**	**48,316r**
Statistical difference *(2)*	529r	-325	-183r	21r
Total demand	**40,210r**	**6,490**	**1,595r**	**48,295r**
Transformation	**37,811r**	**6,490**	**953r**	**45,255r**
Electricity generation	37,539r	-	695r	38,234r
Major power producers	37,521	-	695r	38,215r
Autogenerators	19r	-	-	19r
Heat generation	272	-	-	272
Petroleum refineries	-	-	-	-
Coke manufacture	-	4,977r	-	4,977r
Blast furnaces	-	1,513r	-	1,513r
Patent fuel manufacture and low temperature carbonisation	-	-	259r	259r
Energy industry use	**1r**	**-**	**-**	**1r**
Electricity generation	-	-	-	-
Oil and gas extraction	-	-	-	-
Petroleum refineries	-	-	-	-
Coal extraction	1r	-	-	1r
Coke manufacture	-	-	-	-
Blast furnaces	-	-	-	-
Patent fuel manufacture	-	-	-	-
Pumped storage	-	-	-	-
Other	-	-	-	-
Losses	-	-	-	-
Final consumption	**2,398r**	**-**	**641r**	**3,040r**
Industry	**2,002r**	**-**	**439r**	**2,442r**
Unclassified	-	-	-	-
Iron and steel	2r	-	52r	54r
Non-ferrous metals	25	-	-	25
Mineral products	1,238r	-	0	1,239r
Chemicals	108r	-	-	108r
Mechanical engineering etc.	14r	-	-	14r
Electrical engineering etc.	7r	-	-	7r
Vehicles	70	-	-	70
Food, beverages etc.	44r	-	18r	62r
Textiles, leather etc.	74	-	-	74
Paper, printing etc.	166r	-	-	166r
Other industries	246r	-	369r	615r
Construction	7r	-	-	7r
Transport	**13**	**-**	**-**	**13**
Air	-	-	-	-
Rail *(3)*	13	-	-	13
Road	-	-	-	-
National navigation	-	-	-	-
Pipelines	-	-	-	-
Other	**383r**	-	**202r**	**585r**
Domestic	347r	-	202r	549r
Public administration	24r	-	-	24r
Commercial	5	-	-	5
Agriculture	-	-	-	-
Miscellaneous	7r	-	-	7r
Non energy use	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).

(2) Total supply minus total demand.

(3) Estimate revised following research carried out into heritage railways.

2.4 Supply and consumption of coal

Thousand tonnes

	2012	2013	2014	2015	2016
Supply					
Production	16,287	12,673	11,648	8,598	4,178
Deep-mined	6,153	4,089	3,685	2,784	22
Surface mining *(1)*	10,134	8,584	7,962	5,814	4,156
Other sources *(2)*	680	95	-	-	-
Imports	44,815	50,611r	42,225	22,518r	8,494
Exports	-488	-595r	-425	-385	-443
Stock change *(3)*	+2,966	-2,641r	-5,131r	+6,862r	+5,655
Total supply	**64,259**	**60,143r**	**48,316r**	**37,593r**	**17,883**
Statistical difference *(4)*	+217	-62r	+21r	-18r	-6
Total demand	**64,042**	**60,206r**	**48,295r**	**37,612r**	**17,889**
Transformation	**61,498**	**57,192r**	**45,255**	**34,988r**	**15,678**
Electricity generation	54,901	49,873r	38,234	29,330r	12,058
Major power producers	53,837	49,840r	38,215	29,310r	12,039
Autogenerators	1,064	33	19	19	19
Heat generation	461	362	272	213	213
Coke manufacture	4,965	5,288	4,977	3,673r	1,821
Blast furnaces	987	1,411	1,513	1,544r	1,364
Patent fuel manufacture and low temperature carbonisation	184	259	259	228r	223
Energy industry use	**4**	**3**	**1**	**-**	**-**
Coal extraction	4	3	1	-	-
Final consumption	**2,541**	**3,011r**	**3,040r**	**2,624r**	**2,211**
Industry	**1,826**	**2,323r**	**2,442r**	**2,043r**	**1,615**
Unclassified	-	-	-	-	-
Iron and steel	51	53	54	44	35
Non-ferrous metals	21	21r	25	21	18
Mineral products	1,123	1,338r	1,239r	1,048r	813
Chemicals	76	84r	108r	74	67
Mechanical engineering, etc	11	11r	14	11	11
Electrical engineering, etc	5	5r	7	5	5
Vehicles	50	60r	70	60	53
Food, beverages, etc	44	55r	62r	54	44
Textiles, leather, etc	62	66r	74	66	68
Paper, printing, etc	138	143r	166r	133r	130
Other industries	239	480r	615r	520r	367
Construction	6	6	7	6	5
Transport	**16**	**14**	13	13	**15**
Other	**698**	**675r**	585r	568r	**581**
Domestic	674	640r	549r	552	550
Public administration	12	24r	24r	4r	20
Commercial	5	5	5	5	5
Agriculture	1	-	-	-	-
Miscellaneous	6	7	7	7	7
Non energy use					
Stocks at end of year *(5)*					
Distributed stocks	11,883	15,114r	20,142r	13,471r	7,766
Of which:					
Major power producers	9,561	11,871	17,091	12,595r	6,962
Coke ovens	831	518	795	547r	605
Undistributed stocks	1,120	530r	633r	441r	492
Total stocks *(6)*	**13,003**	**15,644r**	**20,775r**	**13,913r**	**8,258**

(1) The term 'surface mining' has now replaced opencast production. Opencast production is a surface mining technique.
(2) Estimates of slurry etc. recovered from ponds, dumps, rivers, etc.
(3) Stock fall (+), stock rise (-).
(4) Total supply minus total demand.
(5) Excludes distributed stocks held in merchants' yards, etc., mainly for the domestic market, and stocks held by the industrial sector.
(6) For some years, closing stocks may not be consistent with stock changes, due to additional stock adjustments.

2.5 Supply and consumption of coke oven coke, coke breeze and other manufactured solid fuels

Thousand tonnes

	2012	2013	2014	2015	2016
Coke oven coke					
Supply					
Production	3,712	3,769	3,601	2,716	1,332
Imports	147	764	823	1,006	1,110
Exports	-450	-75	-85	-83	-
Stock change *(1)*	+341	+178	-64	+184	-110
Transfers	-1,021	-1,277	-1,075	-970	-459
Total supply	**2,728**	**3,358**	**3,199**	**2,853**	**1,872**
Statistical difference *(2)*	**-**	**-**	**-**	**-**	**-**
Total demand	**2,728**	**3,358**	**3,199**	**2,853**	**1,872**
Transformation	**2,674**	**3,271**	**3,144**	**2,823**	**1,860**
Blast furnaces	2,674	3,271	3,144	2,823	1,860
Energy industry use	**-**	**-**	**-**	**-**	**-**
Final consumption	**55**	**87**	**55**	**30**	**12**
Industry	**48**	**82**	**49**	**27**	**12**
Unclassified	35	69	35	13	0
Iron and steel	13	13	14	15	12
Non-ferrous metals	**-**	**-**	**-**	**-**	**-**
Other	**7**	**6**	**6**	**3**	**0**
Domestic	7	6	6	3	0
Stocks at end of year *(3)*	**393**	**215**	**280**	**95**	**206**
Coke breeze					
Supply					
Production *(4)*	31	32	31	18	16
Imports	46	55	103	107	112
Exports	-71	-11	-3	-7	-
Stock change *(1)*	-255	-283	-132	-123	+1
Transfers	1,021	1,277	1,071	967	455
Total supply	**772**	**1,069**	**1,070**	**962**	**584**
Statistical difference *(2)*	**-**	**-**	**-**	**-**	**-**
Total demand	**772**	**1,069**	**1,070**	**962**	**584**
Transformation	**293**	**442**	**440**	**433**	**280**
Coke manufacture	**-**	**-**	**-**	**-**	**-**
Blast furnaces	293	442	440	433	280
Energy industry use	**-**	**-**	**-**	**-**	**-**
Final consumption	**479**	**627**	**629**	**528**	**304**
Industry	**479**	**627**	**629**	**528**	**304**
Unclassified	10	14	9	4	-0
Iron and steel	469	613	620	525	304
Stocks at end of year *(3)*	**437**	**720**	**852**	**975**	**974**
Other manufactured solid fuels					
Supply					
Production	258	336	274	231	245
Imports	15	15	14	20	29
Exports	-32	-30	-24	-22	-22
Stock change *(1)*	+7	-17	-15	+3	-16
Total supply	**248**	**303**	**249**	**232**	**236**
Statistical difference *(2)*	-5	-1	-1	+0	+0
Total demand	**253**	**304**	**250**	**232**	**236**
Transformation	**-**	**-**	**-**	**-**	**-**
Energy industry use	**-**	**-**	**-**	**-**	**-**
Patent fuel manufacture	**-**	**-**	**-**	**-**	**-**
Final consumption	**253**	**304**	**250**	**232**	**236**
Industry	**-**	**-**	**-**	**-**	**-**
Unclassified	**-**	**-**	**-**	**-**	**-**
Other	**253**	**304**	**250**	**232**	**236**
Domestic	253	304	250	232	236
Stocks at end of year *(3)*	**24**	**42**	**57**	**54**	**70**

(1) Stock fall (+), stock rise (-).
(2) Total supply minus total demand.
(3) Producers stocks and distributed stocks.
(4) See paragraph 2.25.

2.6 Supply and consumption of coke oven gas, blast furnace gas, benzole and tars

GWh

	2012	2013	2014	2015	2016
Coke oven gas					
Supply					
Production	8,257	8,479	8,473	6,890	3,468
Imports	-	-	-	-	-
Exports	-	-	-	-	-
Transfers *(1)*	+60	+64	+146	+439	+360
Total supply	**8,317**	**8,544**	**8,620**	**7,329**	**3,828**
Statistical difference *(2)*	-1	-1	-3	28	1
Total demand	**8,318**	**8,545**	**8,622**	**7,301**	**3,827**
Transformation	**2,858**	**2,741**	**2,538**	**2,067**	**1,322**
Electricity generation	2,440	2,322	2,119	1,649	903
Heat generation	418	418	418	418	418
Other	-	-	-	-	-
Energy industry use	**4,567**	**4,525**	**4,599**	**3,879**	**1,337**
Coke manufacture	3,816	3,643	3,725	3,185	1,049
Blast furnaces	751	882	874	694	289
Other	-	-	-	-	-
Losses	**192**	**389**	**682**	**768**	**203**
Final consumption	**701**	**890**	**804**	**586**	**965**
Industry	**701**	**890**	**804**	**586**	**965**
Unclassified	198	174	165	-	-
Iron and steel	504	716	639	586	965
Blast furnace gas					
Supply					
Production	11,694	15,576	15,386	14,131	10,090
Imports	-	-	-	-	-
Exports	-	-	-	-	-
Transfers *(1)*	-4	-4	-7	-19	-16
Total supply	**11,690**	**15,572**	**15,380**	**14,111**	**10,074**
Statistical difference *(2)*	-48	+17	-34	+13	+8
Total demand	**11,738**	**15,555**	**15,414**	**14,099**	**10,066**
Transformation	**7,052**	**8,782**	**8,686**	**7,637**	**5,554**
Electricity generation	6,873	8,602	8,507	7,457	5,374
Heat generation	179	179	179	179	179
Other	-	-	-	-	-
Energy industry use	**3,569**	**4,516**	**4,732**	**4,451**	**3,509**
Coke manufacture	672	751	711	641	632
Blast furnaces	2,898	3,765	4,021	3,810	2,877
Other	-	-	-	-	-
Losses	**817**	**2,111**	**1,835**	**1,878**	**912**
Final consumption	**300**	**146**	**160**	**133**	**91**
Industry	**300**	**146**	**160**	**133**	**91**
Unclassified	-	-	-	-	-
Iron and steel	300	146	160	133	91
Benzole and tars *(3)*					
Supply					
Production	1,543	1,630	1,582	1,136	531
Final consumption *(4)*	**1,543**	**1,630**	**1,582**	**1,136**	**531**
Unclassified	-	-	-	-	-
Iron and steel	-	-	-	-	-
Non energy use	1,543	1,630	1,582	1,136	531

(1) To and from synthetic coke oven gas, see paragraph 2.51.
(2) Total supply minus total demand.
(3) Because of the small number of benzole suppliers, figures for benzole and tars cannot be given separately.
(4) From 2009, unclassified final consumption has been recorded under non energy use

2.7 Deep mines and surface mines in production at 31 December 2016

Deep mines[(1)]

Licensee	Site Name	Location
Ayle Colliery Company Ltd	Ayle Colliery	Northumberland
European Coal Products Ltd	Eckington Colliery	Derbyshire
Grimebridge Colliery Company Ltd	Hill Top Colliery	Lancashire
NH Colliery Ltd	Nant Hir No.2 Colliery	Neath Port Talbot
Three D's Mining Ltd	Dan-y-Graig No.4 Colliery	Neath Port Talbot

Surface mines[(2)]

Licensee	Site Name	Location
Bryn Bach Coal Ltd	Glan Lash	Carmarthenshire
Celtic Energy Ltd	East Pit	Neath Port Talbot
Glenmuckloch Restoration Ltd	Glenmuckloch Site	Dumfries & Galloway
H J Banks & Company Ltd	Brenkley Lane	Newcastle upon Tyne
	Rusha Site	West Lothian
	Shotton	Northumberland
Hargreaves Surface Mining Ltd	Muir Dean Site	Fife
H M Project Developments Ltd	Halton Lea Gate Remediation Scheme	Northumberland
Kier Minerals Ltd	Greenburn Project	East Ayrshire
Land Engineering Services Ltd	Comrie Colliery Site	Fife
Miller Argent (South Wales) Ltd	Ffos-y-Fran Land Reclamation Scheme	Merthyr Tydfil
OCCW (Broken Cross) Ltd	Broken Cross Site	South Lanarkshire
OCCW (House of Water) Ltd	House of Water Site	East Ayrshire
OCCW (Netherton) Ltd	Netherton	East Ayrshire
PB Restoration Ltd	Potland Burn	Northumberland
Tower Regeneration Ltd	Tower Colliery Surface Mining Site	Rhondda Cynon Taff
UKCSMR Ltd	Minorca	Leicestershire

(1) In addition, there were 3 underground mines on care & maintenance :-
Aberpergwm Colliery in Neath Port Talbot licensed to Energybuild Mining Ltd
Monument Colliery in the Forest of Dean licensed to Messrs Ashly, Daniels and Jones
Redding's Level No.2 Mine in the Forest of Dean licensed to Mr A J Warren

(2) In addition, there were 2 surface mines on care & maintenance :-
Bwlch Ffos site in Neath Port Talbot licensed to Horizon Mining Ltd (in administration)
Nant Helen Remainder in Powys licensed to Celtic Energy Ltd
Selar site in Neath Port Talbot licensed to Celtic Energy Ltd

Source: The Coal Authority

Chapter 3
Petroleum

Key points

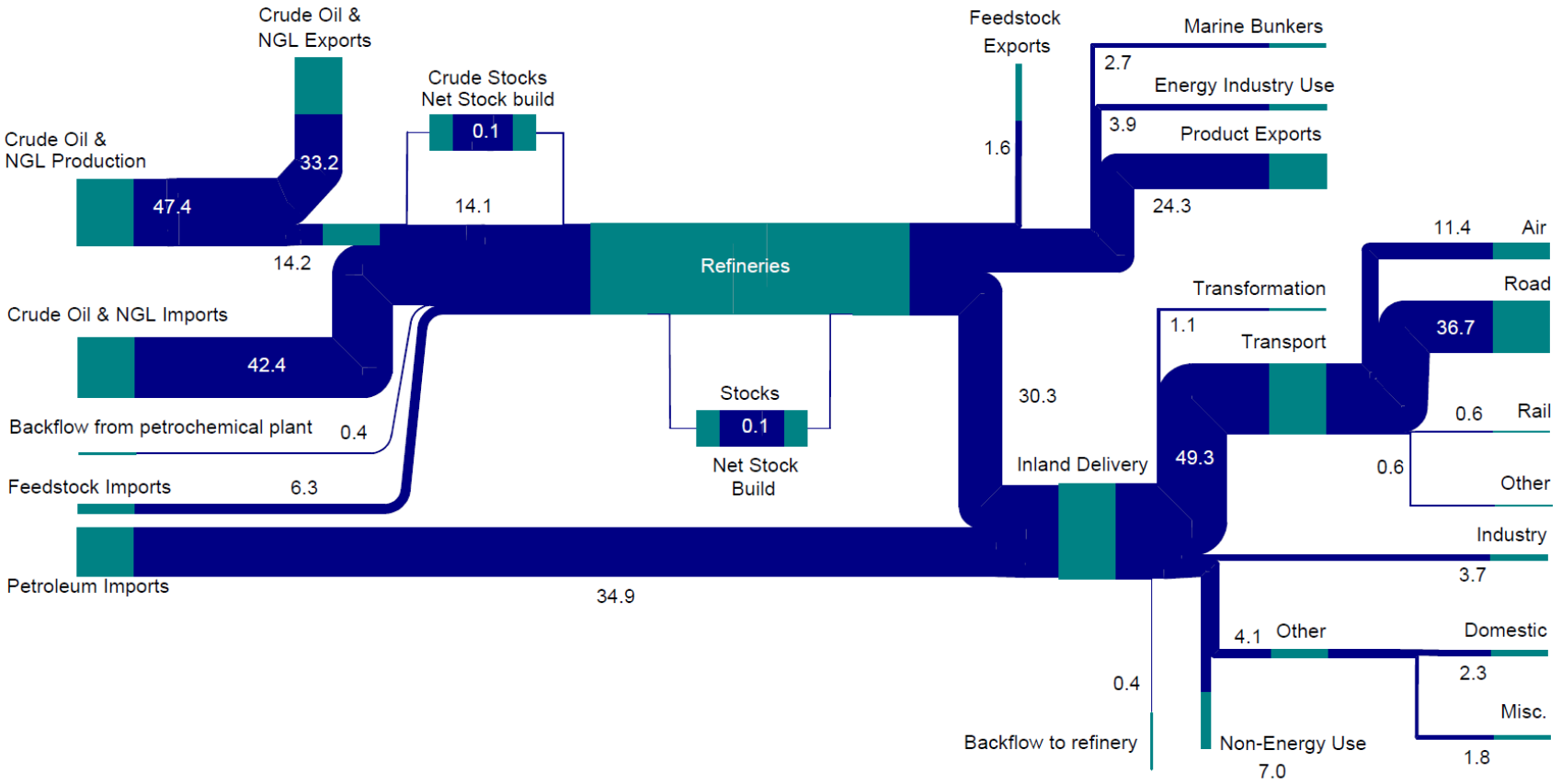
- **Production of crude oil and Natural Gas Liquids from the UK's North Sea increased by 4.8 per cent in 2016,** in contrast with the long-term decline. Production is around a third of the UK's peak of 1999 (Table 3.1, Chart 3.1).
- **Net imports of primary oils decreased in 2016** due to increased production and because refineries were processing more indigenous crude. Exports increased by 1.1 million tonnes on 2015 and imports were down by nearly 2 million tonnes. (Table 3.1, Chart 3.1).
- **UK refinery production decreased 1.7 per cent to 59.9 million tonnes in 2016.** Production was strong in 2015, however many refineries have reduced their distillation capacity in recent years and UK production was still around one-third lower than the peak at the turn of the century (Table 3.2, Chart 3.2).
- **The UK was a net importer of petroleum products in 2016 by more than 10 million tonnes,** the highest such figure since the 1984 miner's strike. Product exports were up 6.0 per cent on 2015 and imports increased by 8.5 per cent in 2016 (Table 3.2, Chart 3.2).
- **Refinery production does not meet demand for every product.** Around 55 per cent of the UK's demand for diesel is produced in the UK and around 40 per cent of jet fuel, whereas refineries continue to produce more than sufficient petrol to meet UK demand (Table 3.2).
- **The increase in consumption in 2016 of 1.8 per cent was lower than the 2.9 per cent seen in 2015.** In each year these increases were largely driven by the use of oil for transport, though demand of oil products for use in petrochemical plants also increased (Table 3.2 to 3.4, Chart 3.2).

Introduction

3.1 Petroleum forms a key part of the UK's energy mix. Around 40 percent of the UK's total energy production is from crude oils extracted from the UK's Continental Shelf, and UK refineries produce around 60 million tonnes of oil products - the 4th largest in Europe. Consumer demand for transport fuels, heating fuels and for feedstocks to produce plastics and other products is around 67 million tonnes, over a third of the UK's energy consumption.

3.2 The flow chart on the following page shows the movement of primary oils and petroleum products, illustrating how crude oils are supplied, transformed in refineries, and then consumed in the various sectors of the UK's economy. The widths of the bands are proportional to the size of the flow they represent.

Petroleum Flow Chart 2016 (million tonnes)



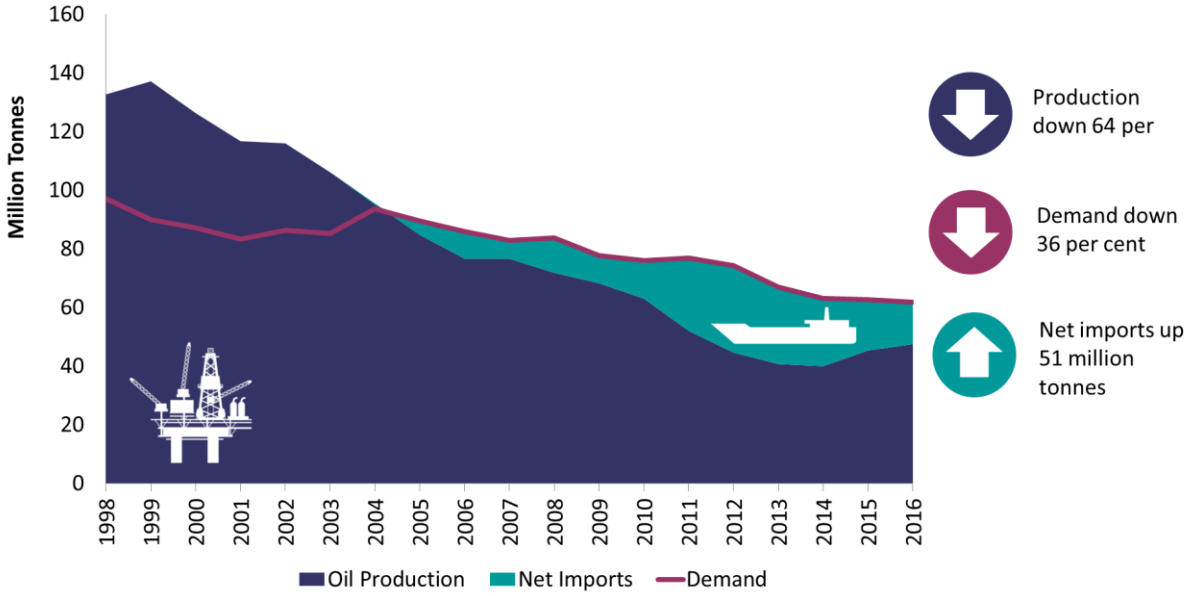
Note:
This flow chart is based on the data that appear in Tables 3.1 and 3.2.
The numbers on either side of the flow chart will not match due to losses in transformation.
Biofuels are not included.

Supply and demand for primary oil (Table 3.1)

3.3 Chart 3.1 summarises how production, trade and demand of crude oils have changed since 1998. Overall demand from refiners has dropped by more than a third since the late part of the last century but there has been a far steeper decline in oil production from the United Kingdom Continental Shelf (UKCS). **From its peak of 137 million tonnes in 1999 UKCS production has dropped nearly two-thirds to 47 million tonnes**, with the UK becoming a net importer in 2005. Recent declines in production have been shallower but imports will become increasingly important in meeting the UK's needs.

3.4 Compared with last year, imports of primary oils are down 3.7 per cent and exports are up 3.4 per cent. The UK was a net importer of crude oil and Natural Gas Liquids (NGLs) by 9.2 million tonnes in 2016, compared to 13.5 million tonnes in 2015. The decrease was because UKCS production increased marginally in 2016, and there was less demand from refineries in 2016 compared to 2015.

Chart 3.1: Primary oil supply and demand 1998-2016

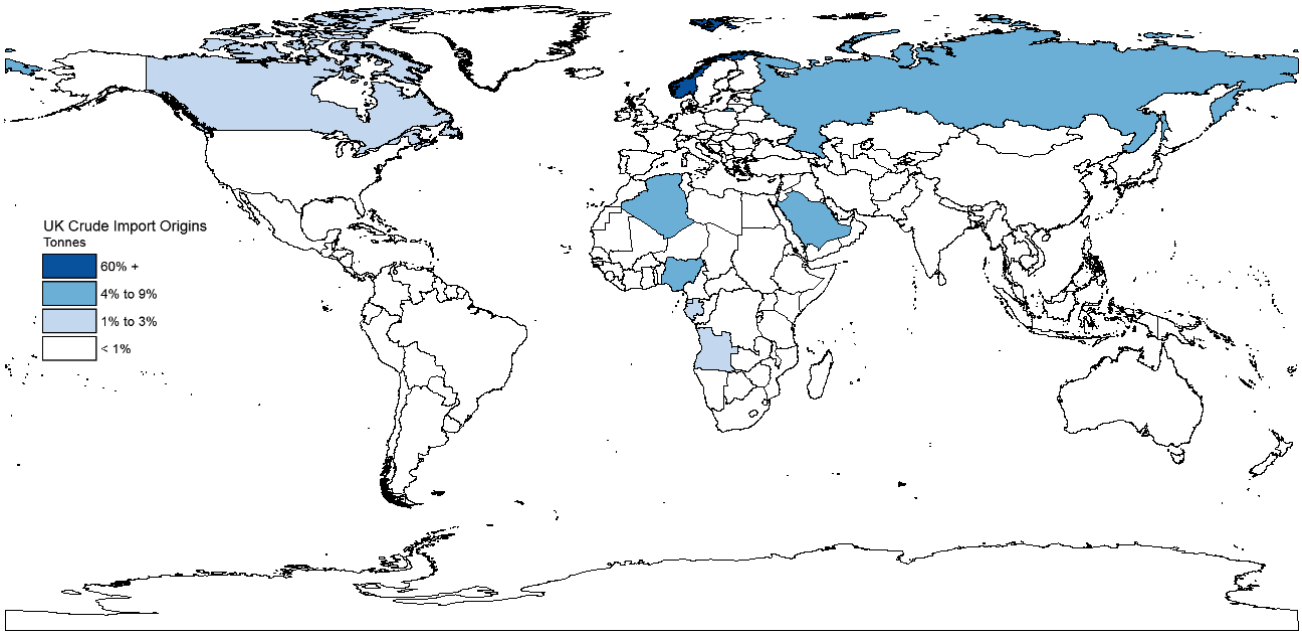


3.5 The sources of crude oil imports from other countries are shown in Map 3A. **The principal source of the UK's imports has consistently been Norway**, historically accounting for around two-thirds of all imports given not only its proximity to the UK but also the similarity in its crude types. This fell to 50 per cent in 2015, but recovered so that in 2016 the proportion of crude oil sourced from Norway stood at 62 per cent.

3.6 **Imports from OPEC countries consisted of 28 per cent of the UK's crude imports in 2016.** Principally imports from OPEC countries come from Nigeria (9 per cent of total imports) and Algeria (7 per cent). Combined volumes from OPEC countries fell by 6.7 million tonnes in 2016, likely because total UK imports decreased by 3.2 million tonnes and imports from Norway increased by 3.4 million tonnes.

3.7 Imports from Russia increased by half a million tonnes in 2016 to comprise 5 per cent of UK crude imports. This made Russia the fourth largest source of imports after Norway, Nigeria and Algeria.

Map 3A: Source of UK crude oil imports 2000 to 2016



3.8 **The UK is a signficiant exporter of crude oils as well as an importer. Crude oil exports increased in 2016 to reach over 30 million tonnes.** Crude oil has historically been pricipally exported to the Netherlands, Germany, France and the US. Exports to the Netherlands recovered in 2016 to comprise 40 per cent of total crude exports after falling to just 31 per cent the previous year. In 2016 exports to France decreased by nearly 1 million tonnes and exports to China increased by 3.3 million tonnes, making China the third largest recipient of UK crude exports after the Netherlands and Germany in 2016.

UK refineries

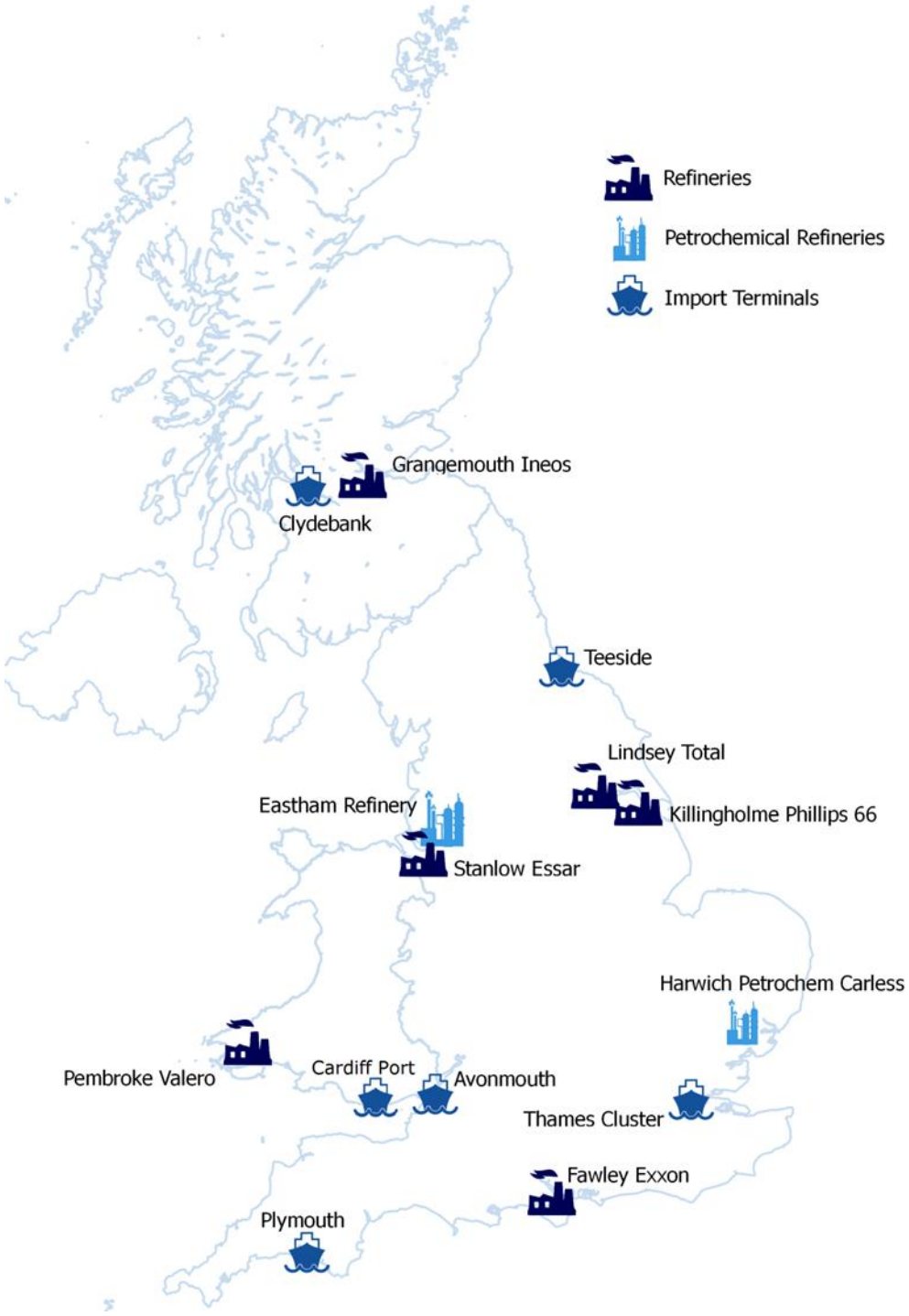
3.9 A significant proportion of the UK's primary oil is processed into petroleum products at the UK's six refineries. Data for refinery capacity as at the end of 2016 are presented in Table 3A, with the location of these refineries illustrated in Map 3B. The location of the UK's petrochemical refineries and major import terminals are also marked on the map.

Table 3A: UK refinery processing capacity as at end 2016

Refinery	Atmospheric Distillation	Reforming	Cracking and Conversion
Fawley Exxon	13.3	4.4	5.0
Stanlow Essar	9.8	1.5	4.0
Pembroke Valero	10.9	2.1	6.3
Grangemouth PetroIneos	10.2	1.9	3.5
Killingholme Phillips 66	11.9	2.6	10.7
Lindsey Total	5.0	0.7	3.8
Petrochemical plant			
Harwich Petrochem Carless	< 1.0	-	-
Eastham Refinery	1.2	-	-
Total	**62.3**	**13.2**	**33.3**

Million tonnes per annum

Map 3B: Distribution of GB refineries and import terminal clusters as at end 2016



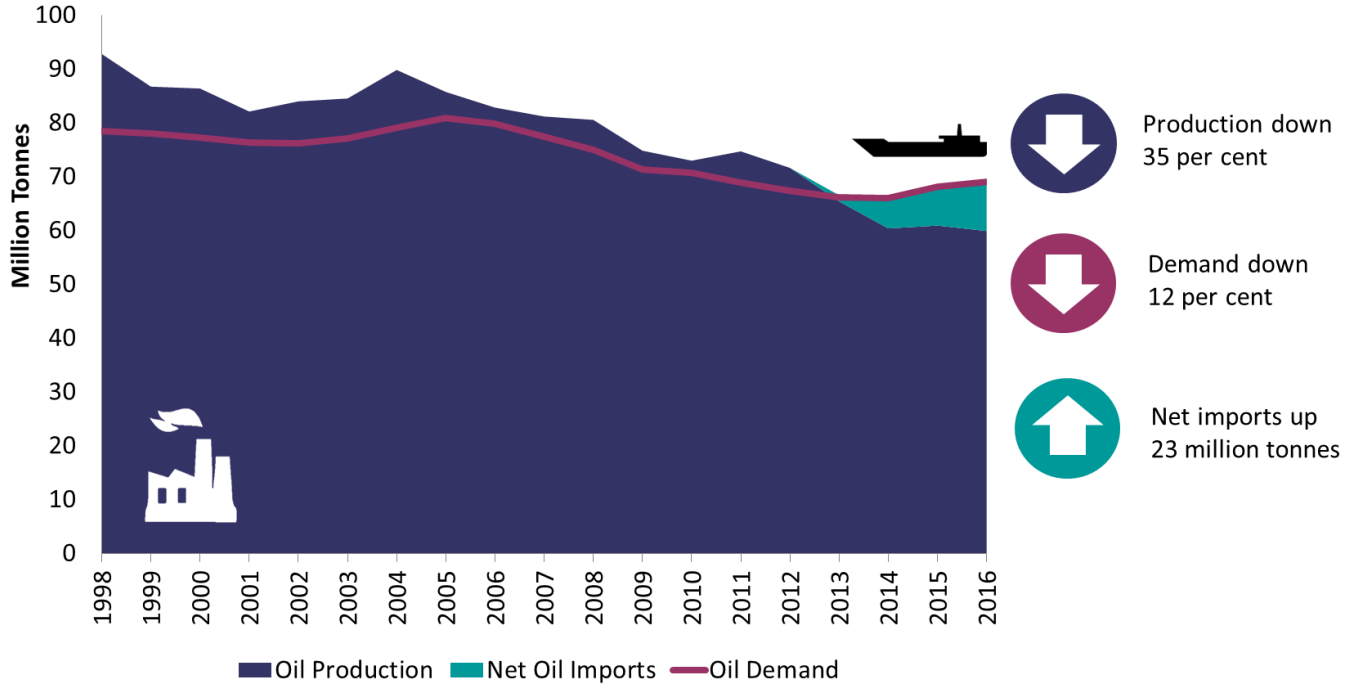
3.10 **Refinery capacity has decreased because of closures in recent years** including Murco at Milford Haven in 2014, as well as the Petroplus Teeside refinery in 2009, and the Petroplus Coryton refinery in 2012. In addition, there has been some rationalisation of capacity at other UK refineries in recent years and refining capacity is down nearly one-third on its 2008 total.

Supply and demand for petroleum products (Tables 3.2 to 3.4)

3.11 Chart 3.2 shows refinery production of petroleum products since 1998. **Despite the recent rationalisation in the sector the UK's refineries produced nearly 60 million tonnes of product in 2016,** down 1.7 per cent on 2015. The price of crude was around $100/bbl until the end of 2014, when it fell to around $50/bbl by the end of 2015 and then to less than $45/bbl by the end of 2016[1]. Production levels in 2015 and 2016 were partly attributable to these low prices, and also because little maintenance was seen overall.

3.12 The UK's refinery capacity remains substantial with only Germany and Italy having significantly greater capacity than the UK. However in the long term 2016 levels were down more than 30 per cent from the peak in 1998.

Chart 3.2: Production and trade in petroleum products 1998- 2016



3.13 In 2016 the UK was a net importer of petroleum products by 10.5 million tonnes, up from 9.2 million tonnes in 2015. Again, this is the largest figure for net imports since 1984 when industrial action in the coal industry led to greater imports of petroleum products (particularly fuel oil) for power generation. With declining production of key fuels the UK has been a net importer of petroleum since 2013, reversing the trend of previous decades as a net exporter.

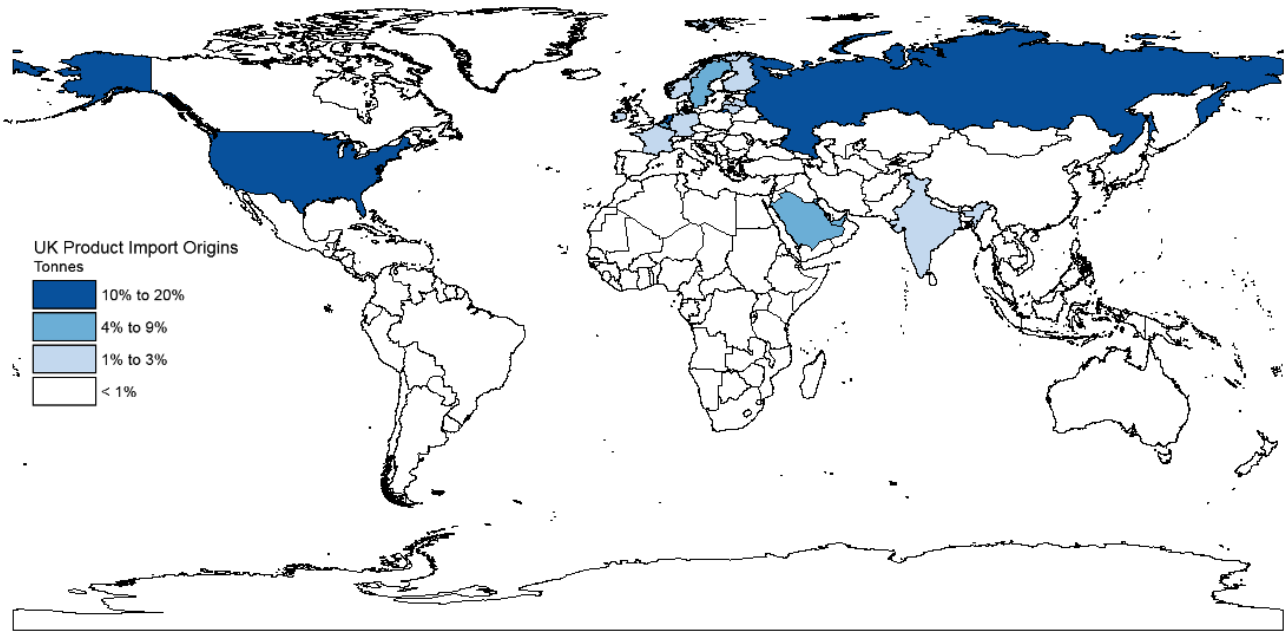
3.14 **As with crude oil, imports are critically important for the UK's domestic demand**. In common with many other countries, domestic supply and demand is not matched on a product-by-product basis. The UK's refineries were developed to produce petrol (motor spirit) for domestic cars and fuel oil for electricity generation. With the increasing dieselisation of the UK's car fleet, and the switch from fuel oil to other fuels for electricity generation, UK production of individual petroleum products is no longer aligned with market demand. To balance demand the UK trades widely and is one of the largest importers of jet fuel and road diesel in the OECD and one of the largest exporters of petrol.

3.15 Map 3C shows the principal trading partners with the UK with regards to petroleum products. Ten countries account for around 80 per cent of the total volume of imports[2]. Historically the bulk of the products have come via the Netherlands, which acts as a major trading hub (the fuel might have been

[1] Platts, from the 2017 BP Statistical Review of World Energy
[2] Diversity of supply for oil and oil products in OECD countries, 2015: www.gov.uk/government/publications/energy-trends-september-2016-special-feature-article-diversity-of-supply-for-oil-and-oil-products-in-oecd-countries-in-2015

refined from elsewhere in Europe or beyond). Russia and the US were the next biggest sources of transport fuels in 2016, being especially large suppliers of diesel. Including the Netherlands, these three countries supplied nearly half (47 per cent) of all UK transport fuel imports in 2016.

Map 3C: Map of imports of petroleum products



3.16 **The diversity of supply is increasing as demand for key transport fuels increases.** There is a clear split between imports from European countries (which are mainly diesel) and imports from Asia (where the bulk of jet fuel is sourced from generally more modern refinery operations than seen in Europe). The top three suppliers of jet fuel were the United Arab Emirates, Saudi Arabia and Kuwait in 2016, comprising nearly half of jet fuel imports that year.

3.17 The misalignment between UK refinery production and domestic demand means that the UK exports 24 million tonnes of petroleum products. Almost half of all exports is petrol (much of which goes to the US), while fuel oil accounts for around 15 per cent.

Consumption of petroleum products (Tables 3.2. to 3.4)

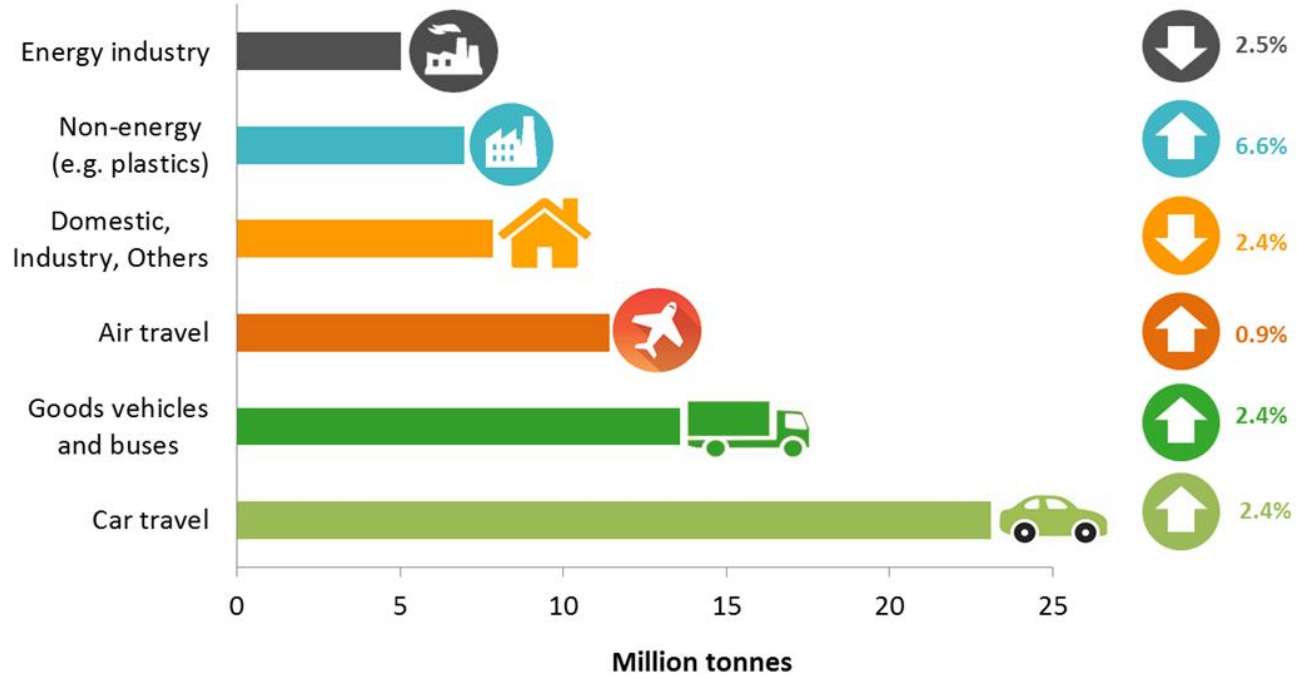
3.18 More than two-thirds of oil is consumed for transport purposes - for planes and road vehicles, including goods vehicles. Oil is critical to transport requirements, and planes and large goods vehicles are arguably less amenable to electrification and other alternative fuels.

3.19 Consumption of petroleum products has increased in 2015 and 2016 following a period of decline (as illustrated in Chart 3.2), likely due to lower prices that have boosted refinery production. Chart 3.3 shows that consumption in 2016 was primarily for road transport fuels and aviation fuel, and that these increased by 2.4 per cent and 0.9 per cent in 2016.

3.20 Outside of transport, 'non-energy' use of oil is the single most significant sector. Here oil is not burnt but instead used as a feedstock to produce plastics and vinyls within the petrochemical industry. Non-energy use of oil has been growing in recent years and now stands at around 10 per cent of total demand for oil. Large imports of petroleum gases into the UK to some petrochemical operations led to a 6.6 per cent increase in non-energy use in 2016.

3.21 Oil products are also used by refineries to fuel the refining process, and very small amounts are used for electricity generation. Use of oil products in the energy industry, which includes electricity generation and petroleum refineries, was 2.5 per cent less in 2016. More significant volumes are used by industry and to heat homes that are 'off-grid' and not connected to the gas transmission network. Use in these other sectors was down by 2.4 per cent overall in 2016.

Chart 3.3: Oil consumption in the UK 2016



3.22 The prevalent trend since 1998 relates to how petrol has been displaced by diesel in the UK's road transport market. The crossing point where diesel displaced petrol occurred in 2004 and the rate of substitution has been broadly consistent over time. Whilst much of this is due to the increased dieselistion of the car fleet, there has been a considerable expansion of the number of miles driven by light good vehicles, which tend to use diesel.

3.23 The increase in diesel sales reflects in part the changing pattern of fuel consumption within the UK. Table 3B shows that the volume of diesel being consumed by cars and taxis trebled between 1995 and 2016, the most recent year for which data is available.

Table 3B: Estimated consumption of road transport fuels by vehicle class

	1995	2000	2005	2010	2016[a]
					million tonnes
Petrol:					
Cars and taxis	19.9	20.2	18.1	14.1	11.6
Light goods vehicles	1.6	1.0	0.5	0.3	0.2
Motor cycles etc.	0.2	0.2	0.2	0.2	0.2
Total	**21.7**	**21.4**	**18.9**	**14.6**	**12.0**
Diesel:					
Cars and taxis	2.8	4.1	6.6	8.6	11.2
Light goods vehicles	2.5	3.5	4.6	4.8	5.8
Heavy goods vehicles	6.2	6.1	6.7	5.9	6.5
Buses and coaches	1.7	1.5	1.5	1.4	1.2
Total	**13.2**	**15.3**	**19.4**	**20.7**	**24.6**

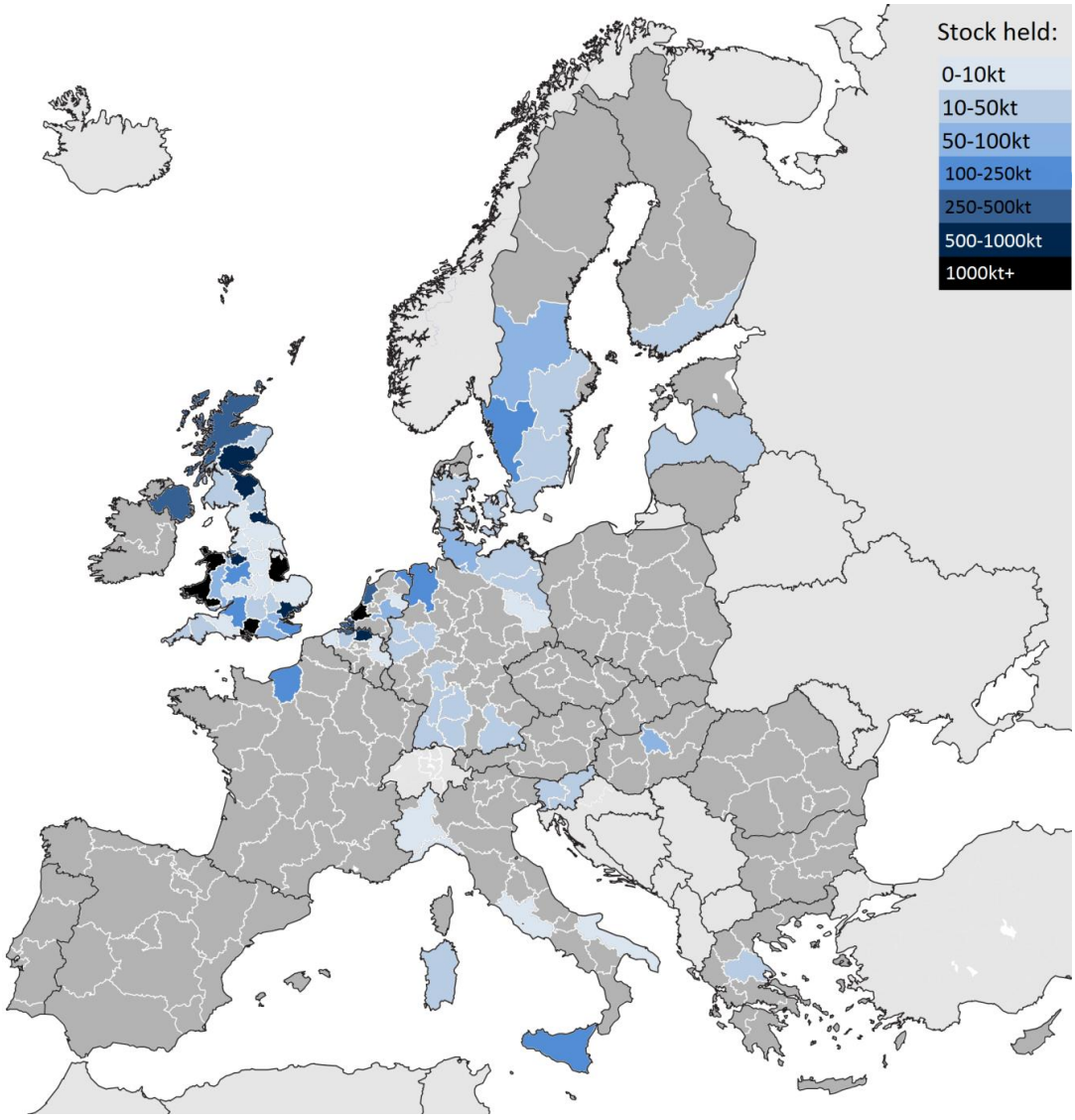
[a] *Data for 2016 have been estimated using 2015 percentage splits.*

Stocks of oil (Table 3.7)

3.24 Under international commitments to both the European Union and the International Energy Agency, the UK is obliged to hold oil stocks to offset the impact of significant disruptions to the global oil market. Such disruptions are relatively rare, but since the Arab-Israeli war of 1974 there have been three globally co-ordinated releases of oil in response to the Gulf War (1990–1991), Hurricane Rita (2005), and the civil war in Libya (2011).

3.25 **In total, the UK holds around 15 million tonnes of stock for emergency purposes, broadly equivalent to around 61 days of consumption.** The stock is held both within the UK, but significant volumes are held overseas under contractual arrangements that allow stocks to be repatriated to the UK if necessary. The map below shows the volume of stocks held in the UK and across the EU[3]. The UK also holds further stocks in the UK (not shown here) under contractual arrangement for other countries.

Map 3D: Map of UK oil stock locations 2016



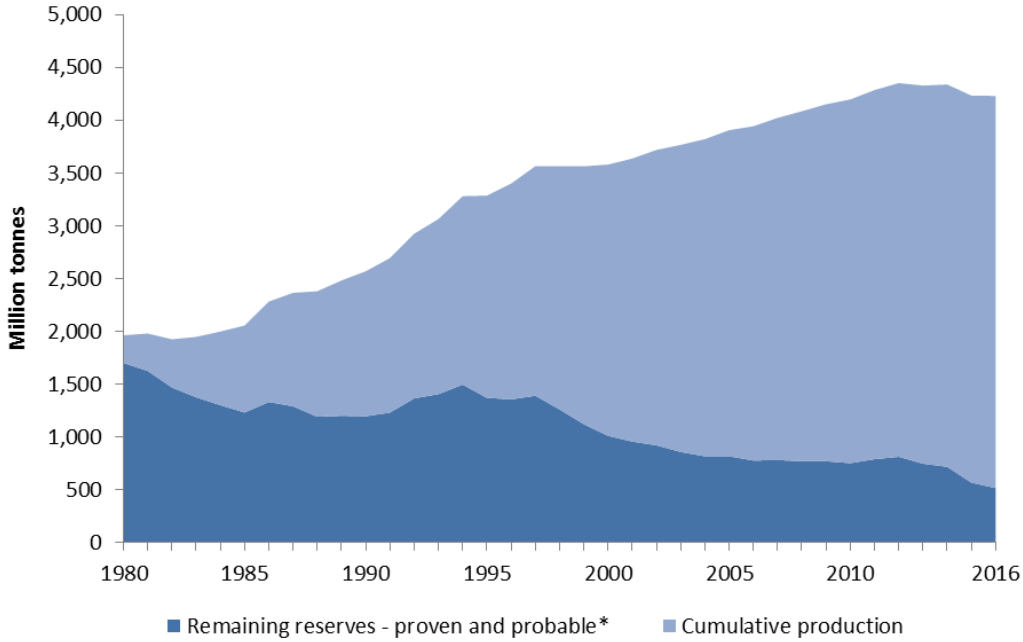
3.26 In addition to the information in this chapter, there is considerable data on BEIS's website. Information on long-term trends (Tables 3.1.1 and 3.1.2) and the annex on the oil and gas resources in the UK (Annex F) provide a more complete picture of the UK oil and gas production sector. These tables are available at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[3] Mapping the UK's oil stocks: www.gov.uk/government/publications/energy-trends-march-2017-special-feature-article-mapping-the-uks-oil-stocks

Oil resources

3.27 The Oil and Gas Authority estimates that there are 515 million tonnes of proven and probable oil reserves at the end of 2016, of which 337 million tonnes are proven reserves. Proven and probable oil reserves have generally been on the decline since 1994. With the addition of cumulative oil production to the end of 2016 the estimated ultimate recovery figure is 4,231 million tonnes, which includes natural gas liquids along with crude oil.

Chart 3.4: Oil reserves



* From 2015 contingent resources have been re-categorised and removed from the probable and proven reserves category.

List of DUKES oil tables

Table	Description	Period
3.1	Primary oil commodity balances	1998-2016
3.1au	Primary oil commodity balances – alternative units (barrels and litres)	2016
3.2-3.4	Petroleum products commodity balances	1998-2016
3.2-3.4au	Petroleum products commodity balances – alternative units (barrels and litres)	2016
3.5	Supply and disposal of petroleum	2012-2016
3.6	Additional information on inland deliveries of selected products	2012-2016
3.7	Stocks of crude oil and petroleum products at end of year	2012-2016
3.8	Additional information on inland deliveries for non-energy uses	2012-2016
3.9	Imports of crude oil and petroleum products by country of origin	2012-2016
3.1.1	Crude oil and petroleum products: production, imports and exports	1970-2016
3.1.2	Inland deliveries of petroleum	1970-2016
F.1	Crude oil and natural gas liquids production	1998-2016
F.3	Natural gas liquids net production	1999-2016
F.4	Disposals of crude oil	1998-2016

Technical notes and definitions

3.28 These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1.

Sources of data

3.29 The majority of the data included in the text and tables of this chapter are derived from BEIS's Downstream Oil Reporting System (DORS), which replaced the UK Petroleum Industry Association (UKPIA) reporting system in 2005. Data relating to the inland operations of the UK oil industry (i.e. information on the supply, refining and distribution of oil in the UK) are collected from companies. The data format and coverage have been designed to meet most of the needs of both Government and the industry itself. Each member of UKPIA and a number of other contributing companies provides returns on its refining activities and deliveries of various products to the internal UK market. This information is supplemented whenever necessary to allow for complete coverage within the statistics, with separate exercises carried out on special topics (for example, supermarket shares) or with the use of additional data (such as trade data from HM Revenue and Customs (HMRC) to cover import activity by non-reporting companies). In addition to these data sources, BEIS make use of the Emissions data from the EU's Emissions Trading Scheme provided on major energy users. In particular ensuring the consistency of data published on fuel used within the refineries (refinery gases and petroleum coke) and the sectoral usage of Gas oil and Fuel oil.

3.30 In 2014 BEIS introduced a new reporting form to major oil importers. The new form indicated the need for more detailed surveys of large importers within the UK and from January 2015 all major importers were obliged to complete the more detailed DORS form used by refiners. The DORS survey now offers substantially greater insight (particularly with respect to trade and blending activities).

Statistical differences

3.31 The upper half of the balance tables represents the supply side and calculates overall availability of the various products in the UK by combining production at refineries with trade (imports and exports), stock changes, product transfers and deliveries to international marine bunkers (fuel used by ships travelling to a foreign destination).

3.32 The lower half of the table reports the demand side and covers the uses made of the different products, including the use made within the refining process, and details of the amounts reported by oil companies within the UK as delivered for final consumption.

3.33 In Tables 3.1 to 3.5, there are headings titled "statistical differences". These are differences between the separately observed figures for production and delivery of crude oil and products during the path of their movement from the point of production to the point of consumption.

3.34 The statistical differences headings listed in the primary oil commodity balances (Table 3.1) are differences between the separately observed and reported figures for production from onshore or offshore fields and supply to the UK market that cannot be accounted for by any specific factors. Primarily they result from inaccuracies in the meters at various points along offshore pipelines. These meters vary slightly in their accuracy within accepted tolerances, giving rise to both losses and gains when the volumes of oil flowing are measured. Errors may also occur when non-standard conditions are used to meter the oil flow.

3.35 The statistical difference for primary oils in the table includes own use in onshore terminals and gas separation plants, losses, platform and other field stock changes. Another factor is the time lag that can exist between production and loading onto tankers being reported at an offshore field and the arrival of these tankers at onshore refineries and oil terminals. This gap is usually minimal and works such that any effect of this at the start of a month is balanced by a similar counterpart effect at the end of a month. However, there can be instances where the length of this interval is considerable and, if it happens at the end of a year, there can be significant effects on the statistical differences seen for the years involved.

3.36 Another technical factor that can contribute to the statistical differences relates to the recording of quantities at the producing field (which is the input for the production data) and at oil terminals and refineries, since they are in effect measuring different types of oil. Terminals and refineries are able to measure a standardised, stabilised crude oil, that is, with its water content and content of Natural Gas

Liquids (NGLs) at a standard level and with the amounts being measured at standard conditions. However, at the producing field they are dealing with a “live” crude oil that can have a varying level of water and NGLs within it. While offshore companies report live crude at field, the disposals from oil terminals and offshore loading fields are reported as stabilised crude oil. This effectively assumes that terminal disposals are stabilised crude production figures. These changes were introduced in the 2002 edition of this Digest.

3.37 Part of the overall statistical difference may also be due to problems with the correct reporting of individual NGLs at the production site and at terminals and refineries. It is known that there is some mixing of condensate and other NGLs in with what might otherwise be stabilised crude oil before it enters the pipeline. This mixing occurs as it removes the need for separate pipeline systems for transporting the NGLs and it also allows the viscosity of the oil passing down the pipeline to be varied as necessary. While the quantity figures recorded by terminals are in terms of stabilised crude oil, with the NGL component removed, there may be situations where what is being reported does not comply with this requirement.

3.38 With the downstream sector, the statistical differences can similarly be used to assess the validity and consistency of the data. From the tables, these differences are generally a very small proportion of the totals involved.

3.39 Refinery data are collated from details of individual shipments received and made by each refinery and terminal operating company. Each year there are thousands of such shipments, which may be reported separately by two or three different companies involved in the movement. While intensive work is carried out to check these returns, it is possible that some double counting of receipts may occur.

3.40 Temperature, pressure and natural leakage also contribute to the statistical differences. In addition, small discrepancies can occur between the estimated calorific values used at the field and the more accurate values measured at the onshore terminal where data are shown on an energy basis. The statistical differences can also be affected by rounding, clerical errors or unrecorded losses, such as leakage. Other contributory factors are inaccuracies in the reporting of the amounts being disposed of to the various activities listed, including differences between the quantities reported as going to refineries and the actual amounts passing through refineries.

3.41 Similarly, the data under the statistical difference headings in Tables 3.2 to 3.4 are the differences between the deliveries of petroleum products to the inland UK market reported by the supplying companies and estimates for such deliveries. These estimates are calculated by taking the output of products reported by refineries and then adjusting it by the relevant factors (such as imports and exports of the products, changes in the levels of stocks etc.).

3.42 It may be thought that such differences should not exist as the data underlying both the observed deliveries into the UK market and the individual components of the estimates (i.e. production, imports, exports, stocks) come from the same source (the oil companies). While it is true that each oil company provides data on its own activities in each area, there are separate areas of operation within the companies that report their own part of the overall data. Table 3C illustrates this.

Table 3C: Sources of data within oil companies

Area covered	Source
Refinery production	Refinery
Imports and exports	Refinery, logistics departments, oil traders
Stocks	Refinery, crude and product terminals, major storage and distribution sites
Final deliveries	Sales, marketing and accounts departments

3.43 Each individual reporting source will have direct knowledge of its own data. For example, refineries will know what they produce and how much leaves the refinery gate as part of routine monitoring of the refinery operations. Similarly other data such as sales to final consumers or imports and exports will be closely monitored. Companies will ensure that each component set of data reported is as accurate as possible but their reporting systems may not be integrated, meaning that internal consistency checks

across all reported data cannot be made. Each part of a company may also work to different timings as well, which may further add to the degree of differences seen.

3.44 The main area where there is known to be a problem is with the “Transfers” heading in the commodity balances. The data reported under this heading have two components. Firstly, there is an allowance for reclassification of products within the refining process. For example, butane can be added to motor spirit to improve the octane rating, aviation turbine fuel could be reclassified as domestic kerosene if its quality deteriorates, and much of the fuel oil imported into the UK is further refined into other petroleum products. Issues can arise with product flows between different reporting companies, for example when company A delivers fuel oil to company B who report a receipt of a feedstock. Secondly, and in addition to these inter-product transfers, the data also include an allowance to cover the receipt of backflows of products from petrochemical plants that are often very closely integrated with refineries. A deduction for these backflows thus needs to be included under the "Transfers" heading so that calculated estimates reflect net output and are thus more comparable with the basis of the observed deliveries data.

3.45 There is scope for error in the recording of these two components of transfers. With inter-product transfers, the data are recorded within the refinery during the refining and blending processes where the usual units used to record the changes are volumes rather than masses. Different factors apply for each product when converting from a volume to mass basis, as shown by the conversion factors given in Annex A of this Digest. Thus, a balanced transfer in volume terms may not be equivalent when converted to a mass basis. This is thought to be the main source of error within the individual product balances.

Revisions to published data

3.46 Following a review of trade data, exports of propane and butane (LPG) and fuel oil have been revised using HMRC data to capture exports by companies that do not report data to BEIS to provide a more complete picture of UK oil trade.

3.47 Minor revisions have been made following the re-introduction of checks on trade between reporting companies, which affects import and consumption data. Other revisions have been made following updates received from data suppliers.

Indigenous production

3.48 The term indigenous is used throughout this chapter and includes oil from the UK Continental Shelf, both offshore and onshore. Production of feedstocks at petrochemical plants that are delivered to refineries as backflows have not been included in production figures in the text or charts in this chapter.

Deliveries

3.49 These are deliveries into consumption, as opposed to being estimates of actual consumption or use. They are split between inland deliveries and deliveries to marine bunkers. Inland deliveries will not necessarily be consumed in the UK (e.g. aviation fuels).

Imports and exports

3.50 The information given under the headings "imports" and "exports" in this chapter are the figures recorded by importers and exporters of oil. They can differ in some cases from the import and export figures provided by HMRC that are given in Annex G on BEIS’s energy statistics website. Such differences arise from timing differences between actual and declared movements but also result from the Customs figures including re-exports. These are products that may have originally entered the UK as imports from another country and been stored in the UK prior to being exported back out of the UK, as opposed to having been actually produced in the UK.

Marine bunkers

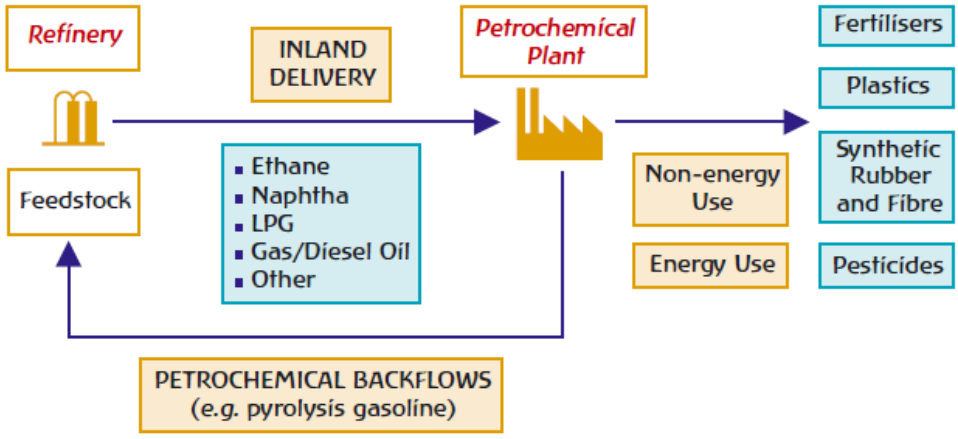
3.51 This covers deliveries to be used by ocean going and coastal vessels under international bunker contracts. Other deliveries to fishing, coastal and inland vessels are excluded. As part of BEIS’s audit programme, UK refinery contacts reviewed the provision of fuel to marine bunkers in 2009. Whilst a number of companies have reviewed their methodology there are still issues with determining the final destination of fuel when these are supplied to third parties that are not part of BEIS’s monitoring programme. This issue impacts on both the volumes delivered directly to marine vessels, and whether those vessels are engaged in domestic or international navigation.

Whilst BEIS will continue to work closely with reporting companies to improve the estimation of marine fuel use. We have aligned energy demand for shipping in line with the estimates of marine fuel use in the UK's National Atmospheric Emissions Inventory (NAEI). The NAEI figures use BEIS's estimate of marine fuels and derive the split between international and domestic use based on an activity based study of the UK's marine fuel use.

Backflows from the petrochemical sector

3.52 BEIS and Industry have also worked to better understand product flows between refiners and petrochemical plants. Whilst most petroleum products are used for energy purposes, substantial volumes are delivered to the petrochemical industry as a feedstock for the manufacturing of plastics, synthetic fibres and other products. These products are used, but they are not combusted. The refining and petrochemical industries are often closely related as shown in Figure 3.1 below. Refineries deliver product to a petrochemical plant for the production of a range of products, but these plants also return some petroleum products back to refineries for further processing.

Figure 3.1: Deliveries to the Petrochemical Sector (Source: IEA)



3.53 Since the 2015 edition of this Digest BEIS have separately identified deliveries of backflows from petrochemical plants under both the upstream side of the balance (in Table 3.1 they are included as part of the 'feedstocks' column) and the downstream part of the balance (in Table 3.2 to 3.4 the volumes are shown on the 'other' row in the transformation section).

Crude and process oils

3.54 These are all feedstocks, other than distillation benzene, for refining at refinery plants. Gasoline feedstock is any process oil whether clean or dirty which is used as a refinery feedstock for the manufacture of gasoline or naphtha. Other refinery feedstock is any process oil used for the manufacture of any other petroleum products.

Refineries

3.55 Refineries distil crude and process oils to obtain petroleum products. This excludes petrochemical plants, plants only engaged in re-distilling products to obtain better grades, crude oil stabilisation plants and gas separation plants.

Products used as fuel (energy use)

3.56 The following paragraphs define the product headings used in the text and tables of this chapter. The products are used for energy, either directly as a fuel or as an input into electricity generation.

Refinery fuel - Petroleum products used as fuel at refineries.

Ethane - A naturally gaseous straight-chain hydrocarbon (C2H6) in natural gas and refinery gas streams. Primarily used, or intended to be used, as a chemical feedstock.

Propane - Hydrocarbon containing three carbon atoms (C3H8), gaseous at normal temperature

but generally stored and transported under pressure as a liquid. Used mainly for industrial purposes, but also as transport, Liquid Petroleum Gas (LPG), and some domestic heating and cooking.

Butane - Hydrocarbon containing four carbon atoms (C4H10), otherwise as for propane. Additionally used as a constituent of motor spirit to increase vapour pressure and as a chemical feedstock.

Naphtha (Light distillate feedstock) - Petroleum distillate boiling predominantly below 200°C.

Aviation spirit - All light hydrocarbon oils intended for use in aviation piston-engine power units, including bench testing of aircraft engines.

Motor spirit - Blended light petroleum components used as fuel for spark-ignition internal-combustion engines other than aircraft engines:

(i) Premium unleaded grade - all finished motor spirit, with an octane number (research method) not less than 95.

(ii) Lead Replacement petrol / Super premium unleaded grade - finished motor spirit, with an octane number (research method) not less than 97.

Aviation turbine fuel (ATF) - All other turbine fuel intended for use in aviation gas-turbine power units and including bench testing of aircraft engines.

Burning oil (kerosene or "paraffin") - Refined petroleum fuel, intermediate in volatility between motor spirit and gas oil, used primarily for heating. White spirit and kerosene used for lubricant blends are excluded.

Gas/diesel oil - Petroleum fuel having a distillation range immediately between kerosene and light-lubricating oil:

(i) **DERV (Diesel Engined Road Vehicle) fuel** - automotive diesel fuel for use in high speed, compression ignition engines in vehicles subject to Vehicle Excise Duty.

(ii) **Gas oil** - used as a burner fuel in heating installations, for industrial gas turbines and as for DERV (but in vehicles not subject to Vehicle Excise Duty e.g. agricultural vehicles, fishing vessels, construction equipment used off road and usually coloured with a red marker dye). Gas oil used for oil and gas extraction is included from 2005 onwards.

(iii) **Marine diesel oil** - heavier type of gas oil suitable for heavy industrial and marine compression-ignition engines.

Fuel oil - Heavy petroleum residue blends used in atomising burners and for heavy-duty marine engines (marine bunkers, etc.) with heavier grades requiring pre-heating before combustion. Excludes fuel oil for grease making or lubricating oil and fuel oil sold as such for road making.

Products not used as fuel (non-energy use)

3.57 The following paragraphs define the product headings used in the text and tables of this chapter, which are used for non-energy purposes.

Feedstock for petroleum chemical plants - All petroleum products intended for use in the manufacture of petroleum chemicals. This includes middle distillate feedstock of which there are several grades depending on viscosity. The boiling point ranges between 200°C and 400°C. (A deduction has been made from these figures equal to the quantity of feedstock used in making the conventional petroleum products that are produced during the processing of the feedstock. The output and deliveries of these conventional petroleum products are included elsewhere as appropriate.)

White spirit and specific boiling point (SBP) spirits - These are refined distillate intermediates with a distillation in the naphtha / kerosene range. **White spirit** has a boiling range of about 150°C to 200°C and is used as a paint or commercial solvent. **SBP spirit** is also known as **Industrial spirit** and has a wider boiling range that varies up to 200°C dependent upon its eventual use. It has a variety of uses that vary from use in seed extraction, rubber solvents and perfume.

Lubricating oils (and grease) - Refined heavy distillates obtained from the vacuum distillation of petroleum residues. Includes liquid and solid hydrocarbons sold by the lubricating oil trade, either alone or blended with fixed oils, metallic soaps and other organic and/or inorganic bodies. A certain percentage of inland deliveries are re-used as a fuel, but all inland deliveries of lubricating oils have been classified as non-energy use only. Some deliveries are used for energy purposes, but it is difficult to estimate energy use figures with any degree of accuracy, hence no such estimates appear in the commodity balance tables. DUKES Table 3.8 (prior to 2010, table 3D, within the main text) provides limited information on the use of lubricants and grease. The information which was published under the heading of "Motors" has been amended to now include "Gear Oils and Transmission" to give a full picture of the lubricants used by vehicles.

Bitumen - The residue left after the production of lubricating oil distillates and vacuum gas oil for upgrading plant feedstock. Used mainly for road making and building construction purposes. Includes other petroleum products such as creosote and tar mixed with bitumen for these purposes and fuel oil sold specifically for road making.

Petroleum wax - Includes paraffin wax, which is a white crystalline hydrocarbon material of low oil content normally obtained during the refining of lubricating oil distillate, paraffin scale, slack wax, microcrystalline wax and wax emulsions. Used for candle manufacture, polishes, food containers, wrappings etc.

Petroleum cokes - Carbonaceous material derived from hydrocarbon oils, uses for which include metallurgical electrode manufacture. Quantities of imports of this product are used as a fuel as it has a higher energy content than coal, though a lower energy content than fuel oils.

Miscellaneous products - Includes aromatic extracts, defoament solvents and other minor miscellaneous products.

Main classes of consumer

3.58 The following are definitions of the main groupings of users of petroleum products used in the text and tables of this chapter.

Electricity generators - Petroleum products delivered for use by major power producers and other companies for electricity generation including those deliveries to the other industries listed below which are used for autogeneration of electricity (Tables 3.2 to 3.4). This includes petroleum products used to generate electricity at oil refineries and is recorded in the Transformation section, as opposed to other uses of refinery fuels that are recorded in the Energy Industry Use section. From the 2009 chapter of the Digest, data in Chapter 3 (Table 3.2 to 3.4) has been aligned with Chapter 5 (Table 5.4). The data on oil used for electricity generation collected from major power producers and autogenerators is judged to be at least as accurate as the data from refiners on deliveries, and has the advantage of consistency.

Agriculture - Deliveries of fuel oil and gas oil/diesel for use in agricultural power units, dryers and heaters. Burning oil for farm use.

Iron and steel - Deliveries of petroleum products to steel works and iron foundries. This is now based on information from the Iron and Steel Statistics Bureau.

Other industries - The industries covered correspond to the industrial groups shown in Table 1G of Chapter 1, excluding Iron and Steel.

National navigation - 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.

Railways - Deliveries of fuel oil, gas/diesel oil and burning oil to railways now based on estimates produced by Ricardo Energy and Environment as part of their work to compile the UK National Atmospheric Emissions Inventory (NAEI).

Air transport - Total inland deliveries of aviation turbine fuel and aviation spirit. The figures cover deliveries of aviation fuels in the UK to international and other airlines, British and foreign Governments (including armed services) and for private flying. In order to compile the NAEI, Ricardo Energy and Environment need to estimate how aviation fuel usage splits between domestic and international consumption. Information from Ricardo Energy and Environment suggests that virtually all aviation spirit is used domestically while just 5 per cent of aviation turbine fuel use is for domestic consumption. A further 5 per cent is estimated to be consumed by the military.

Road transport - Deliveries of motor spirit and DERV fuel for use in road vehicles of all kinds.

Domestic - Fuel oil and gas oil delivered for central heating of private houses and other dwellings and deliveries of kerosene (burning oil) and liquefied petroleum gases for domestic purposes (see Tables 3.2 to 3.4).

Public services - Deliveries to national and local Government premises (including educational, medical and welfare establishments and British and foreign armed forces) of fuel oil and gas oil for central heating and of kerosene (burning oil).

Miscellaneous - Deliveries of fuel oil and gas oil for central heating in premises other than those classified as domestic or public.

Biofuels in transport

3.59 The quantity of biofuels blended into motor spirit and DERV are shown in Table 3.6 of this chapter. Total consumption of biofuels and road fuels are shown in Table 3D, this is based on the volume of fuel for which excise duty has been paid to HM Revenue and Customs (HMRC). As a percentage of road fuels biofuels have increased significantly from 2007 until 2010, but have been relatively flat since. At 3.1 per cent of total road fuels, they are down marginally on last year. Further details on biofuel consumption can be found in Chapter 6. Biofuels are also included in the overall energy balances in Chapter 1.

Table 3D: Consumption of Biodiesel and Bioethanol in the UK 2006 to 2016

Year	Biodiesel	All diesel including biodiesel	Biodiesel as % diesel	Bioethanol	All petrol including bioethanol	Bioethanol as % petrol	Biofuels as % total
2006	169	24,286	0.7%	95	24,724	0.4%	0.5%
2007	347	25,501	1.4%	153	24,019	0.6%	1.0%
2008	886	25,686	3.4%	206	22,709	0.9%	2.3%
2009	1,044	25,089	4.2%	320	22,029	1.5%	2.9%
2010	1,049	25,773	4.1%	631	20,650	3.1%	3.6%
2011	925	25,926	3.6%	652	19,548	3.3%	3.5%
2012	634	26,348	2.4%	775	18,792	4.1%	3.1%
2013	766	26,969	2.8%	820	18,020	4.6%	3.5%
2014	954	27,985	3.4%	814	17,672	4.6%	3.9%
2015	669	28,884	2.3%	795	17,319	4.6%	3.2%
2016	708	30,106	2.4%	759	17,101	4.4%	3.1%

Source: HM Revenue and Customs *Million litres*

Monthly and quarterly data

3.60 Monthly or quarterly aggregate data for certain series presented in this chapter are available. This information can be obtained free of charge by following the links given in the Energy Statistics section of the BEIS website on GOV.UK at:
www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy.

Contacts: *Warren Evans*
Energy Statistics Team
warren.evans@beis.gov.uk
0300 068 5059

Matthew Curds
Upstream Oil Statistics (primary oils)
matthew.curds@beis.gov.uk
0300 068 8414

Natalie Cartwright
Downstream Oil Statistics (petroleum products)
natalie.cartwright@beis.gov.uk
0300 068 5260

3.1 Commodity balances 2014 - 2016[(1)]

Primary oil

Thousand tonnes

	Crude oil	Ethane	Propane	Butane	Condensate	Total NGL	Feedstock (2)	Total primary oil
2014								
Supply								
Production	37,474	384	790	605	675	2,454	400	40,328
Imports	46,570	584	582	418	736	2,320	4,747	53,638
Exports	-28,204	-14	-704	-505	-382	-1,605	-1,060	-30,869
Stock change (3)	-497	-	-	-	-	-26	-69	-592
Transfers (4)	-	-944	-641	-317	-352	-2,255	+817	-1,439
Total supply	**55,342**	-	-	-	-	**888**	**4,835**	**61,066**
Statistical difference (5)(6)	-	-	-	-	-	+1	+2	+4
Total demand (5)	**55,342**	-	-	-	-	**887**	**4,833**	**61,063**
Transformation (Petroleum refineries)	55,342	-	-	-	-	887	4,833	61,063
Energy industry use	-	-	-	-	-	-	-	-
2015								
Supply								
Production	42,826	345	744	642	730	2,462	410	45,698
Imports	42,803r	678r	669r	689r	446r	2,482r	5,318r	50,604r
Exports	-30,054r	-11r	-540r	-577r	-638r	-1,766r	-1,890r	-33,709r
Stock change (3)	-199r	-	-	-	-	28r	73r	-98r
Transfers (4)	-	-995r	-743r	-350r	-265r	-2,353r	1,202r	-1,152r
Total supply	**55,376r**	-	-	-	-	**853r**	**5,114r**	**61,343r**
Statistical difference (5)(6)	-	-	-	-	-	6r	-54r	-48r
Total demand (5)	**55,376r**	-	-	-	-	**847r**	**5,168r**	**61,391r**
Transformation (Petroleum refineries)	55,376	-	-	-	-	847	5,168r	61,391r
Energy industry use	-	-	-	-	-	-	-	-
2016								
Supply								
Production	44,306	525	990	807	818	3,139	428	47,872
Imports	39,438	724	778	857	618	2,977	6,293	48,708
Exports	-30,651	-7	-1,023	-847	-718	-2,596	-1,609	-34,856
Stock change (3)	-31	-	-	-	-	+19	-113	-125
Transfers (4)	-	-1,184	-714	-354	-298	-2,550	+1,268	-1,282
Total supply	**53,061**	-	-	-	-	**989**	**6,267**	**60,317**
Statistical difference (5)(6)	-	-	-	-	-	+11	-56	-46
Total demand (5)	**53,061**	-	-	-	-	**978**	**6,323**	**60,363**
Transformation (Petroleum refineries)	53,061	-	-	-	-	978	6,323	60,363
Energy industry use	-	-	-	-	-	-	-	-

(1) As there is no use made of primary oils and feedstocks by industries other than the oil and gas extraction and petroleum refining industries, other industry headings have not been included in this table. As such, this table is a summary of the activity of what is known as the Upstream oil industry.

(2) Production of feedstock indicates volume received from petrochemical plant as a backflow. See paragraphs 3.54 and 3.55 for more detail.

(3) Stock fall (+), stock rise (-).

(4) Transfers direct from the source to the petrochemical sector.

(5) Total supply minus total demand.

(6) Figures for total demand for the individual NGLs (and thus for the statistical differences as well) are not available.

3.2 Commodity balances 2016

Petroleum products

Thousand tonnes

	Ethane	Propane	Butane	Other gases	Naphtha	Aviation spirit	Motor spirit	White Spirit and SBP	Aviation turbine fuel
Supply									
Production	-	1,421	813	2,388	2,306	-	17,342	95	4,392
Other sources	1,184	714	354	-	298	-	-	-	-
Imports	-	675	123	-	1,412	12	3,911	90	8,849
Exports	-	-460	-513	-	-526	-	-11,128	-41	-1,226
Marine bunkers	-	-	-	-	-	-	-	-	-
Stock change *(2)*	-	15	-6	-	13	-1	5	-1	45
Transfers	-	-	-23	-	-2,234	-	1,850	-0	-631
Total supply	**1,184**	**2,365**	**748**	**2,388**	**1,269**	**12**	**11,980**	**143**	**11,429**
Statistical difference *(3)*	**-**	**-57**	**-30**	**-8**	**-13**	**-2**	**29**	**1**	**2**
Total demand	**1,184**	**2,422**	**778**	**2,396**	**1,282**	**13**	**11,951**	**142**	**11,427**
Transformation	**-**	**17**	**266**	**398**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	251	-	-	-	-	-
Major power producers	-	-	-	-	-	-	-	-	-
Autogenerators	-	-	-	251	-	-	-	-	-
Heat generation	-	8	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Other (4)	-	9	266	147	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**1,935**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	1,935	-	-	-	-	-
Coal extraction	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**1,184**	**2,404**	**512**	**63**	**1,282**	**13**	**11,951**	**142**	**11,427**
Industry	**-**	**308**	**78**	**-**	**89**	**-**	**-**	**-**	**-**
Unclassified	-	277	78	-	89	-	-	-	-
Iron and steel	-	1	-	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-	-	-	-
Mineral products	-	-	-	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-	-	-	-
Mechanical engineering etc	-	-	-	-	-	-	-	-	-
Electrical engineering etc	-	-	-	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-	-	-
Food, beverages etc	-	31	-	-	-	-	-	-	-
Textiles, leather etc	-	-	-	-	-	-	-	-	-
Paper, printing etc	-	-	-	-	-	-	-	-	-
Other industries	-	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-	-
Transport	**-**	**71**	**-**	**-**	**-**	**13**	**11,951**	**-**	**11,427**
Air	-	-	-	-	-	13	-	-	11,427
Rail	-	-	-	-	-	-	-	-	-
Road	-	71	-	-	-	-	11,951	-	-
National navigation	-	-	-	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-	-	-	-
Other	**-**	**654**	**4**	**-**	**-**	**-**	**-**	**-**	**-**
Domestic	-	214	1	-	-	-	-	-	-
Public administration	-	16	-	-	-	-	-	-	-
Commercial	-	335	3	-	-	-	-	-	-
Agriculture	-	89	-	-	-	-	-	-	-
Miscellaneous	-	-	-	-	-	-	-	-	-
Non energy use *(5)*	**1,184**	**1,372**	**431**	**63**	**1,193**	**-**	**-**	**142**	**-**

(1) Includes marine diesel oil.
(2) Stock fall (+), stock rise (-).
(3) Total supply minus total demand.
(4) Backflows delivered from petrochemical plants to refineries for re-processing. See paragraphs 3.53 and 3.54 for further details
(5) For further details on non-energy usage see paragraphs 3.53 to 3.54 and 3.58

3.2 Commodity balances 2016 (continued)

Petroleum products

Thousand tonnes

Burning oil	DERV	Gas Oil(1)	Fuel oils	Lubri -cants	Bitu -men	Petroleum coke	Misc. products	Total Products	
									Supply
2,015	13,548	6,982	4,329	350	968	1,846	1,111	59,904	Production
-	-	-	-	-	-	-	-	2,550	Other sources
788	14,209	2,205	1,287	416	529	223	126	34,854	Imports
-126	-2,421	-2,505	-3,360	-319	-107	-711	-870	-24,312	Exports
-	-	-1,770	-889	-	-	-	-	-2,659	Marine bunkers
38	-208	35	70	-11	-15	85	26	89	Stock change *(2)*
593	-419	-29	-631	-	15	1	239	-1,268	Transfers
3,307	**24,708**	**4,917**	**807**	**436**	**1,389**	**1,444**	**633**	**69,158**	**Total supply**
15	**59**	**33**	**-8**	**8**	**-36**	**-15**	**52**	**31**	**Statistical difference *(3)***
3,292	**24,648**	**4,884**	**815**	**428**	**1,425**	**1,459**	**581**	**69,128**	**Total demand**
-	**-**	**94**	**205**	**-**	**-**	**95**	**18**	**1,094**	**Transformation**
-	-	89	161	-	-	-	-	501	Electricity generation
-	-	45	141	-	-	-	-	185	Major power producers
-	-	44	20	-	-	-	-	316	Autogenerators
-	-	5	45	-	-	-	-	58	Heat generation
-	-	-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	95	-	95	Patent fuel manufacture
-	-	-	-	-	-	-	18	440	Other (4)
-	**-**	**599**	**296**	**-**	**-**	**1,117**	**-**	**3,946**	**Energy industry use**
-	-	-	-	-	-	-	-	-	Electricity generation
-	-	599	64	-	-	-	-	662	Oil and gas extraction
-	-	-	232	-	-	1,117	-	3,284	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	-	-	Other
-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Losses**
3,292	**24,648**	**4,191**	**314**	**428**	**1,425**	**247**	**562**	**64,087**	**Final consumption**
1,372	**-**	**1,575**	**194**	**-**	**-**	**109**	**-**	**3,726**	**Industry**
1,343	-	869	75	-	-	108	-	2,838	Unclassified
-	-	-	3	-	-	-	-	4	Iron and steel
-	-	-	0	-	-	-	-	0	Non-ferrous metals
-	-	171	6	-	-	-	-	177	Mineral products
-	-	84	25	-	-	-	-	109	Chemicals
-	-	-	-	-	-	-	-	-	Mechanical engineering etc
-	-	1	-	-	-	-	-	1	Electrical engineering etc
24	-	155	6	-	-	-	-	184	Vehicles
6	-	21	72	-	-	-	-	130	Food, beverages etc
-	-	41	-	-	-	-	-	41	Textiles, leather etc
-	-	29	-	-	-	-	-	29	Paper, printing etc
-	-	34	0	-	-	-	-	34	Other industries
-	-	172	7	-	-	-	-	178	Construction
-	**24,648**	**1,180**	**0**	**-**	**-**	**-**	**-**	**49,292**	**Transport**
-	-	-	-	-	-	-	-	11,441	Air
-	-	578	-	-	-	-	-	578	Rail
-	24,648	-	-	-	-	-	-	36,671	Road
-	-	602	0	-	-	-	-	603	National navigation
-	-	-	-	-	-	-	-	-	Pipelines
1,919	**-**	**1,419**	**119**	**-**	**-**	**-**	**-**	**4,115**	**Other**
1,919	-	141	-	-	-	-	-	2,275	Domestic
-	-	303	29	-	-	-	-	348	Public administration
-	-	378	60	-	-	-	-	776	Commercial
-	-	337	17	-	-	-	-	442	Agriculture
-	-	261	14	-	-	-	-	274	Miscellaneous
-	**-**	**17**	**-**	**428**	**1,425**	**138**	**562**	**6,954**	**Non energy use *(5)***

3.3 Commodity balances 2015

Petroleum products

Thousand tonnes

	Ethane	Propane	Butane	Other gases	Naphtha	Aviation spirit	Motor spirit	White Spirit and SBP	Aviation turbine fuel
Supply									
Production	-	1,357	850	2,343r	2,368	-	16,894r	151	4,973
Other sources	995	743	350	-	265	-	-	-	-
Imports	-	580r	103r	-	983r	13	3,904r	98	8,236r
Exports	-	-293	-559r	-	-436	-	-10,340	-76	-1,201
Marine bunkers	-	-	-	-	-	-	-	-	-
Stock change *(2)*	-	4	10	-	-8	-0	-137	-7	-201
Transfers	-	-	-	-	-1,986	-	1,754r	-6	-483r
Total supply	**995**	**2,392r**	**755r**	**2,343r**	**1,185r**	**13**	**12,074r**	**160**	**11,324r**
Statistical difference *(3)*	**-**	**4r**	**30r**	**-12r**	**-9r**	**1**	**-8r**	**-0**	**-8r**
Total demand	**995**	**2,388r**	**725r**	**2,356**	**1,195r**	**11**	**12,082**	**160**	**11,332r**
Transformation	**-**	**12**	**282**	**379**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	253	-	-	-	-	-
Major power producers	-	-	-	-	-	-	-	-	-
Autogenerators	-	-	-	253	-	-	-	-	-
Heat generation	-	9	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Other (4)	-	3	282	126	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**1,942**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	1,942	-	-	-	-	-
Coal extraction	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**995**	**2,376r**	**443r**	**35**	**1,195r**	**11**	**12,082**	**160**	**11,332r**
Industry	**-**	**297r**	**72**	**-**	**122r**	**-**	**-**	**-**	**-**
Unclassified	-	282r	72	-	122r	-	-	-	-
Iron and steel	-	2	-	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-	-	-	-
Mineral products	-	-	-	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-	-	-	-
Mechanical engineering etc	-	-	-	-	-	-	-	-	-
Electrical engineering etc	-	-	-	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-	-	-
Food, beverages etc	-	13r	-	-	-	-	-	-	-
Textiles, leather etc	-	-	-	-	-	-	-	-	-
Paper, printing etc	-	-	-	-	-	-	-	-	-
Other industries	-	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-	-
Transport	**-**	**82**	**-**	**-**	**-**	**11**	**12,082**	**-**	**11,332r**
Air	-	-	-	-	-	11	-	-	11,332r
Rail	-	-	-	-	-	-	-	-	-
Road	-	82	-	-	-	-	12,082	-	-
National navigation	-	-	-	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-	-	-	-
Other	**-**	**637r**	**5r**	**-**	**-**	**-**	**-**	**-**	**-**
Domestic	-	204	1	-	-	-	-	-	-
Public administration	-	16r	-	-	-	-	-	-	-
Commercial	-	327r	4r	-	-	-	-	-	-
Agriculture	-	90	0	-	-	-	-	-	-
Miscellaneous	-	-	-	-	-	-	-	-	-
Non energy use *(5)*	**995**	**1,361r**	**366r**	**35**	**1,072**	**-**	**-**	**160**	**-**

(1) Includes marine diesel oil.
(2) Stock fall (+), stock rise (-).
(3) Total supply minus total demand.
(4) Backflows delivered from petrochemical plants to refineries for re-processing. See paragraphs 3.53 and 3.54 for further details
(5) For further details on non-energy usage see paragraphs 3.53 to 3.54 and 3.58

3.3 Commodity balances 2015 (continued)

Petroleum products

Thousand tonnes

Burning oil	DERV	Gas Oil [1]	Fuel oils	Lubri -cants	Bitu -men	Petroleum coke	Misc. products	Total Products	
									Supply
2,031	13,483	7,204	5,094	350	990	1,737	1,104r	60,929r	Production
-	-	-	-	-	-	-	-	2,353	Other sources
890r	12,464r	2,258r	1,062r	444r	509	339	249r	32,133r	Imports
-151	-1,792	-2,806	-3,431r	-365	-61	-455	-958	-22,926r	Exports
-	-	-1,674r	-835	-	-	-	-	-2,509r	Marine bunkers
-46	-94	-105	-83	-19	7	-58	-3r	-743r	Stock change *(2)*
467r	-422	297r	-1,013	-0	14	-	190r	-1,190r	Transfers
3,191r	**23,638r**	**5,172r**	**794r**	**409r**	**1,458**	**1,562**	**581r**	**68,046r**	**Total supply**
-1r	**-18r**	**23r**	**-44r**	**-1r**	**-6**	**-8**	**8r**	**-51r**	**Statistical difference *(3)***
3,192r	**23,656**	**5,149r**	**838r**	**411r**	**1,464**	**1,571**	**573r**	**68,097r**	**Total demand**
-	**-**	**107r**	**210r**	**-**	**-**	**122**	**12**	**1,125r**	**Transformation**
-	-	102r	166r	-	-	39	-	560r	Electricity generation
-	-	42r	136r	-	-	39	-	217r	Major power producers
-	-	60r	30	-	-	-	-	343r	Autogenerators
-	-	5r	45r	-	-	-	-	59r	Heat generation
-	-	-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	84	-	84	Patent fuel manufacture
-	-	-	-	-	-	-	12	423	Other (4)
-	**-**	**634**	**342**	**-**	**-**	**1,127**	**-r**	**4,043r**	**Energy industry use**
-	-	-	-	-	-	-	-	-	Electricity generation
-	-	634	66	-	-	-	-	699	Oil and gas extraction
-	-	-	276	-	-	1,127	-r	3,344r	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	-	-	Other
-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Losses**
3,192r	**23,656**	**4,408r**	**286r**	**411r**	**1,464**	**322**	**561r**	**62,929r**	**Final consumption**
1,270r	**-**	**1,776r**	**168r**	**-**	**-**	**184**	**56r**	**3,944r**	**Industry**
1,239r	-	1,084r	30r	-	-	184	56r	3,068r	Unclassified
-	-	-	3r	-	-	-	-	6r	Iron and steel
-	-	-	0	-	-	-	-	0	Non-ferrous metals
-	-	165r	6r	-	-	-	-	171r	Mineral products
-	-	86r	25r	-	-	-	-	111r	Chemicals
-	-	-	-	-	-	-	-	-	Mechanical engineering etc
-	-	1r	-	-	-	-	-	1r	Electrical engineering etc
24	-	152r	6r	-	-	-	-	181r	Vehicles
6r	-	17r	92r	-	-	-	-	128r	Food, beverages etc
-	-	42r	-	-	-	-	-	42r	Textiles, leather etc
-	-	29r	-	-	-	-	-	29r	Paper, printing etc
-	-	33r	-	-	-	-	-	33r	Other industries
-	-	168r	6r	-	-	-	-	174r	Construction
-	**23,656**	**1,211r**	**-**	**-**	**-**	**-**	**-**	**48,374r**	**Transport**
-	-	-	-	-	-	-	-	11,343r	Air
-	-	583r	-	-	-	-	-	583r	Rail
-	23,656	-	-	-	-	-	-	35,820	Road
-	-	628r	-	-	-	-	-	628r	National navigation
-	-	-	-	-	-	-	-	-	Pipelines
1,922r	**-**	**1,405r**	**118r**	**-**	**-**	**-**	**-**	**4,086r**	**Other**
1,922r	-	146r	-	-	-	-	-	2,273r	Domestic
-	-	296r	28r	-	-	-	-	340r	Public administration
-	-	383r	60r	-	-	-	-	773r	Commercial
-	-	316r	17r	-	-	-	-	423r	Agriculture
-	-	264r	14r	-	-	-	-	278r	Miscellaneous
-	**-**	**17r**	**-**	**411r**	**1,464**	**138**	**505r**	**6,525r**	**Non energy use *(5)***

3.4 Commodity balances 2014

Petroleum products

Thousand tonnes

	Ethane	Propane	Butane	Other gases	Naphtha	Aviation spirit	Motor spirit	White Spirit and SBP	Aviation turbine fuel
Supply									
Production	-	1,382	745	2,266	2,290	-	15,709	165	4,635
Other sources	944	641	317	-	352	-	-	-	-
Imports	-	295	170	-	855r	17	3,527r	46	8,157
Exports	-	-392	-506	-	-585	-	-8,683	-80	-1,072
Marine bunkers	-	-	-	-	-	-	-	-	-
Stock change *(2)*	-	-27	-3	-	-14	2	113	-5	123
Transfers	-	-2	0	24	-1,915r	-	1,660r	-0	-642
Total supply	**944**	**1,898**	**722**	**2,291**	**983r**	**18**	**12,327r**	**125**	**11,201**
Statistical difference *(3)*	**-**	**-29r**	**-5r**	**23**	**-3r**	**0**	**1r**	**-1**	**-19**
Total demand	**944**	**1,927r**	**728r**	**2,267**	**986r**	**18**	**12,326**	**126**	**11,220**
Transformation	**-**	**20**	**277**	**349**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	237	-	-	-	-	-
Major power producers	-	-	-	-	-	-	-	-	-
Autogenerators	-	-	-	237	-	-	-	-	-
Heat generation	-	11	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Other (4)	-	9	277	112	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**1,918**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-	-	-	-
Petroleum refineries	-	-	-	1,918	-	-	-	-	-
Coal extraction	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**944**	**1,907r**	**451r**	*0*	**986r**	**18**	**12,326**	**126**	**11,220**
Industry	**-**	**244r**	**110**	**-**	**169r**	**-**	**-**	**-**	**-**
Unclassified	-	237	110	-	169r	-	-	-	-
Iron and steel	-	3	-	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-	-	-	-
Mineral products	-	-	-	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-	-	-	-
Mechanical engineering etc	-	-	-	-	-	-	-	-	-
Electrical engineering etc	-	-	-	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-	-	-	-
Food, beverages etc	-	5r	-	-	-	-	-	-	-
Textiles, leather etc	-	-	-	-	-	-	-	-	-
Paper, printing etc	-	-	-	-	-	-	-	-	-
Other industries	-	-	-	-	-	-	-	-	-
Construction	-	-	-	-	-	-	-	-	-
Transport	**-**	**88**	**-**	**-**	**-**	**18**	**12,326**	**-**	**11,220**
Air	-	-	-	-	-	18	-	-	11,220
Rail	-	-	-	-	-	-	-	-	-
Road	-	88	-	-	-	-	12,326	-	-
National navigation	-	-	-	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-	-	-	-
Other	**-**	**464**	**1r**	**-**	**-**	**-**	**-**	**-**	**-**
Domestic	-	212	1r	-	-	-	-	-	-
Public administration	-	3	-	-	-	-	-	-	-
Commercial	-	163	-	-	-	-	-	-	-
Agriculture	-	85	0	-	-	-	-	-	-
Miscellaneous	-	-	-	-	-	-	-	-	-
Non energy use *(5)*	**944**	**1,111**	**340**	**0**	**817r**	**-**	**-**	**126**	**-**

(1) Includes marine diesel oil.
(2) Stock fall (+), stock rise (-).
(3) Total supply minus total demand.
(4) Backflows delivered from petrochemical plants to refineries for re-processing. See paragraphs 3.53 and 3.54 for further details
(5) For further details on non-energy usage see paragraphs 3.53 to 3.54 and 3.58

3.4 Commodity balances 2014 (continued)

Petroleum products

Thousand tonnes

Burning oil	DERV	Gas Oil [1]	Fuel oils	Lubri -cants	Bitu -men	Petroleum coke	Misc. products	Total Products	
									Supply
2,093	13,726	8,049	5,409	373	1,006	1,745	798	60,392	Production
-	-	-	-	-	-	-	-	2,255	Other sources
639r	11,470r	1,424r	1,092r	386	465	537	306	29,384r	Imports
-164	-1,942	-3,463	-4,148	-337	-62	-567	-746	-22,748	Exports
-	-	-1,676	-1,148	-	-	-	-	-2,824	Marine bunkers
-15	-61	24	107	29	18	16	-13	292	Stock change *(2)*
621	-509	489	-617	-20	-18	-	199	-730r	Transfers
3,174r	**22,683r**	**4,848r**	**695r**	**430**	**1,409**	**1,730**	**543**	**66,022r**	**Total supply**
-13r	**8r**	**11r**	**1r**	**-6**	**-1**	**-**	**2**	**-29r**	**Statistical difference *(3)***
3,187r	**22,675**	**4,837r**	**695r**	**436**	**1,410**	**1,730**	**541**	**66,051r**	**Total demand**
-	**-**	**117r**	**186r**	**-**	**-**	**91**	**15**	**1,054r**	**Transformation**
-	-	112	141	-	-	-	-	490	Electricity generation
-	-	46	122	-	-	-	-	168	Major power producers
-	-	66	19	-	-	-	-	322	Autogenerators
-	-	5r	45r	-	-	-	-	61r	Heat generation
-	-	-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	91	-	91	Patent fuel manufacture
-	-	-	-	-	-	-	15	413	Other (4)
-	**-**	**647**	**156**	**-**	**-**	**1,140**	**-**	**3,861**	**Energy industry use**
-	-	-	-	-	-	-	-	-	Electricity generation
-	-	647	16	-	-	-	-	663	Oil and gas extraction
-	-	-	140	-	-	1,140	-	3,198	Petroleum refineries
-	-	-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	-	-	Other
-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Losses**
3,187r	**22,675**	**4,072r**	**353r**	**436**	**1,410**	**499**	**526**	**61,135r**	**Final consumption**
1,278r	**-**	**1,542r**	**241r**	**-**	**-**	**350**	**-**	**3,933r**	**Industry**
1,246	-	892r	99r	-	-	350	-	3,102r	Unclassified
-	-	-	3r	-	-	-	-	6r	Iron and steel
-	-	-	0	-	-	-	-	0	Non-ferrous metals
-	-	155r	6r	-	-	-	-	161r	Mineral products
-	-	80r	23r	-	-	-	-	103r	Chemicals
-	-	-	-	-	-	-	-	-	Mechanical engineering etc
-	-	1	-	-	-	-	-	1	Electrical engineering etc
24	-	142r	5r	-	-	-	-	171r	Vehicles
7r	-	17r	99r	-	-	-	-	129r	Food, beverages etc
-	-	40r	-	-	-	-	-	40r	Textiles, leather etc
-	-	28r	-	-	-	-	-	28r	Paper, printing etc
-	-	32r	-	-	-	-	-	32r	Other industries
-	-	155r	6r	-	-	-	-	160r	Construction
-	**22,675**	**1,269r**	**-**	**-**	**-**	**-**	**-**	**47,596r**	**Transport**
-	-	-	-	-	-	-	-	11,238	Air
-	-	624	-	-	-	-	-	624	Rail
-	22,675	-	-	-	-	-	-	35,089	Road
-	-	645r	-	-	-	-	-	645r	National navigation
-	-	-	-	-	-	-	-	-	Pipelines
1,909	**-**	**1,247r**	**112r**	**-**	**-**	**-**	**-**	**3,733r**	**Other**
1,909	-	138r	-	-	-	-	-	2,260r	Domestic
-	-	280r	26	-	-	-	-	309r	Public administration
-	-	336r	57	-	-	-	-	556r	Commercial
-	-	261r	16r	-	-	-	-	362r	Agriculture
-	-	232r	14r	-	-	-	-	246r	Miscellaneous
-	**-**	**15**	**1**	**436**	**1,410**	**149**	**526**	**5,873r**	**Non energy use *(5)***

3.5 Supply and disposal of petroleum[(1)]

Thousand tonnes

	2012	2013	2014	2015	2016
Primary oils (Crude oil, NGLs and feedstocks)					
Indigenous production *(2)*	44,561	41,101	40,328	45,698	47,872
Imports	60,476	58,967	53,638	50,604r	48,708
Exports *(3)*	-30,946	-33,105	-30,869	-33,709r	-34,856
Transfers - Transfers to products *(4)*	-1,982	-2,221	-2,255	-2,353	-2,550
Product rebrands (5)	120	463	817	1,202r	+1,268
Stock change *(6)*	-486	724	-592	-98r	-125
Use during production *(7)*	-	-	-	-	-
Calculated refinery throughput *(8)*	71,741	65,928	61,066	61,343r	60,317
Overall statistical difference *(9)*	-98	-44	4	-48r	-46
Actual refinery throughput	**71,839**	**65,972**	**61,063**	**61,391r**	**60,363**
Petroleum products					
Losses in refining process *(10)*	209	575	671	462r	458
Refinery gross production *(11)*	71,630	65,397	60,392	60,929r	59,904
Transfers - Transfers to products *(4)*	1,982	2,221	2,255	2,353	2,550
Product rebrands *(5)*	-120	-463	-730r	-1,190r	-1,268
Imports	26,207	28,418	29,384r	32,133r	34,854
Exports *(12)*	-29,904	-26,910	-22,748	-22,926r	-24,312
Marine bunkers	-2,663	-2,720	-2,824	-2,509r	-2,659
Stock changes *(6)* - Refineries	102	79	266	-769r	63
Power generators	26	26	26	26	26
Calculated total supply	67,260	66,049	66,022r	68,046r	69,158
Statistical difference *(9)*	-87	-107	-29r	-51r	31
Total demand *(4)*	**67,347**	**66,156**	**66,051r**	**68,097r**	**69,128**
Of which:					
Energy use	61,236	60,226	60,178r	61,572r	62,173
Of which, for electricity generation *(13)*	694	541	490	560r	501
total refinery fuels *(13)*	4,299	3,759	3,198	3,344r	3,284
Non-energy use	6,111	5,930	5,873r	6,525r	6,954

(1) Aggregate monthly data on oil production, trade, refinery throughput and inland deliveries are available - see paragraph 3.62 and Annex C.
(2) Crude oil plus condensates and petroleum gases derived at onshore treatment plants.
(3) Includes NGLs, process oils and re-exports.
(4) Disposals of NGLs by direct sale (excluding exports) or for blending.
(5) Product rebrands (inter-product blends or transfers) represent petroleum products received at refineries/ plants and used as feedstock for refinery or cracking unit operations.
(6) Impact of stock changes on supplies. A stock fall is shown as (+) as it increases supplies, and vice-versa for a stock rise (-).
(7) Own use in onshore terminals and gas separation plants. These figures ceased to be available from January 2001.
(8) Equivalent to the total supplies reported against the upstream transformation sector in Table 3.1.
(9) Supply greater than (+) or less than (-) recorded throughput or disposals.
(10) Calculated as the difference between actual refinery throughput and gross refinery production.
(11) Includes refinery fuels.
(12) Excludes NGLs.
(13) Figures cover petroleum used to generate electricity by all major power producers and by all other generators, including petroleum used to generate electricity at refineries.

3.6 Additional information on inland deliveries of selected products[1]

Thousand Tonnes

	2012	2013	2014	2015	2016
Motor spirit					
of which, Hydrocarbon (2)	13,231	12,574	12,326	12,082	11,951
of which, Bio-ethanol (3)	615	650	645	631	603
Total Motor Spirit including Bio-ethanol	**13,845**	**13,224**	**12,971**	**12,713**	**12,554**
of which, sold through Supermarkets (4)	6,196	5,974	5,755	5,794	5,885
Diesel Road Fuel					
of which, Hydrocarbon (2)	21,538	21,926	22,675	23,656	24,648
of which, Bio-diesel (3)	563	682	850	595	630
Total Diesel Road Fuel including Bio-diesel	**22,101**	**22,607**	**23,525**	**24,251**	**25,279**
of which, sold through Supermarkets (4)	5,959	6,217	6,394	6,644	7,267

1. Monthly data for inland deliveries of oil products are available - See BEIS website: https://www.gov.uk/government/collections/oil-statistics
2. Demand excluding bioethanol. Based on HMRC data.
3. Bioethanol based on HMRC data and excludes other renewables
4. Data for sales by supermarkets collected by a monthly reporting system. Includes Asda, Morrisons, Sainsburys and Tesco only.

3.7 Stocks of crude oil and petroleum products at end of year[(1)]

Thousand tonnes

	2012	2013	2014	2015	2016
Crude and process oils					
Refineries *(2)*	3,829	3,592	3,876	3,156r	3,088
Terminals (3)	1,194	1,102	1,147	1,629	1,795
Offshore (4)	473	513	460	499	526
Net bilateral stocks (5)	195	1,469	1,728	2,289	2,006
Total crude and process oils *(6)*	**5,690**	**6,677**	**7,211**	**7,574r**	**7,415**
Petroleum products					
Ethane	-	-	-	-	-
Propane	28	19	46	37	22
Butane	25	29	35	27	31
Other petroleum gases	-	-	-	-	1
Naphtha	165	112	140	94	81
Aviation spirit	5	4	5	5	5
Motor spirit	727	1,287	1,141	1,246	1,293
White spirit and SBP	9	18	24	31	31
Aviation turbine fuel	1,229	1,162	999	1,232	1,117
Burning oil	198	287	231	281	244
Gas/Diesel oil (7)	4,222	2,482	2,399	2,842	2,976
of which, DERV	1,240	1,662	1,592	1,622	2,139
Fuel oils	514	1,340	1,060	891r	998
Lubricating oils	143	186	67	122	138
Bitumen	106	127	101	88	104
Petroleum wax	4	10	3	8	9
Petroleum coke	274	236	318	343	232
Miscellaneous products	88	228	302	249r	127
Total all products	**7,735**	**7,528**	**6,871**	**7,497r**	**7,408**
Of which: net bilateral stocks (5)	2,441	2,432	2,064	2,022	2,082

(1) Aggregate monthly data on the level of stocks of crude oil and oil products are available - see paragraph 3.61 and Annex C.
(2) Stocks of crude oil, NGLs and process oils at UK refineries.
(3) Stocks of crude oil and NGLs at UKCS (UK continental shelf) pipeline terminals.
(4) Stocks of crude oil in tanks and partially loaded tankers at offshore fields.
(5) The difference between stocks held abroad for UK use under approved bilateral agreements and the equivalent stocks held in the UK for foreign use.
(6) Includes process oils held abroad for UK use approved by bilateral agreements.
(7) Includes marine diesel oil.

3.8 Additional information on inland deliveries for non-energy uses[(1)(2)]

Thousand tonnes

	2012	2013	2014	2015	2016
Feedstock for petroleum chemical plants:					
Propane	1,038	1,218	1,111r	1,361r	1,372
Butane	567	372	340r	366r	431
Other gases	899	884	944	1,031	1,247
Total gases	2,504	2,474	2,395r	2,757r	3,049
Naphtha (LDF)	910	909	817r	1,072	1,193
Middle Distillate Feedstock (MDF)	16	16	15r	17r	17
Other products	-	-	-	-	-
Total feedstock	3,430	3,400	3,226r	3,847r	4,259
Lubricating oils and grease:					
Aviation	4	5	1r	1r	2
Industrial	197	221	297r	269r	287
Marine	17	17	21r	18r	21
Other motors, Gear oils and Transmissions	191	191	114r	120r	115
Agricultural	3	3	3	3	3
Fuel oil sold as lubricant	-	-	-	-	-
Total lubricating oils and grease	412	437	436	411r	428
Other non-energy products:					
Industrial spirit/white spirit	219	279	126	160	142
Bitumen	1,355	1,358	1,410	1,464	1,425
Petroleum coke	154	101	149	138	138
Miscellaneous products	542	358	526	505r	562
Total other non-energy products	2,268	2,096	2,210	2,268r	2,268
Total non-energy use	**6,111**	**5,930**	**5,873r**	**6,525r**	**6,954**

(1) Aggregate monthly data on the total non energy use of oil products are available - see paragraph 3.61 and Annex C
(2) For further details on non-energy usage see paragraphs 3.53 to 3.54 and 3.58.

Chapter 4
Natural Gas

Key points

- **UK natural gas production in 2016 was up 2.4 per cent on 2015 to 463 TWh, continuing the year-on-year increases seen since 2014**. This pattern contrasts with the long-term decline in UK natural gas production, which had fallen by an average of 8 per cent from peak production in 2000 to the end of 2013. Gas production is just over a third of the peak level recorded in 2000 (Table 4.1, Chart 4.1).

- **Net imports were 22 per cent higher in 2016 compared to 2015** (Table 4.1), with imports up 6.8 per cent and exports down by 27 per cent. Exports to Belgium decreased by just over 20 per cent, but still making up more than half of all exports in 2016. (Table 4.5).

- **Imports of Liquefied Natural Gas (LNG) decreased by a fifth to 122 TWh in 2016,** while in contrast pipeline imports increased by a fifth, with increased imports from Belgium, the Netherlands and Norway. (Table 4.5, Chart 4.2).

- **Total gas demand (natural gas plus colliery methane) increased by 12.5 per cent in 2016 to 897 TWh,** mainly driven by increased gas usage for power generation (up just over 40 per cent on 2015) as the reduction in coal generation capacity continues.

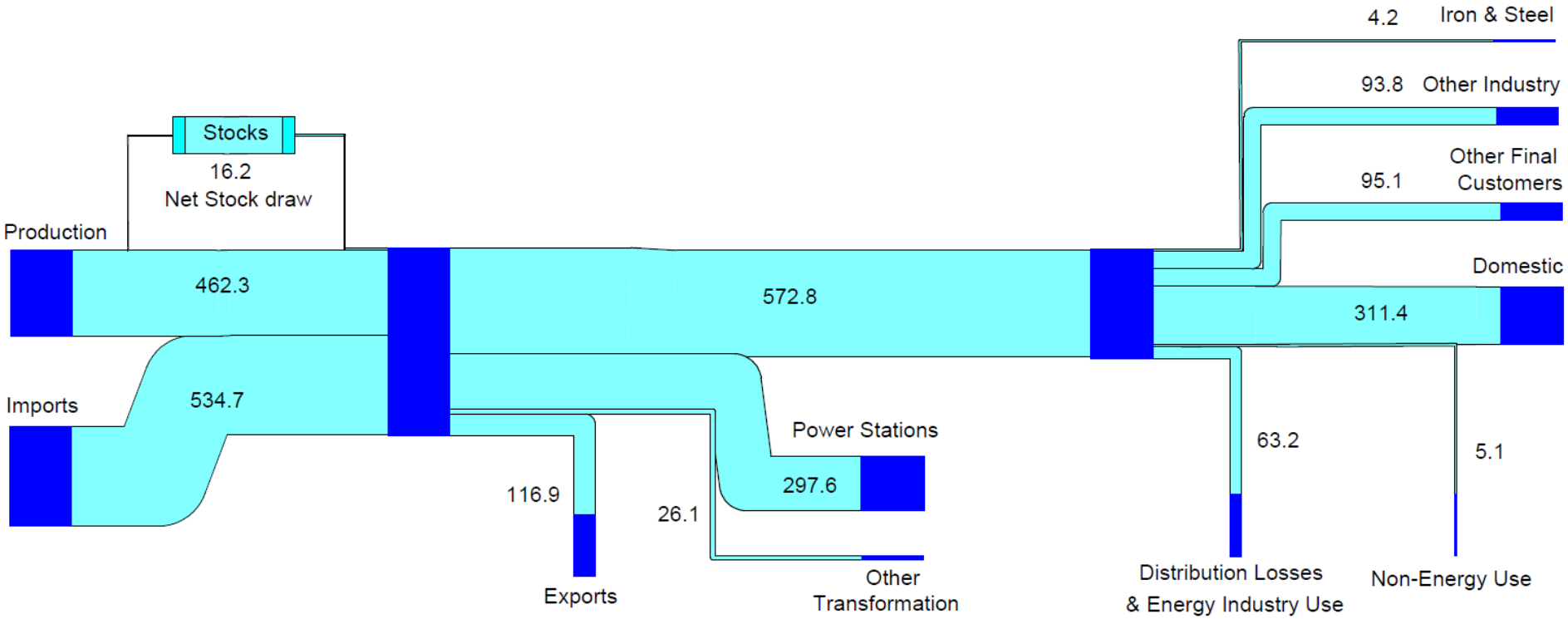
- **Final consumption increased by 3.2 per cent in 2016 to 510 TWh,** the colder winter in 2016 driving increases in the domestic (4.6 per cent), public administration (1.9 per cent) and commercial (5.4 per cent) sectors.

Introduction

4.1 Gas is one of the key pillars of the UK's energy mix, accounting for over 30 per cent of the UK's energy production and is second only to oil. Gas production from the UK's Continental Shelf (UKCS) would be sufficient to meet nearly 60 per cent of gas demand. Gas is particularly important for electricity generation where it meets over half of the fuel required in power stations, a figure substantially up on last year due to the decline of coal in power generation. It is also critical for space heating, domestically and in offices, hotels and restaurants. In 2016 gas met nearly two thirds of total domestic energy demand.

4.2 An energy flow chart for 2016, showing the flows of natural gas from production and imports through to consumption, is included overleaf as a way of simplifying the figures that can be found in the commodity balance tables. It illustrates the flow of gas from the point at which it becomes available from indigenous production or imports (on the left) to the eventual final use of gas (on the right), as well as volumes transformed into other forms of energy or exported.

Natural gas flow chart 2016 (TWh)



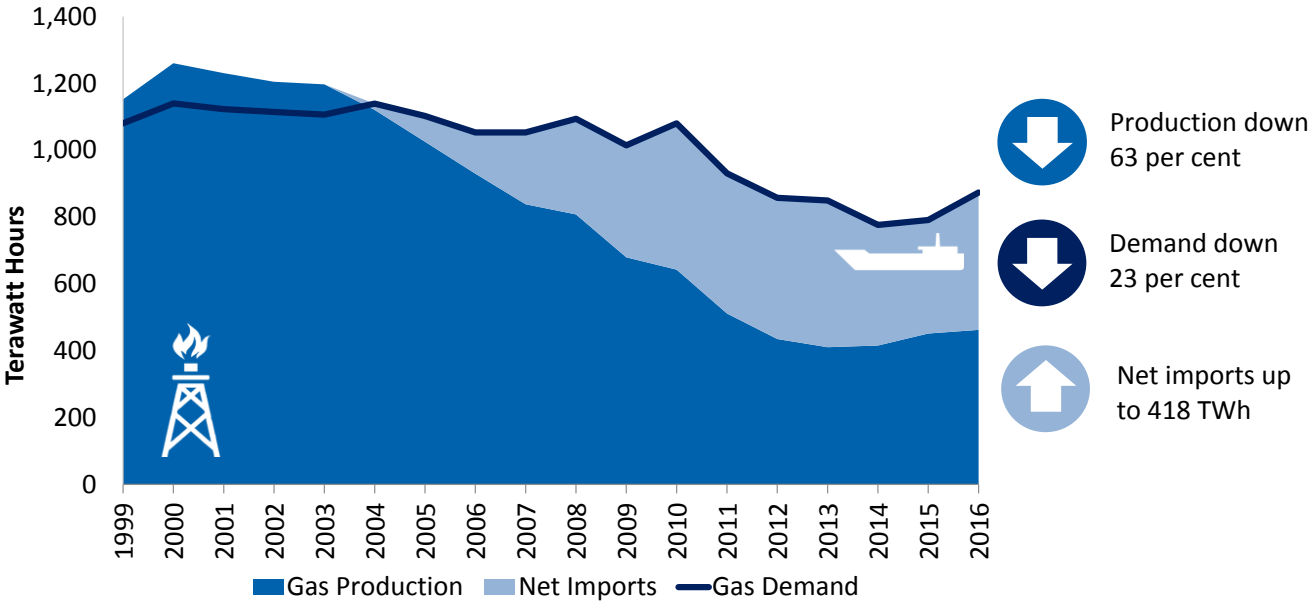
Note:
This flow chart is based on data that appear in Table 4.1, excluding colliery methane.

Supply of gas

4.3 The pattern of gas production since the turn of the century has generally been one of decline, with production declining by around 8 per cent a year between 2000 and 2013. **Whilst production has increased year-on-year since 2014 it stands at a little less of 40 per cent of the peak recorded in 2000.** Despite this the UK, along with the Netherlands, is one of the two major gas-producing nations within the EU.

4.4 Production was up 2.4 per cent in 2016, continuing the upward trend that started in 2014. The development of the Laggan field near the Shetland Islands is one of the main causes of the increase, but there have been some smaller field start-ups during the period.

Chart 4.1: Changes over time in gas production and demand

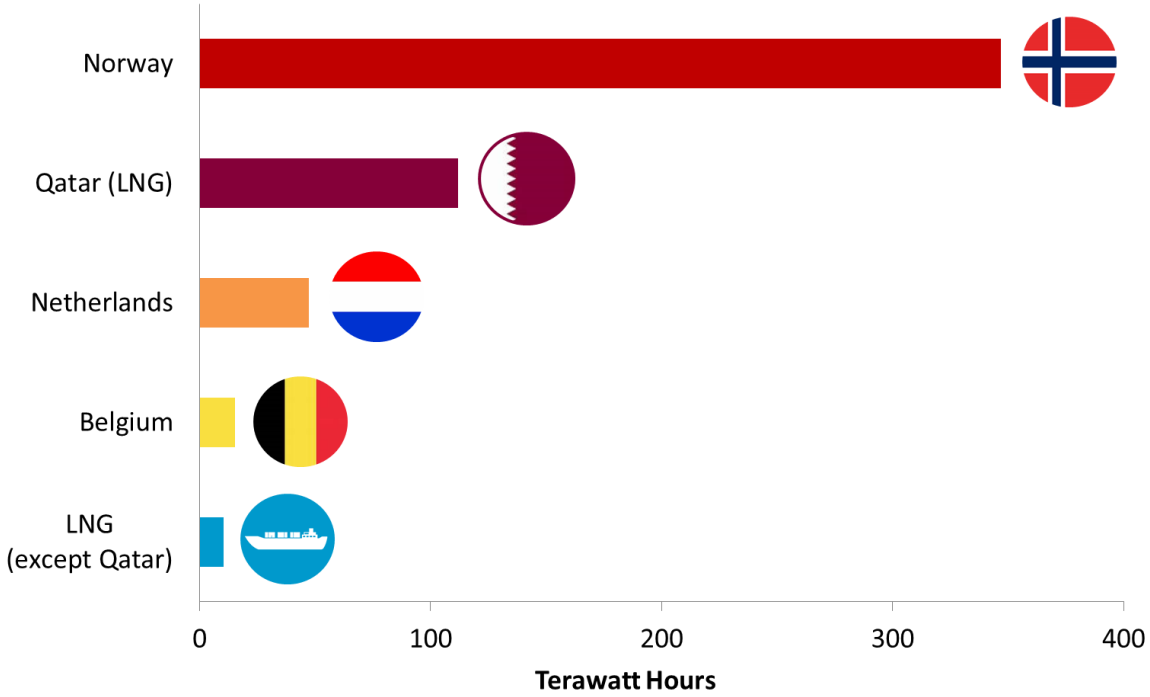


4.5 Chart 4.1 illustrates the growth in net imports despite a decrease in demand since the mid-2000s. The UK imports natural gas via pipeline (from Norway – the principal source of imports, the Netherlands and Belgium) and shipped LNG (to terminals at Milford Haven (South Hook and Dragon), the Isle of Grain and Teesside Gasport). Much of this infrastructure development has been recent and includes the completion of the interconnector from the Netherlands at the end of 2006 and completion of two new LNG terminals in 2009. The latter is a significant development and LNG's share of total gas imports have risen substantially, peaking at 47 per cent in 2011.

4.6 Compared with 2015 imports rose by 6.8 per cent, with net imports rising 22 per cent due to export volumes that were down more than a quarter. **The principal story with imports in 2016 is the sharp contraction in LNG imports, down a fifth on 2015.** Higher demand in Japan and elsewhere in the world has increased prices and affected volumes supplied into Europe and the UK. For the UK the shortfall has been made good through 20 per cent increase in pipeline imports, from Norway, Belgium and the Netherlands.

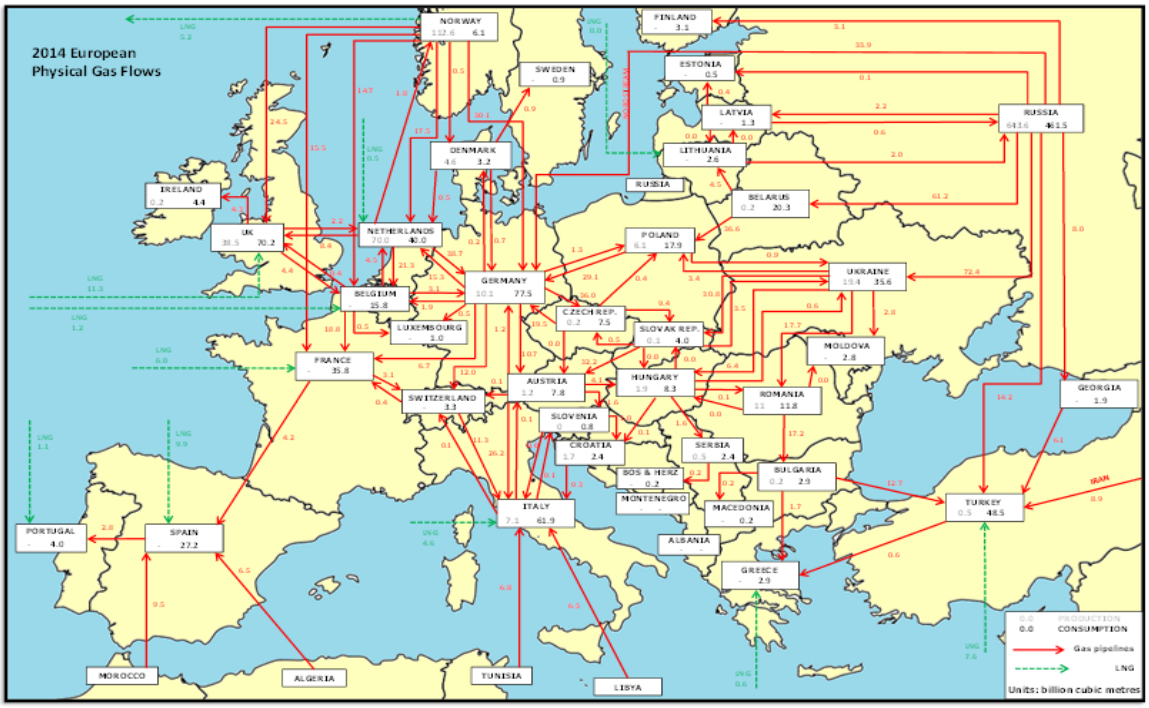
4.7 Chart 4.2 shows imports by source. LNG arrivals by ship cover a variety of countries but the vast bulk arrive from Qatar. Table 4.5 in DUKES shows imports and exports for all countries.

Chart 4.2: Gas imports by country 2016



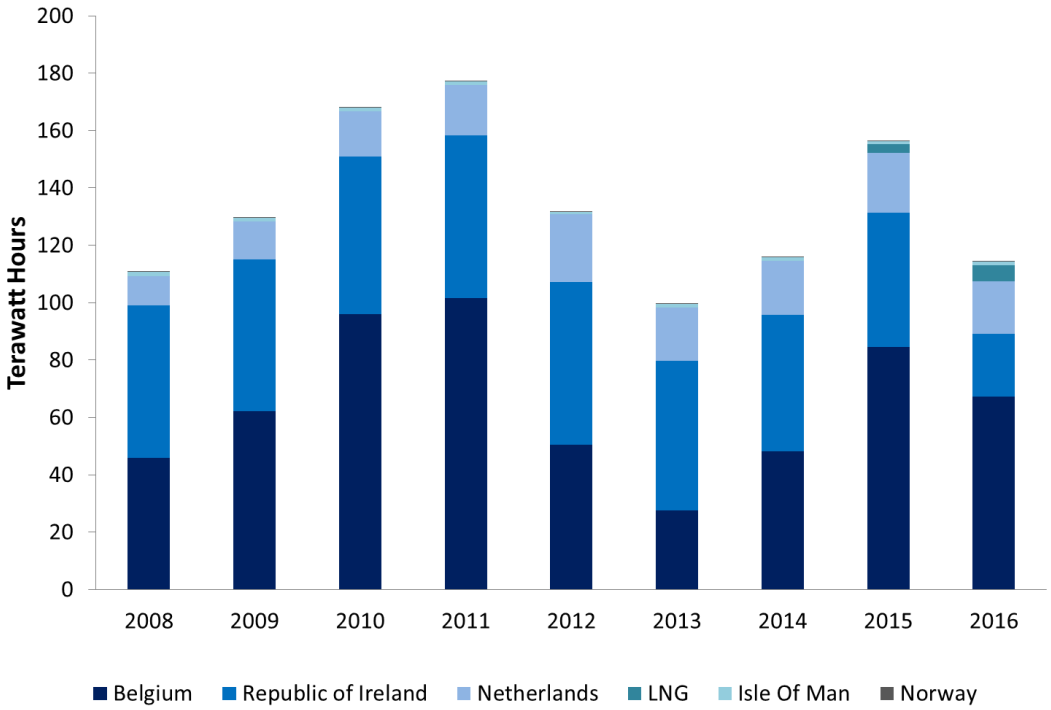
4.8 The European transit system for gas is complex, with multiple connectors giving a high degree of interconnectivity. Map 4A is illustrative of this and shows how gas flows into the EU (from Russia, Norway and by ship principally) and onto the UK (principally from Norway and by ship, with little or no direct reliance on Russian gas). A larger version of the map is available at www.gov.uk/government/publications/energy-trends-december-2016-special-feature-article-physical-gas-flows-across-europe-and-diversity-of-gas-supply-in-2015. The UK National Gas Transmission System is similarly complex a map, which can be found in Map 4B.

Map 4A: The European gas transit system



4.9 With demand outstripping supply from the UK's continental shelf it is perhaps surprising to note that the UK is a large exporter of gas, with exports in several recent years outstripping export volumes at the peak of the UK's indigenous production. Chart 4.3 shows that export volumes have been considerable but somewhat erratic in recent years, and illustrates the sharp contraction of export volumes in 2016 when compared with 2015.

Chart 4.3: Export volumes by year and country



4.10 **The UK exports principally to Belgium and Ireland, in 2016 volumes exported to each country were down.** Chart 4.3 shows the decrease in volumes to Belgium (of nearly one-fifth) and to Ireland (of one-third), largely due to the Corrib gas field off the Irish coast coming online and now supplying Ireland.

4.11 Shipped imports of LNG were down by around a fifth this year due to higher demand in Asia, which increased costs and perhaps increased competition for LNG from other European countries as further terminals open.

Demand for gas

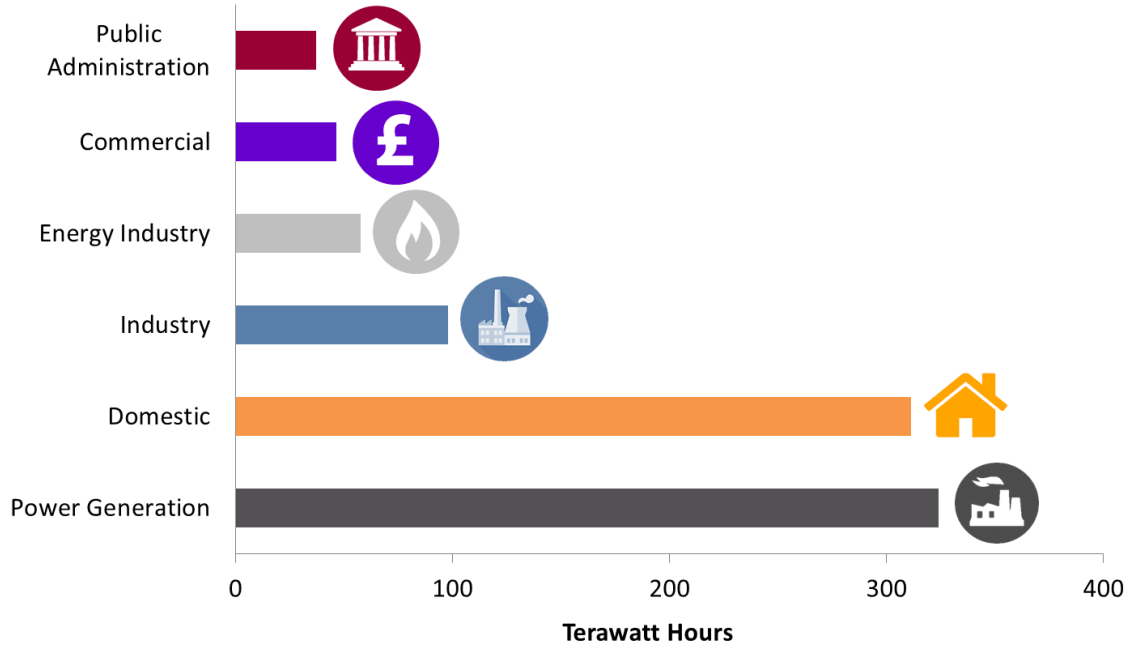
4.12 **Gas demand can be broadly broken down into two main sectors of very substantial size; domestic consumption and gas for electricity generation**, with demand for industry, commercial, public administration and other sectors making up the rest of demand (see Chart 4.4).

4.13 **In 2016 demand was down nearly a fifth compared with 2000** (see Chart 4.5). Most notably, industry demand has shrunk over this period, down to around half of its level in 2000. However, demand for power generation was also down (around 7 per cent) and domestic demand has shrunk by around 16 per cent in the context of both a rising population and a rising number of homes. Increased efficiencies in heat use, including greater levels of home insulation, are a factor.

4.14 **Compared to 2015 however demand is up with an increase of over 12 per cent** to 897 TWh. The principal cause is that **more gas has been used for power generation; an increase of just over 40 per cent due to the drop in coal-powered generation** as plants become mothballed under the plans to close all coal-powered stations by 2025.

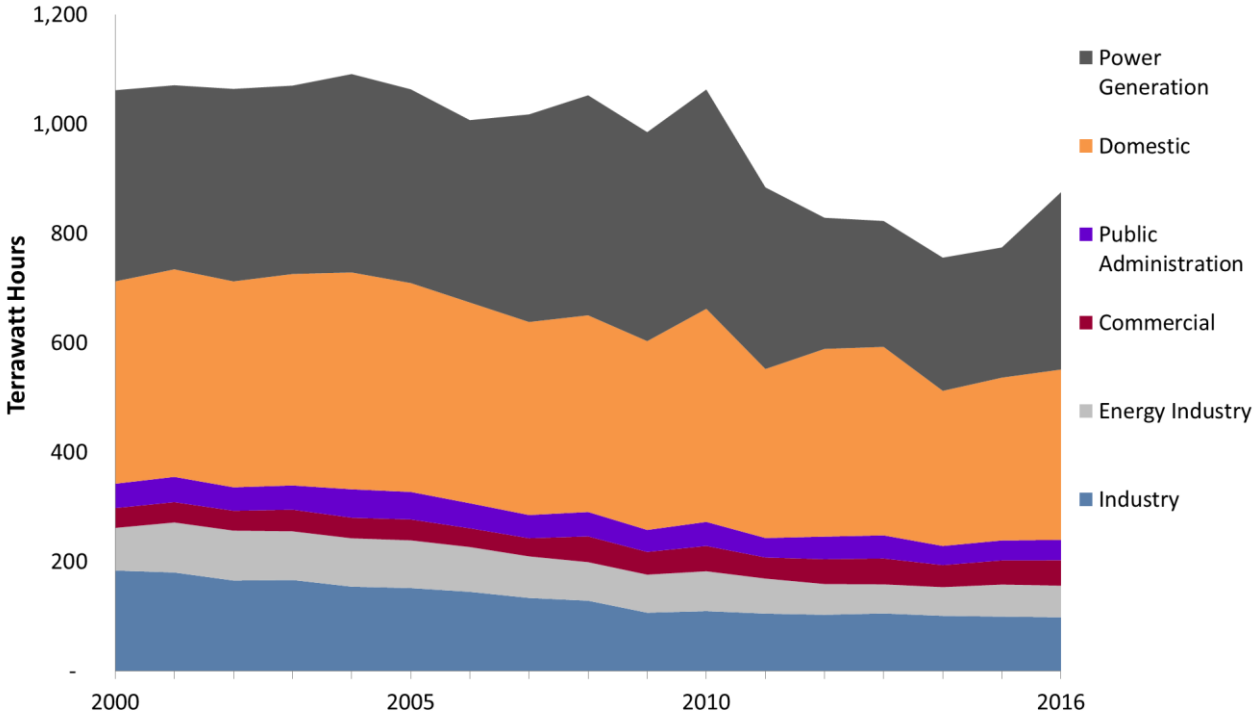
4.15 Final consumption also increased by 3.2 per cent with **domestic consumption up around 5 per cent, the result of a colder winter in 2016 than in 2015** with the average number of heating degree days per month up to 7.7 in Q4 2016 in comparison to 5.5 in Q4 2015.

Chart 4.4: Gas demand in 2016



4.16 Chart 4.5 shows gas demand over time. As noted above, demand has reduced since the mid-2000s but there are notable peaks that correspond with weather variations, which generate a greater demand for space heating in homes and offices.

Chart 4.5: Changes in gas demand over time



4.17 More detailed analysis of gas consumption in the domestic sector is available in the National Energy Efficiency Data-Framework (NEED): www.gov.uk/government/collections/national-energy-efficiency-data-need-framework. For definitions of the various sectors used for sales and consumption analyses see Chapter 1_paragraphs 1.55 to 1.60 and Annex A, paragraphs A.31 to A.42.

Sub-national gas data

4.18 In January 2017, BEIS published sub-national energy statistics data on its website: www.gov.uk/government/collections/sub-national-gas-consumption-data, including consumption data at both regional (NUTS1) and local (LAU1) level. Data for earlier years are presented on the website.

Table 4A: Consumption by gas customers by region in 2015

	Domestic Meters[1]		Total Number of Meters	
Region/Country[2]	**Customers (1000's)**	**Sales (GWh)**	**Customers (1000's)**	**Sales (GWh)**
North East	1,103	14,738	1,113	22,368
North West	2,901	37,278	2,930	60,287
Yorkshire and the Humber	2,121	28,923	2,144	48,274
East Midlands	1,774	23,771	1,792	36,850
West Midlands	2,111	27,847	2,134	43,935
East	2,068	27,902	2,089	42,052
London	3,006	40,014	3,045	58,439
South East	3,199	43,891	3,236	59,856
South West	1,850	21,577	1,868	31,360
Scotland	1,116	13,682	1,125	22,045
Wales	1,994	27,226	2,016	45,469
Great Britain	**23,241**	**306,849**	**23,493**	**470,935**

[1] Customers with an annual consumption of 73,200 kWh or lower will include some small industrial and commercial consumers.
[2] Data excludes approximately 169,000 customers (0.7 per cent) for whom regional allocation was not possible.

4.19 The total number of customers in 2015 remains fairly similar to 2014, with all areas seeing a small rise in the total number of customers. Within this the South East and London have the largest numbers of consumers, whilst the North East and Wales have the lowest. In contrast total sales have fallen in 8 of the 11 regions between 2014 and 2015, with the largest decline (-2.6 per cent) in the South West. In Great Britain as a whole there was an overall decrease in consumption of 0.3 per cent. A more detailed summary of this data can be found at: www.gov.uk/government/statistics/sub-national-electricity-and-gas-consumption-summary-report-2015. These data are published on a regular basis and updated data will be available.

4.20 In March 2017, BEIS published Percentage of domestic gas customers by region and supplier type data on its website: www.gov.uk/government/statistical-data-sets/quarterly-domestic-energy-price-stastics.

Table 4B: Domestic gas market penetration (in terms of percentage of customers supplied[1]) by region, Quarter 4 2016

	All Payment Types	
Region/Country[2]	Home supplier	Other large supplier
South Wales	28	72
North East	29	71
East Midlands	32	68
North Scotland	32	68
South East	33	67
Southern	33	67
Yorkshire	35	65
Eastern	36	64
South Scotland	36	64
South West	36	64
West Midlands	36	64
North West	38	62
Merseyside & N Wales	39	61
London	41	59
Great Britain	**35**	**65**

[1] *Table is not adjusted to account for survey coverage. The Domestic Fuels Inquiry survey coverage is estimated at around 88%. All those not surveyed are with non-home suppliers.*

[2] *The regions used in this table are the distribution areas of the former public electricity suppliers. This marks a change from previous years, where regions were based on Transco local distribution zones (LDZs).*

4.21 **At the end of December 2016, BEIS estimates that 65 per cent of domestic gas customers in Great Britain were no longer with their home supplier, British Gas.** The data in Table 4B are based on the BEIS domestic prices survey, which does not include the majority of small suppliers and therefore underestimates the proportion of customers not with their home supplier. By the end of December 2016 of the companies surveyed, around 35 per cent of customers were supplied by British Gas

4.22 Competition in the domestic, industrial and commercial markets have continued to increase in 2016 as the concentration of sales by the largest three and largest six suppliers for each relevant sector have continued to dilute compared to past years. **Competition remained broadly unchanged between 2008 and 2013, but from 2014 onwards the competition has gradually increased.** In 2016, the largest six domestic suppliers accounted for around 85 per cent of sales, down from 90 per cent of sales in 2015 and 97 per cent of sales in 2013.

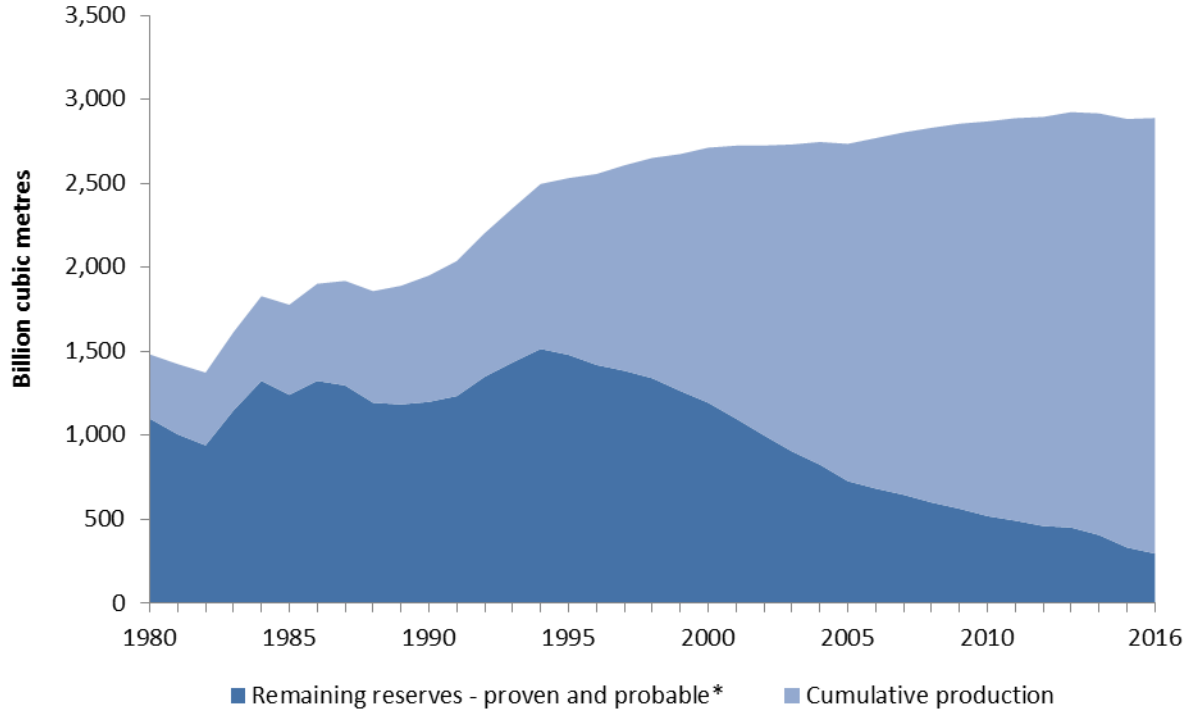
Map 4B: The National Gas Transmission System

Source: International Energy Agency and BEIS

Gas resources

4.23 The Oil and Gas Authority estimates that there are 297 billion cubic metres of proven and probable gas reserves, of which 176 billion cubic metres are proven reserves. There has been a steady decline in proven plus probable reserves since 1994 (as shown in Chart 4.6), initially associated with a higher rate of production. With the addition of cumulative gas production to the end of 2016 the estimated ultimate recovery figure is 2,889 billion cubic metres.

Chart 4.6: Gas reserves



* From 2015, contingent resources have been re-categorised and removed from the probable and proven reserves category.

List of DUKES gas tables

Table	Description	Period
4.1	Natural gas commodity balances	1998-2016
4.2	Supply and consumption of natural gas and colliery methane	2012-2016
4.3	UK continental shelf and onshore natural gas production and supply	2012-2016
4.4	Gas storage sites and import/export facilities in the United Kingdom	May 2016
4.5	Natural gas imports and exports	2012-2016
4.6	Liquefied natural gas imports by terminal	2012-2016
4.1.1	Natural gas and colliery methane production and consumption	1970-2016
F.2	Gas production	Total to 1998-2016

Technical notes and definitions

These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1, paragraphs 1.29 to 1.63. For notes on the commodity balances and definitions of the terms used in the row headings see Annex A, paragraphs A.7 to A.42. While the data in the pdf copy of this Digest cover only the most recent five years, these notes also cover data for earlier years that are available on the BEIS energy statistics web site.

Definitions used for production and consumption

4.24 **Natural gas** production in Tables 4.1 and 4.2 relates to the output of indigenous methane at land terminals and gas separation plants (includes producers' and processors' own use). For further explanation, see Annex F on BEIS's energy statistics web site under 'Production of gas' - www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes. Output of the Norwegian share of the Frigg and Murchison fields is included under imports. A small quantity of onshore produced methane (other than colliery methane) is also included.

4.25 **Colliery methane** production is colliery methane piped to the surface and consumed at collieries or transmitted by pipeline to consumers. As the output of deep-mined coal declines so does the production of colliery methane, unless a use can be found for gas that was previously vented. The supply of methane from coal measures that are no longer being worked or from drilling into coal measures is licensed under the same legislation as used for offshore gas production.

4.26 **Transfers** of natural gas include natural gas use within the iron and steel industry for mixing with blast furnace gas to form a synthetic coke oven gas. For further details see paragraph 2.54 in Chapter 2.

4.27 **Non-energy gas**: Non-energy use is gas used as feedstock for petrochemical plants in the chemical industry as raw material for the production of ammonia (an essential intermediate chemical in the production of nitrogen fertilisers) and methanol. The contribution of liquefied petroleum gases (propane and butane) and other petroleum gases is shown in Tables 3.2 to 3.4 of Chapter 3. Firm data for natural gas are not available, but estimates for 2011 to 2015 are shown in Table 4.2 and estimates for 2013 to 2015 in Table 4.1. The estimates for the years up to 2011 have been obtained from AEA's work for the National Atmospheric Emissions Inventory; 2012-13 data are BEIS extrapolations. For DUKES 2016, we will be exploring non-energy use in more detail to improve the accuracy of these data.

Sectors used for sales/consumption

4.28 For definitions of the various sectors used for sales and consumption analyses see Chapter 1 paragraphs 1.55 to 1.60 and Annex A, paragraphs A.31 to A.42.

Data collection

4.29 Production figures are generally obtained from returns made under OGA's Petroleum Production Reporting System (PPRS). BEIS also obtain data on the transmission of natural gas from National Grid (who operate the National Transmission System) and from other pipeline operators. Data on consumption are based on returns from gas suppliers and UK Continental Shelf (UKCS) producers who supply gas directly to customers, (see paragraph 4.31).

4.30 The production data are for the UK (including natural gas from the UKCS - offshore and onshore). The restoration of a public gas supply to parts of Northern Ireland in 1997 means that all tables in this chapter, except Tables 4A and 4B, cover the UK.

4.31 BEIS carry out an annual survey of gas suppliers to obtain details of gas sales to the various categories of consumer. The larger gas suppliers (defined as those with more than about a 0.5 per cent share of the UK market up to 1997 and those known to supply more than 1,750 GWh per year for 1998 onwards) provide a detailed breakdown of sales for final consumption to BEIS on an annual basis. This provides the main data source for the UK's gas demand. Prior to 2013 data, companies supplying less than 1,750 GWh provided gas sales as a single sum which was then apportioned across sectors using the same proportional split as seen in the data from the large suppliers. From 2013 onwards, data from smaller suppliers were provided broken down by broad sector (e.g. domestic, other industry etc.) to allow more accurate apportioning of these data.

4.32 Data on sectoral gas use are primarily derived from surveys of large and small gas suppliers. Beyond this, data for electricity generation by major power producers are adjusted, such that the data agree with a separate data set collected via the Major Power Producers' (MPP) survey. Data for autogenerators are similarly adjusted to match CHP data (see Chapter 7) provided to BEIS, with the appropriate amount of gas used for autogeneration being subtracted from each sector and added to the autogeneration figure. The same methodology is applied for heat sold, which makes up the heat generation figure. For 2000 and subsequent years, gas consumption for the iron and steel sector is based on data provided by the Iron and Steel Statistics Bureau (ISSB) rather than gas suppliers since gas suppliers were over estimating their sales to this sector. The difference between the ISSB and gas suppliers'' figures has been re-allocated to other sectors.

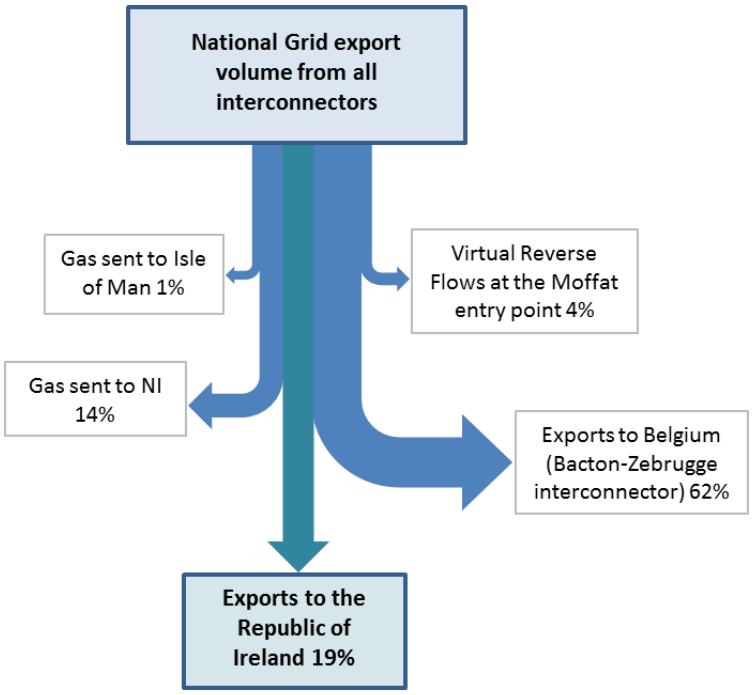
Methodology updates

4.33 Biomethane has been injected into the National Grid from certified Renewable Heat Incentive (RHI) installations since 2014. These volumes have been small, but increasing, with biomethane accounting for 0.2 per cent of supply in 2016. This gas is included in the transfers row in Tables 4.1, 4.2 and 4.3 in this chapter and separately identified in the monthly Energy Trends tables (see Energy Trends June 2017 special feature for details: www.gov.uk/government/uploads/system/uploads/attachment_data/file/622863/Enhancements_to_Energy_Trends_gas_tables.pdf).

4.34 In 2016 BEIS updated the methodology to calculate gas exports to the Republic of Ireland to remove virtual reverse flows, which ensures that only physical flows are reported in line with international reporting standards (see Energy Trends June 2017 special feature for details: www.gov.uk/government/uploads/system/uploads/attachment_data/file/622863/Enhancements_to_Energy_Trends_gas_tables.pdf). Along with this we have used two new data sources, one to identify gas sent to Northern Ireland to improve data capture and another to separately identify gas exports to the Isle of Man. The methodology to calculate exports to the Republic of Ireland is outlined below and illustrated in Figure 4.1:

1. National Grid provide BEIS with data for gas input into the transmission system, stock changes, operator's own use, exports through all interconnectors and gas output from the transmission system in the form of a GM10 report. The exports through all interconnectors are calculated by removing offtakes from Local Distribution Networks (LDZ) from gas transported through companies' pipelines.
2. The export data provided by National Grid is the combined amount of gas sent through the Bacton and Moffat interconnectors along with the Scotland-Northern Ireland Pipeline (SNIP) and therefore is the gas sent out from Great Britain.
3. BEIS then remove gas exports to Belgium through the Bacton interconnector to leave a figure for the amount of gas sent through the Moffat Interconnector to the Republic of Ireland and the Isle of Man along with gas sent to Northern Ireland through the SNIP.
4. BEIS then remove the amount of gas sent to Northern Ireland from Moffat via the SNIP from shipping allocation data from Gas Networks Ireland (GNI).
5. This figure for the Moffat Interconnector from National Grid is currently the nominated flow to Ireland. Therefore, BEIS remove the Virtual Reverse Flow (VRF) from Ireland to the UK to gain a physical flow to ensure that reporting is consistent with methodology from the International Energy Agency (IEA) and Eurostat.
6. The gas taken off on the interconnector to the Isle of Man (data provided by Manx Utilities) is then removed to obtain a figure for the amount of gas exported to the Republic of Ireland.

Figure 4.1: Methodology to calculate exports of gas to Northern Ireland



4.35 BEIS updated our gas data collection methodology and analysis in 2014 (see Energy Trends June 2014 special feature for details: www.gov.uk/government/statistics/energy-trends-june-2014). This change in methodology resulted in shifts in sectoral gas use going back to 2008. In particular, gas use shifted out of the industrial sector, with a subsequent increase in the services sector.

Period covered

4.36 Figures generally relate to years ended 31 December. However, before 2004, data for natural gas for electricity generation relate to periods of 52 weeks as set out in Chapter 5, paragraphs 5.83 and 5.84.

Monthly and quarterly data

4.37 Monthly data on natural gas production and supply are available from BEIS's energy statistics website: www.gov.uk/government/collections/gas-statistics in monthly Table 4.2. A quarterly commodity balance for natural gas (which includes consumption data) is published in BEIS's quarterly statistical bulletin *Energy Trends* and is also available from quarterly Table 4.1 on BEIS's energy statistics web site.

Statistical and metering differences

4.38 Table 4.3 shows production, transmission and consumption figures for UK continental shelf and onshore natural gas. This table departs from the standard balance methodology and definitions to maintain the link with historical data and with monthly data given on BEIS's energy statistics website. This section of the technical notes illustrates how total gas consumption shown in Table 4.3 and Table 4.1.are mapped across. Production includes waste and own use for drilling, production and pumping operations, but excludes gas flared. Gas available in the UK excludes waste, own use for drilling etc., stock change, and includes imports net of exports. Gas transmitted (input into inland transmission systems) is after stock change, own use, and losses at inland terminals. The amount consumed in the UK differs from the total gas transmitted by the gas supply industry because of losses in transmission, differences in temperature and pressure between the points at which the gas is measured, delays in reading meters and consumption in the works, offices, shops, etc. of the undertakings. The figures include an adjustment to the quantities billed to consumers to allow for the estimated consumption remaining unread at the end of the year.

4.39 In Table 4.3 there are several headings that refer to statistical or metering differences. These arise because measurement of gas flows, in volume and energy terms, takes place at several points along the supply chain. The main sub-headings in the table represent the instances in the supply

chain where accurate reports are made of the gas flows at that particular key point in the supply process. It is possible to derive alternative estimates of the flow of gas at any particular point by taking the estimate for the previous point in the supply chain and then applying the known losses and gains in the subsequent part of the supply chain. The differences seen when the actual reported flow of gas at any point and the derived estimate are compared are separately identified in the table wherever possible, under the headings statistical or metering differences.

4.40 The relationship between total UK gas consumption shown in this Table 4.3 and total demand for natural gas given in the balance Table 4.1 is illustrated for 2016 as follows:

	GWh
Total UK consumption (Table 4.3)	836,354
Plus producers' own use	+50,079
Plus operators' own use	+4,177
Consumption of natural gas	**890,610**
Plus upstream losses and metering differences	+0
Plus downstream losses – leakage assessment	+1,249
Plus downstream losses – own gas use	+29
Plus downstream losses – theft	+51
Plus downstream losses – iron and steel losses	+3
Plus downstream metering differences	+4,065
Total demand for natural gas (Table 4.1)	**896,007**

4.41 The statistical difference row in Table 4.1 is made up of the following components in 2016:

	GWh
Statistical difference between gas available at terminals and gas input to downstream (Table 4.3)	-860
Plus Downstream gas industry: Distribution losses and metering differences	+2857
Statistical difference for natural gas (Table 4.1)	**1,997**

4.42 Losses and metering differences attributable to the information provided on the upstream gas industry are zero from 2001 onwards because these data are no longer reported in the revised PPRS System. This simplified system for reporting the production of crude oil, NGLs and natural gas in the UK was implemented from 1 January 2001; it reduced the burden on the respondents and improved the quality of data reported on gas production.

4.43 The differences in the natural gas commodity balances arise from several factors:-

- Limitations in the accuracy of meters used at various points of the supply chain. While standards are in place on the accuracy of meters, there is a degree of error allowed which, when large flows of gas are being recorded, can become significant.
- Differences in the methods used to calculate the flow of gas in energy terms. For example, at the production end, rougher estimates of the calorific value of the gas produced are used which may be revised only periodically, rather than the more accurate and more frequent analyses carried out further down the supply chain. At the supply end, although the calorific value of gas shows day-to-day variations, for the purposes of recording the gas supplied to customers a single calorific value is used. Until 1997 this was the lowest of the range of calorific values for the actual gas being supplied within each LDZ, resulting in a "loss" of gas in energy terms. In 1997 there was a change to a "capped flow-weighted average" algorithm for calculating calorific values resulting in a reduction in the losses shown in the penultimate row of Table 4.3. This change in algorithm, along with improved meter validation and auditing procedures, also reduced the level of the "metering differences" row within the downstream part of Table 4.3.

- Differences in temperature and pressure between the various points at which gas is measured. Until February 1997 British Gas used “uncorrected therms” on their billing system for tariff customers when converting from a volume measure of the gas used to an energy measure. This made their supply figure too small by a factor of 2.2 per cent, equivalent to about 1 per cent of the wholesale market.
- Differences in the timing of reading meters. While National Transmission System meters are read daily, customers’ meters are read less frequently (perhaps only annually for some domestic customers) and profiling is used to estimate consumption. Profiling will tend to underestimate consumption in a strongly rising market.
- Other losses from the system, for example theft through meter tampering by consumers.

4.44 The headings in Table 4.3 show where, in the various stages of the supply process, it has been possible to identify these metering differences as having an effect. Usually they are aggregated with other net losses as the two factors cannot be separated. Whilst the factors listed above can give rise to either losses or gains, losses are more common. However, the negative downstream gas metering difference within the transmission system in 2003 was an anomaly that was investigated by National Grid during 2004. They concluded that this unaccounted for element of National Transmission System shrinkage was due to an exceptional run of monthly negative figures between February and June 2003 within what is usually a variable but mainly positive series. However, after a comprehensive investigation of this exceptional period no causal factors were identified. It is probable that the meter error or errors that caused this issue were corrected during the validation of metering.

4.45 Care should be exercised in interpreting the figures for individual industries in these commodity balance tables. As companies switch contracts between gas suppliers, it has not been possible to ensure consistent classification between and within industry sectors and across years. The breakdown of final consumption includes a substantial amount of estimated data prior to 2013.

Contacts:

Warren Evans
Energy Statistics Team
warren.evans@beis.gov.uk
0300 068 5059

Matthew Curds (upstream gas)
Energy Statistics Team
matthew.curds@beis.gov.uk
0300 068 8414

James Halliwell (downstream gas)
Energy Statistics Team
james.halliwell@beis.gov.uk
0300 068 8121

4.1 Commodity balances

Natural gas

GWh

	2014			2015			2016		
	Natural gas	Colliery methane	Total Natural gas	Natural gas	Colliery methane	Total Natural gas	Natural gas	Colliery methane	Total Natural gas
Supply									
Production	415,515r	391r	415,906r	451,437r	354r	451,791r	462,307	443	462,750
Other sources	-	-	-	-	-	-	-	-	-
Imports	488,937r	-	488,937r	501,563r	-	501,563r	534,740	-	534,740
Exports	-127,907r	-	-127,907r	-159,517r	-	-159,517r	-116,862	-	-116,862
Marine bunkers	-	-	-	-	-	-	-	-	-
Stock change *(1)*	-2,383	-	-2,383	+3,515	-	3,515	16,242	-	16,242
Transfers *(2)*	-4r	-	-4r	559r	-	559r	1,575	-	1,575
Total supply	**774,158r**	**391r**	**774,549r**	**797,558r**	**354r**	**797,912r**	**898,002**	**443**	**898,445**
Statistical difference *(3)*	-3,846r	-	-3,846r	779r	-	779r	1,476	-	1,476
Total demand	**778,004r**	**391r**	**778,395r**	**796,779r**	**354r**	**797,132r**	**896,527**	**443**	**896,970**
Transformation	**243,090r**	**378r**	**243,468r**	**237,682r**	**343r**	**238,025r**	**323,763**	**434**	**324,197**
Electricity generation	217,459r	378r	217,837r	212,289r	343r	212,632r	297,643	434	298,077
Major power producers	189,919	-	189,919	185,955	-	185,955	271,563	-	271,563
Autogenerators	27,540r	378r	27,918r	26,335r	343r	26,678r	26,080	434	26,514
Heat generation *(4)*	25,631	-	25,631	25,393r	-	25,393r	26,120	-	26,120
Petroleum refineries	-	-	-	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Energy industry use	**52,470r**	**-r**	**52,470r**	**58,645r**	**-r**	**58,645r**	**57,773**	**-**	**57,773**
Electricity generation	-	-	-	-	-	-	-	-	-
Oil and gas extraction	45,391	-	45,391	51,024r	-	51,024r	50,079	-	50,079
Petroleum refineries	1,201r	-	1,201r	1,201r	-	1,201r	1,079	-	1,079
Coal extraction	100r	-r	100r	79	-r	79r	61	-	61
Coke manufacture	-	-	-	-	-	-	-	-	-
Blast furnaces	338	-	338	323	-	323	291	-	291
Patent fuel manufacture	-	-	-	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-	-	-	-
Other	5,440r	-	5,440r	6,018r	-	6,018r	6,263	-	6,263
Losses *(5)*	**6,856r**	-	**6,856r**	**6,469r**	-	**6,469r**	**5,396**	-	**5,396**
Final consumption	**475,588r**	**13**	**475,601r**	**493,983r**	**11**	**493,994r**	**509,596**	**9**	**509,605**
Industry	**100,623r**	**13**	**100,636r**	**99,200r**	**11**	**99,211r**	**97,997**	**9**	**98,006**
Unclassified	-	13	13	-	11	11	-	9	9
Iron and steel	5,454	-	5,454	5,374	-	5,374	4,155	-	4,155
Non-ferrous metals	2,073r	-	2,073r	1,832r	-	1,832r	1,879	-	1,879
Mineral products	11,105r	-	11,105r	11,156r	-	11,156r	11,711	-	11,711
Chemicals	19,557r	-	19,557r	19,524r	-	19,524r	19,612	-	19,612
Mechanical Engineering etc	5,938r	-	5,938r	6,054r	-	6,054r	6,079	-	6,079
Electrical engineering etc	2,779r	-	2,779r	3,093r	-	3,093r	3,402	-	3,402
Vehicles	8,321r	-	8,321r	8,695r	-	8,695r	9,109	-	9,109
Food, beverages etc	20,395r	-	20,395r	19,613r	-	19,613r	19,817	-	19,817
Textiles, leather etc	4,579r	-	4,579r	4,467r	-	4,467r	4,139	-	4,139
Paper, printing etc	10,441r	-	10,441r	9,517r	-	9,517r	8,330	-	8,330
Other industries	7,022r	-	7,022r	6,745r	-	6,745r	6,534	-	6,534
Construction	2,957r	-	2,957r	3,126r	-	3,126r	3,231	-	3,231
Transport	-	-	-	-	-	-	-	-	-
Air	-	-	-	-	-	-	-	-	-
Rail	-	-	-	-	-	-	-	-	-
Road	-	-	-	-	-	-	-	-	-
National navigation	-	-	-	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-	-	-	-
Other	**369,535r**	-	**369,535r**	**389,516r**	-	**389,516r**	**406,490**	-	**406,490**
Domestic	283,691r	-	283,691r	297,582r	-	297,582r	311,375	-	311,375
Public administration	34,972r	-	34,972r	36,545r	-	36,545r	37,246	-	37,246
Commercial	40,189r	-	40,189r	44,097r	-	44,097r	46,459	-	46,459
Agriculture	1,073r	-	1,073r	983r	-	983r	946	-	946
Miscellaneous	9,609r	-	9,609r	10,310r	-	10,310r	10,464	-	10,464
Non energy use	**5,430**	-	**5,430**	**5,267**	-	**5,267**	**5,109**	-	**5,109**

(1) Stock fall (+), stock rise (-).
(2) Natural gas used in the manufacture of synthetic coke oven gas.
(3) Total supply minus total demand.
(4) Heat sold to third parties. Heat generation data are not available before 1999. For earlier years gas used to generate heat for sale is allocated to final consumption by sector.
(5) Refers to downstream losses. For an explanation of what is included under these losses, see paragraph 4.40.

4.2 Supply and consumption of natural gas and colliery methane[(1)]

GWh

	2012	2013	2014	2015	2016
Supply					
Production	435,471r	410,893r	415,906r	451,791r	462,750
Imports	566,669r	548,223r	488,937r	501,563r	534,740
Exports	-144,023	-109,664	-127,907r	-159,517r	-116,862
Stock change *(2)*	-269	+621	-2,383	+3,515	+16,242
Transfers	-56	-61	-4r	++559r	+1,575
Total supply	**857,792r**	**850,013r**	**774,549r**	**797,912r**	**898,445**
Statistical difference *(3)*	+3,362r	+1,949r	-3,846r	+779r	+1,476
Total demand	**854,430r**	**848,064r**	**778,395r**	**797,132r**	**896,970**
Transformation	**239,631r**	**230,170**	**243,468r**	**238,025r**	**324,197**
Electricity generation	216,543	205,869	217,837r	212,632r	298,077
Major power producers	184,307	175,210	189,919	185,955	271,563
Autogenerators	32,236	30,659	27,918r	26,678r	26,514
Heat generation	23,089r	24,302	25,631	25,393r	26,120
Other	-	-	-	-	-
Energy industry use	**56,236r**	**53,219r**	**52,470r**	**58,645r**	**57,773**
Electricity generation	-	-	-	-	-
Oil and gas extraction	48,461	46,000r	45,391	51,024r	50,079
Petroleum refineries	1,522r	1,151r	1,201r	1,201r	1,079
Coal extraction	194	60r	100r	79r	61
Coke manufacture	-	-	-	-	-
Blast furnaces	266	363	338	323	291
Other	5,793	5,645	5,440r	6,018r	6,263
Losses *(4)*	**7,891r**	**7,473**	**6,856r**	**6,469r**	**5,396**
Final consumption	**550,672r**	**557,201r**	**475,601r**	**493,994r**	**509,605**
Industry	**102,594r**	**105,015r**	**100,636r**	**99,211r**	**98,006**
Unclassified	18	15	13	11	9
Iron and steel	5,091	5,338	5,454	5,374	4,155
Non-ferrous metals	2,240r	2,180r	2,073r	1,832r	1,879
Mineral products	10,892r	11,125r	11,105r	11,156r	11,711
Chemicals	20,805r	21,676r	19,558r	19,524r	19,612
Mechanical engineering etc	6,536r	6,194r	5,938r	6,054r	6,079
Electrical engineering etc	2,783r	2,812r	2,779r	3,093r	3,402
Vehicles	7,906r	8,480r	8,321r	8,695r	9,109
Food, beverages etc	20,863r	21,096r	20,395r	19,613r	19,817
Textiles, leather etc	4,733r	4,757r	4,579r	4,467r	4,139
Paper, printing etc	10,231r	11,134r	10,441r	9,517r	8,330
Other industries	7,571r	7,171r	7,022r	6,745r	6,534
Construction	2,925r	3,037r	2,957r	3,126r	3,231
Transport	-	-	-	-	-
Road *(5)*	-	-	-	-	-
Other	**442,308r**	**446,589r**	**369,535r**	**389,516r**	**406,490**
Domestic	343,180r	344,501r	283,691r	297,582r	311,375
Public administration	41,323r	42,251r	34,972r	36,545r	37,246
Commercial	45,331r	47,276r	40,189r	44,097r	46,459
Agriculture	1,162	1,096	1,073r	983r	946
Miscellaneous	11,311r	11,465r	9,609r	10,310r	10,464
Non energy use	**5,771**	**5,598**	**5,430**	**5,267**	**5,109**

(1) Colliery methane figures included within these totals are as follows:

	2012	2013	2014	2015	2016
Total production	**530r**	**433r**	**391r**	**354r**	**443**
Electricity generation	414r	418r	378r	343r	434
Coal extraction	98	-	-	-	-
Other industries	18	15	13	11r	9
Total consumption	**530r**	**433r**	**391r**	**354r**	**443**

(2) Stock fall (+), stock rise (-).
(3) Total supply minus total demand.
(4) Refers to downstream losses. For an explanation of what is included under these losses, see paragraph 4.40.
(5) A small amount of natural gas is consumed by road transport, but gas use in this sector is predominantly of petroleum gas, hence road use of gas is reported in the petroleum products balances in Chapter 3.

4.3 UK continental shelf and onshore natural gas production and supply[(1)]

GWh

	2012	2013	2014	2015	2016
Upstream gas industry:					
Gross production *(2)*	434,941r	410,460r	415,515r	451,437r	462307
Minus Producers' own use *(3)*	48,461	46,000r	45,391	51,024r	50079
Exports	144,023	109,664	127,907r	159,517r	116862
Plus Imports of gas	566,669r	548,223r	488,937r	501,563r	534740
Gas available at terminals *(4)*	809,127r	803,019r	731,153r	742,459r	830106
Minus Statistical difference *(5)*	-333r	-459r	-984r	921r	-860
Downstream gas industry:					
Gas input into the national transmission system *(6)*	809,460	803,478	732,137r	741,539r	830966
Minus Operators' own use (7)	3,900	3,534	3,331r	4,009r	4177
Stock change (storage sites) *(8)*	269	-621	2,383	-3,515	-16242
Metering differences *(5)*	6,099	5,697	5,302	5,219r	4065
Gas output from the national transmission system *(9)*	799,191	794,869	721,121	735,826r	838966
Minus Leakage assessment *(10)*	1,537	1,537	1,370	1,070	1249
Own use gas *(11)*	34	34	30	30	29
Theft *(12)*	218r	203	153r	148r	51
Transfers *(13)*	56	61	4r	-559r	-1575
Losses *(14)*	3	2	1	2	3
Statistical difference and metering differences *(5)*	3,695r	2,407r	-2,862r	-141r	2335
Total UK consumption *(15)*	**793,649r**	**790,624r**	**722,425r**	**735,277r**	**836875**
Stocks of gas (at end year) *(16)*	46,422r	45,801r	48,184r	44,669r	28427
Storage capacity *(17)*	47,861r	51,059r	50,728r	50,949r	52294

(1) For details of where to find monthly updates of natural gas production and supply see paragraph 4.37.
(2) Includes waste and producers' own use, but excludes gas flared.
(3) Gas used for drilling, production and pumping operations.
(4) The volume of gas available at terminals for consumption in the UK as recorded by the terminal operators.
(5) Measurement of gas flows, in volume and energy terms, occurs at several points along the supply chain. As such, differences are seen between the actual recorded flow through any one point and estimates calculated for the flow of gas at that point. More detail on the reasons for these differences is given in the technical notes and definitions section of this chapter, paragraphs 4.38 to 4.43.
(6) Gas received as reported by the pipeline operators. The pipeline operators include National Grid, who run the national pipeline network, and other pipelines that take North Sea gas supplies direct to consumers.
(7) Gas consumed by pipeline operators in pumping operations and on their own sites.
(8) Stocks of gas held in specific storage sites, either as liquefied natural gas, pumped into salt cavities or stored by pumping the gas back into an offshore field. Stock rise (+), stock fall (-).
(9) Including public gas supply, direct supplies by North Sea producers, third party supplies and stock changes.
(10) This is a National Grid assessment of leakage through the local distribution system based on the National Leakage Reduction Monitoring Model.
(11) Currently quivalent to about 0.0113 per cent of LDZ throughput, this is an assessment of the energy used to counter the effects of gas cooling on pressure reduction.
(12) Calculated by National Grid as 0.02 per cent of LDZ throughput, this is theft before the gas reaches customer meters.
(13) Transfers are the use within the iron and steel industry for the manufacture of synthetic coke oven gas.
(14) Data for losses from the Iron and Steel Statistics Bureau Survey, converted from gigajoules to GWh assuming 0.2778 terajoules per GWh
(15) See paragraph 4.40 for an explanation of the relationship between these "Total UK consumption" figures and "Total demand" shown within the balance tables.
(16) Due to storage reconciliations, own use and metering differences, over a long period of years the stock levels based on gas put into storage and gas taken out of storage no longer reconciled with storage levels reported by National Grid. For 2011 action was taken to rectify this.
(17) Data compiled by BEIS from individual storage site information. Converted from billion cubic metres to GWh assuming 11.02 kWh per cubic metre.

4.4 Gas storage sites and import/export facilities in the United Kingdom at 1 November 2016 (1)

Owner	Site	Location	Space (Billion m^3)	Approximate maximum delivery (Million m^3/day)	Type	Status *(2)*
Operational storage						
Centrica Storage Ltd	Rough	Southern North Sea	3.30	41	Depleted field	Long
Scottish and Southern Energy & Statoil	Aldbrough	East Yorkshire	0.30	40	Salt cavern	Medium
E.ON	Holford	Cheshire	0.20	22	Salt cavern	Medium
Scottish and Southern Energy	Hornsea	East Yorkshire	0.30	18	Salt cavern	Medium
EDF Trading	Holehouse Farm	Cheshire	0.02	5	Salt cavern	Medium
Humbly Grove Energy	Humbly Grove	Hampshire	0.30	7	Depleted field	Medium
Scottish Power	Hatfield Moor	South Yorkshire	0.07	1.8	Depleted field	Medium
EDF Energy	Hill Top Farm	Cheshire	0.05	12	Salt Cavern	Medium
Storenergy	Stublach	Cheshire	0.20	15	Salt Cavern	Medium

Facilities	Owner	Between / Location	Max flow rate (Million m3/day)
Imports			
Operational pipelines			
Bacton-Zeebrugge Interconnector	Interconnector (UK) Limited	Zeebrugge and Bacton	74
Langeled Pipeline	Gassco	Nyhamna and Easington	72
BBL Pipeline	BBL Company	Balgzand and Bacton	53
Vesterled Pipeline	Gassco	Heimdal Riser Platform	39
Tampen Link	Gassco	Links Statfjord to FLAGS (terminating at St Fergus)	27
Gjøa Pipeline	Gassco	Links Gjøa/Vega to FLAGS and St Fergus (terminating at St Fergus)	17
SAGE Pipeline	Gassco	Links Alvheim to SAGE (terminating at St Fergus)	7
CATS Pipeline	Gassco	Links Rev and Gaupe to CATS (terminating at Teesside)	1
Liquefied Natural Gas (LNG) terminals			
South Hook	Qatar Petroleum and ExxonMobil	Milford Haven	58
Isle of Grain	National Grid Grain LNG	Kent	56
Dragon	BG Group and Petronas	Milford Haven	21
Teesside GasPort	Excelerate	Teesside	11
Exports			
Bacton-Zeebrugge Interconnector	Interconnector (UK) Limited	Bacton and Zeebrugge	55
UK- Irish Gas Interconnector	Bord Gais	Moffat and Ireland	30

(1) Information on gas storage as detailed in the National Grid Gas Ten Year Statement 2016

(2) Long range, medium range or short range storage. Status is determined both by capacity size and injection, deliverability and storage re-cycling rates.

4.5 Natural gas imports and exports *(1)*

GWh

	2012	2013	2014	2015	2016
Imports					
by pipelines from:					
Belgium *(2)*	14,264	35,367	3,949	2,116	15,414
The Netherlands *(3)*	78,258	81,519	70,293	35,933	47,444
Norway *(4)*	311,736r	318,634r	278,818r	307,943r	347,005
Liquefied Natural Gas (5)	150,098	102,620	123,910	152,406	122,310
of which:	-	-	-	-	-
Algeria	*1,312*	*4,492*	*5,774*	*4,807*	*4,776*
Australia	-	-	-	-	-
Belgium					*1,117*
Egypt	*145*	*755*	-	-	*120*
Nigeria	*475*	-	*534*	*436*	*434*
Norway	*1,735*	*1,068*	-	*601*	*2,649*
Qatar	*146,431*	*95,204*	*113,597*	*141,549*	*112,012*
Trinidad & Tobago	-	*1,101*	*4,004*	*5,013*	*1,202*
USA	-	-	-	-	-
Yemen	-	-	-	-	-
Total Imports	**554,356r**	**538,140r**	**476,969r**	**498,398r**	**532,173**
Exports to:					
Belgium (2)	50,343	27,458	48,074	84,465	67,189
The Netherlands (6)	23,729	18,597	18,852	20,789	18,302
Norway (7)	49	20	9	3	1
Republic of Ireland (8)	56,764r	52,257r	47,737r	46,898r	21,943
Isle of Man (9)	825r	1,251r	1,267r	1,192r	1,349
Liquefied Natural Gas (10)	-	-	-	3,005r	5,511
Total Exports	**131,711**	**99,582**	**115,938**	**156,353r**	**114,294**
Net Imports *(11)*	**422,645r**	**438,558r**	**361,030r**	**342,045r**	**417,879**

(1) This table is also shown as Table G.5 of the Internet Annex G to the Digest.

(2) Physical flows of gas through the Bacton-Zeebrugge Interconnector. In tables 4.1 to 4.3 the commercial flows of gas through the pipeline are used. Commercial flows are the amounts of gas that companies requested be supplied through the pipeline. Net imports are the same whichever measurement is used.

(3) Physical flows via the Bacton-Balgzand (BBL) pipeline. Commissioned in November 2006.

(4) Currently via the Langeled and Vesterled pipelines, the Tampen Link (from Statfjord to FLAGS), Gjoa/Vega (to FLAGS), SAGE pipline to St Fergus and CATS pipeline to Teesside.

(5) From various sources to the Isle of Grain, Milford Haven and Teesside.

(6) Direct exports from the Grove, Kew, Chiswick, Markham, Minke, Stamford, Windermere and Wingate offshore gas fields using the Dutch offshore gas pipeline infrastructure.

(7) With effect from September 2007, UK gas from the Blane field to the Norwegian Ula field for injection into the Ula reservoir.

(8) Includes gas to the Isle of Man up until 2004 and then seperately identified.

(9) Gas to Isle of Man seperately identified from exports to the Republic of Ireland from 2005 onwards.

(10) To various sources such as Brazil, United Arab Emirates and Pakistan.

(11) A negative figure means the UK was a net exporter of gas.

4.6 Liquefied Natural Gas imports by terminal

GWh

	2012	2013	2014	2015	2016
LNG Imports via:					
Dragon (*Milford Haven) (1)*	1,819	968	3,326	8,014	4,079
Isle of Grain (*Isle of Grain*) *(2)*	38,196	15,664	13,808r	14,224r	22,152
South Hook (*Milford Haven*) *(3)*	110,082	85,989	106,776	130,169	96,079
Teesside GasPort (*Teesside*) *(4)*	-	-	-	-	-
	150,097	**102,620**	**123,910r**	**152,406r**	**122,310**

(1) Dragon began importing LNG to the UK in August 2009.

(2) LNG imports at Canvey Island commenced in 1965 but ceased in the early 1980's when, with increasing supplies from the North Sea, imports were no longer required. UK natural gas production peaked in 2000 and as a result of falling production LNG imports recommenced at the Isle of Grain in 2005.

(3) South Hook began importing LNG to the UK in April 2009.

(4) Teesside GasPort was commissioned in February 2007.

Chapter 5
Electricity

Key points

- UK electricity generation was broadly stable compared to 2015, at 336 TWh; **however the fuel mix shifted significantly from coal to gas** as policy supported a market preference for gas generation, and coal plants closed. Whilst fuel costs for coal fired generation are lower than for gas, emissions from coal are higher so generators must pay a greater carbon price per GWh produced. (Table 5.1)

- Coal's share of generation fell steeply from 22 to 9 per cent in 2016, as **generation from coal more than halved from 76 TWh to 31 TWh**. Gas generation filled the gap, with its share of generation rising to 42 per cent in 2016, up from 29 per cent in 2015, as generation increased 44 per cent to 143 TWh. (Table 5.6)

- **Renewables' share of generation was stable at 24.5 per cent in 2016**, the same as in 2015. Increased renewables generation capacity was balanced by less favourable weather conditions for solar and wind generation. (Table 6C, in chapter 6)

- **Low carbon electricity's share of generation increased slightly from 46.2 per cent to a record 46.5 per cent**. Nuclear generation was up 2.7 per cent compared to 2015, due to improved availability and fewer outages. (Table 5.6)

- Total electricity supply (including net imports) fell by 0.8 per cent to 357 TWh, as net imports fell by 3.4 TWh. (Tables 5.6 and 5.1). **The UK remained a net importer of electricity in 2016**, with net imports contributing 4.9 per cent of electricity supply. (Table 5.1)

- **Final consumption of electricity has been broadly the same since 2014**, at 304 TWh in 2016, remaining near its lowest level since 1995. (Table 5.1).

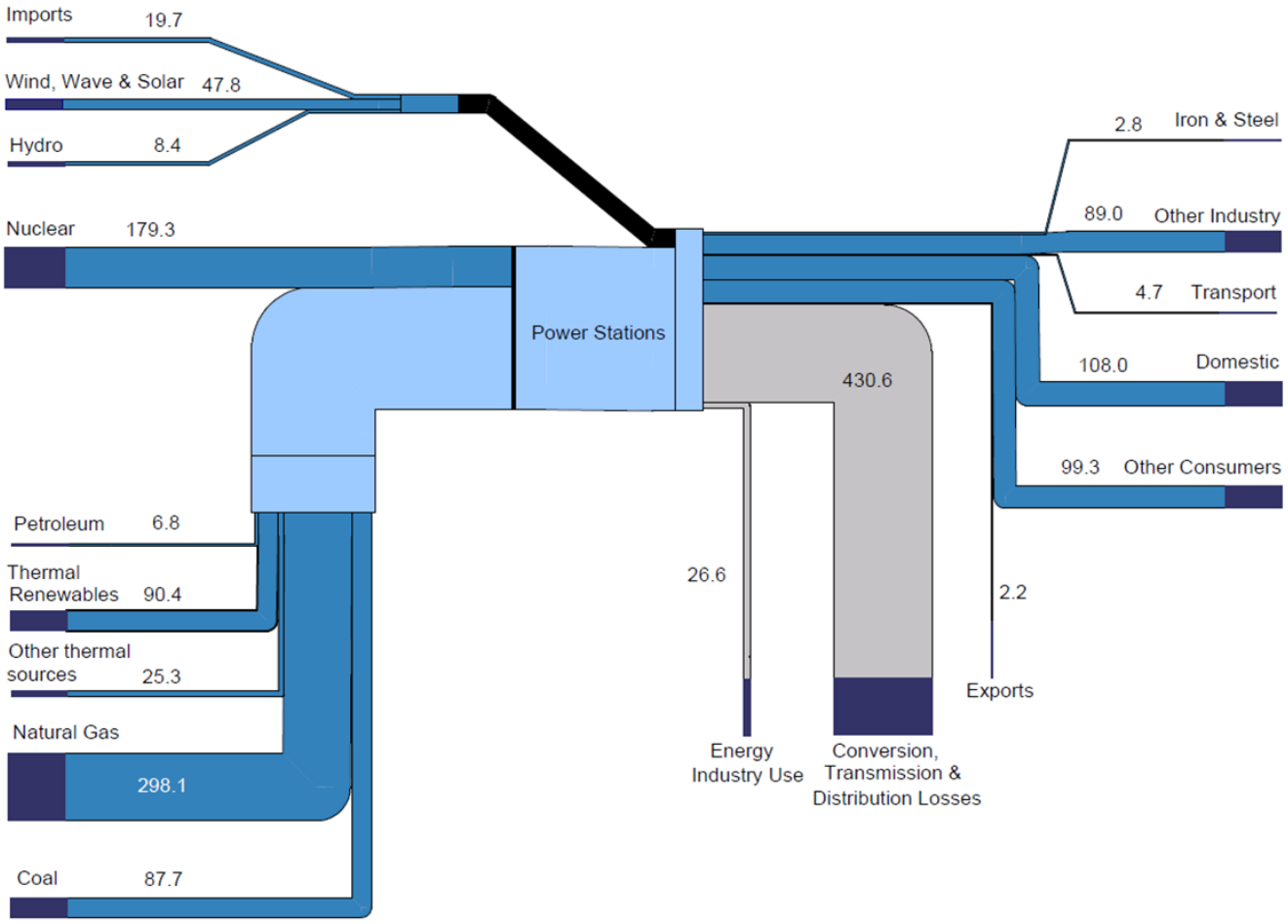
Introduction

5.1 This chapter presents statistics on electricity from generation through to sales, and includes statistics on generating capacity, fuel used for generation, load factors and efficiencies. It also includes a map showing the electricity network in the United Kingdom and the location of the main power stations as at the end of May 2017. A **full list** of tables is available at the end of the chapter.

5.2 **Electricity comprised 17.5 per cent of the UK's final energy consumption in 2016, down from 17.8 per cent in 2015** and 18.2 per cent in 2014; however, this was due to an increase in final consumption of petroleum products and natural gas. Final consumption of electricity remained stable at 304 TWh over the period.

5.3 Overleaf is an energy flow chart for 2016, showing the flows of electricity from fuel inputs through to consumption. It illustrates the flow of primary fuels used for the production of electricity through to the final use of the electricity produced or imported as well as the energy lost in conversion, transmission and distribution. The widths of the bands are proportional to the size of the flows they represent.

Electricity flow chart 2016 (TWh)

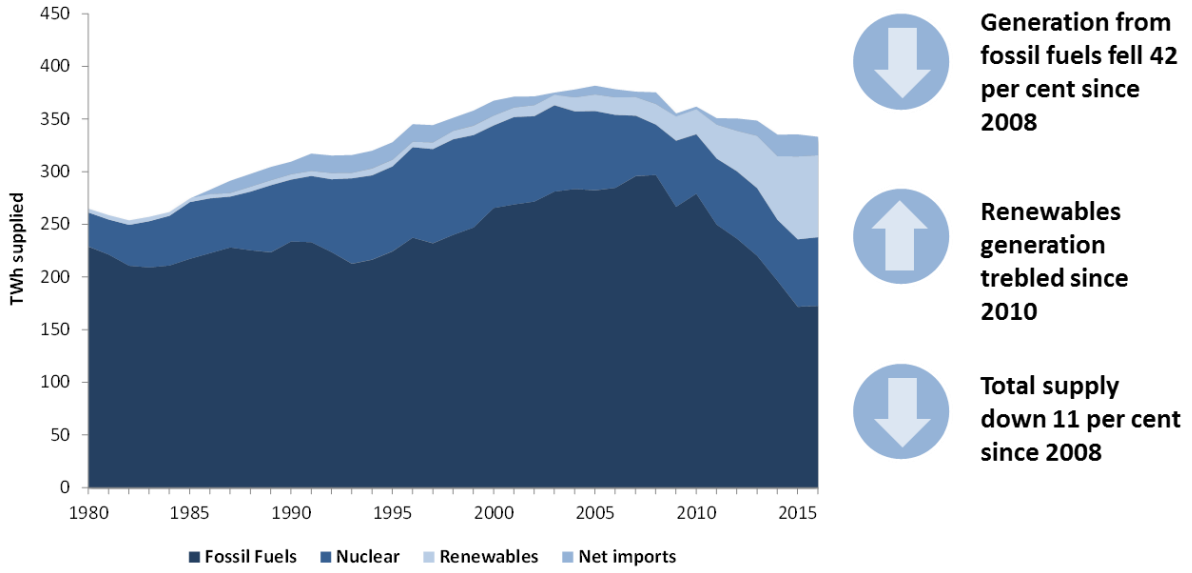


Notes: This flow chart is based on the data in Tables 5.1 (for imports, exports, use, losses and consumption) and 5.6 (fuel used).
1. Hydro includes generation from pumped storage while electricity used in pumping is included under Energy Industry Use.
2. Conversion, Transmission and Distribution Losses is calculated as fuel used (Table 5.6) minus generation (Table 5.6) plus losses (Table 5.1).

Electricity supply (Table 5.1)

5.4 **In 2016, the total UK electricity supply was 357 TWh, slightly lower than 360 TWh in 2015 (-0.8 per cent)**. Of this total supply, just over 95 per cent was home produced with 4.9 per cent from imports, net of exports. For electricity, supply is totally driven by demand – the impacts of improving energy efficiency and overall warmer temperatures have seen demand drop since 2005, with final consumption in broadly stable since 2014 and at its lowest level in a series since 1995 (see paragraph 5.38).

Chart 5.1: Electricity supply



5.5 In 2016, UK generation rose marginally by 0.1 per cent on 2015. Of the 336 TWh produced[1], 86 per cent was from major power producers and 14 per cent from other generators, while 37 per cent was from primary sources (including nuclear, wind, solar and hydro) and 63 per cent from secondary sources (including coal, gas, oil, bioenergy and non-bio waste).

5.6 **Net imports in 2016 were down by 16 per cent to 18 TWh compared to the record 21 TWh in 2015**. The UK has four interconnectors allowing trade with Europe: England-France (2 GW capacity), England-Netherlands (1 GW), Northern Ireland-Ireland (0.6 GW) and Wales-Ireland (0.5 GW). Table 5A below shows the UK's net imports via interconnectors during the past three years.

Table 5A: Net Imports via interconnectors 2014 to 2016

GWh

	France - UK[1]	Ireland - N. Ireland[2]	Netherlands - UK[1]	Ireland - Wales[1]	Total
2014	14,951	121	7,856	-2,408	20,520
2015	13,838	167	7,999	-1,065	20,938
2016	9,728	199	7,306	313	17,546

1. Figures taken from the demand data available on the National Grid website at www2.nationalgrid.com/UK/Industry-information/Electricity-transmission-operational-data/Data-Explorer/.

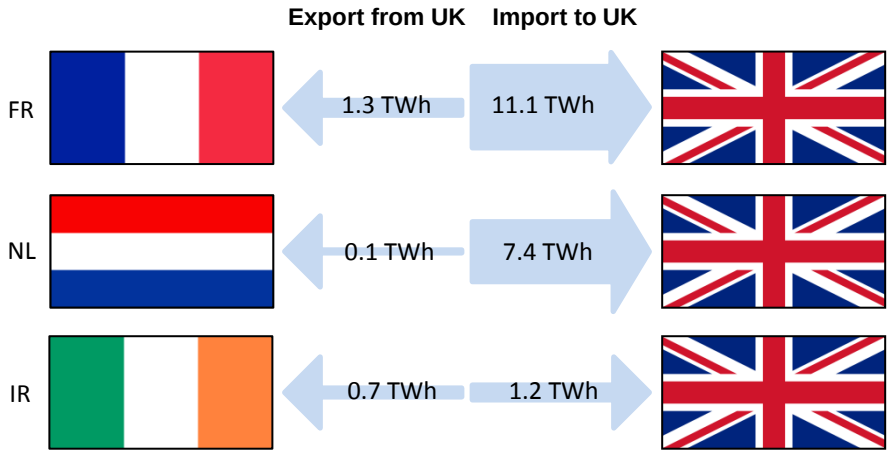
2. Figures taken from data available on the SEMO website at www.semo.com/marketdata/pages/energysettlement.aspx.

5.7 **Imports fell by 13 per cent whilst exports increased 21 per cent as nuclear outages in France increased export demand**. The France-UK interconnector was damaged by a ship's anchor in November 2016 which halved its capacity for the rest of the year. Utilisation of the interconnector

[1] Excluding pumped storage production.

fell from 81 per cent in 2015 to 71 per cent in 2016 and net imports from France fell 30 per cent over the same period.

Chart 5.2: Electricity imports and exports in 2016



5.8 Net imports from the Netherlands were down 8.7 per cent, with utilisation of the interconnector down from 91 per cent in 2015 to 87 per cent in 2016. The UK was a net importer from the Republic of Ireland for the first time since the Ireland-Wales interconnector opened in 2012, with a 0.9 TWh net export in 2015 switching to a 0.5 TWh net import in 2016, due to reduced availability from France.

Electricity distributed via the public distribution system and for other generators (Table 5.2)

5.9 The majority of electricity in the United Kingdom is supplied by the public distribution system (PDS), the interconnected high voltage transmission network and lower voltage distribution network. **In 2016, 93 per cent of UK electricity was supplied by the PDS.** The remainder was provided by other generators (largely autogeneration and generation from renewable sources). Major power producers[2] (MPPs) provide the majority of power to the PDS, with the remainder made up of transfers from other generators which can sell surplus electricity into the PDS, as well as net imports.

5.10 **Since 2009 the proportion of electricity supplied by the public distribution system has slowly declined**, from 95.2 per cent in 2009 to 92.8 per cent in 2016. This was due to an increase in autogeneration and local generation, including a rise in small scale renewables. Of the electricity supplied by other generators, 44 per cent (21 TWh) was transferred to the public distribution system in 2016. This proportion has been broadly flat since 2014.

5.11 In 2016, 6.4 per cent of final consumption of electricity was by other generators and did not pass over the public distribution system. This was up from 5.7 per cent in 2015 and a further increase on the 5.1 per cent in 2014. A substantial proportion of electricity used in the energy industries is self-generated (around 24 per cent in 2016). At petroleum refineries the proportion is even higher; in this sector 72 per cent of electricity consumed in 2016 was self-generated.

5.12 Autogenerators produce electricity as part of their manufacturing or other commercial activities, principally for their own use. **In 2016, 10.8 per cent of the industrial demand for electricity was met by autogeneration, an increase of 1.6 percentage points on the previous year**. Table 5.4 shows the fuels used by autogenerators to generate this electricity within each major sector and also the quantities of electricity generated and consumed

2 *Further information on the definitions of other generators and MPPs can be found in paragraph 5.62.*

5.13 Of the electricity consumed by the domestic sector in 2016, 19 per cent was reported as being purchased under some form of off-peak pricing structure (e.g. Economy 7), down slightly from 20 per cent in 2015. 16 per cent of consumption was through prepayment systems, stable since 2011.

5.14 Domestic electricity generation by households with micro-generation units (such as solar photovoltaic panels) increased sharply since the Feed in Tariff (FiT) scheme was launched in April 2010 in Great Britain (see paragraph 6.61 for further information on FiTs uptake). **In 2016, consumption of self-produced electricity by the domestic sector increased by 20 per cent on 2015**, to 1,356 GWh, which was more than fifty times the 23 GWh consumed in 2010. However, **self-produced electricity still accounts for only 1.3 per cent of domestic consumption**.

Combined Heat and Power (CHP) plants

5.15 Combined Heat and Power (CHP) is the simultaneous generation of useable heat and power in a single process, and is frequently referred to as cogeneration. A large proportion of CHP schemes in the UK are covered by the CHPQA programme and are covered in detail in Chapter 7, along with background information. Table 5B shows how much CHP capacity and generation is covered in Chapter 7 using statistics sourced from the CHPQA programme compared to other CHP plants not covered by the scheme.

Table 5B: Combined Heat and Power (CHP) electricity generation and capacity in 2016, compared to UK generation and capacity

		Generation (GWh)	**Capacity** (MW)
Major Power Producers (Thermal)	CHPQA (ch 7)	6,469	1,990
	CHP (not included in ch 7)	18,310	2,298
	Other thermal generation	228,504	54,030
	Total MPP thermal generation	253,284	58,318
Autogenerators (Thermal)	CHPQA (ch 7)	13,600	3,581
	CHP (not included in ch7)	5,391	452
	Other thermal generation	10,980	2,581
	Total thermal autogeneration	29,972	6,614
Wind, solar & hydro (MPP and autogenerators)		53,182	13,348
Total		**336,438**	**78,279**

5.16 In 2016, CHP comprised 9.8 per cent of MPP's thermal electricity generation, and 63 per cent of thermal autogeneration.

Electricity fuel use, generation and supply (Tables 5.3 & 5.6)

5.17 **Whilst generation was stable, fuel used in 2016 fell 6.2 per cent**, as the generation mix shifted from coal to the more thermally efficient gas-fired stations, from 68 million tonnes of oil equivalent (mtoe) to 64 mtoe. Coal use dropped 62 per cent to 7 mtoe and gas use rose 39 per cent to 25 mtoe (Table 5.3).

5.18 Including 3 TWh of pumped storage, the **United Kingdom generated 339 TWh of electricity in 2016**. UK generation has been flat since 2014. Major power producers (MPPs, companies whose main business is generating electricity as defined in paragraph 5.63) accounted for 86 per cent of generation with the remaining 14 per cent supplied by other generators, including autogenerators. Generation by MPPs was down 1.0 per cent in 2016 compared to the previous year, while generation by other generators was 8 per cent up over the same period, from 43 TWh to 46 TWh (Table 5.6).

5.19 2016 saw a big shift in the mix of fuels for electricity generation as coal was replaced by gas. **Coal-fired electricity generation more than halved** (-60 per cent) compared to 2015, falling by 45 TWh to 31 TWh. **Gas generation increased by 43 TWh** to 143 TWh (+44 per cent) in 2016 compared to the previous year. The main driver for the switch was an increase in the carbon price floor in April 2015, from £9 per tonne of CO_2 to £18 per tonne of CO_2. Since coal generation produces more than double the carbon dioxide per GWh of electricity supplied compared to gas, this made generation from coal more expensive than gas. Therefore the coal-fired plants tended to reserve generation for periods of highest demand. Additionally, two large coal power plants closed in March 2016, reducing coal-fired capacity.

5.20 Nuclear generation rose 2 per cent from 70 TWh to 72 TWh in 2016 as nuclear plants had fewer planned and unplanned outages than in 2015.

5.21 **Renewable generation[3], including wind, solar and biomass, was stable** compared to the previous year, at 83 TWh in 2016. Less favourable weather conditions for hydro, wind and solar (lower wind speeds, reduced rainfall and fewer sun hours compared to 2015's record year) were mitigated by the addition of new generation sites which increased overall wind and solar capacity. Overall wind and solar generation[4] remained constant at 48 TWh. Natural flow hydro generation fell by 14 per cent, from the record 6.3 TWh in 2015 to 5.4 TWh in 2016 due to lower rainfall levels in the catchment areas. Over the same period, **generation from bio-energy (including biodegradable wastes) rose 3 per cent to 30 TWh**, due to the conversion of third unit at Drax from coal to high-range co-firing (85% to <100% biomass) during 2015[5]. More information on renewable electricity can be found in Chapter 6.

5.22 Not all electricity produced by generators is available for use as plants require a portion for their own works. Deducting stations' own use, in 2016 gross electricity supplied was 324 TWh, 0.6 per cent higher than in 2015 (Table 5.6).

5.23 Chart 5.3 shows the share of 2016 generation by fuel, on an output basis (i.e. the percentage of electricity generated by the fuel), compared with 2015. Further information on this and the alternative input basis of comparing fuel use can be found in paragraph 5.71.

5.24 Shares of generation shifted significantly from coal to gas. Coal's share fell 13 percentage points from 22 per cent in 2015 to 9 per cent in 2016. The share was taken by gas which rose 13 percentage points from 29 per cent to 42 percent. Renewables' share of generation was broadly stable at 24.5 per cent, close to 2015's record high of 24.6 per cent, as increased capacity mitigated the less favourable weather conditions. Nuclear's share was stable at 21 per cent.

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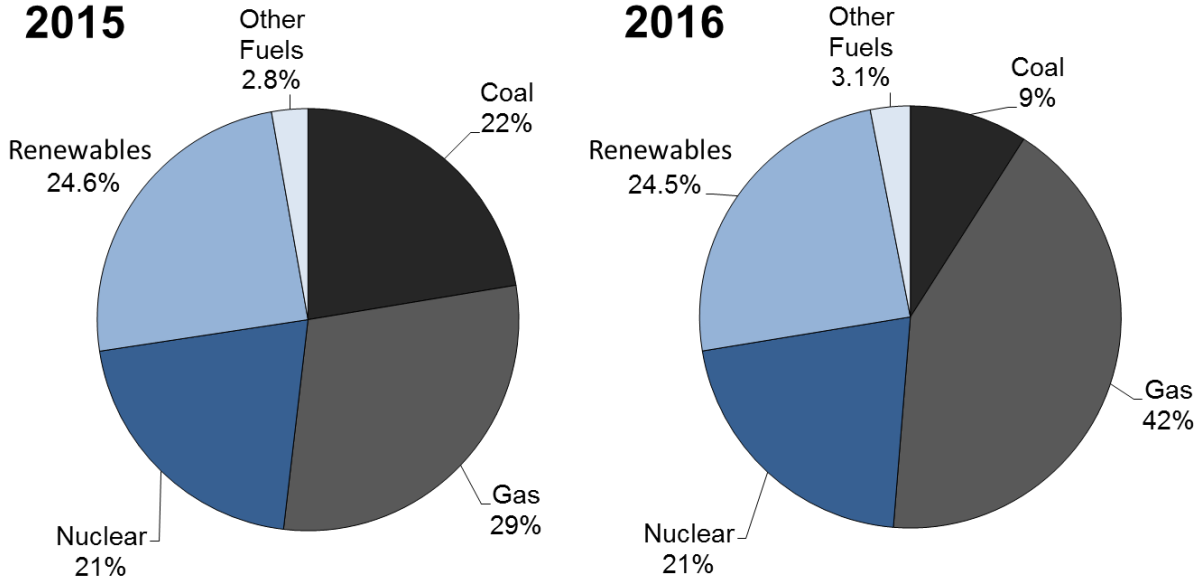
3 Renewables includes wind, natural flow hydro, solar, wave, tidal and bioenergy (including co-firing).

4 Including generation from wave and tidal.

5 For consistency with the Renewables chapter (Chapter 6), non-biodegradable wastes (previously included in thermal renewables / bio-energy) have been moved to the 'other fuels' category for 2007 onwards for autogeneration and for 2013 onwards for MPPs. Prior to this, they remain in thermal renewables.

Chart 5.3: Shares of electricity generation, by fuel



5.25 A historical series of fuel used in generation on a consistent, energy supplied, fuel input basis is available at Table 5.1.1 on the BEIS section of the GOV.UK website and accessible from the Digest of UK Energy Statistics home page: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Plant capacity (Tables 5.7, 5.8 and 5.9)

5.26 Electricity generation capacity is the maximum power available to the UK at any one time. Capacity is provided by Major Power Producers[6] (MPPs, companies whose main business is the generation of electricity) and other generators including non-MPP renewables. In this section, wind, small scale hydro and solar PV capacity is de-rated to account for intermittency, to enable direct comparison with conventional fuels which are less dependent on the weather (Table 5.7).

5.27 **In 2016, total capacity of all generators was 78,279 MW, down 3.4 per cent** from the 81,026 MW installed at the end of 2015. MPPs fell by 3,548 MW, from 71,928 MW to 68,380 MW. This was mostly due to the closure of two coal-fired power plants - Ferrybridge C (in Yorkshire) and Longannet (in Scotland). Some of this reduction in capacity was offset by the increase in wind and solar capacity (de-rated, see paragraph 5.77). Wind capacity increased by 818 MW and solar capacity by 402 MW in 2016. The past six years have seen the closure, capacity reduction, full/partial mothballing or conversion to biomass of several large power stations. These are summarised in table 5C below.

[6] *From 2006 onwards, MPP capacities are measured in Transmission Entry Capacity (TEC) terms, rather than Declared Net Capacity (DNC). The effect of this change has been to increase the capacity of MPPs by about 2,000 MW in total. A full definition of TEC and DNC is given in paragraph 5.76. Wind, small scale hydro, and solar photovoltaic DNC is de-rated to take into account intermittency. Renewables installed capacity figures are given in table 6.4.*

Table 5C: Major Power Producers capacity closed, converted or reduced (as at end of May 2017), since end-2010

Site	Fuel	Status	Previous Capacity (MW)	New Capacity (MW)	Year of closure, capacity reduction or conversion
Fife	CCGT	Closed	123	0	2011
Derwent	CCGT-CHP	Closed	228	0	2012
Shotton	CCGT-CHP	Closed	210	0	2012
Kingsnorth A	Coal/Oil	Closed	1,940	0	2012
Grain A	Oil	Closed	1,300	0	2012
Oldbury	Nuclear [1]	Closed	434	0	2012
Wylfa (Reactor 1)	Nuclear [2]	Partially Closed	980	490	2012
Keadby	CCGT	Mothballed	749	0	2013
Kings Lynn	CCGT	Mothballed	340	0	2013
Roosecote	CCGT	Mothballed	229	0	2013
Cockenzie	Coal	Closed	1,152	0	2013
Drax	Coal [3]	Partially Converted	3,870	3,225	2013
Drax	Biomass	Partially Converted	0	645	2013
Ironbridge	Coal [4]	Converted	940	360	2013
Tilbury B	Coal [5]	Closed	750	0	2013
Didcot A	Coal/Gas	Closed	1,958	0	2013
Fawley	Oil	Closed	1,036	0	2013
Teeside	OCGT [6]	Closed	45	0	2013
Ferrybridge C	Coal [7]	Partially Closed	1,960	980	2014
Drax	Coal [3]	Partially Converted	3,225	2,580	2014
Drax	Biomass	Partially Converted	645	1,290	2014
Uskmouth	Coal [8]	Mothballed	363	0	2014
Barking	CCGT	Closed	1,000	0	2014
Littlebrook D	Oil	Closed	1,370	0	2015
Drax	Coal [3]	Partially Converted	2,580	1,935	2015
Drax	Biomass	Partially Converted	1,290	1,935	2015
Ironbridge	Biomass	Closed	360	0	2015
Killingholme A	CCGT	SBR [9]	665	0	2015
Killingholme B	CCGT	SBR [9]	900	0	2015
Lynemouth	Coal	Mothballed	420	0	2015
Wylfa (Reactor 2)	Nuclear [2]	Closed	490	0	2015
Ferrybridge C	Coal [7]	Closed	980	0	2016
Longannet	Coal	Closed	2,260	0	2016

1. Reactor 2 with capacity of 217 MW closed on 30 June 2011, reactor 1 with capacity of 217 MW closed on 29 February 2012.

2. Reactor 1 closed on 30 April 2012, reactor 2 closed on 31 December 2015 (both with a capacity of 490 MW).

3. Partly converted to biomass. One unit (645 MW) converted to biomass in 2013, a second unit (also 645 MW) converted to biomass in 2014 and a third unit (also 645 MW) converted to high-range co-firing (85% to <100% biomass) in 2015. Overall capacity remains at 3,870 MW (coal 1,935 MW, biomass 1,935 MW).

4. Converted from coal to dedicated biomass in 2013 (at 900 MW), before reducing to 360 MW in April 2014.

5. Converted from coal at 1,063 MW capacity to dedicated biomass at 750 MW capacity in 2011 before closing in 2013.

6. Reduced capacity from 1,875 MW (CCGT 1,830 MW / OCGT 45 MW) to 45 MW (OCGT) in 2011 before closing in 2013.

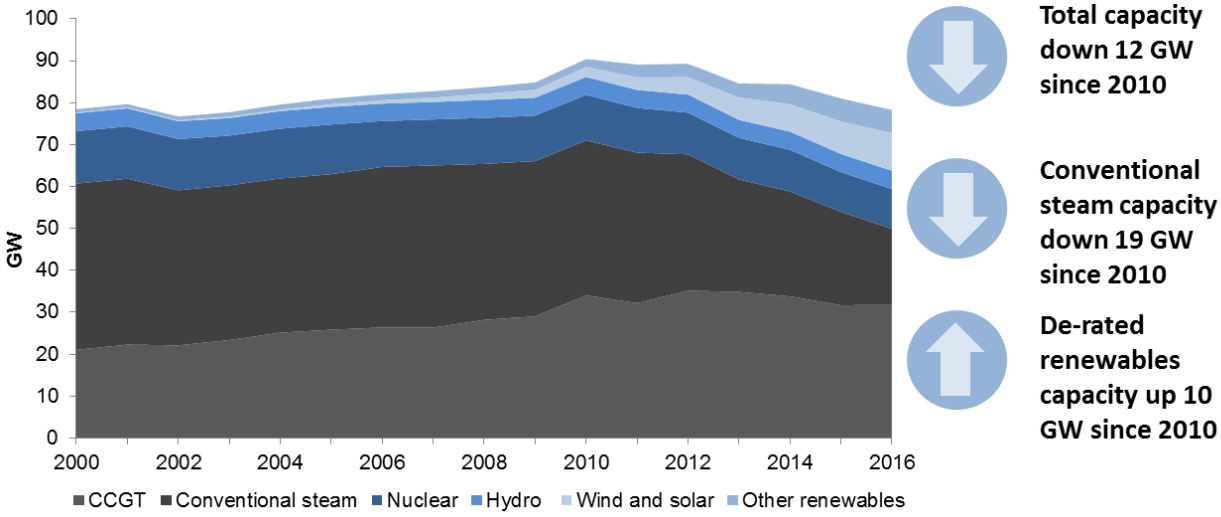
7. Two units (980 MW) closed in April 2014 and the second unit (980 MW) closed in March 2016.

8. One unit (120 MW) closed in April 2013, with the remaining two closing in April 2014. Two units reopened in March 2015, raising capacity to 230 MW.

9. Station placed on Supplemental Balancing Reserve – the station is closed but will be available in times of need, e.g. during winter periods when electricity demand is high.

5.28 Since 2010, Major Power Producers plant closures and an increase in renewable capacity saw the **MPP's proportion of total generating capacity steadily fall from 92 per cent in 2010 to 87 per cent in 2016**. The capacity of other generators increased correspondingly, from 8 per cent to 13 per cent over the period. From 2015 to 2016 the capacity of other generators rose by 801 MW (8.8 per cent), with a 502 MW increase in capacity from renewables other than hydro and wind, a 290 MW increase in capacity from solar[7] and a 218 MW increase in wind capacity. This was partially offset by a net 156 MW decrease in Combined Cycle Gas Turbine (CCGT) stations and a 73 MW decrease in conventional thermal steam. A breakdown of the capacity of all generating plants at the end of December each year from 2000 to 2016 is shown in Chart 5.4.

Chart 5.4: Generating capacity of all power producers 2000-2016



1. 'Conventional steam' includes a small proportion of non-CCGT plants, gas turbines and plants that can be fuelled by a combination of gas, coal and oil.
2. 'Hydro' includes natural flow and pumped storage.
3. 'Other renewables' includes biofuels.
4. Wind included from 2007

5.29 In 2016, 85 per cent of the generating capacity in the UK owned by MPPs was in England and Wales, 12 per cent was in Scotland and 3.7 per cent in Northern Ireland. Of the net decrease in UK MPP capacity of 3,548 MW between 2015 and 2016, there was a 1,529 MW fall in England and Wales and a 2,046 MW fall in Scotland. The capacity in Northern Ireland increased by 27 MW between 2015 and 2016 (Table 5.8).

5.30 Non-MPP generators include autogenerators, businesses that generate their own electricity and may export surplus to the grid, and microgeneration by the domestic and commercial sectors. In 2016, 71 per cent of capacity was in the commercial and domestic sectors, a 7.2 percentage points increase on a year earlier[8]. By industry, the oil and gas sector and chemicals sector had 9 and 7 per cent of capacity respectively, while engineering and other metal trades had a 1.7 per cent share. Paper, printing and publishing and food, drink and tobacco had a combined share of 9 per cent (Table 5.9).

5.31 In Table 5.9, data for the generating capacity for generators other than MPPs are shown according to the industrial classification of the generator. For CHP, schemes are classified according to the sector that receives the majority of the heat (as opposed to the sector in which the CHP operator was considered to operate).

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[7] Includes solar photovoltaic capacity installed under the Feed in Tariff (FiT) scheme. For further information on FiTs, see Chapter 6.

[8] The total capacity of 'Other Generators' fell in 2007 as, from this point, the capacity of major wind farm operators are included under MPPs (see paragraph 5.63). In 2008, Shotton CHP plant was re-classified as a MPP as the electricity generated is now exported to the grid rather than for use in the nearby paper mill. This change in classification led to a fall in capacity in the paper, printing and publishing sector.

Plant loads, demand and efficiency (Table 5.10)

5.32 The maximum load (demand) in the UK during the winter of 2016/2017[9] was 52,909 MW, which occurred on 26 January 2017, in the half-hour ending 18:00; this was 0.3 per cent higher than the previous winter's maximum (on 18 January 2016). This occurred at the time of maximum demand in Great Britain (51,169 MW); at this time, Northern Ireland had a load of 1,740 MW. In Northern Ireland, the maximum load occurred on 5 December 2016 at the period ending 17:30 (1,740 MW), which was 3.1 per cent above that of the previous winter.[10]

5.33 **Maximum demand in 2016/2017 was 77 per cent of the UK capacity of major power producers** (as shown in Table 5.7) as measured at the end of December 2016, a 4 percentage point increase on 2015/2016.

5.34 In Great Britain, maximum demand in 2016/2017 was 78 per cent of the England, Wales and Scotland capacity of MPPs (Table 5.8). For Northern Ireland, the proportion was 68 per cent (65 per cent in 2015/16). These percentages do not include the capacities available via the interconnectors with neighbouring grid systems nor demand for electricity via these interconnectors.

5.35 Plant load factors measure how intensively each type of plant has been used. The load factor of nuclear stations in 2016 at 78.4 per cent was 3.3 percentage points higher than in 2015, and the highest since 80.1 per cent in 1998 as there were fewer planned and unplanned nuclear station outages compared to the previous two years. The CCGT load factor increased to 48.8 per cent, up from 31.7 per cent in the previous year as gas generation replaced coal. The load factor for coal fired power stations fell from 39.3 per cent in 2015 to a record low of 16.5 per cent in 2016.

5.36 Load factors for natural flow hydro and wind (as well as other renewables) can be found in table 6.5[11]. Weather conditions were not as favourable as in 2015, with lower wind speeds and reduced sun hours. This saw the onshore wind load factor (on an unchanged configuration basis) fall from the record 29.4 per cent in 2015 to 24.2 per cent in 2016, and offshore wind load factor fall from 39.7 per cent to 36.7 per cent in 2016. **The overall wind load factor (on an unchanged configuration basis) was 28.8 per cent, down from the record 33.3 per cent in 2015.** Rainfall (in the main hydro areas) was also lower (20 per cent down in 2016 compared to 2015), leading to a decrease in the hydro load factor (on an unchanged configuration basis) of 5.5 percentage points, from 39.5 per cent to a 33.9 per cent in 2016[12]. Pumped storage use is less affected by the weather and the load factor trended downwards from 2008 to 2015, as lower peak time demand for electricity and lower prices deterred its use. In 2016, the load factor rose by 0.9 percentage points from 2015 to 12.3 per cent.

5.37 Thermal efficiency measures the efficiency with which the heat energy in fuel is converted into electrical energy. Generally, nuclear efficiency has remained between 38 and 40 per cent over the last decade, with a rise of 0.9 percentage points from 2015 to 40 per cent in 2016. The efficiencies presented here are calculated using **gross** calorific values to obtain the energy content of the fuel inputs[13].

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9 Maximum demand figures cover the winter period ending the following March. With the advent of the British Electricity Trading and Transmission Arrangements (BETTA) (see paragraph 5.53), England, Wales and Scotland are covered by a single network and a single maximum load is shown for Great Britain for 2006 to 2016.

10 In Great Britain the highest ever load met was 60,118 MW on 10 December 2002.

11 The load factors presented in table 5.10 use transmission entry capacity (as presented in table 5.7). For hydro and wind, this has been de-rated for intermittency, so is not suitable for calculating load factors. The installed capacity measure used in Chapter 6 has not been de-rated.

12 For renewables load factors, including the unchanged configuration and standard (average beginning and end of year) measures, see table 6.5

13 For more information on gross and net calorific values, see paragraph 5.79.

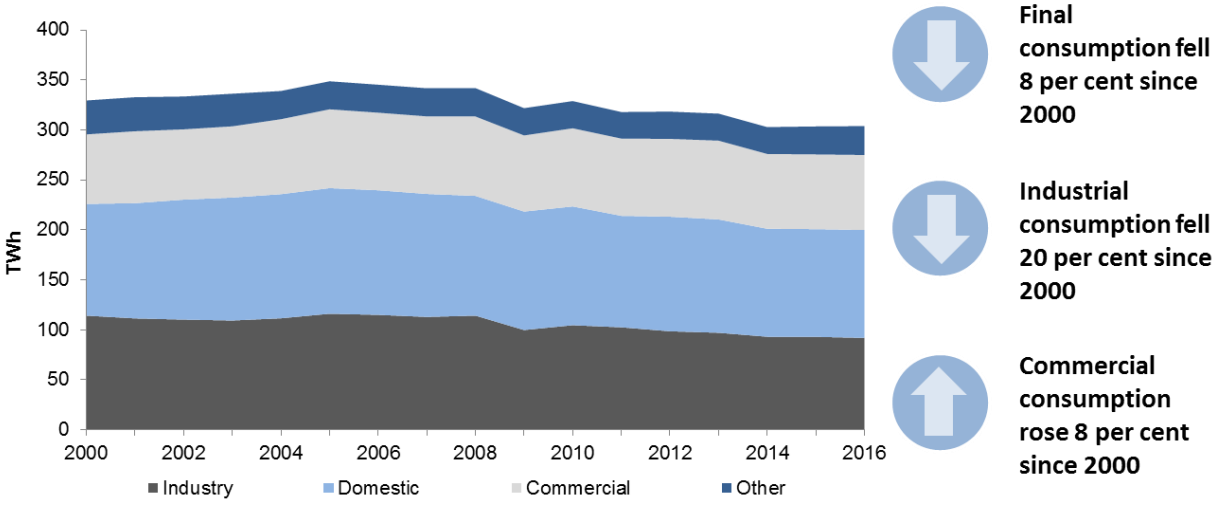
Electricity demand and consumption (Table 5.1)

5.38 **Overall electricity demand fell by only 0.5 per cent**, from 359 TWh in 2015 to 357 TWh in 2016. Of total demand, 27 TWh (7.5 per cent) was used within the energy industry; 26 TWh (7.4 per cent) was accounted for by losses, and 304 TWh (85 per cent) was final consumption, which was broadly similar to 2014 and 2015 and remaining near its lowest level in a series since 1995 . Electricity demand broadly equals supply, although for a number of reasons there is a small difference which is termed the statistical difference[14].

5.39 Temperatures influence the actual level of consumption, especially in the winter months, as customers adjust heating levels in their homes and businesses. The average temperature for the winter months (covering December to February) in 2015-16 was 1.9 degrees warmer than the same period a year earlier as December 2015 was unusually warm. In 2016, the daily average temperature was similar to 2015 while the average temperature during the first six months of 2016 was 0.3 degrees warmer than in 2015.

5.40 **The average temperature in 2016 was similar to the previous year and domestic consumption was also broadly stable at 108 TWh** (+0.2 per cent rise). Domestic consumption has generally declined each year from its peak of 126 TWh in 2005, on account of milder winters and continuing energy efficiency improvements. Commercial sector consumption in 2016 rose by 0.4 per cent, to 75 TWh. Agriculture consumption rose by 7.4 per cent, while public administration consumption rose by 2.4 per cent.

Chart 5.5: Final consumption of electricity by major sector, 2000-2016



5.41 I**ndustrial consumption has fallen 20 per cent since 2000. The trend continued in 2016 with a slight decrease of 1.2 per cent compared to 2015**, from 92.9 TWh to 91.8 TWh. Iron and steel fell by 23 per cent as SSI steelworks at Redcar closed in mid-September 2015, while the other sectors across the industrial sector fell by 0.3 per cent.

5.42 **Consumption in the transport sector rose by 3.4 per cent in 2016**, to 4.7 TWh. Of this total electricity consumption in the transport sector, 97 per cent came from rail with the rest from road which increased by 33 per cent to 129 GWh in 2016 as the number of electric vehicles increased from 29,000 to 39,000[15]. The number of electric vehicles has nearly doubled since 2014.

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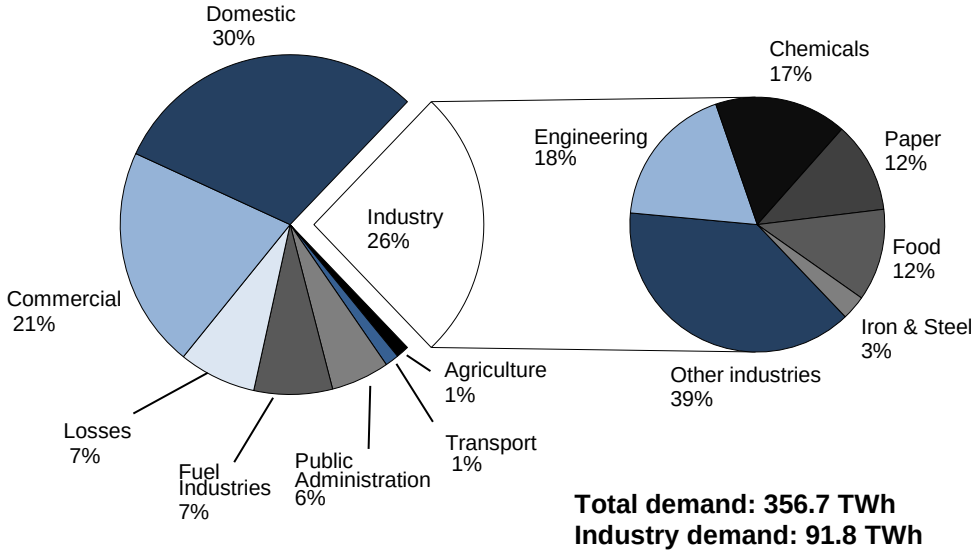
[14] *Further explanations of the statistical difference can be found in paragraph 5.87 and in paragraph A.19 of DUKES annex A.*

[15] *Road use is based on data from the Department for Transport on the number of electric cars (table VEH0203, available at www.gov.uk/government/statistical-data-sets/veh02-licensed-cars) and the number of light goods vehicles (table VEH0403, available at www.gov.uk/government/statistical-data-sets/veh04-licensed-light-goods-vehicles).*

5.43 Industrial consumption accounted for 26 per cent of total demand for electricity, less than the share of consumption by households (30 per cent), with transport and the services sector accounting for 29 per cent. Within the industrial sector, the three largest specified consuming industries are chemicals, food and paper, which together account for 40 per cent of industrial consumption. Taken together, the engineering industries and vehicles accounted for a further 18 per cent of industrial consumption of electricity. The iron and steel sector is also a substantial user of electricity but part of its consumption is included against blast furnaces and coke ovens under energy industry uses. A note on the estimates included within these figures can be found in paragraphs 5.83 to 5.86. Chart 5.6 shows the total demand for electricity in 2016, by final consumer.

Chart 5.6: Electricity demand by sector 2016



Consumption by the energy industries fell by 4.5 per cent. The bulk of the drop was due to a 8.3 per cent reduction in the amount of electricity used in generation, which accounted for 57 per cent of the energy industries' total use of electricity in 2016. The coal extraction and manufacture and blast furnace industries also saw falls, of 11.6 per cent and 39 per cent respectively, reflecting the decline in production in the steel and coke industries. Additionally, 15 per cent of energy industry use is accounted for by pumping at pumped storage stations (see 'pumped storage' line in Table 5.1), while petroleum refineries are also significant consumers with 17 per cent of energy industry use. Energy industry use as a proportion of total demand was 7.5 per cent in 2016.

5.44 Losses as a proportion of electricity demand in 2016, at 7.4 per cent, were down by 0.2 percentage points on 2015 (7.6 per cent). Losses comprise three components[16]:

- transmission losses (7.4 TWh) from the high voltage transmission system, which represented about 28 per cent of the losses figure in 2016;
- distribution losses (19 TWh), which occur between the gateways to the public supply system's network and the customers' meters, and accounted for about 72 per cent of losses; and
- theft or meter fraud (just under 1.0 TWh, around 4 per cent).

16 *See paragraph 5.75 for further information on the calculation of losses.*

Power stations in the United Kingdom (Tables 5.11 and 5.12)

5.45 **The total installed capacity of major UK power stations was 79,815 MW**[17] at the end of May 2017. Table 5.11 is a database of UK capacity with details of these Major Power Producers (MPPs) as well as the four interconnectors allowing trade with Europe, and an aggregate of other generating stations using renewable sources and smaller (<1 MW) Combined Heat and Power (CHP) plants.

5.46 Table 7.10 shows CHP schemes of 1 MW and over for which the information is publicly available. Total power output of these stations is given (electricity plus heat), not just that which is classed as good quality CHP under the CHP Quality Assurance programme (CHPQA, see Chapter 7), since CHPQA information for individual sites is not publicly available.

5.47 Table 5.12 shows capacity of the transmission and distribution networks for Great Britain, Northern Ireland and the United Kingdom as a whole. Transmission network connected capacity for the UK as a whole has reduced each year since 2012 due to closures and conversions of coal, oil and gas plants. These closures have been slightly offset by the increase in renewables capacity, in particular onshore wind which increased by 10 per cent in 2016.

5.48 **The capacity of the distribution network has increased each year since 2011** for Great Britain and Northern Ireland, with capacity in 2016 in each around double that of 2011, driven by increasing quantities of embedded solar and wind. In 2016, distribution-connected capacity in Great Britain increased by 13 per cent (3.1 GW) on 2015, with 2.3 GW of this increase attributable to solar and 1.0 GW to wind. **In 2016, total installed capacity across all networks in the UK was 98.5 GW, up 2.1 per cent on 2015**. Of all capacity in Great Britain, 71 per cent was estimated to have been connected to the transmission network in 2016, and 68 per cent in Northern Ireland. This was down from 74 per cent and 72 per cent respectively, in 2015.

Carbon dioxide emissions from power stations

5.49 **It is estimated that carbon dioxide emissions from power stations accounted for 21 per cent of the UK's total carbon dioxide emissions in 2016**. Emissions vary by type of fuel used to generate the electricity and emissions estimates for all electricity generation for 2014 to 2016 are shown in Table 5D below.

Table 5D: Estimated carbon dioxide emissions from electricity supplied 2014 to 2016 [1,2]

Fuel	Emissions (tonnes of carbon dioxide per GWh electricity supplied)		
	2014	2015	2016[3]
Coal	903	905	925
Gas	386	382	359
All fossil fuels	651	623	477
All fuels (including nuclear and renewables)	399	334	254

1. The carbon intensity figures presented in Table 5D are different to those produced for the Greenhouse Gas Inventory (GHGI). The differences arise due to slightly differing methodologies, including geographical coverage and treatment of autogenerators but principally because the GHGI presents figures based on a 5-year rolling average whereas those in Table 5D are presented as single year figures.

2. The numerator includes emissions from power stations, with an estimate added for auto-generation. The denominator (electricity supplied by all generators) used in these calculations can be found in table 5.6, with the figure for All fuels in 2016 being 320,110 GWh.

3. The 2016 emissions figures are provisional.

5.50 The emissions per GWh electricity supplied from coal increased in 2016 due to the drop in coal generation. Shorter cyles of operation can reduce emissions efficiency for coal plants.

[17] *The total installed capacity for stations listed in table 5.11 differs from the total in table 5.7, as the latter is on a Transmission Entry Capacity basis, and taken as at the end of 2016. See paragraph 5.76 for more information on the measures of capacity.*

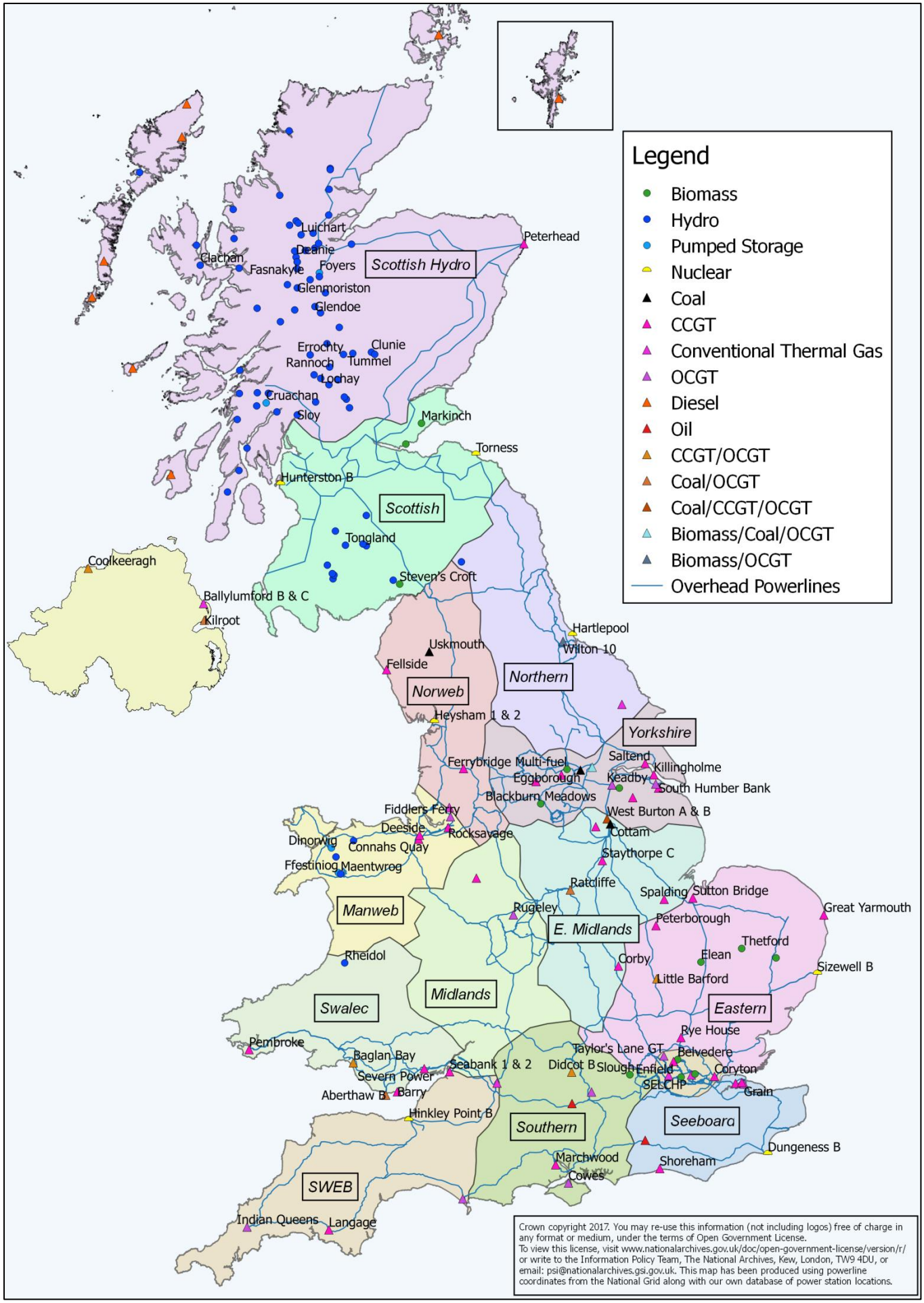
Sub-national electricity data

5.51 The collection of data relating to regional and local consumption of electricity began in 2004. For details of the availability of local level electricity (and gas) data see Chapter 4, paragraph 4.17 and the sub-national electricity statistics pages on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/sub-national-electricity-consumption-data. Data repeated here in previous editions of this publication as Table 5E are available via that link. The regional data will not sum exactly to the figures given in table 5.4 as the regional data are not based exactly on a calendar year and are obtained via different data sources.

Electricity price and market penetration

5.52 Electricity price and market penetration data are published by BEIS in the Quarterly Energy Prices publication, available at www.gov.uk/government/statistical-data-sets/quarterly-domestic-energy-price-statistics. Data on Domestic electricity market penetration, repeated here in previous editions of this publication as Table 5F, are available in table 2.4.1 of Quarterly Energy Prices.

Major Power Producers in the UK (operational May 2017)



List of DUKES electricity tables

Table	Description	Period
5.1	Commodity balances for UK electricity	1998-2016
5.2	Commodity balances for electricity (separates out the *public* distribution system for electricity from the electricity generated and consumed by *autogenerators*)	1998-2016
5.3	Fuels used to generate electricity in the UK (by MPP/other and fuel)	1996-2016
5.4	Fuels consumed for electricity generation (autogeneration) by main industrial groups	1996-2016
5.5	Electricity supply, consumption and sales (links between DUKES tables and long term trends data)	1996-2016
5.6	Electricity fuel use, generation and supply (by MPP/other and fuel type)	1996-2016
5.7	Plant capacity (MPPs, other and all, by type)	1996-2016
5.8	Major Power Producers Plant capacity (by region & type)	1999-2016
5.9	Capacity of other generators (by sector)	1996-2016
5.10	Plant loads, demand and efficiency	1996-2016
5.11	List of major power producers (power stations) in operation	May 2017
5.12	Plant installed capacity, by connection (GB, NI, by plant type)	2011-2016
5A	Net imports via interconnectors	2014-2016
5B	Major Power Producers Capacity closed, converted or reduced	2010-2016
5C	Combined Heat & Power (CHP) generation & capacity (see chapter 7 for more)	2016
5D	Estimated carbon dioxide emissions by electricity supplied	2014-2016
	Long term trends commentary and tables on fuel use, generation, supply and consumption back to 1970 can be found on BEIS section of the GOV.UK website, at: www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes	1970-2016

Structure of the UK electricity industry

5.53 Up to March 2005 the electricity industries of Scotland, Northern Ireland and England and Wales operated independently although interconnectors joined all three grid systems together. From April 2005, under the British Electricity Trading and Transmission Arrangements (BETTA) introduced in the Energy Act 2004, the electricity systems of England and Wales and Scotland have been integrated. The paragraphs below describe the position up to March 2005 but indicate the further changes that have been made under BETTA.

5.54 From the period immediately after privatisation of the industry in 1990, when there were seven generating companies in England and Wales and 12 Regional Electricity Companies distributing and supplying electricity to customers in their designated area, there were many structural and business changes and residual flotations. Competition developed in mainland Britain as follows:

(a) From 1 April 1990, customers with peak loads of more than 1 MW (about 45 per cent of the non-domestic market) were able to choose their supplier;

(b) From 1 April 1994, customers with peak loads of more than 100 kW were able to choose their supplier;

(c) Between September 1998 and May 1999, the remaining part of the electricity market (i.e. below 100 kW peak load) was opened up to competition. Paragraph 5.52 and Table 5E give more details of the opening up of the domestic gas and electricity markets to competition.

5.55 Since the late 1990s, there have been commercial moves toward vertical re-integration between generating, electricity distribution and/or electricity supply businesses. Those mergers that have taken place were approved by the relevant competition authority. Initially the National Grid Company was owned by the 12 privatised regional electricity companies, but was floated on the Stock Exchange in 1995. National Grid (and its predecessors since 1990) has owned and operated the high voltage

transmission system in England and Wales linking generators to distributors and some large customers. The transmission system is linked to continental Europe via an interconnector to France under the English Channel, and since 1 April 2011, to the Netherlands under the North Sea (see Table 5.10). Up to March 2005, the Scottish transmission system was regarded as being linked to that in England and Wales by two interconnectors but under BETTA National Grid also took on responsibility for operating the system in Scotland, to form a single Great Britain transmission network.

5.56 In Scotland, until the end of March 2005, the two main companies, Scottish Power and Scottish and Southern Energy, covered the full range of electricity provision. They operated generation, transmission, distribution and supply businesses. In addition, there were a number of small independent hydro stations and some independent generators operating fossil-fuelled stations, which sold their output to Scottish Power and Scottish and Southern Energy.

5.57 The electricity supply industry in Northern Ireland has been in private ownership since 1993 with Northern Ireland Electricity plc (NIE) (part of the Viridian Group) responsible for power procurement, transmission, distribution and supply in the Province. Generation is provided by three private sector companies who own the four major power stations. In December 2001, the link between Northern Ireland's grid and that of Scotland was inaugurated. A link between the Northern Ireland grid and that of the Irish Republic was re-established in 1996, along which electricity is both imported and exported. However, on 1 November 2007 the two grids were fully integrated and a joint body SEMO (Single Electricity Market Operator) was set up by SONI (System Operator for Northern Ireland) and Eirgrid from the Republic to oversee the new single market. In July 2012, an interconnector between the Irish Republic and Wales began operations.

5.58 In March 2001, the means of trading electricity changed with the introduction in England and Wales of the New Electricity Trading Arrangements (NETA). This replaced the Electricity Pool of England and Wales. These arrangements were based on bi-lateral trading between generators, suppliers, traders and customers. They were designed to be more efficient and provide greater choice for market participants, whilst maintaining the operation of a secure and reliable electricity system. The system included forwards and futures markets, a balancing mechanism to enable National Grid, as system operator, to balance the system, and a settlement process. In April 2005 this system was extended to Scotland under BETTA.

Technical notes and definitions

5.59 These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1. For notes on the commodity balances and definitions of the terms used in the row headings see Annex A, paragraphs A.7 to A.42. While the data in the PDF copy of this Digest cover only the most recent five years, these notes also cover data for earlier years that are available on the BEIS energy statistics web site.

Electricity generation from renewable sources

5.60 Figures on electricity generation from renewable energy sources are included in the tables in this section. Further detailed information on renewable energy sources is included in Chapter 6.

Combined heat and power

5.61 Electricity generated from combined heat and power (CHP) schemes, CHP generating capacities and fuel used for electricity generation are included in the tables in this chapter. However, more detailed analyses of CHP schemes are set out in Chapter 7.

Generating companies

5.62 Following the restructuring of the electricity supply industry in 1990, the term "Major generating companies" was introduced into the electricity tables to describe the activities of the former nationalised industries and distinguish them from those of autogenerators and new independent companies set up to generate electricity. The activities of the autogenerators and the independent companies were classified under the heading "Other generating companies". In the 1994 Digest, a new terminology was adopted to encompass the new independent producers, who were then

beginning to make a significant contribution to electricity supply. Under this terminology, all companies whose prime purpose is the generation of electricity are included under the heading "Major power producers" (or MPPs). The term "Other generators" ("Autogenerators" in the balance tables) is restricted to companies who produce electricity as part of their manufacturing or other commercial activities, but whose main business is not electricity generation. "Other generators" also covers generation by energy services companies at power stations on an industrial or commercial site where the main purpose is the supply of electricity to that site, even if the energy service company is a subsidiary of a MPP. Additionally (and particularly since 2010), this category includes generation from the domestic sector.

5.63 The definition of MPPs was amended in 2008 to include major wind farm companies, but this change only applies to data for 2007 onwards. Most generators of electricity from renewable sources (apart from large scale hydro, large scale wind, large scale solar and some biofuels) are also included as "Other generators" because of their comparatively small size, even though their main activity is electricity generation.

5.64 Major wind farm operators have been included under MPPs, for 2007 onwards, in the monthly, quarterly, and annual tables of electricity statistics produced by BEIS. Until then, all generation using wind turbines was excluded from the MPP classification. This was because originally such generation was by small independent companies and collecting data on a monthly basis was prohibitively costly and unnecessarily burdensome on such companies. Similarly, major solar site operators have been included under MPPs for the first time in 2015.

5.65 Generation from wind has now become more concentrated in the hands of larger companies and BEIS has extended its system of monthly data collection to cover the largest wind power companies and, from 2015, solar. The intention is that, in future, any company whose wind generation capacity increases to above 50 MW will be asked to provide monthly data for generation from wind and thus be included in the list of MPPs.

5.66 The inclusion of major wind farm and solar site operators under MPPs affects the majority of the electricity tables in DUKES, with figures for MPPs and the public distribution system increased, and other generators reduced for 2007 onwards due to wind and from 2015 onwards due to solar.

5.67 **Major power producers at the end of 2016 were:**

AES Electric Ltd, British Energy plc, Carrington Power, Centrica, Coolkeeragh ESB Ltd, Corby Power Ltd, Drax Power Ltd, E.On UK, EDF Energy, Eggborough Power Ltd, ENGIE, Energy Power Resources, Ferrybridge Multifuel Energy Limited, Innogy Renewables UK Ltd, Intergen, LondonWaste Ltd, Magnox Ltd, Marchwood Power Ltd, MPF Operations Ltd, Px Ltd, Riverside Resources Recovery Ltd, RWE Npower Plc, Scottish and Southern Energy, Scottish Power, Seabank Power Ltd, Semcorp Utilities (UK) Ltd, SIMEC, SELCHP Ltd, Statkraft Energy Ltd, Third Energy Trading Ltd, Uniper UK Ltd, Viridor Waste Management, VPI Immingham LLP.

5.68 **Additionally, the following major wind farm companies are included**, beginning with data for 2007:

Beaufort Wind Ltd, CEP Wind 2 Ltd, Cumbria Wind, Dong Energy, E.On UK, Ecotricity, Eneco Wind UK Limited, Engie, Falck Renewables Wind Ltd, Fred Olsen, Greencoat UK Wind, Infinis, Peel Energy Ltd, REG Windpower Ltd, Renewable Energy Systems Ltd, RWE Innogy UK Ltd, Scottish and Southern Energy, Scottish Power, Statkraft Wind UK Ltd, Wind Prospect, Vattenfall Wind Power, XceCo Ltd.

5.69 **Additionally, the following major solar companies are included, beginning with data for 2016:**

Anesco, Beaufort Wind Ltd, British Solar Renewables, Cubico Sustainable Investments Limited, Ecotricity, Foresight Group, Greencoat Solar, Lark Energy, Lightsource, REG Blackrock, Rockfire Capital, Vattenfall Wind Power.

Types of station

5.70 The various types of station identified in the tables of this chapter are as follows:

Conventional steam stations are stations that generate electricity by burning fossil fuels to convert water into steam, which then powers steam turbines.

Nuclear stations are also steam stations but the heat needed to produce the steam comes from nuclear fission.

Gas turbines use pressurised combustion gases from fuel burned in one or more combustion chambers to turn a series of bladed fan wheels and rotate the shaft on which they are mounted. This then drives the generator. The fuel burnt is usually natural gas or gas oil.

Combined cycle gas turbine (CCGT) stations combine in the same plant gas turbines and steam turbines connected to one or more electrical generators. This enables electricity to be produced at higher efficiencies than is otherwise possible when either gas or steam turbines are used in isolation. The gas turbine (usually fuelled by natural gas or oil) produces mechanical power (to drive the generator) and waste heat. The hot exhaust gases (waste heat) are fed to a boiler, where steam is raised at pressure to drive a conventional steam turbine that is also connected to an electrical generator.

Natural flow hydro-electric stations use natural water flows to turn turbines.

Pumped storage hydro-electric stations use electricity to pump water into a high level reservoir. This water is then released to generate electricity at peak times. Where the reservoir is open, the stations also generate some natural flow electricity; this is included with natural flow generation. As electricity is used in the pumping process, pumped storage stations are net consumers of electricity.

Wind farms use wind flows to turn turbines.

Other stations include stations burning fuels such as landfill gas, sewage sludge, biomass and waste.

Electricity supplied – input and output basis

5.71 The energy supplied basis defines the primary input (in million tonnes of oil equivalent, Mtoe) needed to produce 1 TWh of hydro, wind, or imported electricity as:

$$\text{Electricity generated (TWh)} \times 0.085985$$

The primary input (in Mtoe) needed to produce 1 TWh of nuclear electricity is similarly

$$\frac{\text{Electricity generated (TWh)} \times 0.085985}{\text{Thermal efficiency of nuclear stations}}$$

5.72 Figures on fuel use for electricity generation can be compared in two ways. Table 5.3 illustrates one way by using the volumes of **fuel input** to power stations (after conversion of inputs to an oil equivalent basis), but this takes no account of how efficiently that fuel is converted into electricity. The fuel input basis is the most appropriate to use for analysis of the quantities of particular fuels used in electricity generation (e.g. to determine the additional amount of gas or other fuels required as coal use declines under tighter emissions restrictions). A second way uses the amount of electricity generated and supplied by each fuel. This **output** basis is appropriate for comparing how much, and what percentage, of electricity generation comes from a particular fuel. It is the most appropriate method to use to examine the dominance of any fuel and for diversity issues. Percentage shares based on fuel outputs reduce the contribution of coal and nuclear, and increase the contribution of gas (by three percentage points in 2016) compared with the fuel input basis. This is because of the higher conversion efficiency of gas.

Public distribution system

5.73 This comprises the grid systems in England and Wales, Scotland and Northern Ireland. In April 2005 the Scotland and England and Wales systems were combined into a single grid.

Sectors used for sales/consumption

5.74 The various sectors used for sales and consumption analyses are standardised across all chapters of the 2016 Digest. For definitions of the sectors see Chapter 1 paragraphs 1.57 to 1.61 and Annex A paragraphs A.31 to A.42.

Losses

5.75 The losses component of electricity demand are calculated as follows:

Transmission losses: electricity lost as a percentage of electricity entering the GB transmission system (as reported by National Grid); this is applied to the electricity available figure in DUKES 5.5 (337,656 GWh in 2016).

Distribution losses: electricity lost in distribution as a percentage of electricity entering the distribution system (as reported by the distribution network operators); this is applied to electricity available less transmission losses.

Theft: a fixed percentage of 0.3 per cent is assumed to be stolen from the distribution network. This is applied to electricity available less transmission losses.

Transmission Entry Capacity, Declared Net Capacity and Installed Capacity

5.76 Transmission Entry Capacity (TEC) is a Connection and Use of System Code term that defines a generator's maximum allowed export capacity onto the transmission system. In the generating capacity statistics of the 2007 Digest, it replaced Declared Net Capacity (DNC) as the basis of measurement of the capacity of Major Power Producers from 2006. DNC is the maximum power available for export from a power station on a continuous basis minus any power generated or imported by the station from the network to run its own plant. It represents the nominal maximum capability of a generating set to supply electricity to consumers. The maximum rated output of a generator (usually under specific conditions designated by the manufacturer) is referred to as its Installed Capacity. For the nuclear industry, the World Association of Nuclear Operators (WANO) recommends that capacity of its reactors is measured in terms of Reference Unit Power (RUP) and it is the RUP figure that is given as the installed capacity of nuclear stations.

5.77 DNC is used to measure the maximum power available from generating stations that use renewable resources. For wind and wave and small scale hydro a factor is applied to declared net capability to take account of the intermittent nature of the energy source (e.g. 0.43 for wind, 0.365 for small scale hydro and 0.17 for solar photovoltaics). Further information on this can be found in paragraph 6.119, and at: www.legislation.gov.uk/uksi/1990/264/made?view=plain

Load factors

5.78 The following definitions are used in Table 5.10:

Maximum load – This is twice the largest number of units supplied in any consecutive thirty minutes commencing or terminating at the hour.

Simultaneous maximum load met – The maximum load on the transmission network at any one time, net of demand met by generation connected to the distribution network. From 2005 (following the introduction of BETTA – see paragraph 5.53) it is measured by the sum of the maximum load met in Great Britain and the load met at the same time in Northern Ireland. Prior to 2005 it was measured by the sum of the maximum load met in England and Wales and the loads met at the same time by companies in other parts of the United Kingdom.

Plant load factor – The average hourly quantity of electricity supplied during the year, expressed as a percentage of the average output capability at the beginning and the end of year.

System load factor – The average hourly quantity of electricity available during the year expressed as a percentage of the maximum demand nearest the end of the year or early the following year.

Thermal efficiency

5.79 Thermal efficiency is the efficiency with which heat energy contained in fuel is converted into electrical energy. It is calculated for fossil fuel burning stations by expressing electricity generated as a percentage of the total energy content of the fuel consumed (based on average gross calorific values). For nuclear stations it is calculated using the quantity of heat released as a result of fission of the nuclear fuel inside the reactor. The efficiency of CHP systems is illustrated in Chapter 7, Table 7D. Efficiencies based on gross calorific value of the fuel (sometimes referred to as higher heating values or HHV) are lower than the efficiencies based on net calorific value (or lower heating value LHV). The difference between HHV and LHV is due to the energy associated with the latent heat of the evaporation of water products from the steam cycle which cannot be recovered and put to economic use.

Period covered

5.80 Until 2004, figures for the MPPs relate to periods of 52 weeks as listed below (although some data provided by electricity supply companies related to calendar months and were adjusted to the statistical calendar). In 2004, a change was made to a calendar year basis. This change was made in the middle of the year and the data are largely based on information collected monthly. The January to May 2004 data are therefore based on the 21 weeks ended 29 May 2004 and the calendar months June to December 2004, making a total of 361 days. In terms of days, 2004 is therefore 1.1 per cent shorter than 2005:

Year	**52 weeks ended**
2003	28 December 2003
2004	21 weeks ended 29 May 2004 and 7 months ended 31 December 2004
2005 – 2016:	12 months ended 31 December

5.81 Figures for industrial, commercial and transport undertakings relate to calendar years ending on 31 December, except for the iron and steel industry where figures relate to the following 52 or 53 week periods:

Year	**53 weeks ended**
2003	3 January 2004
	52 weeks ended
2004	1 January 2005
2005	31 December 2005
2006	30 December 2006
2007	29 December 2007
2008	27 December 2008
	53 weeks ended
2009	2 January 2010
	52 weeks ended
2010	1 January 2011
2011	31 December 2011
2012	29 December 2012
2013	28 December 2013
2014	27 December 2014
	53 weeks ended
2015	2 January 2016
	52 weeks ended
2016	31 December 2016

Monthly and quarterly data

5.82 Monthly and quarterly data on fuel use, electricity generation and supply and electricity availability and consumption are available on the BEIS section of the GOV.UK website at: www.gov.uk/government/collections/electricity-statistics. Monthly data on fuel used in electricity generation by MPPs are given in Monthly Table 5.3 and monthly data on supplies by type of plant and

type of fuel are given in Monthly Table 5.4. Monthly data on availability and consumption of electricity by the main sectors of the economy are given in Monthly Table 5.5. A quarterly commodity balance for electricity is published in BEIS's quarterly statistical bulletin *Energy Trends* (Quarterly Table 5.2) along with a quarterly table of fuel use for generation, electricity generated, and electricity supplied by all generators (Quarterly Table 5.1). Both these quarterly tables are also available from BEIS's energy statistics web site. See Annex C for more information about *Energy Trends*.

Data collection

5.83 For MPPs, as defined in paragraphs 5.62 to 5.68, the data for the tables in this Digest are obtained from the results of an annual BEIS inquiry, sent to each company, covering generating capacity, fuel use, generation and sales of electricity (where a generator also supplies electricity).

5.84 Similarly, an annual inquiry is sent to licensed suppliers of electricity to establish electricity sales by these companies. Electricity consumption for the iron and steel sector is based on data provided by the Iron and Steel Statistics Bureau (ISSB) rather than electricity suppliers since electricity suppliers tend to over-estimate their sales to this sector by including some companies that use steel rather than manufacture it. The difference between the ISSB and electricity suppliers' figures has been re-allocated to other sectors. A further means of checking electricity consumption data is now being employed on data for 2006 and subsequent years. A monthly inquiry is sent to electricity distributors, as well as the National Grid, to establish electricity distribution and transmission losses. Copies of the survey questionnaires are available in *electricity statistics: data sources and methodologies*, at: www.gov.uk/government/collections/electricity-statistics.

5.85 A sample of companies that generate electricity mainly for their own use (known as autogenerators or autoproducers – see paragraph 5.62, above) is covered by a quarterly inquiry commissioned by BEIS but carried out by the Office for National Statistics (ONS). Where autogenerators operate a combined heat and power (CHP) plant, this survey is supplemented (on an annual basis) by information from the CHP Quality Assessment scheme (for autogenerators who have registered under the scheme – see Chapter 7 on CHP). There are two areas of autogeneration that are covered by direct data collection by BEIS, mainly because the return contains additional energy information needed by the Department. These are the Iron and Steel industry, and generation on behalf of London Underground.

5.86 In addition to the above sources, some administrative data is used for renewable generation and capacity in the hands of non-major power producers - this includes data from the Renewables Obligation and Feed in Tariff schemes.

Statistical differences

5.87 Statistical differences are included in Tables 5.1 and 5.2. These arise because data collected on production and supply do not match exactly with data collected on sales or consumption. One of the reasons for this is that some of the data are based on different calendars as described in paragraphs 5.80 and 5.81, above. Sales data based on calendar years will always have included more electricity consumption than the slightly shorter statistical year of exactly 52 weeks.

5.88 Care should be exercised in interpreting the figures for individual industries in the commodity balance tables. Where companies have moved between suppliers, it has not been possible to ensure consistent classification between and within industry sectors and across years. The breakdown of final consumption includes some estimated data. In 2014, for about five per cent of consumption of electricity supplied by the public distribution system, the sector figures are partially estimated.

Contact: *Stephen Ashcroft*
Energy Statistics Team
electricitystatistics@beis.gov.uk
0300 068 2928

Contact: *Nick Jesson*
Energy Statistics Team
electricitystatistics@beis.gov.uk
0300 068 5346

5.1 Commodity balances

Electricity

GWh

	2012	2013	2014	2015	2016
Total electricity					
Supply					
Production	360,907	355,379	335,213	336,178	336,438
Other sources *(1)*	2,966	2,904	2,883	2,739	2,959
Imports	13,774	17,533	23,243	22,716	19,699
Exports	-1,910	-3,102	-2,723	-1,778	-2,153
Marine bunkers	-	-	-	-	-
Stock change	-	-	-	-	-
Transfers	-	-	-	-	-
Total supply	**375,737**	**372,714**	**358,616**	**359,855**	**356,943**
Statistical difference *(2)*	-622	-1,116	-1,066	1,192	195
Total demand	**376,360**	**373,831**	**359,682**	**358,663**	**356,748**
Transformation	-	-	-	-	-
Energy industry use	**29,171**	**29,893**	**28,382**	**27,896**	**26,631**
Electricity generation	17,983	17,850	16,479	16,654	15,273
Oil and gas extraction	565	570	536	606	589
Petroleum refineries	3,793	4,681	4,873	4,532	4,412
Coal extraction and coke manufacture	902	873	741	549	485
Blast furnaces	369	438	440	344	209
Patent fuel manufacture	-	-	-	-	-
Pumped storage	3,978	3,930	3,884	3,711	4,014
Other	1,581	1,551	1,429	1,500	1,648
Losses	**28,917**	**27,667**	**28,514**	**27,319**	**26,322**
Final consumption	**318,272**	**316,271**	**302,786**	**303,448**	**303,795**
Industry	**98,456**	**96,981**	**93,005**	**92,907**	**91,808**
Unclassified	-	-	-	-	-
Iron and steel	3,579	3,799	3,787	3,688	2,847
Non-ferrous metals	5,028	4,430	4,475	4,423	4,303
Mineral products	6,747	6,726	6,267	6,099	6,018
Chemicals	17,507	16,525	15,476	15,610	15,445
Mechanical engineering etc	7,072	7,064	6,912	6,228	6,237
Electrical engineering etc	6,189	6,172	5,714	5,992	5,839
Vehicles	5,081	5,067	4,831	4,874	4,676
Food, beverages etc	11,137	11,083	10,644	10,774	10,733
Textiles, leather etc	2,910	2,894	2,721	2,692	2,638
Paper, printing etc	10,866	10,806	10,725	10,599	10,595
Other industries	20,848	20,952	20,060	20,567	21,140
Construction	1,494	1,464	1,393	1,362	1,337
Transport *(3)*	**4,480**	**4,352**	**4,504**	**4,516**	**4,669**
Air	-	-	-	-	-
Rail *(4)*	4,454	4,319	4,437	4,419	4,540
Road *(5)*	26	33	68	97	129
National navigation	-	-	-	-	-
Pipelines	-	-	-	-	-
Other	**215,336**	**214,938**	**205,277**	**206,026**	**207,318**
Domestic	114,663	113,412	108,076	107,764	107,971
Public administration	18,903	18,802	18,502	19,371	19,827
Commercial	77,899	78,849	74,854	74,773	75,097
Agriculture	3,871	3,874	3,844	4,117	4,423
Miscellaneous	-	-	-	-	-
Non energy use	-	-	-	-	-

5.1 Commodity balances (continued)

Electricity

GWh

	2012	2013	2014	2015	2016
Electricity production					
Total production *(6)*	**360,907**	**355,379**	**335,213**	**336,178**	**336,438**
Primary electricity	**-**	**-**	**-**	**-**	**-**
Major power producers	**91,732**	**98,174**	**95,145**	**109,913**	**108,427**
Nuclear	70,405	70,607	63,748	70,345	71,726
Large scale hydro *(6)*	3,898	3,349	4,333	4,578	3,682
Small scale hydro	272	260	301	328	269
Wind *(7)(8)*	17,157	23,958	26,762	34,662	32,750
Other generators	**5,187**	**7,546**	**10,507**	**14,595**	**16,481**
Nuclear	-	-	-	-	-
Large scale hydro	733	678	720	736	697
Small scale hydro	406	415	533	656	747
Wind, wave and solar photovoltaics *(7)(8)*	4,048	6,454	9,253	13,203	15,037
Secondary electricity	**-**	**-**	**-**	**-**	**-**
Major power producers	**233,592**	**223,545**	**202,794**	**183,338**	**181,558**
Coal	140,118	130,175	100,167	75,812	30,655
Oil	1,132	745	530	683	555
Gas	86,229	82,891	88,871	88,461	131,978
Renewables	6,113	9,212	12,698	17,694	17,401
Other	-	522	528	689	968
Other generators	**30,395**	**26,115**	**26,768**	**28,331**	**29,972**
Coal	2,992	83	72	66	56
Oil	1,441	1,321	1,390	1,354	1,285
Gas	13,940	12,952	12,021	11,415	11,384
Renewables	8,621	8,888	9,921	11,546	12,641
Other	3,401	2,870	3,363	3,950	4,606
	-	-	-	-	-
Primary and secondary production *(9)*	-	-	-	-	-
Nuclear	70,405	70,607	63,748	70,345	71,726
Hydro	5,310	4,701	5,888	6,298	5,395
Wind, wave and solar photovoltaics	21,205	30,412	36,016	47,865	47,788
Coal	143,111	130,258	100,239	75,878	30,711
Oil	2,573	2,066	1,920	2,037	1,839
Gas	100,170	95,843	100,892	99,875	143,362
Other renewables	14,734	18,100	22,619	29,240	30,043
Other	3,401	3,392	3,891	4,639	5,574
Total production	**360,907**	**355,379**	**335,213**	**336,178**	**336,438**

(1) Pumped storage production.
(2) Total supply minus total demand.
(3) From 2004, non-traction Transport sector consumption is included under 'Transport Services'.
(4) From 2004, this includes light rail and metro systems (eg. London Underground).
(5) Included from 2004.
(6) Excludes pumped storage production.
(7) From 2007, major wind farm companies are included under Major Power Producers, see paragraph 5.63
(8) From 2015, major solar companies are included under Major Power Producers, see paragraph 5.65
(9) These figures are the same as the electricity generated figures in Table 5.5 except that they exclude pumped storage production. Table 5.5 shows that electricity used on works is deducted to obtain electricity supplied. It is electricity supplied that is used to produce Chart 5.2 showing each fuel's share of electricity output (see paragraph 5.23).

5.2 Commodity balances

Public distribution system and other generators

GWh

	2014			2015			2016		
	Public distribution system	**Other generators**	**Total**	**Public distribution system**	**Other generators**	**Total**	**Public distribution system**	**Other generators**	**Total**
Supply									
Major power producers	297,938r	-	297,938r	293,251r	-	293,251r	289,985	-	289,985
Other generators	-	37,274r	37,274r	-	42,926r	42,926r	-	46,453	46,453
Other sources *(1)*	2,883	-	2,883	2,739	-	2,739	2,959	-	2,959
Imports	23,243	-	23,243	22,716	-	22,716	19,699	-	19,699
Exports	-2,723	-	-2,723	-1,778	-	-1,778	-2,153	-	-2,153
Transfers	15,084r	-15,084r	-	19,113r	-19,113r	-	20,613	-20,613	-
Total supply	**336,426r**	**22,190r**	**358,616r**	**336,042r**	**23,813r**	**359,855r**	**331,103**	**25,840**	**356,943**
Statistical difference *(2)*	-1,066r	-r	-1,066r	1,192r	-r	1,192r	+299	-104	+195
Total demand	**337,492r**	**22,190r**	**359,682r**	**334,850r**	**23,813r**	**358,663r**	**330,804**	**25,944**	**356,748**
Transformation	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Energy industry use	**21,539r**	**6,843r**	**28,382r**	**21,374r**	**6,522r**	**27,896r**	**20,170**	**6,460**	**26,631**
Electricity generation	13,957r	2,522r	16,479r	13,818r	2,836r	16,654r	12,340	2,933	15,273
Oil and gas extraction	536	-	536	606r	-	606r	589	-	589
Petroleum refineries	1,218	3,655r	4,873r	1,345r	3,187r	4,532r	1,219	3,194	4,412
Coal extraction and coke manufacture	665	76	741	501r	49	549r	468	17	485
Blast furnaces	-	440	440	-	344	344	-	209	209
Pumped storage	3,884	-	3,884	3,711	-	3,711	4,014	-	4,014
Other fuel industries	1,280	150r	1,429r	1,394r	106r	1,500r	1,540	107	1,648
Losses	**28,497r**	**17**	**28,514r**	**27,315r**	**4**	**27,319r**	**26,321**	**1**	**26,322**
Transmission losses	6,509	-	6,509	7,395r	-	7,395r	7,395	-	7,395
Distribution losses	21,124	17	21,141	19,064r	4	19,068r	18,907	1	18,908
Theft	1,000	-	1,000	997r	-	997r	997	-	997
Final consumption	**287,456r**	**15,330r**	**302,786r**	**286,161r**	**17,287r**	**303,448r**	**284,313**	**19,482**	**303,795**
Industry	**84,780**	**8,225r**	**93,005r**	**84,382r**	**8,524r**	**92,907r**	**81,935**	**9,873**	**91,808**
Iron and steel	2,967	820	3,787	2,974	714	3,688	2,263	584	2,847
Non-ferrous metals	3,721	754r	4,475r	3,642r	781r	4,423r	3,564	738	4,303
Mineral products	6,159	108r	6,267r	5,986r	113r	6,099r	5,922	96	6,018
Chemicals	13,862	1,614r	15,476r	13,919r	1,690r	15,610r	13,372	2,073	15,445
Mechanical engineering, etc	6,798	114r	6,912r	6,225r	4r	6,228r	6,230	7	6,237
Electrical engineering, etc	5,708	6r	5,714r	5,986r	6r	5,992r	5,832	6	5,839
Vehicles	4,676	154r	4,831r	4,693r	180r	4,874r	4,495	182	4,676
Food, beverages, etc	9,300	1,343r	10,644r	9,401r	1,373r	10,774r	9,456	1,277	10,733
Textiles, leather, etc	2,714	7r	2,721r	2,685r	7r	2,692r	2,634	4	2,638
Paper, printing, etc	8,857	1,868r	10,725r	8,797r	1,802r	10,599r	8,576	2,019	10,595
Other industries	18,639	1,421r	20,060r	18,727r	1,840r	20,567r	18,270	2,871	21,140
Construction	1,378	15	1,393	1,347r	15	1,362r	1,322	15	1,337
Transport *(3)*	**4,504**	**-**	**4,504**	**4,516r**	**-**	**4,516r**	**4,669**	**-**	**4,669**
Rail *(4)*	4,437	-	4,437	4,419r	-	4,419r	4,540	-	4,540
Road *(5)*	68	-	68	97	-	97	129	-	129
Other	**198,171r**	**7,105r**	**205,277r**	**197,263r**	**8,763r**	**206,026r**	**197,709**	**9,609**	**207,318**
Domestic *(6)*	107,185r	891r	108,076r	106,630r	1,134r	107,764r	106,615	1,356	107,971
Standard	72,967r	-	72,967r	72,313r	-	72,313r	72,378	-	72,378
Economy 7 and other off-peak *(7)*	17,083	-	17,083	17,130r	-	17,130r	16,883	-	16,883
Prepayment (standard)	13,144	-	13,144	13,197r	-	13,197r	13,539	-	13,539
Prepayment (off-peak) *(7)*	3,946r	-	3,946r	3,953r	-	3,953r	3,768	-	3,768
Sales under any other arrangement	43	-	43	37r	-	37r	47	-	47
Public administration	15,355	3,147r	18,502r	15,619r	3,752r	19,371r	15,468	4,359	19,827
Public lighting *(8)*	1,855	-	1,855	1,897r	-	1,897r	1,939	-	1,939
Other public sector	13,500	3,147r	16,647r	13,723r	3,752r	17,475r	13,530	4,359	17,889
Commercial	71,787	3,067r	74,854r	70,897r	3,876r	74,773r	71,202	3,895	75,097
Shops	28,029	-	28,029	27,858r	-	27,858r	28,176	-	28,176
Offices	23,631	-	23,631	23,249r	-	23,249r	23,213	-	23,213
Hotels	8,384	-	8,384	8,155r	-	8,155r	7,990	-	7,990
Combined domestic/commercial premises	2,395	-	2,395	2,349r	-	2,349r	2,344	-	2,344
Post and telecommunications	5,937	-	5,937	5,605r	-	5,605r	5,790	-	5,790
Unclassified	-	-	-	-	-	-	-	-	-
Transport services	3,412	-	3,412	3,682r	-	3,682r	3,690	-	3,690
Agriculture	3,844	-	3,844	4,117r	-	4,117r	4,423	-	4,423

(1) Pumped storage production.
(2) Total supply minus total demand.
(3) From 2004, non-traction Transport sector consumption is included under 'Transport Services'.
(4) From 2004, this includes light rail and metro systems (eg. London Underground).
(5) Included from 2004.
(6) From 2011, this includes consumption by domestic generators. See paragraph 5.14.
(7) Electricity consumed under an off-peak tariff.
(8) Sales for public lighting purposes are increasingly covered by wider contracts that cannot distinguish the public lighting elemen

5.3 Fuel used in generation[(1)]

	Unit	2012	2013	2014	2015	2016
						Original units of measurement
Major power producers *(2)*						
Coal	M tonnes	53.84	49.84	38.22	29.18	12.04
Oil *(3)*	"	0.30	0.19	0.17	0.17	0.19
Gas *(4)*	GWh	184,307	174,070	189,695	185,955	271,563
Other generators *(2)*						
Transport undertakings:						
Gas	GWh	12.88	10.28	9.65	7.17	13.78
Undertakings in industrial and commercial sectors:						
Coal *(5)*	M tonnes	1.06	0.03	0.02	0.02	0.02
Oil *(4)*	"	0.28	0.30	0.32	0.33	0.32
Gas *(6)*	GWh	32,236	30,659	27,918r	26,678r	26,514
Major power producers *(2)*						**Millions of tonnes of oil equivalent equivalent**
Coal		33.67	31.31	24.00	18.33r	7.03
Oil *(3)*		0.41	0.24	0.18	0.23r	0.22
Gas		15.85	15.07	16.33	15.99r	23.05
Nuclear		15.21	15.44	13.85	15.48r	15.41
Hydro (natural flow) *(7)*		0.36r	0.31	0.40	0.42r	0.34
Wind		1.48r	2.06r	2.30r	2.86r	2.64
Solar		-r	-	-	0.12r	0.18
Other renewables *(7)*		2r	2.22	2.97	3.59r	3.67
Other fuels *(8)*			0.18	0.19	0.47r	0.56
Net imports		1.02r	1.24r	1.76	1.80r	1.51
Total major power producers *(2)*		**69.75r**	**68.07r**	**61.98r**	**59.29r**	**54.61**
Of which: conventional thermal and other stations *(9)*		37.56r	36.19r	29.88r	25.85r	14.56
combined cycle gas turbine stations		**15.60r**	**14.89r**	**16.09r**	**15.73r**	**22.79**
Other generators *(2)*						
Transport undertakings:						
Gas (6)		0.00	0.00	0.00	0.00r	0.00
Undertakings in industrial and commercial sectors:						
Coal (5)		0.66	0.02	0.01	0.01	0.01
Oil (4)		0.32	0.35	0.37r	0.38r	0.37
Gas		2.77	2.64	2.40r	2.29r	2.28
Hydro (natural flow) *(7)*		0.10r	0.09r	0.11r	0.12r	0.12
Wind, wave and solar photovoltaics		0.35r	0.55r	0.80r	1.14r	1.30
Other renewables *(7)*		3.19r	2.81r	3.14r	3.57r	3.82
Other fuels *(8)*		1.11	1.41	1.62r	1.71r	1.90
Total other generators *(2)*		**8.51r**	**7.88r**	**8.45r**	**9.23r**	**9.79**
All generating companies						
Coal *(5)*		34.33	31.33	24.01	18.34r	7.04
Oil *(3)(4)*		0.73	0.59	0.55r	0.61r	0.58
Gas *(6)*		18.62	17.70	18.73r	18.28r	25.33
Nuclear		15.21	15.44	13.85	15.48	15.41
Hydro (natural flow) *(7)*		0.46r	0.40r	0.51r	0.54r	0.46
Wind, wave and solar photovoltaics		1.82r	2.61	3.10	4.12	4.12
Other renewables *(7)*		4.96r	5.04r	6.11r	7.16r	7.49
Other fuels *(9)*		1.11	1.41	1.62r	1.71r	1.90
Net imports		1.02r	1.24r	1.76	1.80	1.51
Total all generating companies		**78.25r**	**75.77r**	**70.24r**	**68.05r**	**63.84**

(1) A monthly update of fuel used in electricity generation by major power producers is given in Table 5.1 of Energy Trends, and a quarterly update of fuel used in electricity generation by all generating companies is given in Table 5.4 of Energy Trends.
(2) See paragraphs 5.62 to 5.69 for information on companies covered.
(3) Includes orimulsion, oil used in gas turbine and diesel plant, and oil used for lighting up coal fired boilers.
(4) Includes refinery gas.
(5) Includes coke oven coke.
(6) Includes colliery methane.
(7) Renewable sources which are included under hydro and other renewables in this table are shown separately in Table 6.6 of Chapter 6.
(8) Main fuels included are coke oven gas, blast furnace gas, and waste products from chemical processes.
(9) Includes gas turbines and oil engines and plants producing electricity from renewable sources other than hydro.

5.4 Fuels consumed for electricity generation (autogeneration) by main industrial groups[(1)]

Thousand tonnes of oil equivalent
(except where shown otherwise)

	2012	2013	2014	2015	2016
Iron and steel and non-ferrous metals					
Coal (2)	521	-	-	-	-
Blast furnace gas	591	740	731	641	462
Coke oven gas	182	172	154	137	72
Natural gas	39	39	34	43	42
Petroleum	7	7	7	16	6
Other (including renewables) (3)	63	58	62	63	60
Total fuel input (4)	**1,402**	**1,016**	**989**	**901**	**643**
Electricity generated by iron & steel and non-ferrous	**389r**	**185**	**335**	**166**	**132**
metals (5) (in GWh)	4,520r	2,147	3,896	1,928	1,538
Electricity consumed by iron and steel and non-ferrous	**204r**	**166**	**181r**	**163r**	**133**
metals from own generation (6) (in GWh)	2,373r	1,931	2,106r	1,892r	1,551
Chemicals					
Coal	110	7	7	7	6
Natural gas	727	627	454r	419r	424
Petroleum	6	0	0r	0r	0
Other (including renewables) (3)	56r	34r	29r	38r	137
Total fuel input (4)	**899r**	**668r**	**491r**	**464r**	**567**
Electricity generated by chemicals (5)	**417r**	**301**	**211r**	**190r**	**233**
(in GWh)	4,853r	3,501	2,450r	2,214r	2,715
Electricity consumed by chemicals from own generation (6)	**247r**	**161**	**139r**	**145r**	**178**
(in GWh	2,869r	1,875	1,614r	1,690r	2,073
Metal products, machinery and equipment					
Coal	-	-	-	-	-
Natural gas	42	40	27	30r	30
Petroleum	6	6	6	6	6
Other (including renewables) (3)	48	49r	63	63r	67
Total fuel input (4)	**95**	**94r**	**96**	**99r**	**102**
Electricity generated by metal products, machinery	**22**	**24**	**25**	**26r**	**27**
and equipment (5) (in GWh)	256	279	286	301r	310
Electricity consumed by metal products, machinery	**21**	**23**	**24r**	**16r**	**17**
and equipment from own generation (6) (in GWh)	245	267	275r	190r	195
Food, beverages and tobacco					
Coal	4	4	5	5	3
Natural gas	352	345	360	365r	358
Petroleum	3	3	2	2r	2
Other (including renewables) (3)	10	25r	31	31r	31
Total fuel input (4)	**369**	**377r**	**397**	**403r**	**394**
Electricity generated by food, beverages and tobacco (5)	**187**	**187**	**198**	**199r**	**191**
(in GWh)	2,178	2,177	2,300	2,310r	2,227
Electricity consumed by food, beverages and tobacco	**115**	**112**	**116r**	**118r**	**110**
from own generation (6) (in GWh)	1,339	1,301	1,343r	1,373r	1,277

(1) Industrial categories used are described in Table 1I.
(2) The power plant in this category was reclassified as a Major Power Producer in 2013 so no longer appears in the autogeneration figures
(3) Includes hydro electricity, solid and gaseous renewables and waste.
(4) Total fuels used for generation of electricity. Consistent with figures for fuels used by other generators in Table 5.6.

5.4 Fuels consumed for electricity generation (autogeneration) by main industrial groups[(1)] (continued)

Thousand tonnes of oil equivalent
(except where shown otherwise)

	2012	2013	2014	2015	2016
Paper, printing and publishing					
Coal	26	10	-	-	-
Natural gas	417	301	272	247r	271
Petroleum	0	0r	0r	0r	0
Other (including renewables) (3)	94	145r	240r	270	315
Total fuel input (4)	**538**	**456r**	**512r**	**517r**	**586**
Electricity generated by paper, printing and publishing (5)	**210**	**187**	**207r**	**194r**	**214**
(in GWh)	2,441	2,180	2,402r	2,257r	2,492
Electricity consumed by paper, printing and publishing	**141**	**137**	**161r**	**155r**	**174**
from own generation (6) (in GWh)	1,642	1,590	1,868r	1,802r	2,019
Other industries					
Coal	-	-	-	-	-
Coke oven gas	28	28	28	5	5
Natural gas	71	59	60	64r	66
Petroleum	6	2	3	3r	3
Other (including renewables) (3)	1,950r	1,948r	1,926r	1,892r	1,856
Total fuel input (4)	**2,055r**	**2,038r**	**2,017r**	**1,964r**	**1,929**
Electricity generated by other industries (5)	**120r**	**129r**	**155r**	**191r**	**341**
(in GWh)	1,401r	1,501r	1,807r	2,220r	3,963
Electricity consumed by other industries from own	**108r**	**119r**	**146r**	**179r**	**266**
generation (6) (in GWh)	1,258r	1,390r	1,700r	2,080r	3,093
Total					
Coal	661	20	12	12	10
Blast furnace gas	591	740	731	641	462
Coke oven gas	210	200	182	142	78
Natural gas	1,647	1,411	1,208	1,168r	1,189
Petroleum	27	19r	18r	28r	17
Other (including renewables) (3)	2,222r	2,259r	2,351r	2,356r	2,466
Total fuel input (4)	**5,358r**	**4,648r**	**4,502r**	**4,347r**	**4,222**
Electricity generated (5)	**1,346r**	**1,013r**	**1,130r**	**966r**	**1,139**
(in GWh)	15,649r	11,784r	13,142r	11,229r	13,245
Electricity consumed from own generation (6)	**836r**	**718r**	**766r**	**776r**	**878**
(in GWh)	9,725r	8,354r	8,907r	9,027r	10,208

(5) Combined heat and power (CHP) generation (i.e. electrical output from Table 7.8) plus non-chp generation, so that the total electricity generated is consistent with the "other generators" figures in Table 5.6.

(6) This is the electricity consumed by the industrial sector from its own generation and is consistent with the other generators final users figures used within the electricity balances (Tables 5.1 and 5.2). These figures are less than the total generated because some of the electricity is sold to the public distribution system and other users.

(7) The figures presented here are consistent with other figures presented elsewhere in this publication as detailed at (4), (5), and (6) above but are further dissaggregated. Overall totals covering all autogenerators can be derived by adding in figures for transport, services and the fuel industries. These can be summarised as follows:

Thousand tonnes of oil equivalent

Fuel input	**2012**	**2013**	**2014**	**2015**	**2016**
All industry	5,317	4,561	4,502r	4,347r	4,222
Fuel industries	1,981	1,799	2,043r	2,304r	2,497
Transport, Commerce and Administration	367	379	409r	406r	456
Services	814	1,143	1,492r	2,172r	2,611
Total fuel input	**8,478**	**7,882**	**8,445r**	**9,230r**	**9,786**
Electricity generated	**3,036**	**2,893**	**3,205r**	**3,691r**	**3,994**
Electricity consumed	**1,489**	**1,503**	**1,691r**	**1,804r**	**1,970**
					GWh
Electricity generated	**35,309**	**33,647**	**37,274r**	**42,926r**	**46,453**
Electricity consumed	**17,318**	**17,484**	**19,668r**	**20,977r**	**22,907**

5.5 Electricity supply, electricity supplied (net), electricity available, electricity consumption and electricity sales

GWh

	2012	2013	2014	2015	2016
Total supply					
(as given in Tables 5.1 and 5.2)	375,737r	372,714r	358,616r	359,855r	356,943
less imports of electricity	-13,774r	-17,533r	-23,243	-22,716	-19,699
plus exports of electricity	+1,910r	+3,102r	+2,723	+1,778	2,153
less electricity used in pumped storage	-3,978	-3,930	-3,884	-3,711	-4,014
less electricity used on works	-17,983r	-17,850r	-16,479r	-16,654r	-15,273
equals					
Electricity supplied (net)	341,912r	336,504r	317,733r	318,552r	320,110
(as given in Tables 5.5, 5.1.2 and 5.1.3)					
Total supply					
(as given in Tables 5.1 and 5.2)	375,737r	372,714r	358,616r	359,855r	356,943
less electricity used in pumped storage	-3,978	-3,930	-3,884	-3,711	-4,014
less electricity used on works	-17,983r	-17,850r	-16,479r	-16,654r	-15,273
equals					
Electricity available	353,776r	350,935r	338,253r	339,491r	337,656
(as given in Table 5.1.2)					
Final consumption					
(as given in Tables 5.1 and 5.2)	318,272r	316,271r	302,786r	303,448r	303,795
plus Iron and steel consumption counted as energy industry use	+485	+572	+561	+411	242
equals					
Final users	318,757r	316,844r	303,347r	303,860r	304,038
(as given in Table 5.1.2)					
Final consumption					
Public distribution system					
(as given in Table 5.2)	304,221	302,690	287,456r	286,161r	284,313
plus Oil and gas extraction use	+565	+570	+536	+606r	589
plus Petroleum refineries use	+1,338	+1,291	+1,218	+1,345r	1,219
plus Coal and coke use	+825	+796	+665	+501r	468
plus Other fuel industries use	+1,460	+1,402	+1,280	+1,394r	1,540
equals					
UK Electricity sales *(1)*	308,408	306,748	291,153r	290,007r	288,129

(1) A calendar year estimate of the Renewables Obligation percentage can be calculated using the "total generation from sources eligible for the Renewable Obligation" figure from Table 6.4 as the numerator, and this figure as the denominator. Separate electricity sales data for public electricity suppliers are given for England and Wales, Scotland and Northern Ireland in Table 5.5 of Energy Trends on the BEIS website at:
www.gov.uk/government/publications/electricity-section-5-energy-trends

5.6 Electricity fuel use, generation and supply

GWh

	Thermal sources							Non-thermal sources			
	Coal	Oil	Gas	Nuclear	Renew-ables (1)	Other (3)	Total	Hydro-natural flow	Hydro-pumped storage	Wind and solar (4)	Total All sources
2012											
Major power producers *(2) (5)*											
Fuel used	391,530	4,736	184,307	176,846	20,535	-	777,954	4,170r	2,966	17,157r	802,247r
Generation	139,800r	1,451r	86,229	70,405	6,113r	-	303,998r	4,170r	2,966	17,157r	328,291r
Used on works	7,100r	204r	1,474	6,456	614r	-	15,848r	2r	10	-	15,860r
Supplied (gross)	132,700r	1,247r	84,755	63,949	5,499r	-	288,150r	4,168	2,956	17,157r	312,431r
Used in pumping											3,978
Supplied (net)											308,454r
Other generators *(2) (5)*											
Fuel used	7,687	3,720	32,236	-	37,143r	12,932	93,718r	1,140r	-	4,048r	98,906r
Generation	2,992	1,441r	13,940r	-	8,621r	3,401r	30,395r	1,140r	-	4,048r	35,582r
Used on works	170	106r	432r	-	1,183r	210r	2,102r	22r	-	-	2,124r
Supplied	2,822	1,335r	13,508r	-	7,438r	3,190r	28,293r	1,118r	-	4,048r	33,459r
All generating companies											
Fuel used	399,217	8,456	216,543	176,846	57,678r	12,932	871,672r	5,310r	2,966	21,205r	901,153r
Generation	142,792r	2,891r	100,170r	70,405	14,734r	3,401r	334,392r	5,310r	2,966	21,205r	363,874r
Used on works	7,270r	310r	1,906r	6,456	1,797r	210r	17,950r	23r	10	-	17,983r
Supplied (gross)	135,522r	2,581r	98,264r	63,949	12,937r	3,190r	316,443r	5,286r	2,956	21,205r	345,890r
Used in pumping											3,978
Supplied (net)											341,912r
2013											
Major power producers *(2) (5)*											
Fuel used	364,141	2,775	175,210	179,601	25,832	2,119	749,678	3,609	2,904	23,958r	780,149r
Generation	130,175r	745r	82,891r	70,607	9,212r	522	294,152r	3,609	2,904	23,958r	324,623r
Used on works	6,678r	97r	1,409r	6,474	925r	52	15,636r	13	10	-	15,658r
Supplied (gross)	123,497r	648r	81,482r	64,133	8,287r	470	278,516r	3,596	2,894	23,958r	308,964r
Used in pumping											3,930
Supplied (net)											305,034r
Other generators *(2) (5)*											
Fuel used	239	4,066	30,659	-	32,728r	16,440	84,132r	1,092r	-	6,454r	91,678r
Generation	83	1,321	12,952	-	8,888r	2,870r	26,115r	1,092r	-	6,454r	33,661r
Used on works	4	97	402	-	1,501r	166r	2,169r	22r	-	-	2,191r
Supplied	79	1,224	12,550	-	7,388r	2,705r	23,945r	1,071r	-	6,454r	31,470r
All generating companies											
Fuel used	364,380	6,841	205,869	179,601	58,560r	18,559	833,810r	4,701r	2,904	30,412r	871,827r
Generation	130,258r	2,066r	95,843r	70,607	18,100r	3,392r	320,266r	4,701r	2,904	30,412r	358,283r
Used on works	6,682r	195r	1,810r	6,474	2,426r	218r	17,805r	35r	10	-	17,850r
Supplied (gross)	123,576r	1,872r	94,033r	64,133	15,674r	3,174r	302,461r	4,667r	2,894	30,412r	340,434r
Used in pumping											3,930
Supplied (net)											336,504r
2014											
Major power producers *(2) (5)*											
Fuel used	279,117	2,112	189,919	161,079	34,503	2,204	668,934	4,635	2,883	26,762r	703,214r
Generation	100,167r	530r	88,871r	63,748	12,698r	528	266,542	4,635	2,883	26,762r	300,822r
Used on works	5,154r	72r	1,519r	5,845	1,275r	53	13,919	29	10	-	13,958
Supplied (gross)	95,013r	458r	87,352r	57,903	11,423r	475	252,623	4,606	2,873	26,762r	286,864r
Used in pumping											3,884
Supplied (net)											282,980r
Other generators *(2) (5)*											
Fuel used	135	4,311r	27,918r	-	36,517r	18,829r	87,711r	1,253r	-	9,253r	98,218r
Generation	72	1,390r	12,021r	-	9,921r	3,363r	26,768r	1,253r	-	9,253r	37,274r
Used on works	3	102r	373r	-	1,812r	204r	2,495r	28r	-	-	2,522r
Supplied	69	1,288r	11,648r	-	8,109r	3,159r	24,273r	1,226r	-	9,253r	34,752r
All generating companies											
Fuel used	279,252	6,423r	217,837r	161,079	71,020r	21,033r	756,645r	5,888r	2,883	36,016r	801,432r
Generation	100,239r	1,920r	100,892r	63,748	22,619r	3,891r	293,309r	5,888r	2,883	36,016r	338,096r
Used on works	5,157r	174r	1,892r	5,845	3,087r	257r	16,413r	57r	10	-	16,480r
Supplied (gross)	95,082r	1,746r	99,000r	57,903	19,532r	3,634r	276,896r	5,831r	2,873	36,016r	321,616r
Used in pumping											3,884
Supplied (net)											317,732r

5.6 Electricity fuel use, generation and supply (continued)

GWh

	Thermal sources							Non-thermal sources			
	Coal	Oil	Gas	Nuclear	Renew-ables *(1)*	Other *(3)*	Total	Hydro-natural flow	Hydro-pumped storage	Wind and solar *(4)*	Total All sources
2015											
Major power producers *(2) (5)*											
Fuel used	213,158r	2,626r	185,955	180,025	44,483	2,738	628,984r	4,907	2,739	34,662r	671,292r
Generation	75,812r	683	88,461	70,345	17,694	689	253,683r	4,907	2,739	34,662r	295,991r
Used on works	3,890r	88	1,517	6,450	1,777	69	13,791r	17	10	-	13,818r
Supplied (gross)	71,922r	595	86,943	63,895	15,917	620	239,892r	4,889	2,730	34,662r	282,173r
Used in pumping											3,711
Supplied (net)											278,462r
Other generators *(2) (5)*											
Fuel used	137	4,422r	26,678r	-	41,575r	19,932r	92,744r	1,392r	-	13,203r	107,339r
Generation	66	1,354r	11,415r	-	11,546r	3,950r	28,331r	1,392r	-	13,203r	42,926r
Used on works	3	99r	354r	-	2,079r	268r	2,802r	34r	-	-	2,836r
Supplied	63	1,255r	11,061r	-	9,468r	3,682r	25,529r	1,358r	-	13,203r	40,090r
All generating companies											
Fuel used	213,296r	7,048r	212,632r	180,025	86,057r	22,670r	721,728r	6,298r	2,739	47,865r	778,631r
Generation	75,878r	2,037r	99,875r	70,345	29,240r	4,639r	282,014r	6,298r	2,739	47,865r	338,917r
Used on works	3,893r	187r	1,871r	6,450	3,855r	337r	16,593r	51r	10	-	16,654r
Supplied (gross)	71,985r	1,850r	98,005r	63,895	25,385r	4,302r	265,421r	6,247r	2,730	47,865r	322,263r
Used in pumping											3,711
Supplied (net)											318,552r
2016											
Major power producers *(2) (5)*											
Fuel used	87,557	2,545	271,563	179,263	45,977	3,259	590,163	3,951	2,959	32,750	629,824
Generation	30,655	555	131,978	71,726	17,401	968	253,284	3,951	2,959	32,750	292,944
Used on works	1,571	75	2,248	6,577	1,747	97	12,316	14	10	-	12,340
Supplied (gross)	29,084	479	129,730	65,149	15,654	871	240,968	3,937	2,949	32,750	280,604
Used in pumping											4,014
Supplied (net)											276,590
Other generators *(2) (5)*											
Fuel used	113	4,245	26,514	-	44,393	22,060	97,325	1,444	-	15,037	113,806
Generation	56	1,285	11,384	-	12,641	4,606	29,972	1,444	-	15,037	46,453
Used on works	3	95	352	-	2,144	301	2,894	38	-	-	2,933
Supplied	53	1,190	11,032	-	10,497	4,305	27,077	1,405	-	15,037	43,520
All generating companies											
Fuel used	87,669	6,790	298,077	179,263	90,369	25,319	687,488	5,395	2,959	47,788	743,630
Generation	30,711	1,839	143,362	71,726	30,043	5,574	283,255	5,395	2,959	47,788	339,397
Used on works	1,573	170	2,600	6,577	3,892	398	15,210	52	10	-	15,273
Supplied (gross)	29,138	1,669	140,762	65,149	26,151	5,176	268,045	5,342	2,949	47,788	324,124
Used in pumping											4,014
Supplied (net)											320,110

	2012		2013		2014		2015		2016	
	Conv-entional thermal *(6)*	CCGT	Conv-entional thermal *(6)*	CCGT	Conv-entional thermal *(6)*	CCGT	Conv-entional thermal *(6)*	CCGT	Conv-entional thermal *(6)*	CCGT
Major power producers *(2)*										
Generated	147,946	85,647	141,011r	82,533	114,534	88,259	95,606r	87,732	50,281	131,276
Supplied (gross)	139,994	84,207	133,238r	81,145	107,945	86,775	89,741r	86,256	46,750	129,069
Other generators										
Generated	20,813r	9,582r	15,162r	10,953r	18,794r	7,974r	21,519r	6,812r	45,067	6,225
Supplied (gross)	19,189r	9,104r	13,539r	10,406r	16,697r	7,576r	19,056r	6,473r	40,143	5,915
All generating companies										
Generated	168,758r	95,229r	156,173r	93,486r	133,328r	96,233r	117,125r	94,544r	95,348	137,502
Supplied (gross)	159,183r	93,311r	146,777r	91,552r	124,642r	94,351r	108,797r	92,729r	86,893	134,984

(1) Thermal renewable sources are those included under bioenergy in Chapter 6. Prior to 2007, non-biodegradable wastes are also included.

(2) See paragraphs 5.62 to 5.69 on companies covered.

(3) Other thermal sources include coke oven gas, blast furnace gas and waste products from chemical processes. From 2007, non-biodegradable wastes are also included.

(4) For Major Power Producers before 2015, this is wind only; for Major Power Producers from 2015 and for other generators, this includes solar photovoltaics as well as wave and tidal.

(5) From 2007, major wind farm companies are included under Major Power Producers, see paragraph 5.64.

(6) Includes gas turbines, oil engines and plants producing electricity from thermal renewable sources; also stations with some CCGT capacity but mainly operate in conventional thermal mode.

5.7 Plant capacity - United Kingdom

MW

	end December				
	2012	2013	2014	2015	2016
Major power producers *(1)*					
Total transmission entry capacity *(2)*	**81,877**	**77,167**	**75,694**	**71,928**	**68,380**
Of which:					
Conventional steam stations:	28,523	23,141	21,282	18,714	14,627
Coal fired	23,072	20,591	18,732	17,534	13,447
Oil fired	2,338	1,370	1,370	-	-
Mixed or dual fired *(3)*	3,113	1,180	1,180	1,180	1,180
Combined cycle gas turbine stations	33,113	32,967	31,994	30,080	30,306
Nuclear stations	9,946	9,906	9,937	9,487	9,497
Gas turbines and oil engines	1,651	1,639	1,643	1,386r	1,417
Hydro-electric stations:					
Natural flow *(4)*	1,398	1,399	1,400	1,400	1,401
Pumped storage	2,744	2,744	2,744	2,744	2,744
Wind *(4) (5)*	3,276r	3,947	4,528	4,917r	5,517
Solar *(4)*				288r	400
Renewables other than hydro, wind and solar *(6)*	1,226r	1,424r	2,166r	2,911	2,471
Other generators *(1)*					
Total capacity of own generating plant ***(7)***	**7,423r**	**7,430**	**8,718r**	**9,098r**	**9,899**
Of which:					
Conventional steam stations *(8)*	2,373r	2,045r	2,108r	2,171r	2,098
Combined cycle gas turbine stations	2,037r	1,905	1,813	1,616r	1,460
Hydro-electric stations (natural flow) *(4)*	158r	163r	169r	186r	206
Wind *(4) (9)*	608r	905r	1,094r	1,238r	1,457
Solar *(4)*	298r	499r	940r	1,333r	1,622
Renewables other than hydro, wind and solar *(6)*	1,949r	1,914r	2,594r	2,554r	3,056
All generating companies					
Total capacity	**89,301r**	**84,596r**	**84,412r**	**81,026r**	**78,279**
Of which:					
Conventional steam stations *(8)*	30,897r	25,186r	23,390r	20,885r	16,725
Combined cycle gas turbine stations	35,150r	34,872	33,807	31,696r	31,766
Nuclear stations	9,946	9,906	9,937	9,487	9,497
Gas turbines and oil engines	1,651	1,639	1,643	1,386r	1,417
Hydro-electric stations:					
Natural flow *(4)*	1,556r	1,561r	1,569r	1,586r	1,607
Pumped storage	2,744	2,744	2,744	2,744	2,744
Wind *(4)*	3,884r	4,851r	5,622r	6,156r	6,973
Solar *(4)*	298r	499r	940r	1,621r	2,023
Renewables other than hydro, wind and solar *(6)*	3,175r	3,338r	4,760r	5,465r	5,527

(1) See paragraphs 5.62 to 5.69 for information on companies covered.
(2) See paragraph 5.76 for definition. Data before 2006 are based on declared net capacity.
(3) Includes gas fired stations that are not Combined Cycle Gas Turbines, or have some CCGT capability but mainly operate as conventional thermal stations.
(4) Small-scale hydro, wind and solar photovoltaics capacity are shown on declared net capability basis, and are de-rated to account for intermittency, by factors of 0.365, 0.43 and 0.17 respectively. See paragraph 5.77.
(5) From 2007, major wind farm companies are included under Major Power Producers, see paragraph 5.64
(6) For Major Power Producers, this includes bioenergy; for other generators, this includes bioenergy, wave and tidal.
(7) "Other generators" capacities are given in declared net capacity terms, see paragraph 5.77.
(8) For other generators, conventional steam stations include combined heat and power plants (electrical capacity only) but exclude combined cycle gas turbine plants, hydro-electric stations and plants using renewable sources.
(9) Falls in capacity in 2007, 2010 and 2012 due to re-classification of capacity to Major Power Producers.
(10) Stations on Supplemental Balancing Reserve, ie. those that are closed but available for times of high demand such as winter, are classed as having zero capacity.

5.8 Major Power Producers Plant capacity - England and Wales, Scotland, and Northern Ireland

MW

	2012	2013	2014	2015	2016
					end December
Major power producers in England and Wales *(1)*					
Total transmission entry capacity *(2)*	**68,840r**	**65,019r**	**63,348r**	**59,425r**	**57,897**
Of which:					
Conventional steam stations:	24,007	19,821	17,962	15,394	13,567
Coal fired	19,616	18,331	16,472	15,274	13,447
Oil fired	2,338	1,370	1,370	-	-
Mixed or dual fired *(3)*	2,053	120	120	120	120
Combined cycle gas turbine stations	30,915	30,765	29,792	27,876	28,102
Nuclear stations	7,657	7,617	7,648	7,198	7,208
Gas turbines and oil engines	1,261	1,191	1,195	938r	969
Hydro-electric stations:					
Natural flow	141	141	141	141	141
Pumped storage	2,004	2,004	2,004	2,004	2,004
Wind *(4)*	1,682	2,110	2,526	2,795r	3,104
Solar				277r	385
Renewables other than hydro and wind *(5)*	1,172r	1,370r	2,080r	2,802	2,417
Major power producers in Scotland *(1)*					
Total transmission entry capacity *(2)*	**10,602**	**9,630**	**9,827**	**9,977r**	**7,931**
Of which:					
Conventional steam and combined cycle gas turbine stations	4,638	3,442	3,442	3,440	1,180
Nuclear stations	2,289	2,289	2,289	2,289	2,289
Gas turbines and oil engines	131	131	131	131	131
Hydro-electric stations:					
Natural flow	1,257	1,258	1,259	1,259	1,260
Pumped storage	740	740	740	740	740
Wind *(4)*	1,493	1,716	1,881	2,001r	2,266
Solar				8r	11
Renewables other than hydro and wind *(5)*	54	54	86	109	54
Major power producers in Northern Ireland *(1)*					
Total transmission entry capacity *(2)*	**2,436**	**2,518**	**2,518**	**2,525r**	**2,552**

(1) See paragraphs 5.62 to 5.69 for information on companies covered
(2) See paragraph 5.76 for definition. Data before 2006 are based on declared net capacity
(3) Includes gas fired stations that are not Combined Cycle Gas Turbines, or have some CCGT capability but mainly operate as conventional thermal stations.
(4) From 2007, major wind farm companies are included under Major Power Producers, see paragraph 5.64
(5) Bioenergy only.

5.9 Capacity of other generators

MW

	2012	2013	2014	2015	2016
					end December
Capacity of own generating plant *(1) (2)*					
Undertakings in industrial and commercial sector:					
Oil and gas terminals and oil refineries	1,019	1,019	917	875	863
Iron and steel	314	314	314	314	206
Chemicals	1,061	815	767	714	661
Engineering and other metal trades	644	199	199	171	171
Food, drink and tobacco	442	438	457	464	469
Paper, printing and publishing	467	470	508	499	397
Other *(3)*	3,371	4,072	4,581	5,802	7,029
Total industrial, commercial and domestic sector	7,317	7,327	7,744	8,838	9,796
Undertakings in transport sector	103	103	103	103	103
Total other generators	**7,420**	**7,430**	**7,847**	**9,098r**	**9,899**

(1) For combined heat and power plants the electrical capacity only is included. Further CHP capacity is included under major power producers in Table 5.7. A detailed analysis of CHP capacity is given in the tables of Chapter 7 Figures may not sum to 5.7 due to rounding.
(2) From 2007, major wind farm companies are included under Major Power Producers, see paragraph 5.64
(3) Includes companies in the commercial sector, and domestic installations

5.10 Plant loads, demand and efficiency

Major power producers [1]

	2012	2013	2014	2015	2016
Simultaneous maximum load met *(2) (3)*	57,490	53,420	53,858	52,753	52,909
of which England and Wales	..	..	..	..	..
Scotland	..	..	..	..	..
Great Britain	55,765	51,811	52,516	51,100	51,169
Northern Ireland	1,725	1,609	1,342	1,653	1,740
Maximum demand as a percentage of UK Major Power Producers' capacity	70.2r	69.2r	71.2r	73.3r	77.4
Plant load factor *(2) (4)*					
Combined cycle gas turbine stations	30.3	28.0	30.5	31.7	48.8
Nuclear stations	70.7	73.8	66.6	75.1	78.4
Pumped storage hydro	12.3	12.0	12.0	11.4	12.3
Conventional thermal and other stations *(5)*	57.0r	61.0r	57.2r	52.7r	37.7
of which coal-fired stations *(6)*	56.9	58.1	50.7	39.3r	16.5
All plant *(7)*	**46.2r**	**46.1r**	**44.8r**	**45.5r**	**47.0**
System load factor *(8)*	**66.3r**	**70.7r**	**67.0r**	**68.3r**	**67.3**
Thermal efficiency *(9)*					
(gross calorific value basis)					
Combined cycle gas turbine stations	47.2	47.7	47.2	48.0	49.5
Coal fired stations	35.8	35.8	35.9r	35.6r	35.0
Nuclear stations	39.8	39.3	39.6	39.1	40.0

(1) See paragraphs 5.62 to 5.69 for information on companies covered.
(2) Load met by transmission network, net of demand met by embedded generation. See paragraph 5.78 for definitions
(3) Data cover the 12 months ending March of the following year, e.g. 2016 data are for the year ending March 2017.
(4) Load factors for renewable sources, including wind and hydro, can be found in Table 6.5.
(5) Conventional steam plants, gas turbines and oil engines and plants producing electricity from thermal renewable sources.
(6) Includes both coal-fired stations, and dual/mixed fired stations that mainly use coal.
(7) Includes wind (from 2008) and natural flow hydro, using capacity that has not been de-rated for intermittency.
(8) Average electricity available as percentage of maximum demand. See paragraph 5.78.
(9) See paragraph 5.79 for definition of thermal efficiency.

5.11 Power Stations in the United Kingdom

(operational at the end of May 2017)[1]

Company Name	Station Name	Fuel	Installed Capacity (MW)	Year of commission or year generation began	Location Scotland, Wales, Northern Ireland or English region	
AES	Ballylumford C	CCGT	616	2003	Northern Ireland	
	Kilroot	Coal / oil	520	1981	Northern Ireland	
	Ballylumford B	Gas	540	1968	Northern Ireland	
	Ballylumford B OCGT	Gas oil	116	1968	Northern Ireland	
	Kilroot OCGT	Gas oil	142	1981	Northern Ireland	
British Energy (now part of EDF)	Dungeness B	Nuclear	1,050	1983	South East	
	Hartlepool	Nuclear	1,180	1984	North East	
	Heysham 1	Nuclear	1,155	1984	North West	
	Heysham 2	Nuclear	1,230	1988	North West	
	Hinkley Point B	Nuclear	955	1976	South West	
	Hunterston B	Nuclear	965	1976	Scotland	
	Sizewell B	Nuclear	1,198	1995	East	
	Torness	Nuclear	1,185	1988	Scotland	
British Solar Renewables	Bradenstoke Solar Park	Solar	70	2015	South West	
Carrington Power	Carrington	CCGT	900.0	2016	North West	
Centrica	Barry	CCGT	235	1998	Wales	*(2)*
	Glanford Brigg	CCGT	150	1993	Yorkshire and the Humber	*(2)*
	Langage	CCGT	905	2010	South West	
	Peterborough	CCGT	240	1993	East	*(2)*
	South Humber Bank	CCGT	1,310	1996	Yorkshire and the Humber	
Coolkeeragh ESB Ltd	Coolkeeragh	CCGT	408	2005	Northern Ireland	
	Coolkeeragh OCGT	Gas oil	53	2005	Northern Ireland	
Corby Power Ltd	Corby	CCGT	401	1993	East Midlands	
Cubico Sustainable Investments Limited	Broxted Solar Park	Solar	32	2015	East	
	Owl's Hatch Solar Park	Solar	51.9	2016	South East	
Cumbria Wind	Beckburn	Wind	31	2017	North West	
	Burnfoot Hill	Wind	30	2010	Scotland	
	Corriemoillie	Wind	48	2016	Scotland	
	Fallago Rig	Wind	144	2013	Scotland	
	Green Rigg	Wind	36	2012	North East	
	Longpark	Wind	38	2009	Scotland	
	Teesside	Wind (offshore)	62	2014	North East	
Dong Energy	Barrow	Wind (offshore)	90	2006	North West	
	Burbo Bank	Wind (offshore)	90	2009	North West	
	Gunfleet Sands 1	Wind (offshore)	108	2010	South East	
	Gunfleet Sands 2	Wind (offshore)	65	2010	South East	
	Lincs	Wind (offshore)	270	2012	East	
	Walney 1	Wind (offshore)	184	2011	North West	
	Walney 2	Wind (offshore)	184	2011	North West	
	West of Duddon Sands	Wind (offshore)	389	2014	North West	
	Westermost Rough	Wind (offshore)	210	2015	South East	
Drax Power Ltd	Drax - coal units	Coal	1,980	1974	Yorkshire and the Humber	
	Drax - biomass units	Biomass	1,980	1974	Yorkshire and the Humber	
	Drax GT	Gas oil	75	1971	Yorkshire and the Humber	
E.On UK	Blackburn Meadows	Biomass	33	2015	Yorkshire and the Humber	
	Steven's Croft *	Biomass	50	2007	Scotland	
	Castleford	CCGT	56	2002	Yorkshire and the Humber	
	Sandbach	CCGT	56	1999	North West	
	Thornhill	CCGT	50	1998	Yorkshire and the Humber	
	Camster	Wind	50	2012	Scotland	
	Tween Bridge	Wind	44	2012	North East	
	Humber Gateway	Wind (offshore)	219	2015	North East	
	London Array	Wind (offshore)	630	2012	South East	
	Robin Rigg East	Wind (offshore)	90	2010	Scotland	
	Robin Rigg West	Wind (offshore)	90	2010	Scotland	
	Scroby Sands	Wind (offshore)	60	2004	East	
EDF Energy	West Burton CCGT	CCGT	1,332	2012	East Midlands	
EDF Energy	Cottam	Coal	2,008	1969	East Midlands	
EDF Energy	West Burton	Coal	2,012	1967	East Midlands	
EDF Energy	Barkantine Heat & Power Company *	Gas	1	2000	London	
EDF Energy	London Heat & Power Company *	Gas	9	2000	London	
EDF Energy	West Burton GT	Gas oil	40	1967	East Midlands	
Eggborough Power Ltd	Eggborough	Coal	1,960.0	1967	Yorkshire and the Humber	
Eneco Wind UK Limited	Lochluichart	Wind	69.0	2014	Scotland	
	Moy	Wind	60.0	2016	Scotland	

For footnotes see page 150

5.11 Power Stations in the United Kingdom

(operational at the end of May 2017)[1] (continued)

Company Name	Station Name	Fuel	Installed Capacity (MW)	Year of commission or year generation began	Location Scotland, Wales, Northern Ireland or English region
ENGIE	Deeside	CCGT	515	1994	Wales
	Saltend *	CCGT	1,200	2000	Yorkshire and the Humber
	Indian Queens	Gas oil / kerosene	140	1996	South West
	Dinorwig	Pumped storage	1,800	1983	Wales
	Ffestiniog	Pumped storage	360	1961	Wales
EPR Ely Limited	Elean	Straw	38	2001	East
EPR Eye Ltd	Eye Suffolk	Biomass	14	1992	East
EPR Glanford Ltd	Glanford	Meat & bone meal	14	1993	East
EPR Scotland Ltd	Westfield	Biomass	13	2000	Scotland
EPR Thetford Ltd	Thetford	Biomass	42	1998	East
Falck Renewables Wind Ltd	Cambrian	Wind	38	2016	Wales
	Earlsburn	Wind	38	2007	Scotland
	Kilbraur	Wind	68	2008	Scotland
	Millennium	Wind	65	2008	Scotland
	West Browncastle	Wind	30	2014	Scotland
Ferrybridge MFE Limited	Ferrybridge Multi-fuel	Biomass	79	2015	Yorkshire and the Humber
Foresight Group	Shotwick	Solar	72	2017	England
Fred Olsen	Crystal Rig	Wind	63	2003	Scotland
	Crystal Rig 2	Wind	138	2010	Scotland
	Mid Hill	Wind	76	2014	Scotland
	Paul's Hill	Wind	64	2005	Scotland
	Rothes	Wind	51	2004	Scotland
	Rothes 2	Wind	41	2013	Scotland
Greencoat Solar	Coltishall 1	Solar	34	2016	England
	Eveley	Solar	49	2016	England
Greencoat UK Wind	Braes of Doune Wind Farm	Wind	72.0	2007	Scotland
Infinis	A'Chruach	Wind	43	2016	Scotland
	Dalswinton	Wind	31	2008	Scotland
	Galawhistle	Wind	66	2017	Scotland
	Minsca	Wind	37	2008	Scotland
	Slieve Divena	Wind	30	2009	N Ireland
Intergen	Coryton	CCGT	800	2001	East
	Rocksavage	CCGT	810	1998	North West
	Spalding	CCGT	880	2004	East Midlands
Lightsource	Crundale	Solar	43.7	2016	England
	Exning	Solar	30.3	2016	England
Londonwaste Limited	Edmonton	Waste	60.0	1970	South East
Magnox Ltd	Maentwrog	Hydro	35.3	1928	Wales
Marchwood Power Limited	Marchwood	CCGT	842.0	2009	South West
MPF Operations Limited	Baglan Bay CCGT	CCGT	520.0	2002	Wales
MPF Operations Limited	Severn Power	CCGT	850.0	2010	Wales
MPF Operations Limited	Sutton Bridge	CCGT	819.0	1999	East
MPF Operations Limited	Baglan Bay OCGT	OCGT	32.3	2002	Wales
Peel Energy Ltd	Frodsham Wind Farm Ltd	Wind	50.4	2017	North West
Px Limited	Fellside CHP *	Gas	180.0	1995	North West
Renewable Energy Systems Ltd	Hill of Towie	Wind	48.3	2012	Scotland
Riverside Resource Recovery Limited	Belvedere	Waste	80.0	2011	South East
Rockfire Capital	Swindon Solar Park	Solar	60.9	2017	England
RWE Innogy UK Ltd	Markinch CHP *	Biomass	65.0	2014	Scotland
RWE Innogy UK Ltd (Part of RWE Npower)	Carno	Wind	33.6	2016	Wales
	Causeymire	Wind	48.3	2004	Scotland
	Farr	Wind	92.0	2006	Scotland
	Ffynnon Oer	Wind	32.0	2006	Wales
	Goole Fields	Wind	33.0	2013	North East
	Goole Fields 2	Wind	34.9	2016	England
	Little Cheyne Court	Wind	59.8	2008	South East
	Middlemoor	Wind	54.0	2013	North East
	Novar 2	Wind	36.8	2012	Scotland
	Gwynt y Mor	Wind (offshore)	576.0	2013	Wales
	North Hoyle	Wind (offshore)	60.0	2003	Wales
	Rhyl Flats	Wind (offshore)	90.0	2009	Wales

For footnotes see page 150

5.11 Power Stations in the United Kingdom

(operational at the end of May 2017)[1] (continued)

Company Name	Station Name	Fuel	Installed Capacity (MW)	Year of commission or year generation began	Location Scotland, Wales, Northern Ireland or English region	
RWE Npower Plc	Didcot B	CCGT	1,470.0	1998	South East	
	Great Yarmouth	CCGT	420.0	2001	East	
	Little Barford	CCGT	720.0	1995	East	
	Pembroke	CCGT	2,180.0	2012	Wales	
	Staythorpe C	CCGT	1,772.0	2010	East Midlands	
	Aberthaw B	Coal	1,586.0	1971	Wales	
	Aberthaw GT	Gas oil	51.0	1971	Wales	
	Cowes	Gas oil	140.0	1982	South East	
	Didcot GT	Gas oil	100.0	1972	South East	
	Little Barford GT	Gas oil	17.0	2006	East	
Scottish and Southern: Hydro Schemes - Affric/Beauly	Deanie	Hydro	38.0	1963	Scotland	
	Fasnakyle	Hydro	69.0	1951	Scotland	
Scottish and Southern: Hydro Schemes - Breadalbane	Lochay	Hydro	46.0	1958	Scotland	
Scottish and Southern: Hydro Schemes - Conon	Luichart	Hydro	34.0	1954	Scotland	
Scottish and Southern: Hydro Schemes - Foyers	Foyers	Hydro / pumped storage	300.0	1974	Scotland	
Scottish and Southern: Hydro Schemes - Great Glen	Glendoe	Hydro	100.0	2008	Scotland	
	Glenmoriston	Hydro	37.0	1957	Scotland	
	Clachan	Hydro	40.0	1955	Scotland	
Scottish and Southern: Hydro Schemes - Sloy/Awe	Sloy	Hydro	152.5	1950	Scotland	
Scottish and Southern: Hydro Schemes - Tummel	Clunie	Hydro	61.2	1950	Scotland	
	Errochty	Hydro	75.0	1955	Scotland	
	Rannoch	Hydro	45.0	1930	Scotland	
	Tummel	Hydro	34.0	1933	Scotland	
Scottish and Southern: Island Generation	Arnish	Diesel	10.0	2001	Scotland	
	Barra	Diesel	3.0	1990	Scotland	
	Bowmore	Diesel	6.0	1946	Scotland	
	Kirkwall	Diesel	16.0	1953	Scotland	
	Lerwick	Diesel	67.0	1953	Scotland	
	Loch Carnan, South Uist	Diesel	9.0	1971	Scotland	
	Stornoway	Diesel	24.0	1950	Scotland	
	Tiree	Diesel	3.0	1945	Scotland	
Scottish and Southern: Thermal	Keadby	CCGT	710.0	1994	Yorkshire and the Humber	
	Medway	CCGT	700.0	1995	South East	
	Peterhead	CCGT	1,180.0	1980	Scotland	(3)
	Fiddler's Ferry	Coal / biomass	1,961.0	1971	North West	
	Slough *	Coal / biomass / gas / waste derived fue	35.0	1918	South East	
	Chippenham	Gas	10.0	2002	South West	
	Burghfield	Gas / oil	45.0	1998	South East	
	Chickerell	Gas / oil	45.0	1998	South West	
	Fiddler's Ferry GT	Gas oil	34.0	1969	North West	
	Keadby GT	Gas oil	25.0	1994	Yorkshire and the Humber	
	Five Oaks	Light oil	8.7	1995	South East	
	Thatcham	Light oil	8.7	1994	South East	
Scottish and Southern: Wind	Achany	Wind	38.0	2010	Scotland	
	Clyde Central	Wind	112.7	2011	Scotland	
	Drumderg	Wind	36.8	2008	Scotland	
	Dunmaglass	Wind	94.1	2017	Scotland	
	Fairburn	Wind	40.0	2009	Scotland	
	Gordonbush	Wind	70.0	2011	Scotland	
	Griffin	Wind	188.6	2011	Scotland	
	Hadyard Hill	Wind	119.6	2005	Scotland	
	Keadby	Wind	68.0	2013	Yorkshire and the Humber	
	Slieve Kirk	Wind	73.6	2011	Northern Ireland	
	Strathy North	Wind	67.7	2015	Scotland	
	Tievenameenta	Wind	34.5	2017	Northern Ireland	
	Greater Gabbard	Wind (offshore)	504.0	2011	East	
	Clyde North	Wind	108.1	2012	Scotland	
	Clyde South	Wind	128.8	2011	Scotland	
Scottish Power: Hydro schemes - Cruachan	Cruachan	Pumped storage	440.0	1966	Scotland	
Scottish Power: Hydro schemes - Galloway	Tongland	Hydro	33.0	1935	Scotland	
Scottish Power: Thermal	Blackburn	CCGT	59.0	2011	North West	
	Damhead Creek	CCGT	805.0	2000	South East	
	Rye House	CCGT	715.0	1993	East	
	Shoreham	CCGT	420.0	2000	South East	
	Pilkington - Greengate *	Gas	10.0	1998	North West	
Scottish Power: Wind	Arecleoch	Wind	120.0	2010	Scotland	
	Beinn an Tuirc 2	Wind	43.7	2012	Scotland	
	Black Law	Wind	124.2	2005	Scotland	
	Black Law 2	Wind	55.4	2017	Scotland	
	Harestanes	Wind	136.0	2013	Scotland	
	Mark Hill	Wind	56.0	2011	Scotland	
	Penryddian & Llidiartywaun	Wind	30.6	1992	Wales	
	Whitelee	Wind	322.0	2007	Scotland	
	Whitelee 2	Wind	217.0	2012	Scotland	

For footnotes see page 150

5.11 Power Stations in the United Kingdom

(operational at the end of May 2017)[1] (continued)

Company Name	Station Name	Fuel	Installed Capacity (MW)	Year of commission or year generation began	Location Scotland, Wales, Northern Ireland or English region
Seabank Power Limited	Seabank 1	CCGT	812.0	1998	South West
	Seabank 2	CCGT	410.0	2000	South West
Sembcorp Utilities (UK) Ltd	Wilton 10	Biomass	38.0	2007	North East
	Wilton GT1 *	Gas	42.0	1952	North East
	Wilton GT2	Gas	42.0	2005	North East
SIMEC	Uskmouth Power	Coal	230.0	1966	Wales
South East London Combined Heat & Power Ltd	SELCHP ERF *	Waste	32.0	1994	London
Statkraft Energy Ltd	Rheidol	Hydro	56.0	1961	Wales
Statkraft Wind UK Ltd	Andershaw	Wind	36.3	2016	Scotland
	Baillie	Wind	52.5	2013	Scotland
	Berry Burn	Wind	66.7	2013	Scotland
	Dudgeon BMU 2	Wind	90.0	2017	England
	Dudgeon BMU 3	Wind	102.0	2017	England
	Sheringham Shoal BMU 1 & 2	Wind	316.0	2012	England
Third Energy Trading Ltd (Formerly RGS)	Knapton	Gas	40.0	1994	Yorkshire and the Humber
Uniper UK Limited	Connahs Quay	CCGT	1,380.0	1996	Wales
	Cottam Development Centre	CCGT	395.0	1999	East Midlands
	Enfield	CCGT	408.0	1999	London
	Grain CHP *	CCGT	1,404.0	2010	South East
	Ratcliffe	Coal	2,000.0	1968	East Midlands
	Grain GT	Gas oil	56.0	1978	South East
	Ratcliffe GT	Gas oil	34.0	1966	East Midlands
	Taylor's Lane GT	Gas oil	144.0	1979	London
	Killingholme	OCGT	600.0	1993	Yorkshire and the Humber
Vattenfall Wind Power	Clashindarroch	Wind	36.9	2015	Scotland
	Edinbane	Wind	41.0	2010	Scotland
	Pen y Cymoedd	Wind	228.0	2016	Wales
	Ray	Wind	54.4	2017	England
	Kentish Flats	Wind (offshore)	90.0	2005	South East
	Kentish Flats Extension	Wind (offshore)	49.5	2015	South East
	Ormonde	Wind (offshore)	150.0	2011	North West
	Thanet	Wind (offshore)	300.0	2010	South East
Viridor Waste Management	Ardley EfW	Waste	26.0	2014	South East
	Bolton EfW	Waste	8.0	1971	North West
	Cardiff EfW	Waste	30.0	2014	South Wales
	Exeter EfW	Waste	3.5	2014	South West
	Lakeside EfW	Waste	37.0	2010	South West
	Peterborough EfW	Waste	7.3	2016	East Midlands
	Runcorn EfW	Waste	81.0	2014	North West
VPI Immingham LLP	VPI Immingham *	Gas	1,240.0	2004	Yorkshire and the Humber
Wind Prospect	Corriegarth	Wind	69.0	2017	Scotland
Wind Prospect	Scout Moor	Wind	65.0	2009	North West
XceCo Ltd	Inner Dowsing	Wind (offshore)	97.0	2009	East Midlands
	Lynn	Wind (offshore)	97.0	2009	East Midlands
Total			**74,373**		

For footnotes see page 150

Other power stations

Renewable sources and combustible wastes	Other MPP wind onshore	2,115
	Other MPP wind offshore	532
	Other generators wind	3,388
	Other generators landfill gas	1,062
	Other generators sewage gas	257
	Other generators biomass and waste	1,738
	Other MPP hydro	545
	Other generators hydro	206
	Other MPP Solar	1,911
	Other generators solar photovoltaics and wave/tidal	9,544

For footnotes see page 150

5.11 Power Stations in the United Kingdom

(operational at the end of May 2017)[1] (continued)

Interconnectors

	Capacity (MW)
England - France	2,000
England - Netherlands	1,000
Scotland - Northern Ireland	500
Wales - Irish Republic	500
Northern Ireland - Irish Republic	600

Footnotes

(1) This list covers stations owned or operated by Major Power Producers, apart from non-thermal renewable sites under 30MW capacity (which are included in the database tab); other power stations (including many renewable sites and auto-generators) are included in the sub table on page 149.

(2) Capacity reduced in 2013, with these stations typically now operating as Open Cycle Gas Turbines.

(3) Total capacity is 1,840 MW but because of transmission constraints only 1,180 MW can be used at any one time.

* indicates CHP plant

5.12 Plant installed capacity, by connection - United Kingdom

MW

	end December				
	2012	2013	2014	2015	2016
Transmission Network - Great Britain					
Installed capacity (1)	**79,514**	**73,998**	**72,213**	**68,548**	**67,274**
Coal (2)	25,291	20,216	18,353	16,473	13,737
CCGT	32,067	30,805	29,880	29,444	29,854
Oil	2,725	1,370	1,370	-	-
Nuclear - Magnox	490	490	490	-	-
Nuclear - PWR	1,191	1,198	1,198	1,198	1,198
Nuclear - AGR	7,550	7,685	7,720	7,720	7,720
OCGT	981	1,112	1,076	937	888
Hydro	1,213	1,213	1,226	1,228	1,228
Onshore Wind	1,805	2,713	2,747	2,777	3,660
Offshore Wind	2,397	2,721	3,507	3,716	3,628
Bioenergy (3)	976	1,647	1,817	2,226	2,460
Pumped Storage	2,828	2,828	2,828	2,828	2,900
Distribution Network - Great Britain					
Installed capacity (1)	**13,985r**	**15,652r**	**19,395r**	**24,643r**	**27,730**
Coal (2)	589	28	33	22	22
CCGT	2,562r	2,530r	2,586r	2,363r	2,221
Oil	468	448	350r	374r	302
Diesel Engines	134	134	138	138	-
OCGT	166	105	90	90	-
Conventional Thermal Gas	707r	833r	883r	835r	862
Hydro	473	487	494	539r	597
Onshore Wind	3,640r	4,221	5,100	5,713r	6,377
Offshore Wind	599	975	994	1,378r	1,666
Bioenergy	2,160r	2,344r	2,693	2,968r	3,194
PV	1,751r	2,846	5,362	9,429r	11,763
Wave/Tidal	5	6	7	8	13
Other Fuels (4)	732	695	664r	788r	714
Transmission Network - Northern Ireland					
Installed capacity (1)	**2,395**	**2,395**	**2,395**	**2,395**	**2,375**
Coal (2)	520	520	520	520	500
CCGT	1,024	1,024	1,024	1,024	1,024
OCGT	311	311	311	311	311
Conventional Thermal Gas	540	540	540	540	540
Distribution Network - Northern Ireland					
Installed capacity (1)	**497r**	**647**	**798**	**912r**	**1,114**
Hydro	8	9	9	9r	10
Onshore Wind	458r	582	689	731r	886
Bioenergy	23r	28	37	64r	82
PV	6r	27	62	106r	136
Wave/Tidal	1	1	1	1	-
Transmission Network - Total UK					
Installed capacity (1)	**81,909**	**76,393**	**74,608**	**70,943**	**69,649**
Coal (2)	25,811	20,736	18,873	17,013	14,257
CCGT	33,091	31,829	30,904	30,468	30,878
Conventional Thermal Gas	540	540	540	540	540
Oil	2,725	1,370	1,370	-	-
Nuclear - Magnox	490	490	490	-	-
Nuclear - PWR	1,191	1,198	1,198	1,198	1,198
Nuclear - AGR	7,550	7,685	7,720	7,720	7,720
OCGT	1,292	1,423	1,387	1,248	1,199
Hydro	1,213	1,213	1,226	1,228	1,228
Onshore Wind	1,805	2,713	2,747	2,777	3,660
Offshore Wind	2,397	2,721	3,507	3,716	3,628
Bioenergy	976	1,647	1,817	2,226	2,460
Pumped Storage	2,828	2,828	2,828	2,828	2,900
of which, good quality CHP	2,159	2,113	2,141	1,976	1,976
Distribution Network - Total UK					
Installed capacity (1)	**14,482r**	**16,299r**	**20,193r**	**25,555r**	**28,843**
Coal (2)	589	28	33	22	22
CCGT	2,562r	2,530r	2,586r	2,363r	2,221
Oil	468	448	350r	374r	302
Diesel Engines	134	134	138	138	-
OCGT	166	105	90	90	-
Conventional Thermal Gas	707r	833r	883r	835r	862
Hydro	482	496	503	548r	607
Onshore Wind	4,099	4,803	5,789	6,445r	7,263
Offshore Wind	599	975	994	1,378r	1,666
Bioenergy	2,183r	2,372r	2,731	3,032r	3,275
PV	1,756r	2,873	5,424	9,535r	11,899
Wave/Tidal	7	7	9	9	13
Other Fuels (4)	732	695	664r	788r	714
of which, good quality CHP	3,806r	3,811r	3,752r	3,754r	3,595

(1) See paragraph 5.76 for definition.

(2) Includes mixed fuel stations (coal/oil, coal/gas) and co-firing coal stations.

(3) Includes 48 MW of Slough Heat and Power's mixed fuel capacity (remaining 13 MW included under coal).

(4) Includes coke oven gas, blast furnace gas, other gas/liquid/solid waste and waste heat from high temperature and chemical processes.

Chapter 6
Renewable sources of energy

Key points

Progress against the Renewable Energy Directive (RED) target

- **In 2016, 8.9 per cent of total energy consumption came from renewable sources;** up from 8.2 per cent in 2015. Renewable electricity represented 24.6 per cent of total generation; renewable heat 6.2 per cent of overall heat; and renewables in transport, 4.5 per cent.
- **The UK has now exceeded its third interim target;** averaged over 2015 and 2016, renewables achieved 8.5 per cent against its target of 7.5 per cent

Trends in generation

- **Electricity generation (table 6.4) in the UK from renewable sources fell marginally by 0.2 per cent between 2015 and 2016, to 83.2 TWh.** Lower rainfall and wind speeds resulted in lower hydro and wind generation, more than offsetting a 16 per cent increase in total capacity, to 35.7 GW in 2016 (table 6.4).
- For the second year running, **solar photovoltaics were the leading technology in capacity** terms at 11.9 GW, representing a third of total electricity capacity. This resulted in a 38 per cent increase in generation (table 6.4).
- **Onshore wind generation fell by 8.4 per cent to 21.0 TWh and offshore fell by 5.8 per cent to 16.4 GWh.** Wind speeds were lower than in 2015 which had been the highest in fifteen years, more than offsetting additional capacity for both onshore and offshore winds (table 6.4).
- **Generation from hydro sources fell by 14 per cent to 5.4 TWh in 2016**, although 2015 had seen the second highest rainfall during the preceding 15 years (table 6.4).

Renewable Heat

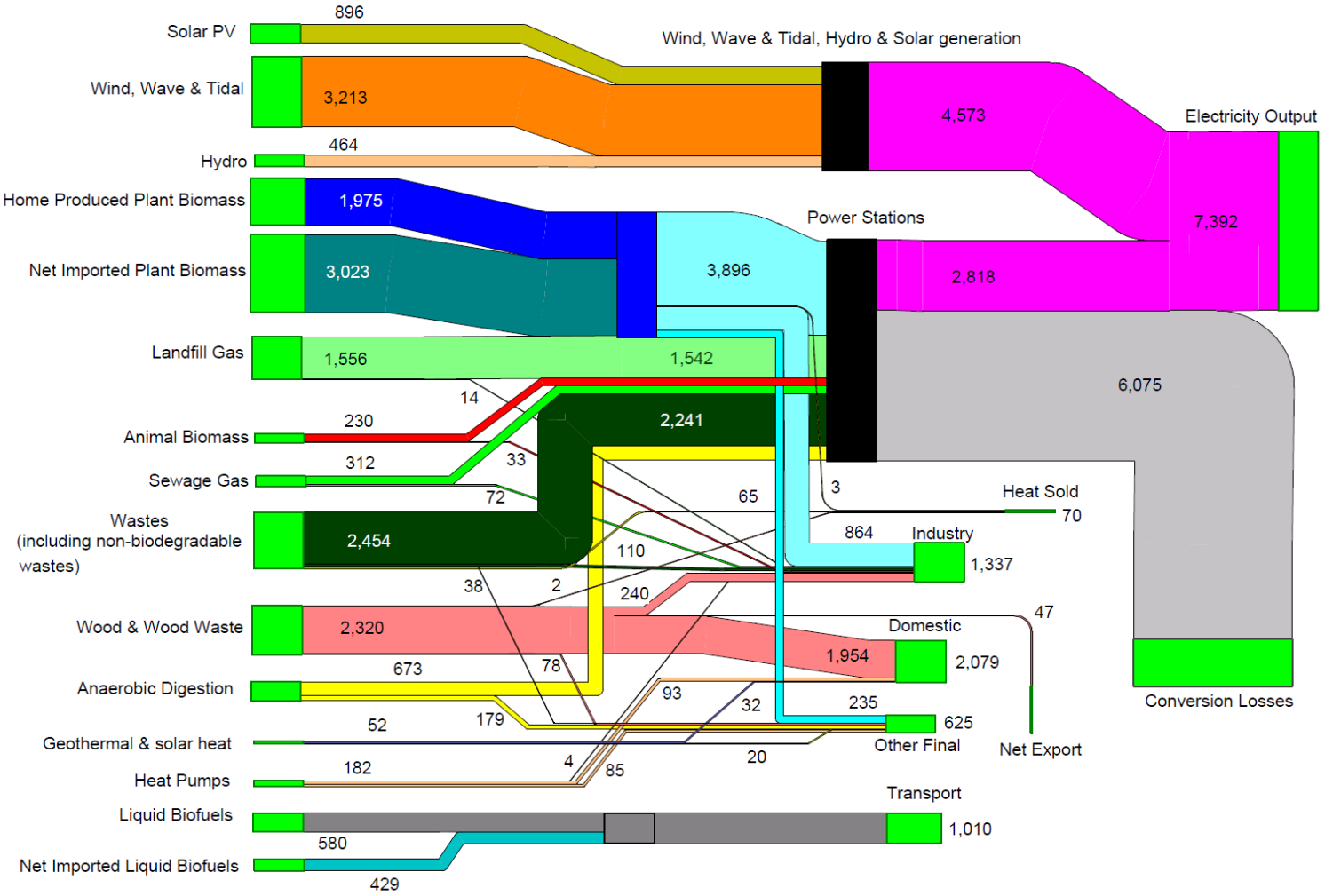
- **Renewable heat increased by 12 per cent** due to increases in plant biomass and anaerobic digestion schemes supported by the Renewable Heat Incentive (RHI)
- **The RHI supported 15 per cent of renewable heat in 2016**, an increase of 4.0 percentage points on 2015

Introduction

6.1 Energy from renewable sources has been steadily increasing since 2000 as a result of national and international incentives including the EU Renewable Energy Directive which requires the EU as a whole to achieve 20 per cent of its energy from renewable sources by 2020 (the UK's target is set at 15 per cent) (see the technical annex for a description of the policy context). The UK has a varied mix of renewable technologies including biomass which is a key fuel source in both electricity generation and heat. Wind, solar photovoltaics, hydro and shoreline wave and tidal also contribute to electricity generation and active solar, heat pumps and deep geothermal are used in heat generation (see the technical annex for descriptions of the sources of renewable energy). Liquid biofuels in transport also contribute to the separate RED transport target (for the UK, this is set at 10 per cent). Although solar photovoltaics was the leading technology in 2016 (a third of total capacity), in generation terms, bioenergy accounted for the largest proportion (36 per cent) followed by onshore wind (25 per cent) and offshore wind (20 per cent).

6.2 The renewable energy flow chart on page 154 summarises the flows of renewables from fuel inputs through to consumption for 2016 and includes energy lost in conversion; the data are sourced from the commodity balance table 6.1 and table 6.4 for electricity outputs.

Renewables flow chart 2016 (thousand tonnes of oil equivalent)



Note: This flow chart is based on data that appear in Tables 6.1 and 6.4

Renewable fuel demand (Tables 6.1 and 6.6)

6.3 The commodity balances tables for renewables (tables 6.1 to 6.3) show that a large proportion (83 per cent) of renewable fuel sources are produced domestically, largely due to the local nature of utilising natural resources such as wind, solar and hydro. However, bio energy fuels are transportable and a significant proportion is imported (27 per cent in 2016, including wood and liquid biofuels). Plant biomass showed the largest proportion of imports at 61 per cent, mainly wood pellets for electricity generation.

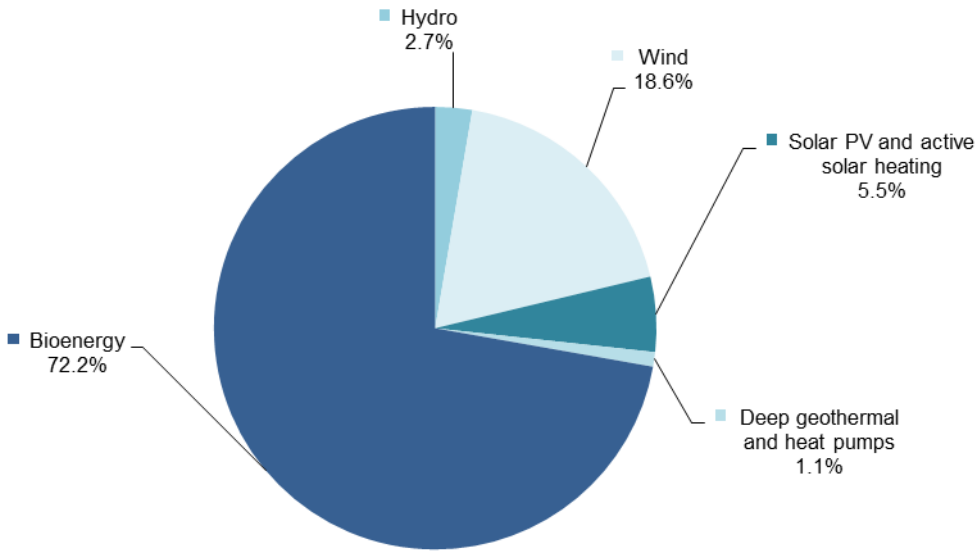
6.4 The balances also show for the first time, a transfer out from bioenergy. This represents biogas generated from farm waste digestion and injected into the gas grid. This has also been included for 2014 and 2015 as a revision (see paragraph 6.51). The amount transferred is then included as a positive transfer in the natural gas balance of chapter 4 (table 4.1).

6.5 Unlike other fuel sources, the renewables energy balances have zero statistical differences as the data are mostly taken from a single source where there is less likelihood of differences due to timing, measurement, or differences between supply and demand.

6.6 Table 6.6 shows how renewable fuel demand (excluding non-biodegradable waste) by source (i.e. on an input basis[1]) is split between electricity generation, heat and as a fuel in transport. Excluding non-biodegradable energy from waste, total demand in 2016 increased by 4.3 per cent, to 17,296 ktoe. This growth was due to an increase in bio energy demand, particularly in biodegradable energy from waste and anaerobic digestion used for electricity generation and also plant biomass used for heating purposes.

6.7 In 2016, 72 per cent of renewable energy demand was accounted for by bioenergy with wind accounting for 19 per cent. Chart 6.1 shows a comparison for the key renewables sources;

Chart 6.1: Renewable fuel use 2016

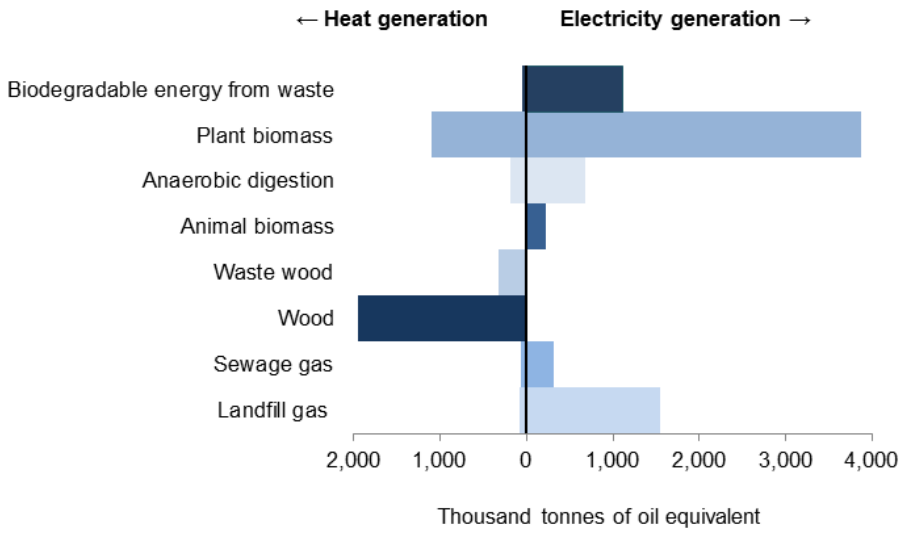


Total renewables used = 17,296 thousand tonnes of oil equivalent (ktoe)

[1] For combustible fuels used to generate electricity, this refers to the energy value of the fuel source rather than the actual electricity generated. For heat generation and primary electricity sources (solar photovoltaics, wind, hydro, and wave and tidal), the output energy is deemed to be equal to the fuel inputs.

6.8 Whilst several renewable technologies are specific to either electricity generation or heat production, combustible fuels are used for both purposes. In 2016, 68 per cent of biomass was used in electricity generation. Chart 6.2 below shows a further breakdown of biomass by source and also how its use is split between heating and electricity generation.

Chart 6.2: Biomass fuel use 2016

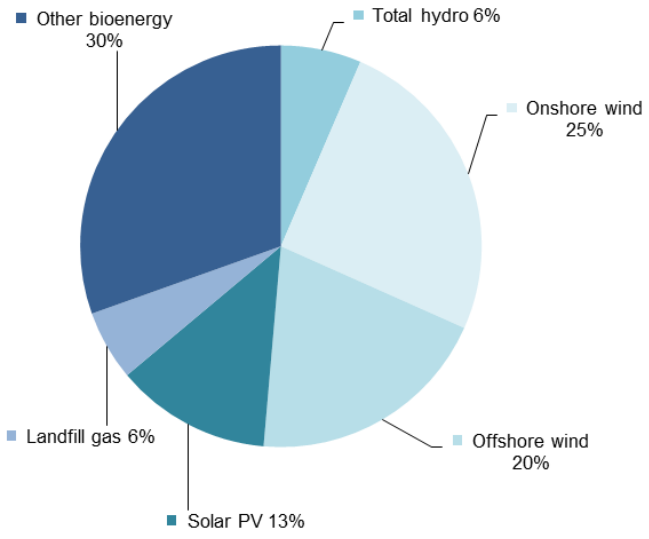


6.9 Where biofuels are used for generation, a comparison is made in the electricity generation section (paragraph 6.11) between the fuel input split and actual output generation.

Comparison of fuel use in heat consumption and electricity generation (Tables 6.6 and 6.4)

6.10 While bioenergy dominates on a fuel input basis (chart 6.1), hydroelectricity, wind power and solar together provide a larger contribution when the **output** of electricity is being measured as chart 6.3 shows;

Chart 6.3: Electricity generation by fuel source 2016



This is because on an energy supplied basis the inputs are deemed to be equal to the electricity produced for hydro, wind, wave and solar, i.e. are deemed to be 100 per cent efficient (see Chapter 5, paragraph 5.71). However for landfill gas, sewage sludge, municipal solid waste and other bioenergy sources a substantial proportion of the energy content of the input is lost in the process of conversion to electricity (6,075 ktoe in 2016), as the renewables flow chart (page 154) illustrates.

6.11 Generally growth in bioenergy fuels used in electricity generation will be similar to the growth in output generation unless there is a change in thermal efficiency (the amount of fuel required to produce a unit of electricity). Table 6.1 below shows the comparative growth rates between 2015 and 2016 for bioenergy fuel inputs and generation outputs;

Table 6A: Growth in fuel inputs versus generation for bioenergy

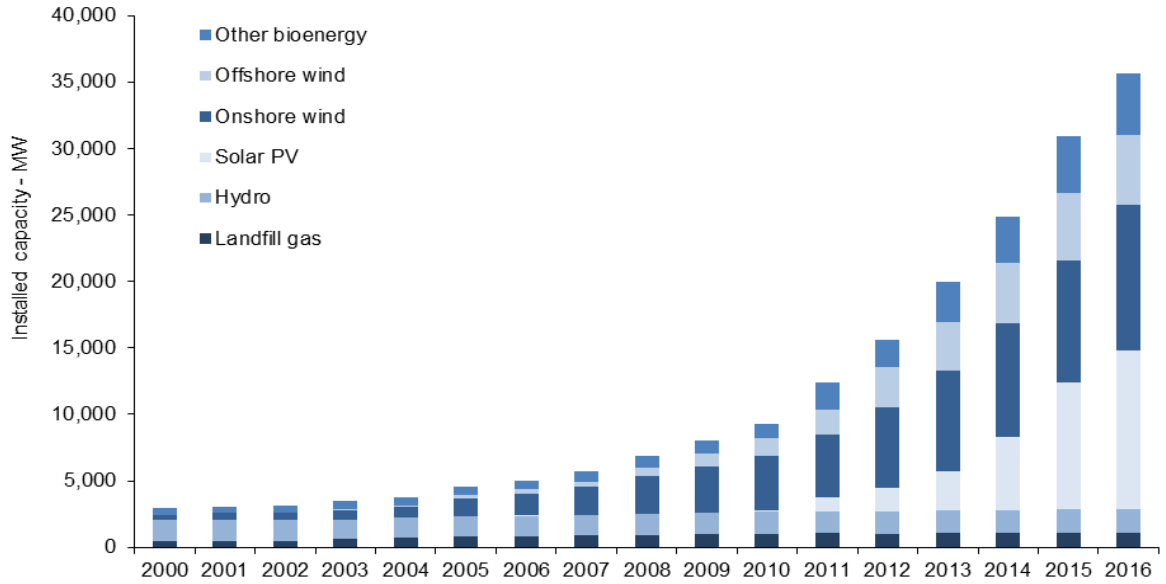
Growth between 2015 and 2016	**Fuel use** (table 6.6)	**Generation** (table 6.4)
Bioenergy:		
Landfill gas	-3.5%	-3.5%
Sewage sludge digestion	6.3%	6.3%
Biodegradable energy from waste	23.4%	6.0%
Co-firing with fossil fuels	-34.8%	-35.9%
Animal Biomass	-2.2%	0.4%
Anaerobic digestion	39.5%	39.5%
Plant Biomass	0.6%	1.3%
Total bioenergy	**5.0%**	**2.7%**

6.12 For the majority of biofuels, growth in fuel use is similar to generation growth with the exception of energy from waste. This is due to a drop in efficiency between 2015 and 2016.

Trends in Overall Electricity Generation and Capacity (table 6.4)

6.13 Although total generation capacity increased between 2015 and 2016 (by 16 per cent to 35.7 MW), generation actually fell (by 0.2 per cent to 83.2 GWh). Charts 6.4 and 6.5 below show the long term trends, highlighting 2016 as the first year to show a decrease (although generation supported by the Renewables Obligation showed an increase, by 0.8 per cent, table 6.4);

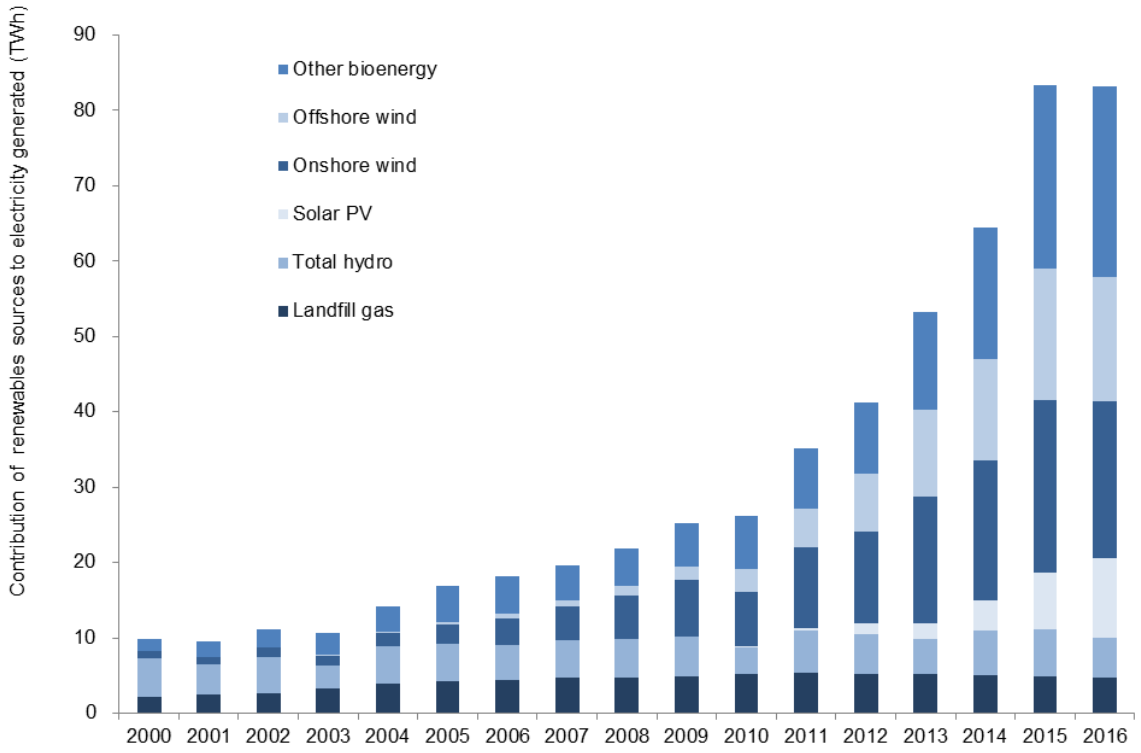
Chart 6.4: Electrical generating capacity of renewable energy plant



(1) All waste combustion plant is included because both biodegradable and non-biodegradable wastes are burned together in the same plant.

(2) Hydro includes both large scale and small scale, and shoreline wave (13.5 MW in 2016).

Chart 6.5: Electricity generation by main renewable sources



Note: Hydro bar includes shoreline wave/tidal (0.0007TWh in 2016)

6.14 The fall in generation in 2016 is due to lower wind and hydro generation; wind speeds were considerably lower than in 2015 and rainfall (in the main catchment areas) was also comparatively low. This is despite an increase in wind generation capacity, mostly in onshore wind which increased by 18 per cent to 10.9 GW, ahead of closure of the Renewables Obligation (RO) on 31 March 2017 (see para 6.57). Hydro generating capacity also increased; although large scale capacity is fairly stable, small scale increased by 20 per cent though from a small base (0.3 GW).

6.15 The decrease in wind and hydro generation was almost offset by a large increase in solar photovoltaic generation (by 38 per cent to 10.4 TWh, a record). This is the result of a large increase in capacity from both smaller installations supported by the Feed in Tariff (FiT) and particularly larger schemes supported by the Renewables Obligation. Although this increase in capacity has resulted in solar photovoltaics being the leading technology by capacity, its share of generation is fourth after onshore wind, offshore wind, and bioenergy. This is due to solar photovoltaics having a low load factor compared to other technologies [2] Table 6.B below shows the share of total generation and capacity and also their load factors for 2016;

Table 6B Share of generation and capacity by leading technologies

	Share of total capacity	Share of total generation	Load factor
Solar photovoltaics	33.3%	12.5%	11.1%
Onshore wind	30.6%	25.2%	23.7%
Bioenergy	16.1%	36.1%	62.0%
Offshore wind	14.8%	19.7%	36.0%
Hydro	5.1%	6.5%	34.0%
Total	100%	100%	

6.16 The table shows that the technologies with highest capacity do not necessarily have the highest share of generation, since this depends on the load factor (a high load factor giving a relatively higher share of generation).

Different measures of electricity generation (tables 6.4 and 6.7)

6.17 **Renewable sources provided 24.5 per cent of the electricity generated in the UK in 2016** compared to 24.6 per cent in 2015 (measured using the "international basis", i.e. electricity generated from all renewables except non-biodegradable wastes as a percentage of all electricity generated in the UK).

6.18 Generation from **renewable sources claiming Renewable Obligation Certificates (ROCs)** in 2016, at 76.1 TWh, was 0.8 per cent greater than in 2015 and a record. RO supported generation has increased by over 70 TWh since its introduction in 2002, a thirteen fold increase[3]. As a proportion of total electricity sales, RO supported generation actually increased (by 0.2 percentage points) to 26.2 per cent, compared to a fall in the share on the international basis. Table 6A and chart 6.6 show the three measures. Chart 6.6 illustrates the steady growth until this year, but shows the impact of weather conditions on generation this year, despite an increase in capacity.

[2] A measure of actual generation compared to maximum output. See individual technology sections and the methodology note for more details of drivers of load factors and how they are calculated.
[3] A small amount is due to existing hydro stations being refurbished and thus becoming within the scope of the RO definition, as opposed to new capacity being installed.

Table 6C: Percentages of electricity derived from renewable sources

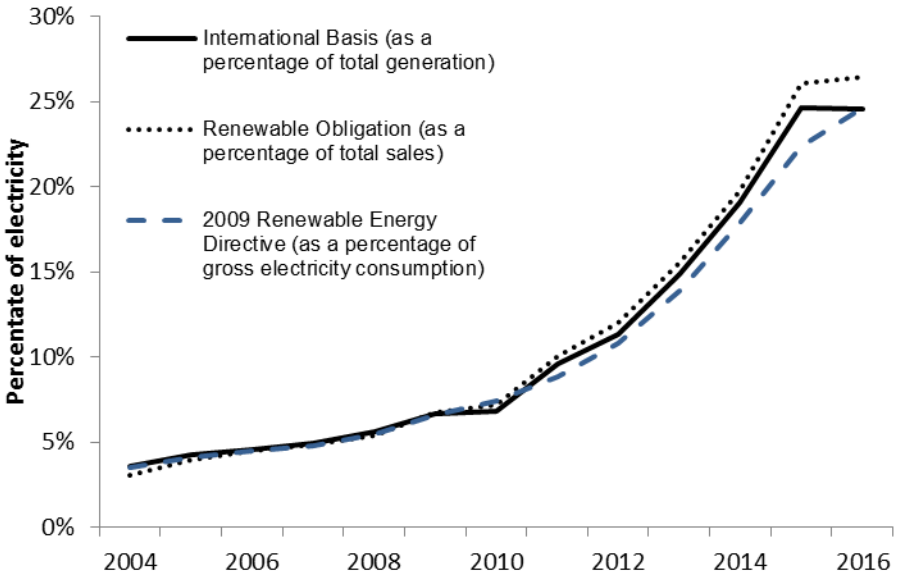
	2012	2013	2014	2015	2016
International Basis *(1)*	11.3	14.9	19.1	24.6	24.5
Renewable Obligation *(2)*	12	15.5	19.8	26.1	26.2
2009 Renewable Energy Directive *(3)*	10.8	13.8	17.8	22.3	24.6

[1] *All renewable electricity as a percentage of total UK electricity generation*

[2] *Measured as a percentage of UK electricity sales*

[3] *2009 Renewable Energy Directive measured as a percentage of gross electricity consumption*

Chart 6.6: Growth in electricity generation from renewable sources since 2004



Electricity Generation, Capacity, and Load Factors by technology (tables 6.4 and 6.5)

6.19 This section discusses trends in generation, capacity (table 6.4),and load factors (table 6.5), for the key technologies. Within renewables, load factors[4] can be heavily influenced by weather conditions; wind speeds affect the load factors for onshore and offshore wind, rainfall similarly impacts the load factor for hydro and, to a lesser extent, hours of sunshine impact the load factor for solar pv. The load factor calculation assumes that capacity is added evenly throughout the year which may not always be the case; for example, a large generator could add a high capacity installation towards the end of the year but may only generate for a very short period. To remove this, the second part of table 6.5 shows load factors on an "unchanged configuration basis". This calculation includes only those generators who are producing at the start and end of the year providing a more reflective picture of the underlying trend.

6.20 **Chart 6.7 at the end of this section shows trends in load factors for wind, hydro, and bioenergy**. The impacts of new capacity and changes in weather conditions can be observed in this time series.

Solar Photovoltaics[5]

6.21 **Solar photovoltaic generation showed the largest absolute increase of the renewable technologies, rising by 2.9 TWh (38 per cent) to 10.4 TWh in 2016, a record**. This is due to

[4] For further details of how load factors are calculated, refer to the methodology note

[5] See paragraphs 6.73 to 6.75 for a description of solar photovoltaics.

increases in capacity in both larger schemes supported by the RO and smaller schemes under the FiT programme; capacity increased by 25 per cent to 11.9 GW in 2016. For the second year, solar PV is the leading technology in capacity terms, representing a third of total capacity, though in generation terms, it accounts for just 13 per cent.

6.22 The load factor for solar pv decreased slightly in 2016, by 0.4 percentage points to 11.1. On an unchanged configuration, it fell by 0.5 percentage points to 10.8. The slightly lower load factor on the unchanged configuration basis is mainly due to the large amount of capacity that came online earlier in the year, largely in March (ahead of the closure of the RO to grace period large-solar and non-grace period small solar – see para 6.57).

6.23 The decrease in load factors (on both bases) could be explained by shorter average hours of sunshine in 2016; average hours in 2015 were in line with the ten year mean of 4.4 hours per day compared to 4.2 in 2016. June in particular showed particularly short hours of sun hours at 4.4 hours compared with the ten year mean of 6.8 hours per day and 7.5 for the month in 2015.

Wind[6]

6.24 **Total wind generation fell by 7.3 per cent to 37.4 TWh, despite an increase in capacity of 1.9 GW (13 per cent), mostly in onshore wind**. The reduction in generation is due to lower wind speeds in 2016 compared to 2015, though wind speeds for that year had been the highest for the preceding 15 years. In 2016, average wind speeds were 8.3 Knots, compared with 9.4 for 2015 and a ten year mean of 8.4 Knots. Wind speeds were particularly low for the months of November and December when compared to 2015, with November's wind speeds 3.4 knots lower and December's 4.6 knots lower.

6.25 **Onshore wind saw the largest fall in generation, by 8.4 per cent to 21.0 GWh in 2016**, despite a record 1.7 GW (18 per cent) increase in capacity, including Dunmaglass (94 MW) and Dersalloch (69 MW) in Scotland, and the first 156 MW of Wales's largest onshore wind farm, Pen y Cymoedd (256 MW on completion). The standard load factor fell by 5.7 percentage points to 23.7. On an unchanged configuration basis, the load factor was slightly higher (24.2 per cent), reflecting the higher levels of deployment towards the end of the year (76 per cent in the second half of the year) on this basis, the fall was 5.2 percentage points, as a result of the low wind speeds for the year.

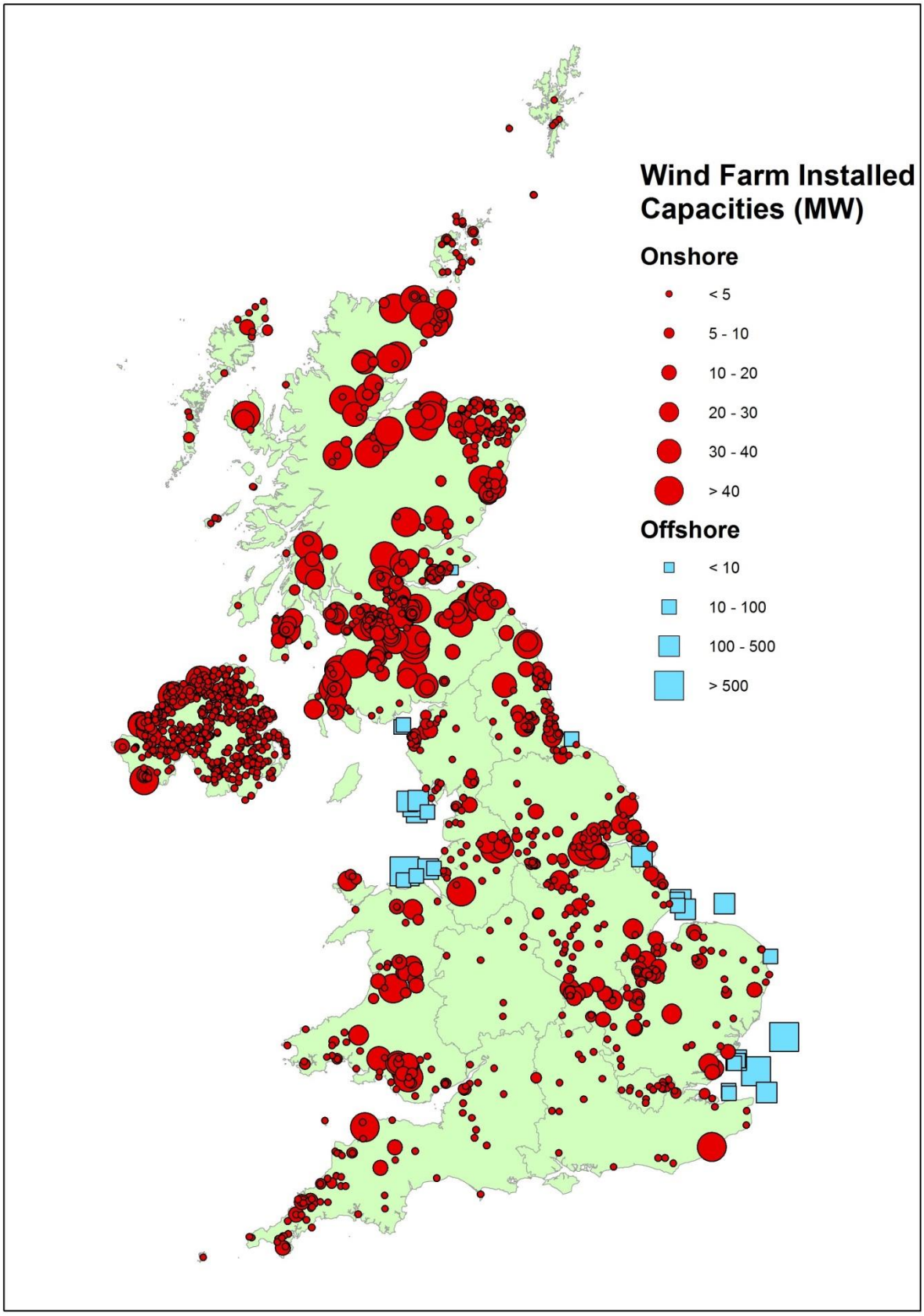
6.26 **Offshore wind generation fell by 1.0 GWh (5.8 per cent),** less than for onshore wind but with a much smaller increase in capacity. Capacity is now at 5.3 GW, an increase of 3.9 per cent (200 MW) on 2015, due to the installation of the first 200 MW (25 turbines) at the extension to Burbo Bank offshore wind farm in late 2016. This late installation resulted in the standard load factor being 0.5 percentage points lower than the unchanged configuration measure. The load factor fell on both bases, by 5.5 percentage points (standard) and by 3.1 percentage points (unchanged configuration) to 36.0 and 36.7 respectively.

Table 6C: Number of operational wind turbines split by FiTs and non FiTs accredited sites, as at end of December 2016

	FiTs confirmed	Other sites	Total
Onshore Wind	7,414	5,686	13,100
Offshore Wind	-	1,465	1,465
Total	**7,414**	**7,151**	**14,565**

The map on the following page shows the location of wind farms operational at the end of 2016 along with an indication of capacity;

[6] See paragraphs 6.76 to 6.6.82 for a description of onshore and offshore wind capacity and generation.


Wind Farm Installed Capacities (MW)
Onshore
< 5
5 - 10
10 - 20
20 - 30
30 - 40
> 40
Offshore
< 10
10 - 100
100 - 500
> 500

Hydro generation[7]

6.27 **Generation from hydro fell, by 14 per cent to 5.4 TWh in 2016**, partly due to 2015 being a record year, the result of high rainfall (in the main hydro catchment areas). Average rainfall in 2016 was 1,386 mm compared to 1,723 mm in 2015, the wettest year in the preceding fifteen years. Rainfall in 2015 was particularly high in December and was twice the ten year mean for that month. In comparison, rainfall in December 2016 was less than the ten year mean. Whilst large-scale hydro capacity remained unchanged, an increase in schemes supported by FiTs increased small-scale hydro by a record 59 MW (20 per cent). On a standard basis, the load factor fell, also the result of lower rainfall; by 5.5 percentage points for small scale hydro to 35.2 (34.6 per cent on an unchanged configuration basis), and by 7.3 percentage points for large scale, to 33.8.

Bioenergy[8]

6.28 **Generation from bioenergy increased by 2.7 per cent to 30.0 TWh, whilst capacity increased by 9.1 per cent to 5.7 GW**. The majority of the increase in generation was from anaerobic digestion with plant biomass accounting for most of the increase in capacity. Changes in load factors between 2015 and 2016 account for the differences in these trends; the load factor for anaerobic digestion increased in contrast to a decrease for plant biomass.

6.29 **Anaerobic digestion generation increased by 40 per cent to 2.1 TWh, a record**. Largely driven by installations supported by FiTs, capacity increased by 30 per cent to 0.4 GW. The differences in trends can be explained by the load factors; on an actual basis, the load factor increased by 3.5 percentage points to 62.8 per cent. On an unchanged configuration basis, the load factor increased by just 1.9 percentage points to 59.4[9].

6.30 **Generation from plant biomass increased by 1.3 per cent to 18.8 TWh compared to 9.3 per cent growth in capacity (to 2.9 GW in 2016**), the second highest absolute growth in capacity (after solar PV). Of the 244 MW of new plant biomass capacity, the Brigg and Snetterton straw–fired plants accounted for around 100 MW, with the remainder smaller plants. The actual load factor for plant biomass was 78.6 per cent for 2016, 8.7 percentage points less than for 2015, in part reflecting outages at Drax in the second half of the year (though the 2015 figure had been inflated due to the conversion of a third unit at Drax early in the first half of the year). On an unchanged configuration basis, the load factor actually increased in 2016 from 74.3 per cent to 78.9 per cent

6.31 **There were several new sites in 2016, generating using energy from waste**, including the 50 MW scheme at the Wilton complex at Redcar. This new capacity resulted in growth of 10 per cent to 1.0 GW in 2016, and prompted growth in generation from non-biodegradable waste of 6 per cent, to 2.7 TWh. The standard load factor fell from 36.8 in 2015 to 32.1 in 2016; on an unchanged configuration basis, the load factor fell by 1.7 percentage points to 34.6, with over 90 per cent of capacity being installed in the second half of the year.

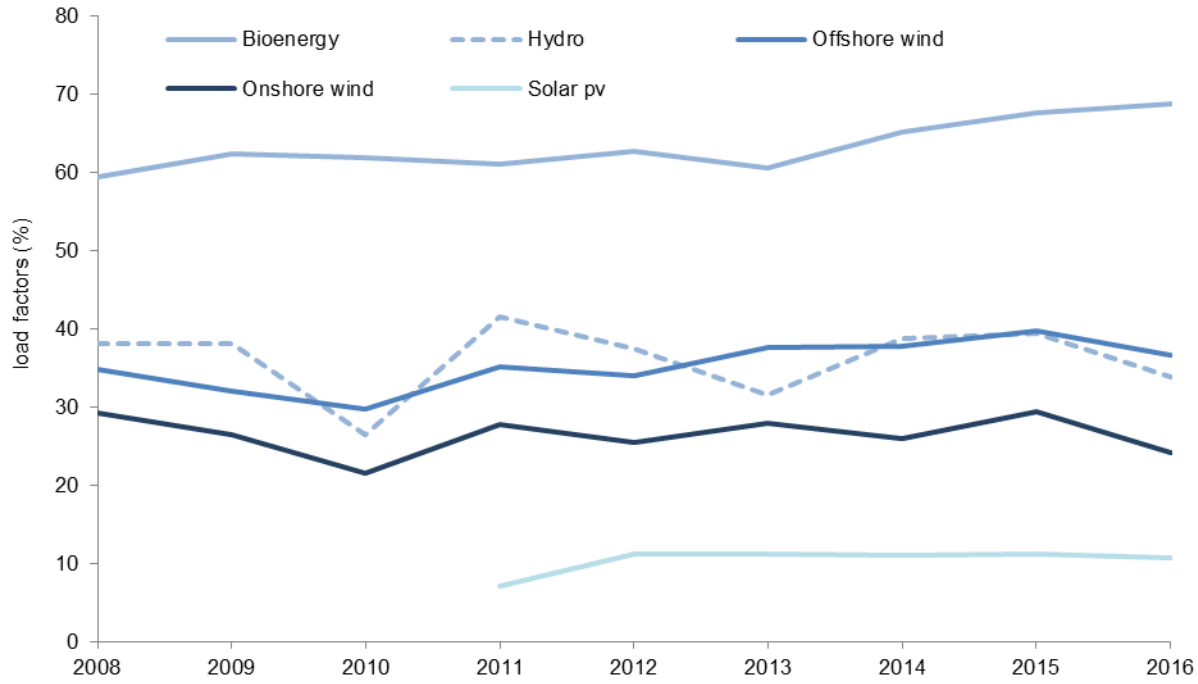
6.32 Generation from landfill gas fell for the fifth year in a row, as sites continue to become exhausted, and increasing quantities of waste are being recycled. Generation peaked in 2011 at 5.3 TWh and was 4.7 TWh in 2016, a decrease of 12 per cent. Generation fell by 3.5 per cent between 2015 and 2016. Over the same period, generation capacity for landfill gas (2011 to 2016) increased by 8.4 GW (0.8 per cent). On an unchanged configuration basis, the load factor for landfill gas has been falling since 2011; from 59.8 to 49.9 in 2016.

6.33 **Animal biomass generation increased by 0.4 per cent to 0.7 TWh with an increase in capacity of 17 per cent to 0.1 GW.** The load factor fell by 5.2 percentage points to 61.7 per cent in 2016 and by 9.7 percentage points to 57.2 per cent on an unchanged configuration basis). **Growth in sewage gas generation was 6.3 per cent, achieving 1.0 TWh in 2016**, due to an 11 per cent growth in capacity (to 0.3 GW). Although the load factor remained stable between 2015 (44.2) and 2016 (44.3), on an unchanged configuration basis, it fell by 5.1 percentage points to 43.1.

[7] See paragraphs 6.87 to 6.88 for a description of large and small scale hydro capacity and generation.
[8] See paragraphs 6.95 to 6.113 for a description of the various bio energy technologies.
[9] Generation from the majority of FiT schemes is estimated at an aggregate level; therefore, these schemes are not included in the unchanged configuration measure, which will largely be sites accredited on the RO.

6.34 Chart 6.7 below shows the load factors for the key renewable technologies since 2000. Although bioenergy has been grouped into one category, it is mostly influenced by plant biomass which represents 63 per cent of all generation from bioenergy. The chart shows that for weather dependent technologies, the load factors have fluctuated from year to year though there is no evidence of an underlying trend. However, for bioenergy, there has been a steady increase since 2011 representing an improvement in generation load factors, largely driven by the three Drax unit conversions, which tend to operate at high load factors, with a large share of bioenergy capacity.

Chart 6.7: Load factors[10] for renewable electricity generation since 2008



[10] On an unchanged configuration basis

Renewable heat (table 6.6)

6.35 **Renewable heat generation increased by 12 per cent in 2016 to 3,943 ktoe.** Of this increase (413 ktoe) 68 per cent was plant biomass. The largest increase in percentage terms was anaerobic digestion which increased 88 per cent. **Renewable energy from heat pumps increased by 17 per cent in 2016, from 156 ktoe to 182 ktoe,** due to an increase in capacity. Apart from a very small decrease in heat from sewage gas (by 1.4 per cent), heat from animal biomass was the only fuel source to see a decline in 2016; from 31 ktoe to 23 ktoe (25 per cent).

6.36 **Around 15 per cent of renewable heat was supported by the Renewable Heat Incentive (RHI) or Renewable Heat Premium Payment (RHPP) in 2016, compared to 11 per cent in 2015**. This increase is largely due to growth in RHI supported heat; from 379 ktoe (4,412 GWh) in 2015 to 589 ktoe, (6,583 GWh) in 2016[11]. The majority of the increase can be accounted for by bio methane injected into the gas grid, and also demand for biomass driven by the increase in small and medium biomass boilers in the non-domestic sector. Further information on the RHI and RHPP schemes can be found in paragraphs 6.70 to 6.72.

6.37 **Around 23 per cent of renewable sources were used to generate heat in 2016**, 2.0 percentage points higher than in 2015.

6.38 **Domestic wood combustion retained the largest share of renewable heat at 50 per cent**, followed by 28 per cent for plant biomass. Non-bioenergy renewable heat sources include solar thermal, deep geothermal and heat pumps, and combined these accounted for 5.9 per cent of total renewable heat, the same level as in 2015.

Liquid biofuels for transport (tables 6.1 and 6.6)[12]

6.39 Biofuels are made from recently-living biological material[13] and can be waste products, non-agricultural residue, or sourced from crops. The petrol substitutes are biomethanol and MTBE (methyl tern-butyl ether), and the diesel substitutes are FAME (fatty acid methyl ester), HVO (hydrogenated vegetable oil), pure plant oil.

6.40 **In 2016, 708 million litres of biodiesel[14] were consumed, 5.8 per cent higher than in 2015.** Biodiesel is considered the 'marginal fuel' supplied under the RTFO and therefore the supply of biodiesel fluctuates in response to changing market conditions. It is estimated that 385 million litres of biodiesel were produced in the UK in 2016, more than double the volume produced in 2015. Of this, about 96 million litres are known to have been used for non-transport applications or exported. Therefore, at least 420 million litres of biodiesel were imported in 2016. The total annual capacity for biodiesel production in the UK in 2016 is estimated to be around 541 million litres.

6.41 **Consumption of bioethanol fell in 2016, by 4.5 per cent to 759 million litres**. The UK capacity for bioethanol production at the end of 2016 was estimated to be around 910 million litres, although actual production was estimated to be 468 million litres, around half actual capacity. Of UK production, 219 million litres was known to be used for non-transport applications, or exported, so at least 509 million litres was imported.

6.42 During 2016, biodiesel accounted for 2.4 per cent of diesel, and bioethanol 4.4 per cent of motor spirit. The combined contribution of liquid biofuels for transport was 3.1 per cent, a decrease of 0.1 percentage points on 2015.

6.43 Volume data have been converted from litres to tonnes of oil equivalent and are shown in both the commodity balances (Tables 6.1 to 6.3) and in Table 6.6. In addition these data are also included in the aggregate energy balances (Tables 1.1 to 1.3). The tables show the contribution that liquid biofuels are making towards total renewable sourced energy. Renewable biofuels used for transport

[11] Note RHI and RHPP data is by date of payment as opposed to when the heat was generated
Source; www.gov.uk/government/collections/renewable-heat-incentive-statistics.
[12] See paragraphs 6.114 to 6.115 for a description of liquid biofuels.
[13] Department for Transport Renewable Transport Fuel Obligation statistics, notes and definitions;
www.gov.uk/government/uploads/system/uploads/attachment_data/file/519910/notes-and-definitions.pdf
[14] The most usual way for biodiesel to be sold is for it to be blended with ultra-low sulphur diesel fuel.

increased by 1.2 per cent (to 1,010 ktoe) between 2015 and 2016 with the majority of the increase being due to biodiesel (bioethanol consumption actually fell in 2016). In 2016, liquid biofuels for transport comprised 5.8 per cent of total renewable sources, 0.2 percentage points less than 2015.

6.44 When measuring the contribution of transport biofuels for the Renewable Energy Directive, only those meeting sustainability criteria count. The data referred to above do not contain sustainability information, including which fuels carry a higher reward (mostly sourced from waste), and the table which does, is not yet a complete data set for 2016. This is due to the RTFO allowing suppliers to make claims for RTFCs up to August after the obligation period (in order to allow suppliers to optimise their supply chain verification processes), as well as, allowing sufficient time for the Department for Transport to make necessary compliance checks before applications are processed. Table 6.7 records progress against the directive and includes an estimate of the proportion of bio liquids being compliant and also the proportion meeting the double credited criteria (mostly those from waste sources). Further information on the RTFO is given in paragraphs 6.66 to 6.69.

Renewable sources data used to indicate progress under the 2009 EU Renewable Energy Directive (RED) (Table 6.7)

6.45 The 2009 Renewable Energy Directive (RED) has a target for the UK to obtain 15 per cent of its energy from renewable sources by 2020. The target uses a slightly different definition of renewable and total energy than is used in the rest of the Digest, including the use of 'normalised' wind and hydro generated electricity. Further details on the RED methodology can be found in the methodology document.

6.46 Table 6.7 brings together the relevant renewable energy and final energy consumption data to show progress towards the target of 15 per cent of UK energy consumption to be sourced from renewables by 2020[15], and also shows the proportions of electricity, heat and transport energy coming from renewable sources. It is an update of the provisional figure published in the June 2017 edition of Energy Trends. D**uring 2016, 8.9 per cent of final energy consumption was from renewable sources**. **The third interim target, averaged across 2015 and 2016, was set at 7.5 per cent, and was exceeded at 8.5 per cent**. The fourth interim target is 10.2 per cent averaged across 2017 and 2018.

6.47 Overall renewable sources, excluding non-biodegradable wastes, provided 9.2 per cent of the UK's total primary energy requirements in 2016 (excluding energy products used for non-energy purposes). This is a different measure to that reported in the RED. The primary energy demand basis typically produces higher percentages because thermal renewables are measured including the energy that is lost in transformation. The thermal renewables used in the UK are less efficient in transformation than fossil fuels, so as non-thermal renewables such as wind (which by convention are 100 per cent efficient in transformation) grow as a proportion of UK renewables use, then the gross final energy consumption percentage will overtake the primary energy demand percentage. Both of these percentage measures are directly influenced by overall energy use: for instance, whilst the renewable energy component (the numerator in the RED calculation) increased by 9.4 per cent, the final consumption denominator increased by just 0.8 per cent. Table 6D shows both measures.

[15] This is an update of the first estimate of the UK progress published in the June 2017 edition of Energy Trends. It includes a member state comparison for 2015 and progress for the EU as a whole
www.gov.uk/government/statistics/energy-trends-june-2017-special-feature-article-renewable-energy-in-2016

Table 6D: Percentages of energy derived from renewable sources since 2012

	2012	2013	2014	2015	2016
Eligible renewable energy sources as a percentage of capped gross final energy consumption (i.e. the basis for the Renewable Energy Directive)	4.7%	5.7%	7.0%	8.2%	8.9%
Renewable energy as a percentage of primary energy demand	4.9%	5.9%	7.3%	8.8%	9.2%

Revisions to published data and new reporting

6.48 Renewables data have been revised back to 2010, with the most recent years seeing the largest revisions; mostly the result of more up to date information. There were also some reclassifications and also new reporting. Where revisions have been made, the values in the excel versions of the tables have been suffixed with an "r" to indicate the value has been changed since last published.

6.49 Some revisions have also been made to installed generating capacities (table 6.4) following an exercise to replace previously estimated data points with actual data, for 2010 to 2014, and including a reconciliation of different sources of survey and administrative data sources.

6.50 New data have enabled consumption in the industrial sector to be allocated to the relevant subgroup whereas previously it was all reported under "unclassified". This has also been included for 2015 data (tables 6.1 and 6.2).

6.51 For the first time biomethane injected into the gas grid has been reported for 2014, 2015, and 2016; previously there were so few sites, including it would have disclosed individual sites. This is shown in the energy balances tables (6.1 to 6.3) as a transfer out, and a corresponding transfer in is included in the natural gas commodity balance table.

6.52 RHI supported biomass has been reclassified (table 6.6, heat generation); this was included in industrial wood but is now reported under plant biomass with the negative revision for industrial wood combustion offsetting the positive revision for biomass.

6.53 Updated assumptions used in the calculation of heat generated by heat pumps have resulted in revisions (tables 6.1 and 6.6); previous research undertaken by University College London (UCL) in to the performance of heat pumps in situ has been updated and republished[16].

[16] www.gov.uk/government/publications/detailed-analysis-of-data-from-heat-pumps-installed-via-the-renewable-heat-premium-payment-scheme-rhpp

Technical Notes

European and UK Renewable Energy Policy Context

EU Renewable Energy Directive

6.54 In March 2007, the European Council agreed to a common strategy for energy security and tackling climate change. An element of this was establishing a target of 20 per cent of EU's energy to come from renewable sources. In 2009, a new Renewable Energy Directive (Directive 2009/29/EC) ('RED') was implemented on this basis and resulted in agreement of country "shares" of this target. For the UK, its share is that 15 per cent of final energy consumption - calculated on a net calorific value basis, and with a cap on fuel used for air transport - should be accounted for by energy from renewable sources by 2020. The RED included interim targets, and required each Member State to produce a National Renewable Energy Action Plan (which contains a progress trajectory and identifies measures which will enable countries to meet their targets). The Directive also requires each Member State to submit a report to the Commission on progress in the promotion and use of energy sources every two years. The UK's action plan and the first three progress reports (covering performance during 2009-2010, 2011-12, and 2013-14) are available at:
www.gov.uk/government/uploads/system/uploads/attachment_data/file/47871/25-nat-ren-energy-action-plan.pdf,

www.gov.uk/government/publications/first-progress-report-on-the-promotion-and-use-of-energy-from-renewable-sources-for-the-uk,

www.gov.uk/government/publications/second-progress-report-on-the-promotion-and-use-of-energy-from-renewable-sources-for-the-united-kingdom,

www.gov.uk/government/publications/third-progress-report-on-the-promotion-and-use-of-energy-from-renewable-sources-for-the-united-kingdom

The fourth progress report will cover 2015-16 and will be published in January 2018.

UK Renewables Policy

6.55 The UK's low carbon policies have seen renewable electricity capacity increase by more than three times since 2010. In 2016, renewables provided nearly one quarter of the UK's electricity generation, and we are on track to comfortably exceed our ambition of delivering 30% of the UK's electricity from renewables in 2020-21.

Renewables Obligation (RO)

6.56 The Renewables Obligation (RO) came into effect in April 2002[17]. It is an obligation on electricity suppliers to source a specific proportion of electricity from eligible renewable sources or pay a penalty. The proportion is measured against total electricity sales (as shown in Table 5.5 contained in the electricity chapter of this Digest). The Obligation is intended to incentivise an increase in the level of renewable generating capacity and so contribute to our climate change targets. Examples of RO eligible sources include wind energy, bioenergy (including landfill gas, sewage gas, biomass, anaerobic digestion and energy from waste), hydro, photovoltaics, wave and tidal energy and deep geothermal. Ofgem (which administers the RO) issues Renewables Obligation Certificates (ROCs) to qualifying renewable generators. These certificates may be sold by generators directly to licensed electricity suppliers or to traders. Suppliers present ROCs to Ofgem to demonstrate their compliance with the obligation.

[17] Parliamentary approval of the Renewables Obligation Orders under The Utilities Act 2000 was given in March 2002. The Renewables Obligation covering England and Wales and the analogous Renewables (Scotland) Obligation came into effect in April 2002. Northern Ireland introduced a similar Renewables Obligation in April 2005. Strictly speaking until 2005, the RO covers only Great Britain, but in these UK based statistics Northern Ireland renewable sources have been treated as if they were also part of the RO.

6.57 When the Obligation was first introduced, 1 ROC was awarded for each MWh of renewable electricity generated. In 2009, 'banding' was introduced into the RO, meaning different technologies now receive different numbers of ROCs depending on their costs and potential for large scale deployment; for example new offshore wind in Great Britain receives 1.8 ROCs/MWh while onshore wind receives 0.9 ROCs/MWh. The more established renewable technologies such as sewage gas receive 0.5 ROCs/MWh. A review of the bands across the UK concluded in 2012 and set the level of support under the RO from 1 April 2013 – 31 March 2017. Banding reviews ensure that, as market conditions and innovation within sectors change and evolve, renewables developers continue to receive the appropriate level of support necessary to maintain investments within available resources. In Great Britain, the RO closed to large-scale solar PV (over 5MW) on 31 March 2015 and to small-scale solar (up to 5MW) on 31 March 2016. It closed to all capacities of onshore wind in Great Britain on 12 May 2016. In Northern Ireland, it closed to large-scale onshore wind (over 5MW) on 31 March 2016 and to small-scale onshore wind (up to 5MW) on 30 June 2016. The scheme closed to all other technologies on 31 March 2017, although existing generating stations will continue to receive support for 20 years, up to 2037. Various grace periods are available which extend the closure date in certain specified situations. Details of the grace periods are available on Ofgem's website at: www.ofgem.gov.uk/environmental-programmes/renewables-obligation-ro/information-generators/closure-renewables-obligation-ro .

A list of technologies eligible for the RO, details of the RO banding review, and the level of ROCs received, is available at:
www.gov.uk/guidance/calculating-renewable-obligation-certificates-rocs

6.58 Table 6.4 contains a row showing the total electricity eligible for the RO. Prior to 2002 the main instruments for pursuing the development of renewables capacity were the Non Fossil Fuel Obligation (NFFO) Orders.

Electricity Market Reform (EMR)

6.59 Contracts for Difference has replaced the RO for new renewable energy stations. Contracts for Difference tackle the risks and uncertainties of the underlying economics of different forms of electricity generation by offering long term contracts for low carbon energy.

6.60 In effect, companies will get a fixed and secure price at which they can sell their electricity to consumers. This will allow investors to be confident about the returns of their capital in advance of investing billions into new infrastructure schemes. It will also encourage banks to lend at cheaper rates because the projects are less risky. Further details are available at:
www.gov.uk/government/publications/contracts-for-difference/contract-for-difference

Feed-in Tariffs (FiTs)

6.61 The Feed-in Tariff (FiT) scheme is a policy mechanism designed to support investment in small-scale renewable and low carbon electricity generation projects up to 5MW capacity. It offers long term support to projects and provides tariffs based on the costs of generation for each technology. The technologies supported are: solar PV, onshore wind power, hydropower, anaerobic digestion (AD), and micro (<2kW) combined heat and power (micro-CHP). Under the scheme, generators receive three sources of income/savings:

- A Generation tariff - a payment for every kWh generated, dependent on the technology and capacity of the installation, and date installed;
- An Export tariff - an additional payment for every kWh exported to the local electricity network; and
- Bill savings - additional benefit from usage of electricity "onsite" as opposed to paying the retail price for importing that energy from the grid.

Provisionally, overall Feed-in Tariff (FIT)-scale deployment at the end of May 2017 was 6,091 MW (902,560 installations). This represented an 8% increase in total FIT installed capacity and a 4% increase in the number of installations compared to the same period in 2016. Around 99% are solar PV installations (82% of capacity). Statistical reports are available at:
www.gov.uk/government/statistics/monthly-small-scale-renewable-deployment

6.62 The scheme has been hugely successful in attracting investment. A review of the scheme took place in 2015 and new measures were introduced in early 2016 to ensure the scheme's costs are effectively controlled and it provides value for money for the consumers that fund it through their bills. A review of support for AD and mCHP concluded in February 2017 with similar measures introduced. Details are available at:

www.gov.uk/government/consultations/review-of-support-for-anaerobic-digestion-and-micro-combined-heat-and-power-under-the-feed-in-tariffs-scheme

Feed in Tariff Supported Capacity

6.63 Much small scale (up to 5 MW capacity) renewable electricity in Great Britain is supported by and has increased as a result of, the Feed in Tariff (FiT) scheme. During the first nine months (April and December 2010) of the FiT scheme, a total of 71 MW of renewable capacity was installed and subsequently confirmed on it. During 2011, a further 976 MW of FiT supported renewable capacity was installed. For 2012, 892 MW of capacity was added and in 2013, 624 MW. In 2014, 996 MW of capacity was added, while in 2015, a further 1,726 MW of FiT capacity was installed, with 84 per cent of this new capacity coming from solar photovoltaics (PV). A further 676 MW of solar PV capacity was installed in 2016.

6.64 **The greatest increase in FiT capacity in percentage terms in 2016 was from solar photovoltaics**, from 4,368 MW at the end of 2015 to 4,856 MW at the end of 2016. Onshore wind increased from 608 MW at the end of 2015 to 695 MW at the end of 2016, while hydro capacity increased from 124 MW to 181 MW, and anaerobic digestion from 229 MW to 274 MW. At the end of 2016, solar PV represented 81 per cent of commissioned FiTs capacity (down from 82 per cent at the end of 2015), with onshore wind 12 per cent (up from 11 per cent), and anaerobic digestion 4.6 per cent (up from 4.3 per cent) and hydro increased from 2.3 to 3.0 per cent. It should be noted that, due to administrative lags of around three months, much capacity installed towards the end of 2016 was not confirmed until the first quarter of 2017 (so the amount of capacity installed under FiTs at the end of 2016 will not equal the amount actually confirmed on the Central FiTs Register).[18]

6.65 Table 6B shows the number of sites generating renewable electricity at the end of 2016. There were 917,488 sites, although this figure is dominated by small-scale solar PV installations confirmed on FiTs.

Table 6E: Number of sites generating renewable electricity, as at end of December 2016 (excluding co-firing)[19]

	FiTs confirmed	Other sites	Total
Onshore Wind	7,414	5,686	13,100
Offshore Wind	-	1,465	1,465
Marine energy	-	14	14
Solar PV	786,502	113,643	900,145
Hydro	971	344	1,315
Landfill gas	-	450	450
Sewage sludge digestion	-	192	192
Energy from waste	-	51	51
Animal biomass (non-AD)	-	6	6
Anaerobic digestion	366	160	526
Plant biomass	-	224	224
Total	**795,253**	**122,235**	**917,488**

[18] At the end of 2016, 5,421 MW of renewable capacity was commissioned (and subsequently confirmed) on the Central FiTs Register. This includes 37 MW commissioned prior to the start of FiTs on 1 April 2010.
[19] The number of sites (as with overall capacity) is subject to revision, due to lags in data sources. This particularly affects solar PV, where more sites may have come online since compiling this edition of DUKES.

Renewable Transport Fuel Obligation (RTFO)

6.66 The Renewable Transport Fuel Obligation, introduced in April 2008, placed a legal requirement on road transport fuel suppliers (who supply more than 450,000 litres of fossil petrol, diesel or renewable fuel per annum to the UK market) to ensure that 4.75 per cent (by volume) of their overall fuel sales were from a renewable source by 2013/14 and all subsequent years, with incremental levels of 2.5 per cent (by volume) for 2008/09, 3.25 per cent (by volume) in 2009/10, 3.5 per cent (by volume) in 2010/11, 4.0 per cent (by volume) in 2011/12, and 4.5 per cent (by volume) in 2012/13. Under the RTFO all obligated companies are required to submit data to the RTFO administrator on volumes of fossil and renewable fuels they supply. Renewable Transport Fuel certificates are issued in proportion to the quantity of biofuels registered.

6.67 The RTFO (amendment) Order, made in 2011, introduced mandatory carbon and sustainability criteria for all renewable fuels and double rewards for some fuel types, including those made from waste and residue materials. From April 2013 the end uses covered by the RTFO were amended to include non-road mobile machinery, agriculture and forestry tractors and recreational craft when not at sea. Further information on the RTFO policy can be found at: www.gov.uk/government/collections/renewable-transport-fuels-obligation-rtfo-orders#guidance

6.68 The verified RTFO biofuels statistics, including information on origin and sustainability from 2008 onwards can be found at: www.gov.uk/government/collections/biofuels-statistics.

6.69 The Department for Transport consulted in 2016 on a range of proposals to increase the supply and sustainability of renewable transport fuels, including proposals to increase the obligation from 2017 and to set a trajectory to 2020 and beyond. Other proposals included increasing the supply of waste derived fuels, encouraging the production of advanced, or 'development', fuels, and renewable fuels of non-biological origin and setting a maximum level for the supply of fuels made from crops. The consultation closed in January 2017 and the department aims to publish its response in due course.

Renewable Heat Incentive and Premium Payment

6.70 The Renewable Heat Incentive (RHI) scheme is a government financial incentive scheme introduced to encourage a switch to renewable heating systems in place of fossil fuels. The tariff based scheme is split into two parts:

- The non-domestic RHI scheme which has been open to commercial, industrial, public sector, not for profit and community generators of renewable heat since November 2011.
- The domestic RHI scheme which opened on 9 April 2014 and is available to homeowners, private and social landlords and people who build their own homes.

Further information on this scheme, including details of the technologies, can be found at: www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi.

6.71 The Renewable Heat Premium Payment (RHPP) voucher scheme, launched in August 2011, made one-off payments to householders to help them buy renewable heating technologies. This scheme closed on 31 March 2014 prior to the introduction of the domestic RHI scheme. Further information on the RHPP can be found at www.gov.uk/renewable-heat-premium-payment-scheme with further data available at www.gov.uk/government/collections/renewable-heat-incentive-renewable-heat-premium-payment-statistics.

6.72 Table 6E below shows the breakdown of technologies accredited to the domestic scheme, over the period 9 April 2014 (launch date) to 31 December 2016, with average installed capacity and heat paid out for under the scheme. In total there were 52,971 accreditations, with 1,408,656 MWh of heat generated and paid for. Further data and information relating to the RHI can be found at: www.gov.uk/government/collections/renewable-heat-incentive-statistics.

Table 6F: Domestic Renewable Heat Incentive accreditations, average capacity installed and estimated heat generation to December 2016

Technology	Number of accreditations	Average (mean) capacity installed (kW)	Heat paid out under the scheme (MWh)
Air source heat pump	25,031	9.8	338,336
Ground source heat pump	7,738	12.3	213,054
Biomass systems	12,164	24	784,787
Solar thermal	8,038	-	22,478
Total	**52,971**	**-**	**1,408,656**

Sources of Renewable Energy

Active solar heating

6.73 Active solar heating employs solar collectors to heat water mainly for domestic hot water systems but also for swimming pools and other applications. There are primarily two key designs: flat-plate, comprising a dark absorbing material with a cover to reduce heat loss and a liquid – usually water with antifreeze – to extract the heat from the absorber, and evacuated-tube collectors that use heat pipes for their core to extract the energy instead of passing liquid directly through them. Planning permission is required for free-standing domestic solar panels of more than $9m^2$, but the more common form of installation is the roof mounted scheme which does not require planning permission.

Solar photovoltaics (PV)

6.74 Photovoltaics (PV) is the direct conversion of solar radiation into direct current electricity by the interaction of light with the electrons in a semiconductor device or cell. Within the UK, PV installations are primarily either ground-mounted solar farms, usually built on low-grade farmland and disused facilities (e.g., airfields) or rooftop devices mostly retrofitted to existing buildings. The installation costs associated with these has fallen dramatically in recent years. Since April 2010 support for small scale (less than 5 MW) solar PV and other micro-generation technologies in Great Britain had been provided by FiTs (see paragraph 6.62), resulting in a rapid expansion in solar PV capacity. Larger-scale (> 50 kW) solar PV and all installations in Northern Ireland were supported by the Renewables Obligation (RO) (see paragraph 6.57)[1]. As of 31 March 2017, the Renewables Obligation is now closed to all new generating capacity which was replaced by the FiT Contracts for Difference (CFD) scheme but only for the first round.

6.75 The small Scale Feed In Tariff Scheme has seen significant cuts in support through both revisions to the scheme, and uptake-based degression, and will in any case end in 2019. There are indications the market is seeking to develop schemes without subsidy, though these are likely to seek other ways of ensuring cost effectiveness, e.g., through private wire, or combining with storage to sell at other times of day, or simply being very large (several tens of MW).

6.76 On Saturday 25 March 2017, demand on the National Transmission System was, for the first time ever, lower during the afternoon, than it was overnight. This was due to very high levels of PV generation, even in March. This will become common place in future summer days with implications for management of the grid and for operation of fossil fuelled plant.

Onshore wind power

6.77 Onshore wind is one of the most mature renewable energy technologies. The UK has a good onshore wind resource, with wind speeds particularly good in Scotland, Northern Ireland and Wales but less suitable in England, particularly in the South East. A wind turbine extracts energy from the wind by means of a rotor (usually a three-bladed horizontal-axis rotor) that can be pitched to control the rotational speed of a shaft linked via a gearbox to a generator.

6.78 For larger scale installations, turbine size has increased steadily over the years. The average new turbine size for operational schemes over the last 5 years was around 2.5 MW. For those schemes under construction, however, this is moving towards 3 MW. A small number of the early projects which were installed around 20 years ago have re-powered. This involves replacing ageing turbines with larger, more efficient ones and increasing tower height to take advantage of the higher wind speeds found at increased height above ground level. Multiple turbines are often sited together in ‘wind farms’ and the electricity generated is supplied to the electricity grid. In England and Wales, planning applications for large-scale (>50MW) wind farms are now handled by local authorities. In addition, the Renewables Obligation is now closed to all new generating capacity which is replaced by the Contracts for Difference (CFD) scheme administered by National Grid.

[1] Eligible GB schemes between 50 kW and 5 MW capacity can currently choose between the RO and FiTs.

6.79 In the small-medium wind market (1.5–100 kW), generated energy is often used to satisfy on-site demand. Small-scale wind system technology can be subdivided into three categories: micro wind turbines (0–1.5 kW), small wind turbines (1.5–15 kW) and small–medium wind turbines (15–100 kW). The two main designs are the horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT).

6.80 In terms of operational characteristics, siting considerations and the value and nature of the market, small-scale wind systems vary markedly from large-scale units. Small-scale wind systems can be off-grid or on-grid; mobile or fixed; free-standing or building-mounted; or they can form part of combined installations, most commonly with photovoltaic systems. As a result, they have a greater range of applications, compared to large-scale wind turbines and can be used in commercial, public or domestic settings and as single or multiple installations providing power to communities.

Offshore wind power

6.81 The UK has some of the best offshore wind resource in Europe, with relatively shallow waters and strong winds. The Renewable Energy Roadmap[20] highlights offshore wind as a key technology that will help the UK meet the 2020 RED target, with a potential deployment by 2020 of up to 18 GW subject to cost reduction. This would correspond to around 17 per cent of the UK's net electricity production.

6.82 Offshore winds tend to blow at higher speeds and are more consistent than on land, thus allowing turbines to produce more electricity (because the potential energy produced from the wind is directly proportional to the cube of the wind speed, increased wind speeds of only a few miles per hour can produce a significantly larger amount of electricity) but it is more-costly to implement than onshore wind. However, onshore constraints such as planning, noise effects, visual impact and the effects of transportation of large components are reduced offshore. As a result, offshore turbines are generally larger than their onshore counterparts, with the current commercially available turbines having a rated capacity of between 3 and 6 MW. A number of larger, offshore specific, turbines, however, are currently being developed. Floating concepts are also being developed as they are considered by many to be more viable (both economically and environmentally) in deeper waters.

6.83 In the development of the UK's offshore wind capacity, the Crown Estate have run a number of leasing rounds under which areas of the seabed have been made available for the development of offshore wind farms. Round 1 started in December 2000, Round 2 in July 2003 and Round 3 in January 2010. Construction of some Round 3 capacity (Rampion) has already begun. The Crown estate published a detailed account of progress with operational offshore wind in 2016[21].

Marine energy (wave and tidal stream power)

6.84 Ocean waves are created by the interaction of winds with the surface of the sea. Because of the UK's position on the north eastern rim of the Atlantic it has some of the highest wave power levels in the world. Tidal currents are created by the movement of the tides, often magnified by local topographical features such as headlands and channels. Tidal current energy is the extraction of energy from this flow, analogous to the extraction of energy from moving air by wind turbines. Tidal range power can be extracted from tidal barrage and tidal lagoon systems. With a tidal barrage across an estuary, water is collected during the flood tide, creating a head of water. During the ebb tide the water flows out of the pool through low-head hydro turbines thus generating electricity. Some technologies also allow generation on ebb and flood. A tidal lagoon works in a similar manner, but an artificial pool is used to collect the water. The UK is still seen as the world leader in wave and tidal stream technology; however a number of other countries are rapidly developing sites for wave and tidal installations with the associated supply chain such as Canada, France, South Korea and Australia.

6.85 In 2015, The Crown Estate announced a new programme of leasing for small scale wave and tidal current test and demonstration projects under 3MW. This allows developers to apply for leases when their technology is ready and they have raised sufficient finance rather than being restricted to

[20] www.gov.uk/government/collections/uk-renewable-energy-roadmap
[21] www.thecrownestate.co.uk/media/1050888/operationalwindreport2017_final.pdf

leasing calls. This provides greater opportunities for tidal turbines of 100kW or less to be deployed, with a large number of developers successfully commissioning small scale prototype turbines.

6.86 Atlantis and Andritz both commissioned turbines in 2017 and are currently completing operational trials. Scotrenewables report having generating 18MWh over a 24-hour period with their 2MW device, subject to losses, this equates to an offshore wind competitive 37.5% capacity factor. Conversely Sustainable Marine Energy moved their prototype testing overseas reducing the potential for installed capacity in UK waters this year, whilst Delta Stream went into administration.

6.87 Wave Energy Scotland continue to provide research and development funding to a number of wave developers to look at ways of improving the performance and reliability of wave device subsystems and components. Innovate UK have also opened a call to support wave and tidal projects. Wave energy deployment in the UK is still limited to early prototypes. The UK Government review of tidal lagoons was published at the end of 2016. This concluded that tidal lagoons can play a cost effective role in the UK's energy mix. The review recommends a less than 500MW pathfinder project is identified to take forward as tidal lagoons would help deliver security of supply; they would assist in delivering our decarbonisation commitments; and they would bring real and substantial opportunities for the UK supply chain.

Large scale hydro

6.88 In hydro schemes the turbines that drive the electricity generators are powered by the direct action of water either from a reservoir or from the run of the river. Large-scale hydro cover plants with a capacity of 5 MW and over and most of these are located in Scotland and Wales where they mainly draw their water from high-level reservoirs with their own natural catchment areas. The data in this Chapter excludes pumped storage stations. The UK has one mixed pump storage and natural flow hydro station, at Foyers in Scotland. Whilst it is primarily a pumped storage site, the generation attributed to the natural flow component of this station can be calculated, and is included in the large-scale hydro generation figures in this Chapter. However, the natural flow share of the capacity cannot be separated, and is therefore not included.

Small scale hydro

6.89 Hydro electricity generation schemes with a capacity below 5 MW are classified as small scale, with those less than 50kW referred to as micro-scale. These are schemes for either domestic/farm purposes or for local sale to electricity supply companies. The majority of new development will fall into this category and will remain eligible for FITs support following the closure of the RO on 31st March 2017.

Deep geothermal energy

6.90 There are two broad types of deep geothermal technology; for direct heat use (where temperatures are above 60^{o}C) and for power generation (though normally for combined heat and power) usually where the resource temperature is above 120^{o}C. The UK's deep geothermal resources include hot aquifers (i.e. subterranean bodies of water) in the North East, Wessex and Cheshire and the 'hot dry rocks' in Cornwall which are likely to have the greatest potential (at 5km depth) for power generation. There are two simple models for deep geothermal projects. Where a hot aquifer has been identified, it is possible to simply pump the hot water to the surface and use it directly, for example in a heat network. The water then needs to be either disposed of or re-injected into the ground via a second borehole. An alternative model is to pump cold water from the surface down into a volume of hot rock, exploiting existing fractures in the rock or creating these through Enhanced Geothermal System techniques, and then recovering it to the surface once it has been heated.

6.91 The Government has provided grant support for this sector. Deep geothermal electricity generation was also supported under the RO and is now eligible for support under the Contracts for Difference. Deep geothermal energy for direct heat use, defined as coming from a drilling depth of at least 500m, is eligible for support under the Renewable Heat Incentive. The tariff is currently set at 5.22p/kWh (commissioned on or after 4 December 2013) from 1 April 2015.

6.92 At present there are no deep geothermal power plants in the UK. The UK's only existing geothermal heat generating station is at Southampton, where an 1800m borehole taps into the edge of the aquifer under Wessex and provides heat to the Southampton district heat network.

Heat pumps

6.93 Heat pumps extract heat from the local surroundings, either from the air (ASHP), the ground (GSHP) or water (WSHP). Only heat extracted from ambient surroundings is eligible as renewable heat, i.e. exhaust heat from other processes is not included. Heat pumps can be dedicated to heat production or reversible, such that they can be operated in either a heating or cooling mode. Currently only heat from dedicated heat pumps is included in the statistics. Dedicated ASHP and GSHP are eligible technologies in both the domestic and non-domestic RHI.

6.94 Heat pumps require an energy source to operate. The majority use electricity to operate a compression cycle. The seasonal performance factor (SPF) estimates the ratio of the heating output of the heat pump to the electricity input over the whole heating season and so reflects the efficiency a heat pump achieves when installed. The Renewable Energy Directive (Annex VII) sets out the equation for calculating how much of the energy generated by heat pumps should be considered renewable and a minimum SPF is part of that equation. Heat pumps which do not meet the minimum SPF are not counted as renewable under the Directive. The latest available guidance from the European Commission gives a minimum SPF of 2.5, based on an average pan-European electricity efficiency. Recent analysis of performance of a sample of the domestic heat pumps installed in the UK under the Renewable Heat Premium Payment Scheme (RHPP)[22] showed that about 62% of ASHP and 80% of GSHP achieved the minimum SPF.

6.95 Eurostat now requires that renewable heat statistics should include renewable heat from all heat pumps, including those with an SPF lower than the minimum required under RED. This edition of DUKES follows the Eurostat methodology.

Bioenergy and wastes

(a) Landfill gas

6.96 Landfill gas is a methane-rich gas formed from the natural decomposition of organic material in landfill sites. The gas can be used to fuel reciprocating engines or turbines to generate electricity or used directly in kilns and boilers. In other countries, the gas is cleaned to pipeline quality or used as a vehicle fuel. Landfill gas exploitation benefited considerably from NFFO and this resulted in a large rise in electricity generation from 1992. The load factor continues to steadily decrease, as the gas producing resource becomes depleted. Landfill operators respond to reducing gas yields by removing modular generating sets when it is no longer economic to run.

(b) Sewage sludge digestion

6.97 Sewage sludge digestion is the break down of the solid part of sewage by natural bacteria in a sealed tank in the absence of oxygen to produce a methane rich sewage gas. Some plants only use the sewage gas to generate heat but many use combined heat and power (CHP) systems, with the electricity generated being used on site or sold. Some sites also co-digest other feedstocks (e.g., food waste) with sewage sludge.

(c) Domestic wood combustion

6.98 Wood has been used for home heating, cooking and hot water for many years. Traditionally, wood has been used in the form of logs in multi-fuel stoves and open fires. It is difficult to obtain information on domestic wood fuel use as wood is sourced from a wide range of sources, many of them informal.

6.99 Domestic wood consumption represents a sizeable contribution to UK renewable heat production. In 2015, BEIS commissioned a large scale survey of households in the UK to provide an updated baseline estimate. The results suggested that wood fuel use had previously been

[22] Final report on analysis of heat pump data from the RHPP scheme. UCL energy institute, March 2017.

underestimated by a factor of three[23]. The survey confirmed that closed stoves and open fires remain the most common wood fuel appliances installed. These appliances are usually used to supply some of the home heating, although about 12% of wood fuel users use wood as their main fuel. Logs remain the most common form of wood fuel (90% of wood fuel users). The survey indicated a substantial contribution to domestic wood fuel supply from the informal sector including from farmers, garden contractors, self-supply, foraging, and use of discarded wood.

6.100 Wood fired boilers and wood pellet stoves are eligible for the domestic RHI. These appliances utilise mainly wood pellets and wood chips. Currently the proportion of wood pellets and wood chips fuelling these appliances remains a small proportion (about 4%) of the total domestic wood fuel use.

(d) Non-domestic wood combustion

6.101 Use of sawmill residues, furniture manufacturing offcuts etc.as wood fuel (Industrial wood fuel use) has been included as a separate category since 1997. This wood is either used for heat or CHP in house, or is sold as wood fuel. Surveys in 2000 and 2006 showed that the in-house use of wood residues had declined due to the imposition of more stringent emissions controls. Since the introduction of the Renewable Heat Incentive (RHI) in 2011, there has been increased interest in the use of wood fuel. The wood fuel is sourced both from forestry and woodland management (Plant Biomass), and from in-house and recycled by-products (Industrial wood fuel). Typically wood fuel is used for space heating and hot water in commercial and public sector properties such as hotels, schools, hospitals, nursing homes, poultry farms, horticulture, and government buildings. The non-domestic RHI has supported some 9,365 GWh of heat from biomass, mostly wood, to December 2016 since its inception in November 2011. This is equivalent to some 1.5 million oven dried tonnes of commercial wood pellets.

(e) Energy crops and forestry residues

6.102 Miscanthus and Short Rotation Coppice (SRC) are grown in the UK as energy crops intended for the heat and electricity energy markets. To date they have been burnt in power stations, CHP units and heating systems. Official area estimates of Miscanthus and SRC grown in England are available from 2008 in the Defra June survey of Agricultural statistics, and have been summarised by Defra[24]. These show that only small areas of these crops are currently planted in England, with estimates of about 6,900ha of Miscanthus and 2,900ha of SRC in 2015. Based on Renewables Obligation sustainability reporting data, Defra estimate that about 33,000 tonnes of UK Miscanthus and 15,000 tonnes of UK SRC was used in UK power stations in 2014/15. Data for 2016 are not yet available but are unlikely to be too dissimilar.

(f) Straw combustion

6.103 Straw can be burnt in high temperature boilers, designed for the efficient and controlled combustion of solid fuels and biomass to supply heat, hot water and hot air systems; there are large numbers of these small-scale batch-fed whole-bale boilers.

6.104 There has also been a rapid growth in the number of straw-fired power stations, with schemes in the high straw production areas of the eastern parts of England at Ely, Cambridgeshire (40MW), Sleaford (45MW), Brigg (54.6MW) and Snetterton (45MW).

(g) Waste combustion

6.105 Domestic, industrial and commercial wastes represent a significant resource for materials and energy recovery. Unprocessed wastes may be combusted in purpose built incinerators or the waste can be processed into a range of refuse derived fuels (RDF) for both on-site and off-site use. RDF can be partially processed to produce coarse RDF that can then be burnt in a variety of ways. By further processing the refuse, including separating off the fuel fraction, compacting, drying and densifying, it is possible to produce an RDF pellet. This pellet has around 60 per cent of the gross calorific value of British coal. Only the biodegradable portion of waste is counted in renewables statistics although non-biodegradable wastes are included in this chapter as “below the line” items. The paragraphs below describe various categories of waste combustion in greater detail.

[23] Summary Results of the Domestic Wood Fuel survey. BEIS. Published in Energy Trends March 2016. www.gov.uk/government/publications/summary-results-of-the-domestic-wood-use-survey

[24] www.gov.uk/government/statistics/area-of-crops-grown-for-bioenergy-in-england-and-the-uk-2008-2015

6.106 **Municipal solid waste (MSW) combustion:** MSW comprises domestic waste plus other feedstocks, such as, general industrial waste, building demolition waste and tree clippings from civil amenities. Sample areas for the analysis of household collected waste are selected using ACORN socio-economic profiles (ACORN stands for A Classification Of Residential Neighbourhoods). This is based on the premise that households of similar socio-economic characteristics are likely to have similar behavioural, purchasing and lifestyle characteristics; this will be reflected in the quantity and composition of waste that those households produce. Since 2014, approximately 50% of these feedstocks is considered to be biodegradable and therefore only this is taken into account when calculating the renewable statistics from this resource. These wastes are primarily burnt in purpose-built combustion facilities fitted with enhanced flue gas treatment. There is considerable interest in the use of Advanced Conversion Technologies (ACT) as an alternative treatment technology but there are known to be technical issues with several of the facilities.

6.107 **General industrial waste (GIW) combustion:** Certain wastes produced by industry and commerce can be used as a source of energy for industrial processes or space heating. These wastes include general waste from factories such as paper, cardboard, wood and plastics. A survey conducted in 2001 noted that GIW was now burnt in MSW waste-to-energy facilities. As no sites are solely burning GIW for heat or electricity generation, this feedstock is being handled under the MSW category.

6.108 **Specialised waste combustion:** Specialised wastes arise as a result of a particular activity or process. Materials in this category include scrap tyres, hospital wastes, poultry litter, meal and bone and farm waste digestion.

6.109 **Specialist non-biodegradable waste**. Although a dedicated tyre incineration plant with energy recovery has not generated since 2000, the cement industry has burned some waste tyres in its cement and lime kilns. Although part of waste tyre combustion is of biodegradable waste, this small biodegradable content has currently been included under non-biodegradable wastes in this chapter.

6.110 **Hospital waste**. The combustion of clinical waste has been used to produce both heat and electricity. The results of the survey showed an ongoing process of centralisation and consolidation, in response to changes in pollution emissions and clinical waste regulations. Generation has now focused on larger plants with many smaller facilities closing as the cost of compliance with regulations made them no longer viable.

6.111 **Animal biomass**. The first small-scale CHP poultry litter combustion project began generating towards the end of 1990 but was subsequently closed due to new emissions regulations. It provided useful data which resulted in the World's first poultry litter-fired power station in 1992 closely followed by a second in 1993. Further schemes started generating in 1998, 2000 and 2001. One of the earlier poultry litter projects was modified to be fuelled mainly by meat and bone; two additional schemes fuelled primarily by meat and bone have also been built.

(h) Anaerobic digestion (AD)

6.112 Anaerobic Digestion uses natural bacteria to break down biomass in a sealed tank in the absence of oxygen to produce a methane rich biogas. The biomass fuel includes wet wastes such as animal manures and slurries, crop residues and food waste and/ or purpose grown crops such as maize. The biogas can be used for process heat, or for heat and electricity generation using a combined heat and power unit. Alternatively, the biogas can be upgraded to biomethane by removal of the carbon dioxide and cleaning/ conditioning the gas for use in transport applications or injection into the gas grid. Increasingly the energy requirements for the biomethane production are provided by an on-site CHP powered by biogas. The CHP unit may also export excess electricity to the grid.

6.113 The indigestible material left after the AD process is called digestate. This is rich in nutrients and can be used as a fertilizer. Digestate can be used whole and spread on land. Alternatively, it can be separated into liquor and fibres. Separated fibre can be used fresh as a soil conditioner or, after further aerobic composting to stabilise it, used as a compost product.

(i) Co-firing of biomass with fossil fuels

6.114 Compared with dedicated renewable facilities, co-firing has a relatively low capital cost and is quick to implement. Biomass fuel is usually fed into a conventional power station boiler by means of the existing firing mechanism as a partial substitute for fossil fuel. The pulverised fuel preparation, transport and combustion system of a modern power plant may cope with approximately 5 - 10 per cent substitution without any major mechanical changes. The boiler design and airflows however may permit much higher percentages if the burner systems are modified. Specially designed burners have been introduced on some installations in the UK. Interest in co-firing has now waned as this will no longer be supported under the RO and has encouraged some stations to undergo conversion to dedicated biomass firing.

(j) Biodiesel and bioethanol (Liquid Biofuels for Transport)

6.115 Biodiesel is a liquid fuel produced from biological sources of oils and fats by trans-esterification. The ester content of biodiesel is not less than 96.5 per cent by weight and the sulphur content must not exceed 0.005 per cent by weight[25] Biodiesel can be blended in low proportions with fossil diesel for use in diesel engines. Diesel fuel currently sold at retail outlets in the UK can contain up to 7 per cent biodiesel. Biodiesel can be produced from oil crops, such as rapeseed and soy or from waste fats and oils. In 2015/16 the feedstock for biodiesel consumed in the UK for transport was almost entirely waste fats and oils[26].

6.116 Bioethanol a liquid fuel consisting of ethanol produced from biomass. Bioethanol can be blended with petrol at low proportions for use in petrol engines. Petrol currently sold in at retail outlets in the UK can contain up to 5% bioethanol. Since March 2013 a revised petrol standard (EN228) allows retailers to sell petrol containing up to 10% ethanol by volume (E10), if appropriately labelled[27]. Bioethanol can be produced from sugar or starch from purpose grown crops such as corn (maize), wheat and sugar beet. It can also be produced from waste feedstocks such as sugar/ starch residues. In 2015/16 about 20% of bioethanol consumed in the UK was supplied from waste feedstocks.

Combined Heat and Power (CHP)

6.117 A CHP plant is an installation where useful heat and power (usually electricity) are supplied from a single generation process. Some CHP installations are fuelled either wholly or partially by renewable fuels. The main renewable fuel currently used in CHP is sewage gas, closely followed by other biomass.

6.118 Chapter 7 of this Digest summarises information on the contribution made by CHP to the UK's energy requirements in 2010 to 2016 using the results of annual studies undertaken to identify all CHP schemes (CHPSTATS). Included in Tables 7.1 to 7.9 of that chapter is information on the contribution of renewable sources to CHP generation in each year from 2010 to 2016. Corresponding data for 1996 to 2008 are available on the BEIS section of the gov.uk website. The information contained in those tables is therefore a subset of the data contained within the tables presented in this chapter. There are occasionally differences in the numbers reported by CHPSTATS compared with RESTATS that are primarily attributed to whether the electricity is considered to come from 'good quality' CHP (further details on 'good quality' CHP are provided in Chapter 7). In addition, there are oddities with some CHP facilities where both biomass and fossil fuels are burnt (though not always as co-firing). The total installed capacity recorded for the site under CHPSTATS can cover multiple generators, some of which only handle fossil fuels (e.g. gas turbines). As it would be misleading to record the entire capacity reported in RESTATS as being potentially available for renewables generation, only the appropriate capacity figures are recorded.

Generating capacity and load factor

6.119 The electrical capacities are given in Table 6.4 as installed capacities i.e. the maximum continuous rating of the generating sets in the stations. In Chapter 5 Declared Net Capacity (DNC) is used, i.e. the maximum continuous rating of the generating sets in the stations, less the power

[25] www.gov.uk/government/publications/excise-notice-179e-biofuels-and-other-fuel-substitutes/excise-notice-179e-biofuels-and-other-fuel-substitutes

[26] RTFO year 8 report. www.gov.uk/government/statistics/biofuel-statistics-year-8-2015-to-2016-report-6

[27] www.gov.uk/government/uploads/system/uploads/attachment_data/file/232126/petrol-protection-extention-ia.pdf

consumed by the plant itself, and reduced by a specified factor to take into account the intermittent nature of the energy source e.g. 0.43 for wind, 0.365 for small hydro, 0.33 for shoreline wave, and 0.17 for solar photovoltaics. DNC represents the nominal maximum capability of a generating set to supply electricity to consumers. For electrical capacities of generation using renewables in DNC terms see Table 6.1.1 on the BEIS section of the gov.uk website.

6.120 Plant load factors shown in Table 6.5 have been calculated in terms of installed capacity (i.e. the maximum continuous rating of the generating sets in the stations) and express the average hourly quantity of electricity generated as a percentage of the average of the capacities at the beginning and end of the year. Additionally, the unchanged configuration load factor has now been used for a number of years, which calculates the amount of electricity generated from wind farms compared with the amount that such turbines would have generated had they been available for the whole of the calendar year and running continually and at maximum output throughout the calendar year.

6.121 It is recognised that one of the shortcomings of the data contained in the Digest (end of calendar year) is that finalised ROCs data are often not available for several months following the compilation process for the Digest. In particular this can have an impact on the schemes included in the unchanged configuration definition as new data could include or remove particular schemes. This should be kept in mind if users wish to reanalyse these results.

Contacts: *Liz Waters*
BEIS Energy Statistics Team
elizabeth.waters@beis.gov.uk
0300 068 5735

James Hemingway
BEIS Energy Statistics Team
james.hemingway@beis.gov.uk
0300 068 5042

6.1 Commodity balances 2016

Renewables and waste

Thousand tonnes of oil equivalent

	Waste wood	Wood	Animal biomass and anaerobic digestion *(4)*	Plant biomass *(5)*	Sewage gas	Landfill gas
Supply						
Production	298	2,022	1,271	1,975	384	1,556
Other sources	-	-	-	-	-	-
Imports	38	41	-	3,032	-	-
Exports	-17	-109	-	-9	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-165	-	-	-
Total supply (2)	**319**	**1,954**	**1,106**	**4,998**	**384**	**1,556**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**319**	**1,954**	**1,106**	**4,998**	**384**	**1,556**
Transformation	**2**	**-**	**903**	**3,899**	**312**	**1,542**
Electricity generation	-	-	903	3,896	312	1,542
Major power producers	-	-	210	3,233	-	-
Autogenerators	-	-	693	663	312	1,542
Heat generation	2	-	-	3	-	-
Petroleum refineries	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Other	-	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-
Coal extraction	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-
Other	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**317**	**1,954**	**202**	**1,099**	**72**	**14**
Industry	**240**	**-**	**33**	**864**	**72**	**14**
Unclassified	-	-	12	40	-	-
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	13	-	11	147	-	14
Chemicals	-	-	-	26	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	7	30	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	3	596	-	-
Other industries	227	-	-	26	72	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**78**	**1,954**	**169**	**235**	**0**	**-**
Domestic	-	1,954	-	-	-	-
Public administration	-	-	-	-	0	-
Commercial	38	-	-	156	-	-
Agriculture	40	-	169	79	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).
(2) Including non-biodegradable wastes, which accounted for 1,291 ktoe.
(3) Total supply minus total demand.
(4) Includes poultry litter, meat and bone and farm waste
(5) Includes straw, short rotation coppice (SRC), and other plant based biomass
(6) Municipal solid waste, tyres, general industrial waste and hospital waste.
(7) The amount of marine energy was very small.

6.1 Commodity balances 2016 (continued)

Renewables and waste

Thousand tonnes of oil equivalent

Waste *(6)*	Solar photovoltaics, active solar heating, and deep geothermal	Heat pumps	Hydro	Wind and marine energy *(7)*	Liquid biofuels	Total renewables	
							Supply
2,454	948	182	464	3,213	580	15,347	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	632	3,743	Imports
-	-	-	-	-	-203	-338	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-165	Transfers
2,454	**948**	**182**	**464**	**3,213**	**1,010**	**18,587**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
2,454	**948**	**182**	**464**	**3,213**	**1,010**	**18,587**	**Total demand**
2,307	**896**	**-**	**464**	**3,213**	**-**	**13,537**	**Transformation**
2,241	896	-	464	3,213	-	13,467	Electricity generation
790	175	-	340	2,641	-	7,389	Major power producers
1,451	721	-	124	572	-	6,078	Autogenerators
65	-	-	-	-	-	70	Heat generation
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Energy industry use**
-	-	-	-	-	-	-	Electricity generation
-	-	-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Losses**
148	**52**	**182**	**-**	**-**	**1,010**	**5,050**	**Final consumption**
110	**-**	**4**	**-**	**-**	**-**	**1,337**	**Industry**
78	-	4	-	-	-	134	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	185	Mineral products
-	-	-	-	-	-	26	Chemicals
2	-	-	-	-	-	2	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	37	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	599	Paper, printing, etc
31	-	-	-	-	-	355	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**1,010**	**1,010**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	1,010	1,010	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
38	**52**	**178**	**-**	**-**	**-**	**2,704**	**Other**
-	32	93	-	-	-	2,079	Domestic
37	0	-	-	-	-	38	Public administration
1	20	85	-	-	-	299	Commercial
-	-	-	-	-	-	288	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	**-**	

6.2 Commodity balances 2015

Renewables and waste

Thousand tonnes of oil equivalent

	Waste wood	Wood	Animal biomass and anaerobic digestion *(4)*	Plant biomass *(5)*	Sewage gas	Landfill gas
Supply						
Production	342r	2,011r	928r	1,924r	366r	1,612
Other sources	-	-	-	-	-	-
Imports	50r	35	-	2,836r	-	-
Exports	-73	-138	-	-37r	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-84r	-	-	-
Total supply (2)	**319r**	**1,908r**	**844r**	**4,723r**	**366r**	**1,612**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**319r**	**1,908r**	**844r**	**4,723r**	**366r**	**1,612**
Transformation	**2r**	**-**	**718r**	**3,892r**	**293r**	**1,598**
Electricity generation	-	-	718r	3,885r	293r	1,598
Major power producers	-	-	209	3,381	-	-
Autogenerators	-	-	509r	505r	293r	1,598
Heat generation	2r	-	-	6r	-	-
Petroleum refineries	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Other	-	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-
Coal extraction	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Pumped storage	-	-	-	-r	-	-
Other	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**317r**	**1,908r**	**126r**	**831r**	**73**	**14**
Industry	**239r**	**-**	**39r**	**648r**	**73r**	**14**
Unclassified	-r	-	14r	11r	-	-r
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	12r	-	17r	159r	-	14r
Chemicals	-	-	-	16r	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	5r	22r	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	3r	408r	-	-
Other industries	227r	-	-	32r	73r	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**78r**	**1,908r**	**87r**	**183r**	**0r**	**-**
Domestic	-	1,908r	-	-	-	-
Public administration	-	-	-	-	0r	-
Commercial	38r	-	-	104r	-	-
Agriculture	40r	-	87r	78r	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).
(2) Including non-biodegradable wastes, which accounted for 1,070 ktoe.
(3) Total supply minus total demand.
(4) Includes poultry litter, meat and bone and farm waste
(5) Includes straw, short rotation coppice (SRC), and other plant based biomass
(6) Municipal solid waste, tyres, general industrial waste and hospital waste.
(7) Marine energy was 0.2 ktoe.

6.2 Commodity balances 2015 (continued)

Renewables and waste

Thousand tonnes of oil equivalent

Waste *(6)*	Solar photovoltaics, active solar heating, and deep geothermal	Heat pumps	Hydro	Wind and marine energy *(7)*	Liquid biofuels	Total renewables	
							Supply
2,020r	700r	182r	542r	3,467r	325r	14,419r	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	790r	3,712r	Imports
-	-	-	-	-	-117	-366r	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-84r	Transfers
2,020r	**700r**	**182r**	**542r**	**3,467r**	**998r**	**17,681r**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
2,020r	**700r**	**182r**	**542r**	**3,467r**	**998r**	**17,681r**	**Total demand**
1,880r	**649r**	**-**	**542r**	**3,467r**	**-**	**13,040r**	**Transformation**
1,817r	649r	-	542r	3,467r	-	12,968r	Electricity generation
471	121r	-	422	2,860r	-	7,463r	Major power producers
1,346r	528r	-	120r	607r	-	5,506r	Autogenerators
63r	-	-	-	-	-	71r	Heat generation
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Energy industry use**
-	-	-	-	-	-	-	Electricity generation
-	-	-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-r	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Losses**
140r	**52r**	**182r**	**-**	**-**	**998r**	**4,641r**	**Final consumption**
103r	**-**	**4r**	**-**	**-**	**-**	**1,121r**	**Industry**
69r	-	4r	-	-	-	99r	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	202r	Mineral products
-	-	-	-	-	-	16r	Chemicals
2r	-	-	-	-	-	2r	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	27r	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	411r	Paper, printing, etc
33r	-	-	-	-	-	365r	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**998r**	**998r**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	998r	998r	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
37r	**52r**	**178r**	**-**	**-**	**-**	**2,523r**	**Other**
-r	32r	93r	-	-	-	2,033r	Domestic
37r	0	-	-	-	-	38r	Public administration
-r	19r	85r	-	-	-	246r	Commercial
-	-	-	-	-	-	205r	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	**-**	

6.3 Commodity balances 2014

Renewables and waste

Thousand tonnes of oil equivalent

	Waste wood	Wood	Animal biomass and anaerobic digestion *(4)*	Plant biomass *(5)*	Sewage gas	Landfill gas
Supply						
Production	374r	1,767	638r	1,354r	343r	1,664r
Other sources	-	-	-	-	-	-
Imports	24	14	-	2,190	-	-
Exports	-79	-83	-	-44	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-12r	-	-	-
Total supply (2)	**319r**	**1,698**	**626r**	**3,499r**	**343r**	**1,664r**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**319r**	**1,698**	**626r**	**3,499r**	**343r**	**1,664r**
Transformation	**-**	**-**	**560r**	**2,943r**	**276r**	**1,651r**
Electricity generation	-	-	560r	2,938r	276r	1,651r
Major power producers	-	-	195	2,583	-	-
Autogenerators	-	-	366r	355r	276r	1,651r
Heat generation	-	-	-	5r	-	-
Petroleum refineries	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Other	-	-	-	-	-	-
Energy industry use	**-**	**-**	**-**	**-**	**-**	**-**
Electricity generation	-	-	-	-	-	-
Oil and gas extraction	-	-	-	-	-	-
Petroleum refineries	-	-	-	-	-	-
Coal extraction	-	-	-	-	-	-
Coke manufacture	-	-	-	-	-	-
Blast furnaces	-	-	-	-	-	-
Patent fuel manufacture	-	-	-	-	-	-
Pumped storage	-	-	-	-	-	-
Other	-	-	-	-	-	-
Losses	**-**	**-**	**-**	**-**	**-**	**-**
Final consumption	**319r**	**1,698**	**66r**	**556r**	**68**	**14**
Industry	**319r**	**-**	**35**	**128r**	**-**	**14**
Unclassified	319r	-	35	128r	-	14
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	-	-	-	-	-	-
Chemicals	-	-	-	-	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	-	-	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	-	-	-	-
Other industries	-	-	-	-	-	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**-**	**1,698**	**31r**	**428r**	**68**	**-**
Domestic	-	1,698	-	-	-	-
Public administration	-	-	-	-	68	-
Commercial	-	-	-	-	-	-
Agriculture	-	-	31r	428r	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).
(2) Including non-biodegradable wastes, which accounted for 847 ktoe.
(3) Total supply minus total demand.
(4) Includes poultry litter, meat and bone and farm waste
(5) Includes straw, short rotation coppice (SRC), and other plant based biomass
(6) Municipal solid waste, tyres, general industrial waste and hospital waste.
(7) Marine energy was 0.2 ktoe.

6.3 Commodity balances 2014 (continued)

Renewables and waste

Thousand tonnes of oil equivalent

Waste *(6)*	Solar photovoltaics, active solar heating, and deep geothermal	Heat pumps	Hydro	Wind and marine energy *(7)*	Liquid biofuels	Total renewables	
							Supply
1,605r	399r	107r	506r	2,748r	423r	11,927r	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	975	3,203	Imports
-	-	-	-	-	-155	-361	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-12r	Transfers
1,605r	**399r**	**107r**	**506r**	**2,748r**	**1,243r**	**14,757r**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
1,605r	**399r**	**107r**	**506r**	**2,748r**	**1,243r**	**14,757r**	**Total demand**
1,426r	**349r**	**-**	**506r**	**2,748r**	**-**	**10,458r**	**Transformation**
1,371r	349r	-	506r	2,748r	-	10,398r	Electricity generation
379	-	-	399	2,301r	-	5,856r	Major power producers
992r	349r	-	108r	447r	-	4,542r	Autogenerators
55r	-	-	-	-	-	60r	Heat generation
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Energy industry use**
-	-	-	-	-	-	-	Electricity generation
-	-	-	-	-	-	-	Oil and gas extraction
-	-	-	-	-	-	-	Petroleum refineries
-	-	-	-	-	-	-	Coal extraction
-	-	-	-	-	-	-	Coke manufacture
-	-	-	-	-	-	-	Blast furnaces
-	-	-	-	-	-	-	Patent fuel manufacture
-	-	-	-	-	-	-	Pumped storage
-	-	-	-	-	-	-	Other
-	-	-	-	-	-	-	**Losses**
179r	**50**	**107r**	**-**	**-**	**1,243r**	**4,299r**	**Final consumption**
97r	**-**	**2r**	**-**	**-**	**-**	**594r**	**Industry**
97r	-	2r	-	-	-	594r	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	-	Mineral products
-	-	-	-	-	-	-	Chemicals
-	-	-	-	-	-	-	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	-	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	-	Paper, printing, etc
-	-	-	-	-	-	-	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**1,243r**	**1,243r**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	1,243r	1,243r	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
82r	**50**	**105r**	**-**	**-**	**-**	**2,462r**	**Other**
20r	50	70r	-	-	-	1,837r	Domestic
51r	0	-	-	-	-	119r	Public administration
11r	0	35r	-	-	-	47r	Commercial
-	-	-	-	-	-	459r	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	**-**	**Non energy use**

6.4 Capacity of, and electricity generated from, renewable sources

	2012	2013	2014	2015	2016
Installed Capacity (MW) *(1)*					
Wind:					
Onshore	6,035	7,586	8,573	9,222	10,923
Offshore	2,995	3,696	4,501	5,093	5,293
Marine energy (wave and tidal stream)	9	8	9	9	13
Solar photovoltaics	1,753	2,937	5,528	9,535	11,899
Hydro:					
Small scale	216	232	253	300	358
Large scale *(2)*	1,477	1,477	1,477	1,477	1,477
Bioenergy:					
Landfill gas	1,042	1,050	1,058	1,061	1,062
Sewage gas	212	201	230	231	257
Energy from waste *(3)*	513	545	680	925	1,017
Animal biomass *(4)*	111	111	111	111	129
Anaerobic digestion	121	163	243	323	420
	1,166	1,955	2,258	2,607	2,850
Total bioenergy and wastes	3,163	4,025	4,579	5,258	5,736
Total	15,649	19,961	24,920	30,893	35,700
Co-firing (6)	208	39	14	21	13
Generation (GWh)					
Wind:					
Onshore *(7)*	12,244	16,925	18,555	22,895	20,962
Offshore	7,603	11,472	13,405	17,423	16,406
Marine energy (wave and tidal stream)(8)	4	5	2	2	0
Solarphotovoltaics	1,354	2,010	4,054	7,546	10,420
Hydro:					
Small scale(7)	678	675	835	984	1,016
Large scale(2)	4,632	4,026	5,053	5,314	4,379
Bioenergy:					
Landfill gas	5,208	5,175	5,033	4,872	4,703
Sewage gas	739	766	840	894	950
Biodegradable energy from waste(9)	1,773	1,648	1,900	2,585	2,741
Co-firing with fossil fuels	1,829	337	124	183	117
Animal biomass(4)	643	628	614	648	650
Anaerobic digestion	495	713	1,023	1,471	2,052
Plant biomass(5)	4,048	8,832	13,086	18,587	18,829
Total bioenergy	14,734	18,100	22,619	29,240	30,043
Total generation	41,249	53,213	64,522	83,403	83,225
Non-biodegradable wastes *(10)*	1,428	1,480	1,901	2,586	2,742
Total generation from sources eligible for the Renewable Obligation *(11)*	36,967	47,539r	57,569r	75,505	76,106

(1) Capacity on a DNC basis is shown in Long Term Trends Table 6.1.1 available on the BEIS website.
(2) Excluding pumped storage stations. Capacities are as at the end of December.
(3) Includes waste tyres and hospital waste.
(4) Includes the use of poultry litter and meat & bone.
(5) Includes the use of straw combustion and short rotation coppice energy crops.
(6) This is the proportion of fossil fuelled capacity used for co-firing of renewables based on the proportion of generation accounted for by the renewable source.
(7) Actual generation figures are given where available, but otherwise are estimated using a typical load factor or the design load factor, where known.
(8) Includes electricity from the EMEC test facility.
(9) Biodegradable part only.
(10) Non-biodegradable part of municipal solid waste plus waste tyres, hosptal waste and general industrial waste.
(11) See paragraphs 6.56 to 6.57 for definition and coverage.

6.5 Load factors for renewable electricity generation

Per cent

	2012	2013	2014	2015	2016
Load factors - based on average beginning and end of year capacity (1)					
Wind	28.9	31.9	30.0	33.6	27.9
Onshore	25.8	28.4	26.2	29.4	23.7
Offshore	35.8	39.1	37.3	41.5	36.0
Marine energy (wave and tidal stream)	7.7	6.5	3.0	2.6	0.0
Solar photovoltaics	11.2	9.8	10.9	11.4	11.1
Hydro	35.9	31.6	39.1	41.0	34.0
Small scale	37.0	34.4	39.3	40.7	35.2
Large scale	35.7	31.1	39.1	41.1	33.8
Bioenergy (excludes cofiring and non-biodegradable wastes)	46.9	56.4	59.7	67.4	62.0
Landfill gas	56.6	56.5	54.5	52.5	50.4
Sewage sludge digestion	40.9	42.3	44.4	44.2	44.3
Energy from waste (3)	39.8	35.6	35.4	36.8	32.1
Animal biomass (4)	66.2	64.9	63.4	66.9	61.7
Anaerobic digestion	57.9	57.5	57.6	59.3	62.8
Plant Biomass (5)	39.6	64.6	70.9	87.2	78.6
All renewable technologies (excluding cofiring and non-biodegradable wastes)	32.0	33.9	32.8	34.0	28.4
Load factors - for schemes operating on an unchanged configuration basis (2)					
Wind	27.7	31.0	29.8	33.3	28.8
Onshore	25.5	27.9	25.9	29.4	24.2
Offshore	34.1	37.6	37.8	39.7	36.7
Solar photovoltaics	11.2	11.3	11.1	11.2	10.8
Hydro	37.5	31.6	38.8	39.5	33.9
Small scale	39.5	36.1	39.7	41.8	34.6
Large scale	37.3	31.2	38.8	39.2	33.8
Bioenergy (excludes cofiring and non-biodegradable wastes)	62.7	60.5	65.1	67.6	68.9
Landfill gas	58.4	57.5	55.2	52.6	49.9
Sewage sludge digestion	45.4	49.8	48.0	48.2	43.1
Energy from waste (3)	40.4	35.3	35.5	36.3	34.6
Animal biomass (4)	66.2	70.4	63.4	66.9	57.2
Anaerobic digestion	59.2	61.5	57.5	57.6	59.4
Plant biomass (5)	69.9	60.6	70.5	74.3	78.9
All renewable technologies (excluding cofiring and non-biodegradable wastes)	36.0	36.1	37.8	38.2	33.0

(1) See methodology note for details of the calculation.

(2) See methodology note for details of the calculation.

(3) Calculation is based on biodegradable waste generation but all waste capacity; this reduces the load factor.

(4) Includes the use of poultry litter and meat & bone.

(5) Includes the use of straw combustion and short rotation coppice energy crops.

6.6 Renewable sources used to generate electricity and heat and for transport fuels*(1)(2)*

Thousand tonnes of oil equivalent

	2012	2013	2014	2015	2016
Used to generate electricity *(3)*					
Wind:					
Onshore	1,052.8	1,455.3	1,595.4	1,968.6	1,802.4
Offshore	653.8	986.4	1,152.6	1,498.1	1,410.6
Marine energy (4)	0.4	0.4	0.2	0.2	0.0
Solar photovoltaics	116.4	172.8	348.6	648.8	896.0
Hydro:					
Small scale	58.3	58.0	71.8	84.6	87.4
Large scale *(5)*	398.2	346.2	434.5	456.9	376.5
Bioenergy:					
Landfill gas	1,708.3	1,697.2	1,650.8	1,598.0	1,542.4
Sewage gas	242.2	251.2	275.5	293.3	311.7
Biodegradable energy from waste	638.5	564.7	682.1	905.2	1,117.4
Co-firing with fossil fuels	400.5	53.7	25.1	37.8	24.6
Animal biomass *(6)*	225.0	226.4	224.8	235.3	230.1
Anaerobic digestion	162.2	233.9	335.4	482.4	673.1
Plant biomass *(7)*	1,062.3	2,008.3	2,912.9	3,847.6	3,871.0
Total bioenergy	4,439.1	5,035.3	6,106.6	7,399.6	7,770.4
Total	6,718.9	8,054.5	9,709.7	12,056.9	12,343.3
Non-biodegradable wastes *(8)*	520.3	513.1	688.4	911.5	1,123.7
Used to generate heat					
Active solar heating	45.9	47.9	49.6	50.7	51.2
Bioenergy:					
Landfill gas	13.6	13.6	13.6	13.6	13.6
Sewage gas	63.7	68.3	67.7	73.1	72.1
Wood	1,518.5	1,787.7	1,698.1	1,908.5	1,954.0
Waste wood	309.1	315.4	319.1	318.7	319.1
Animal biomass *(9)*	31.5	29.1	34.5	30.7	23.0
Anaerobic digestion	14.5	18.5	42.9	95.5	179.4
Plant biomass *(10)*	285.4	418.8	561.2	837.7	1,102.2
Biodegradable energy from waste *(6)*	29.8	29.7	22.4	45.6	45.7
Total bioenergy	2,266.2	2,681.1	2,759.6	3,323.3	3,709.1
Deep geothermal	0.8	0.8	0.8	0.8	0.8
Heat Pumps	54.8	96.5	106.7	155.8	182.2
Total	2,367.8	2,826.3	2,916.6	3,530.6	3,943.3
Non-biodegradable wastes *(8)*	144.1	154.7	158.4	158.5	167.6
Renewable sources used as transport fuels					
Bioethanol	436.9	462.2	458.8	449.1	427.8
Biodiesel	520.9	629.4	783.8	554.1	581.7
Total	957.8	1,091.6	1,242.7	1,003.1	1,009.5
Total use of renewable sources and wastes					
Solar heating and photovoltaics	162.3	220.7	398.1	699.5	947.2
Onshore wind	1,052.8	1,455.3	1,595.4	1,968.6	1,802.4
Offshore wind	653.8	986.4	1,152.6	1,498.1	1,410.6
Marine energy (wave and tidal stream)	0.4	0.4	0.2	0.2	0.0
Hydro	456.6	404.3	506.3	541.6	463.9
Bioenergy	6,705.3	7,716.4	8,866.2	10,722.9	11,479.4
Deep geothermal	0.8	0.8	0.8	0.8	0.8
Heat pumps	54.8	96.5	106.7	155.8	182.2
Transport biofuels	957.8	1,091.6	1,242.7	1,003.1	1,009.5
Total	10,044.5	11,972.4	13,869.0	16,590.6	17,296.1
Non-biodegradable wastes *(8)*	664.4	667.8	846.8	1,070.0	1,291.3
All renewables and wastes *(11)*	10,708.9	12,640.2	14,715.8	17,660.6	18,587.5

(1) Includes some waste of fossil fuel origin.
(2) See the Digest of UK Energy Statistics for technical notes and definitions of the categories used in this table.
(3) For wind, solar PV and hydro, the figures represent the energy content of the electricity supplied but for bioenergy the figures represent the energy content of the fuel used.
(4) Wave and tidal stream; Includes the EMEC test facility.
(5) Excluding pumped storage stations.
(6) Includes electricity from poultry litter combustion and meat & bone combustion.
(7) Includes electricity from straw and energy crops.
(8) Non-biodegradable part of municipal solid waste plus waste tyres, hospital waste, and general industrial waste.
(9) Includes heat from farm waste digestion, and meat and bone combustion.
(10) Includes heat from straw, energy crops, paper and packaging.
(11) The figures in this row correspond to the total demand and total supply figures in Tables 6.1, 6.2 and 6.3.

6.7 Renewable sources data used to indicate progress under the 2009 EU Renewable Energy Directive (measured using net calorific values)

Thousand tonnes of oil equivalent

	2012	2013	2014	2015	2016
Electricity generation component:					
Normalised hydro generation *(1) (2)*	448	445	448	461	481
Normalised wind generation *(3)*	1,638	2,228	2,714	3,224	3,506
Electricity generation from renewables other than wind, hydro, and compliant biofuels	1,383	1,730	2,295	3,174	3,506
Electricity generation from compliant biofuels	-	-	-	1	2
Total renewable generation from all compliant sources	3,468	4,402	5,457	6,859	7,493
Total Gross Electricity Consumption *(2)*	32,046	31,798	30,587	30,706	30,437
Percentage of electricity from renewable sources	10.8%	13.8%	17.8%	22.3%	24.6%
Heat component:					
Renewable energy for heating and cooling	1,993	2,387	2,468	3,020	3,408
Total Gross energy consumption for heating and cooling	57,733	59,180	52,997	54,791	55,266
Percentage of heating and cooling energy from renewable sources	3.5%	4.0%	4.7%	5.5%	6.2%
Transport component (excluding air transport):					
Road transport renewable electricity	0	1	1	2	3
Non-road transport renewable electricity	75	81	90	96	107
Biofuels (restricted to those meeting sustainability criteria from 2011) *(4)*	896	1,045	1,176	943	936
Total electricity consumption in transport	385	374	387	388	401
Total petrol and diesel consumption in transport	37,065	36,777	37,270	37,960	38,816
Total transport component numerator (including weighted components) *(5)*	1,539	1,824	2,090	1,780	1,823
Total transport component denominator (including weighted components) (5)	38,913	38,894	39,653	40,022	40,919
Percentage of transport energy from renewable sources *(5)*	4.0%	4.7%	5.3%	4.4%	4.5%
Overall directive target:					
Renewables used for:					
Electricity generation	3,392	4,321	5,366	6,761	7,383
Heating and Cooling	1,993	2,387	2,468	3,020	3,408
Transport biofuels (restricted to those meeting sustainability criteria from 2011)	971	1,127	1,267	1,041	1,046
Total Final Consumption of Renewable Energy ["Row A"]	6,356	7,835	9,101	10,822	11,837
Final Electricity Consumption *(6)*	26,981	26,820	25,648	25,704	25,720
Transport Final Energy Consumption (including air transport) *(7)*	50,316	50,107	50,720	51,282	52,231
Heating and Cooling Final Energy Consumption	57,722	59,170	52,988	54,782	55,255
Total Final Energy Consumption *(8)*	135,019	136,097	129,356	131,767	133,207
plus Distribution losses for electricity	2,425	2,283	2,360	2,452	2,280
plus Distribution losses for heat	-	-	-	-	-
plus Consumption of electricity in the electricity and heat generation sectors	1,548	1,535	1,417	1,432	1,313
plus Consumption of heat in the electricity and heat generation sectors	-	-	-	-	-
Gross Final Energy Consumption (GFEC)	138,992	139,915	133,133	135,651	136,800
of which Air transport	11,788	11,812	11,798	11,903	12,003
Air transport as a proportion of GFEC	8.48%	8.44%	8.86%	8.77%	8.77%
Air transport cap specificed in Directive	6.18%	6.18%	6.18%	6.18%	6.18%
Capped air transport	8,590	8,647	8,228	8,383	8,454
Capped Gross Final Energy Consumption (CGFEC) ["Row B"] *(9)*	135,794	136,750	129,562	132,131	133,251
Headline Directive percentage : Renewable Energy Consumption as a percentage of Capped Gross Final Energy Consumption ["Row A" divided by "Row B"]	4.7%	5.7%	7.0%	8.2%	8.9%

(1) Based on a 15 year average hydro load factor.
(2) Excludes generation from pumped storage.
(3) Based on a 5 year average wind load factor.
(4) For the current year, an estimate has been made for the proportion of biofuels meeting the sustainability criteria
(5) Some sustainable biofuels are double weighted in the numerator of this calculation, as specified by the Directive.
(5) Final Electricity Consumption is Gross Electricity Consumption minus generators' own use of electricity and losses.
(7) Includes consumption of petrol and diesel, biofuels, other oil products, and coal.
(8) Total final consumption less non-energy use, as shown in Annex I, Table I.1, available on the BEIS website.
(9) This row includes adjustments for loses, and generators own use of electricity, combined with the capping mechanism for air transport as specified in the Directive.

Chapter 7
Combined heat and power

Key Points

- The Good Quality CHP capacity fell by 159 MWe between 2015 and 2016 from 5,730 MWe to 5,571 MWe. (Table 7A)
- The amount of good quality electricity produced in 2016 was 20.1 TWh (Table 7.4), which is 2.6 per cent higher than in 2015. The good quality electricity generated by CHP in 2016 corresponds to 6.3 per cent of all electricity supplied in the UK.
- Seventy-one percent of the fuel used in CHP schemes was natural gas. This is 1.1 percentage points higher than in 2015. In 2016, the share of total fuel that was renewable was 12 per cent, a 0.7 percentage point increase between 2015 and 2016.
- The Oil and Gas sector has the largest Good Quality CHP capacity (40 per cent), followed by the Chemicals sector (20 per cent), the Transport Commerce and Administration sector (9 per cent) and then the Food and Drink sector (8 per cent). The Paper sector is now only the sixth largest sector in terms of installed capacity. As recently as 2014 the Paper sector was the third largest sector.
- The absolute CO_2 savings delivered by CHP in 2016 were lower than in 2015. This is due to the provisional values for CO_2 intensity of electricity displaced by CHP electricity being substantially lower in 2016 than in 2015, rather than falls in the outputs of CHP or efficiency of operation.

Introduction

7.1 This chapter sets out the contribution made by Combined Heat and Power (CHP) to the United Kingdom's energy requirements. The data presented in this chapter have been derived from information submitted to the CHP Quality Assurance programme (CHPQA) or by following the CHPQA methodology in respect of data obtained from other sources. The CHPQA programme was introduced by the Government to provide the methods and procedures to assess and certify the quality of the full range of CHP schemes. It is a rigorous system for the Government to ensure that the incentives on offer are targeted fairly and benefit schemes in relation to their environmental performance.

7.2 CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process. The term CHP is synonymous with cogeneration, which is commonly used in other Member States of the European Community and the United States. CHP uses a variety of fuels and technologies across a wide range of sizes and applications. The basic elements of a CHP plant comprise one or more prime movers (a reciprocating engine, gas turbine or Rankine cycle turbine using steam or organic fluids) driving electrical generators, with the heat generated in the process captured and put to further productive use, such as for industrial processes, hot water and space heating or cooling.

7.3 CHP is typically sized to make use of the available heat[1], and connected to the lower voltage distribution system (i.e. embedded). This means that unlike conventional power stations, CHP can provide efficiency gains by avoiding significant transmission and distribution losses. These gains are reflected in the calculation of CO_2 savings delivered by CHP (see 7.27-7.28). CHP can also provide important network services such as black start[2], improvements to power quality, and some have the ability to operate in island mode if the grid goes down. There are five principal types of CHP system: steam turbine, gas turbine, combined cycle systems, reciprocating engines and Organic Rankine Cycle (ORC) systems. Each of these is defined in paragraph 7.35 later in this chapter.

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[1] *But not always, see paragraph 7.4. In such cases there is an impact upon the electrical capacity and electrical output classified as CHP.*

[2] *Black start is the capability to operate in island mode if the grid goes down.*

UK energy markets, and their effect on CHP

7.4 Two major factors affecting the economics of CHP are the relative cost of fuel (principally natural gas) and the value that can be realised for electricity both for own use and export. This is known as the spark gap (i.e. the difference between the price of electricity and the price of the gas required to generate that electricity). Energy price trends that are applicable to CHP schemes differ depending upon the size and sector of the scheme. At the start of 2013 the spark gap started to increase and has done so each quarter since. While longer term, sustained improvements in the spark gap would be necessary to encourage investment in new CHP capacity, there is evidence that the improvements to date have encouraged some large schemes to generate more electricity. This evidence is a sharp increase in the Load Factor (actual) compared to a modest increase in the Load Factor (CHPQA), as shown in Table 7A. The Load Factor (actual) in 2016 was at its highest level since 2008, while the Load Factor (CHPQA) in 2016 was at its highest level since 2012.

Use of CHPQA in producing CHP statistics

7.5 The CHPQA programme is the major source for CHP statistics. The following factors need to be considered when using the statistics produced:

- Through CHPQA, scheme operators have been given guidance on how to determine the boundary of a CHP scheme (what is regarded as part of the CHP installation and what is not). A scheme can include multiple CHP prime movers[3], along with supplementary boilers and generating plant, subject to appropriate metering being installed to support the CHP scheme boundaries proposed, and subject to appropriate metering and threshold criteria. (See CHPQA Guidance Note 11 available at www.gov.uk/chpqa-guidance-notes). This point is relevant when considering the figures in Table 7D, where the power efficiencies, heat efficiencies and heat to power ratios stated in that table for 2016 are those of the scheme, which may not be just the prime mover.
- The output of a scheme is based on gross power output. This means that power consumed by parasitic plant such as pumps and fans is included in the power output of the scheme.
- The main purpose of a number of CHP schemes is the generation of electricity including export to other businesses and to the grid. Such schemes may not be sized to use all of the available heat. In such cases, the schemes' total electrical capacity and electrical output have been scaled back using the methodologies outlined in CHPQA (see www.gov.uk/chpqa-guidance-notes). Only the output from highly-efficient or "Good Quality" schemes is counted in this chapter. Chapter 5 includes all CHP capacity, fuel inputs and power outputs, for both highly-efficient or "Good Quality" and less efficient, under the categories "Other generators".
- For year of operation 2011 onwards, new scale back criteria came into force in order to be consistent with the EU Cogeneration Directive. This results in a more severe scale back than was previously the case. This has contributed to some of the decrease in Good Quality electricity output and associated fuel consumption seen after 2010.
- There are two load factors presented in Table 7A. Load Factor (CHPQA) is based on the Good Quality Power Output and Good Quality Power Capacity reported in this Chapter. Load Factor (Actual) is based on the Total Power Capacity and the Total Power Output. The Load Factor (CHPQA) is lower than the Load Factor (Actual) for schemes that have been scaled back on the power outputs. The load factor gives an indication of the degree to which the power generating capacity is utilized. Between 2007 and 2013 Load Factor (CHPQA) steadily declined, but has modestly improved over the last couple of years. This decline was confined to the industrial sectors, and was especially pronounced in the chemical and oil refinery sectors. As discussed above, there was an appreciable upturn in the Load Factor (Actual) in 2016, explained by a number of large CHP generators increasing their production of electricity.

3 The CHP prime mover is the heart of a CHP system and is a mechanical machine which drives the electricity generator or develops mechanical power for direct use

Table 7A: A summary of the recent development of CHP(1)

	Unit	2012	2013	2014	2015	2016
Number of schemes		1,942	2,029	2,076	2,139	2,182
Net No. of schemes added during year (2)		156	87	47	63	43
Electrical capacity (CHP_{QPC})	MWe	5,965	5,924	5,892	5,730	5,571
Net capacity added during year		204	-41	-32	-162	-159
Capacity added in percentage terms	Per cent	3.5	-0.7	-0.5	-2.8	-2.8
Heat capacity	MWth	22,545	22,167	22,228	20,123	19,673
Heat to power ratio *(3)*		2.1	2.26	2.13	2.06	2.01
Fuel input *(4)*	GWh	95,701	88,430	86,207	82,669	84,125
Electricity generation (CHP_{QPO})	GWh	22,226	19,592	19,695	19,558	20,070
Heat generation (CHP_{QHO})	GWh	46,690	44,350	41,957	40,261	40,423
Overall efficiency *(5)*	Per cent	72	72.3	71.5	72.4	71.9
Load factor (CHPQA) *(4)*	Per cent	42.5	37.8	38.2	39	41.1
Load factor (Actual) *(6)*	Per cent	53.2	51.7	52.3	50.9	60

(1) Data in this table for 2012 and 2015 have been revised since last year's Digest (see text for explanation).
(2) Net number of schemes added = New schemes – Decommissioned existing schemes
(3) Heat to power ratios are calculated from the qualifying heat output (QHO) and the qualifying power output (QPO).
(4) The load factor (CHPQA) is based on the qualifying power generation and capacity and does not correspond exactly to the number of hours run by the prime movers in a year
(5) Overall efficiencies are calculated using gross calorific values. Net efficiencies will be higher.
(6) The load factor (Actual) is based on the total power generated and total capacity

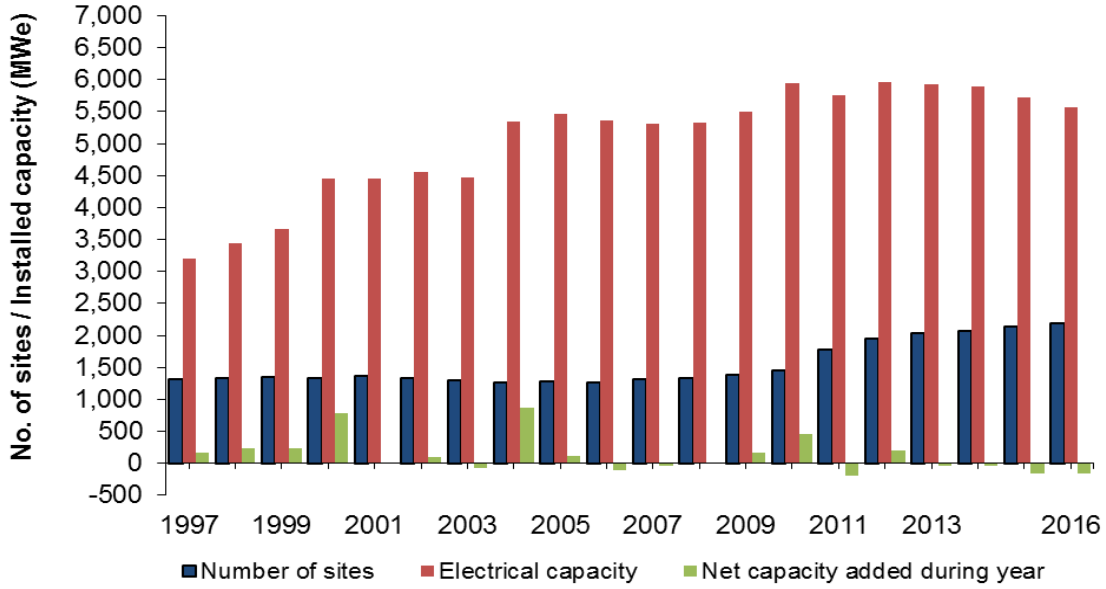
Efficiency of CHP schemes

7.6 Good Quality CHP denotes schemes that have been certified as being highly efficient through the UK's CHP Quality Assurance (CHPQA) programme. The criteria used are in line with the requirements for high efficiency CHP set down in the Energy Efficiency Directive (2012/27/EU). A Good Quality CHP scheme, with installed capacity >1 MWe, must achieve 10 per cent primary energy savings compared with the EU reference values for separate generation of heat and power i.e. via a boiler and power station.

Changes in CHP capacity

7.7 Chart 7.1 shows the change in installed CHP capacity since 2001, when the CHPQA programme began. Installed capacity at the end of 2016 stood at 5,571 MWe, a decrease of 159 MWe (2.8 per cent) compared to 2015. In spite of this capacity decrease, there was a net increase of 43 (2.0 per cent) schemes between 2015 and 2016. Overall, between 2015 and 2016, there were 62 new schemes included in the database and a removal of 19 schemes. There have been revisions to the capacity figures for 2012 to 2015 shown in the previous edition of the Digest, as recent information on the operational status of some schemes has come to light.

Chart 7.1: Operating CHP capacity by year



7.8 Table 7A gives a summary of the overall CHP market. CHP schemes generated 20,070 GWh in 2016 of Good Quality electricity, 2.6 per cent higher than in 2015. This generated electricity represents 5.9 per cent of the total electricity generated in the UK. Good Quality electricity generated in industry was 2.6 per cent higher in 2016 than in 2015, despite a 3.9 per cent decrease in Good Quality power generating capacity. This was substantially due to an increase in Good Quality power output in the Oil and Gas sector. There were also increases in Good Quality electricity generated of 0.5 per cent and 9.1 per cent in the Transport, Commercial and Administration and Other sectors, respectively.

7.9 Table 7A shows that in 2016 CHP schemes supplied a total of 40,423 GWh of heat. This was a small increase of 0.4 per cent compared to 2015. Over the long term, the trend in heat supplied by CHP has been a decreasing one as the heat supplied by industrial CHP schemes has fallen. However, between 2015 and 2016 the heat output in industry overall was steady, with large increases (6.4 per cent) in the Oil and Gas sector balancing large falls in Mineral Products (9.6 per cent), Food and Drink (6.1 per cent), and Paper (1.2 per cent). The heat output from schemes in the TCA and Other sectors were higher in 2016 than in 2015.

7.10 In terms of electrical capacity by size of scheme, schemes larger than 10 MWe represent 75 per cent of the total electrical capacity of CHP schemes as shown in Table 7B. However, schemes less than 1 MWe constitute the majority (82 per cent) in terms of the number of schemes and 6.1 per cent of the capacity. Table 7.5 provides data on electrical capacity for each type of CHP installation.

Table 7B: CHP schemes by capacity size ranges in 2016

Electrical capacity size range	Number of schemes	Share of total	Total electricity capacity (MWe)	Share of total
Less then100 kWe	627	29	40	0.7
100 kWe - 1 MWe	1,158	53	303	5.4
1 MWe - 2 MWe	151	6.9	218	3.9
2 MWe - 10 MWe	180	8.2	824	15
> 10 MWe +	66	3	4,185	75
Total	**2,182**	**100**	**5,571**	**100**

7.11 Table 7.5 shows nearly 62 per cent of total electrical capacity is in combined cycle gas turbine (CCGT) mode, followed by reciprocating engines at 22 per cent. Over the years there has been a gradual decrease in the total capacity taken up by CCGT schemes and a gradual increase in the total capacity taken up by reciprocating engines. This is mirrored in the results for Table 7B where, over the years, there has been a gradual fall in the proportion of capacity >10 MWe and a gradual increase in the proportion of capacity falling under the other capacity ranges, where reciprocating engines are deployed. Over the long term there has been a significant fall in the proportion of overall capacity that is back pressure steam turbine, as this relatively inefficient and inflexible technology is phased out. The pass out condensing steam turbine also went through a decline in its proportion of total capacity. However, in recent years its share has increased as more biomass and waste fuelled CHP schemes have been brought on line.

7.12 Excluded from the statistics tables presented in this chapter are a number of very small CHP schemes (micro-CHP) installed since 2010 in response to the Feed-in Tariff (FiT) scheme. The overwhelming majority of these schemes are domestic. At the end of 2016 there were 511 such schemes registered with Ofgem for FiTs with a total installed capacity of 538 kWe. There are no data on electricity generation or fuel consumption for these schemes and, consequently, they have been left out of the statistics tables. However, if included, there would have a negligible impact upon the capacity and generation figures presented in the statistics tables.

7.13 Table 7.7 provides data on heat capacity for each type of CHP installation. Starting in the 2013 edition of the Digest, there has been a change implemented in how the heat capacity has been derived. Prior to this, for a number of schemes, the data held on heat capacity were either not complete or were not a true reflection of the capacity of the scheme to generate heat in CHP operating mode. To allow for this, a standard methodology was developed and applied for the first time in the 2013 edition of the Digest for the determination of the heat capacity. This is applied to new schemes and schemes undergoing a change in plant. Details of this methodology may be found in the CHP methodology note which is available at:
www.gov.uk/government/publications/combined-heat-and-power-statistics-data-sources-and-methodologies

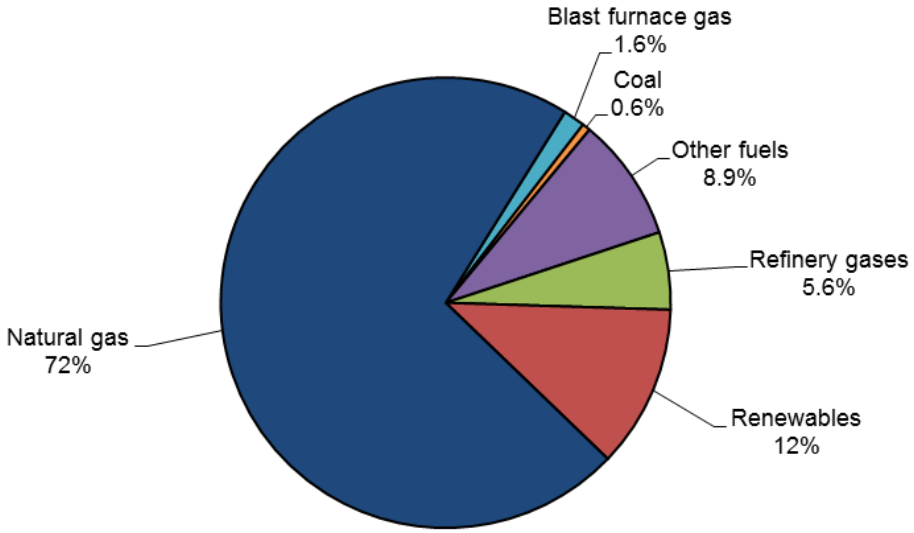
Fuel used by types of CHP installation

7.14 Table 7.2 shows the fuel used to generate electricity and heat in CHP schemes (see paragraphs 7.36 to 7.38, below for an explanation of the convention for dividing fuel between electricity and heat production). Table 7.3 gives the overall fuel used by types of CHP installation (which are explained in paragraph 7.35). Total fuel use is summarised in Chart 7.2. In 2016, 71 per cent of the total fuel use was natural gas. This is an increase of 1.1 percentage points compared with 2015. CHP schemes accounted for 7.2 per cent of UK gas demand in 2016 (see Table 4.3). The use of coal and fuel oil is now at extremely low levels, together taking up less than 1 per cent of overall fuel use in 2016.

7.15 The proportion of total fuel consumption that was renewable increased slightly between 2015 and 2016 from 11 per cent to 12 percent of the total. Gaseous renewable fuels constitute the single largest type of renewable fuel (47 per cent), followed by waste fuels (28 per cent) and biomass (24 per cent), with the balance being liquid renewable fuels.

7.16 Fuels which are liquids, solids or gases that are by-products or waste products from industrial processes, or are renewable fuels, accounted for 27 per cent of all fuel used in CHP in 2016. This proportion is substantially unchanged from 2015. Some of these by-product fuels are not commonly used by the mainstream electricity generating industry, and some would otherwise be flared or disposed of by some means. These fuels, with the exception of some waste gases, will generally be utilised in steam turbines being fed by boilers. In almost all cases, the technical nature of the combustion process, and the lower fuel quality (lower calorific value of the fuel, high moisture content of the fuel and the need to maintain certain combustion conditions to ensure complete disposal) will generally result in a lower efficiency. However, given that the use of such fuels avoids the use of fossil fuels, and since they need to be disposed of in some way, the use of these fuels in CHP provides environmental benefits.

Chart 7.2: Types of fuel used by CHP schemes in 2016



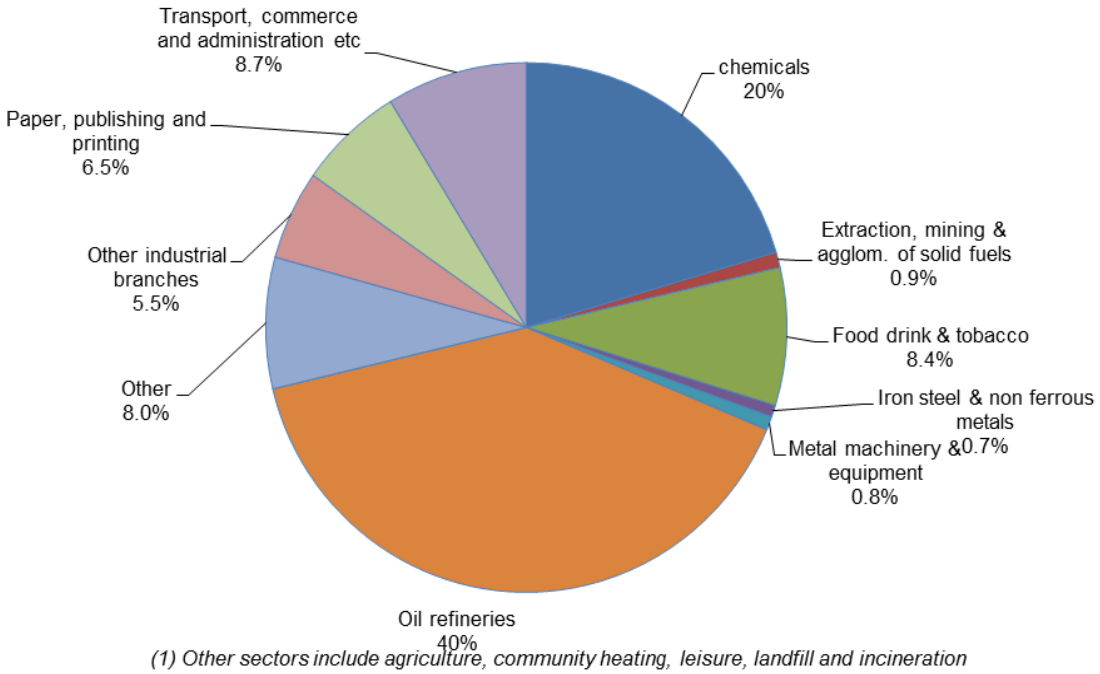
CHP capacity, output and fuel use by sector

7.17 In this chapter of the Digest, CHP is analysed by the sector using the heat or, where the heat is used by more than one sector, by the sector using the majority of the heat. This method of assigning a CHP scheme to a sector was rigorously applied for the first time in the 2008 edition of the digest and resulted in the movement of CHP schemes between sectors. One consequence of this was the removal of all schemes once allocated to the "electricity supply" sector and their distribution to other sectors. Full details of this reassignment are provided in paragraph 6.33 and Table 6J of the 2008 edition of the digest.

7.18 Table 7.8 gives data on all operational schemes by economic sector. A definition of the sectors used in this table can be found in Chapter 1, paragraph 1.60 and Table 1H:

- 399 schemes (83 per cent of electrical capacity) are in the industrial sector and 1,783 schemes (17 per cent of capacity) are in the agricultural, commercial, public administration, residential and transport sectors. The share of capacity taken up by industrial schemes is slightly lower than in 2015 and this continues a longer term trend for a greater share of total CHP capacity to be installed at non-industrial sites. This trend is the result of both a loss in industrial capacity, which has occurred every year since 2012, while the capacity in the non-industrial sectors has increased.
- The share of total installed Good Quality capacity taken up by each sector is shown in Chart 7.3. The oil refineries sector, which has been the largest sector since 2009, continues to have the largest share of total installed capacity, accounting for 40 per cent of all capacity. The chemicals sector has the second highest share of total installed capacity (20 per cent) followed by transport, commerce and administration (8.8 per cent) and the food and drink sector (8.4 per cent). The most significant development since the last edition of the digest has been the fall in capacity in the paper sector, which has led to it becoming the sixth largest sector in terms of installed capacity. As recently as 2014 it was the third largest. This is substantially explained by the closure of one significant paper manufacturing site. Over the last year the installed capacity fell in all of the following industrial sectors: Iron and steel and non-ferrous, chemicals, oil refineries and paper. It was unchanged in all other industrial sectors with the exception of sewage treatment, where there was a modest increase.

Chart 7.3: CHP electrical capacity by sector in 2016



(1) Other sectors include agriculture, community heating, leisure, landfill and incineration
(2) Other industry includes textiles, clothing and footware and sewage treatment

7.19 Table 7C gives a summary of the 1,580 schemes installed in the commercial sector, public sector and residential buildings. These schemes form a major part of the "Transport, commerce and administration" and "Other" sectors in Tables 7.8 and 7.9. The vast majority of these schemes are based on spark ignition reciprocating engines fuelled with natural gas, though the larger schemes use compression ignition reciprocating engines or gas turbines. The largest proportion of the capacity is in the health sector (33 per cent), mainly hospitals. The leisure and hotel sectors remain the two sectors with the largest number of installed schemes. This is a reflection of the suitability of CHP for meeting the demand profiles for heating and hot water in these types of building. Of note is the large ratio of heat to power generating capacity in the health sector. This is a reflection of the especially acute need for security of heat supply required at hospitals, provided by back-up boilers, rather than the heat to power capacity ratios inherent in the prime mover used for power generation (see Definitions of schemes under Technical notes and definitions).

Table 7C: Number and capacity of CHP schemes installed in buildings by sector in 2016

	Number of schemes	Electrical capacity (MWe)	Heat capacity (MWth)
Leisure	508	66	113
Hotels	278	40	66
Health	224	183	1020
Residential Group Heating	111	89	410
Universities	96	93	489
Offices	40	14	18
Education	60	15	50
Government Estate	31	14	48
Retail	229	46	74
Other *(1)*	3	1	1
Total	**1,580**	**561**	**2,288**

(1) All schemes under Other are at airports

7.20 District heating and cooling, according to the Energy Performance in Buildings Directive, is the distribution of thermal energy in the form of steam, hot water or chilled products from a centralised place of production through a network to multiple buildings or sites for space or process heating or cooling. Observing this definition, research has been undertaken to identify the number, capacity and outputs of CHP schemes serving district heating and cooling. In 2016 there were considered to be 93 CHP schemes serving district heating and cooling, with a Good Quality CHP capacity of 2,091 MWe and Good Quality power outputs and heat outputs of 5,779 GWh and 11,549 MWh, respectively. CHP serving communal heating and cooling schemes are not included in this figure, where 'communal' is taken to mean serving a number of customers in the same building. These data were gathered as part of a district heating and cooling survey carried out for the ten Department of Energy and Climate Change.

CHP performance by main prime mover

7.21 Table 7D gives a summary of the performance of schemes in 2016 by main prime mover type. In 2016 the prime mover type with the highest average operating hours was gas turbines followed by back pressure steam turbines.

7.22 In 2016, the average operating hours were 3,603 hours. The average operating hours in 2015 was 3,413 hours, indicating a slight increase in the utilisation of good quality capacity between the two years. The revision to 2015 figures was the result of the submission of data for this year of operation too late to be incorporated in 2016 edition of the Digest. These are the highest average operating hours since 2012.

7.23 In 2015, the average electrical efficiency was 24 per cent and the heat efficiency 48 per cent, giving an overall average of 72 per cent, which is the same as the revised figure for 2015. Overall efficiency is simply the sum of the individual electrical and heat efficiencies.

Table 7D: A summary of scheme performance in 2016

Main prime mover in CHP plant	Average operating hours per annum (Full load equivalent)	Average electrical efficiency (% GCV)	Average heat efficiency (% GCV)	Average overall efficiency (% GCV)	Average heat to power ratio
Back pressure steam turbine	4,047	13	60	74	4.5
Pass out condensing steam turbine	2,342	11	55	65	5.2
Gas turbine	5,057	22	51	73	2.3
Combined cycle	3,574	26	48	74	1.9
Reciprocating engine	3,586	29	40	69	1.4
All schemes	**3,603**	**24**	**48**	**72**	**2**

CHP schemes which export and schemes with mechanical power output

7.24 Table 7E shows the electrical exports from CHP schemes between 2014 and 2016. In the 2015 edition of the Digest, for the first time we presented rigorous values for both total power exported and the Qualifying Power Output (QPO) exported. In previous editions of the Digest, power export figures have been based upon information voluntarily supplied by scheme operators. From the 2015 edition of the Digest, power export figures are based upon export meter data. The total power exported given below is therefore the value registered on the power export meter, with one adjustment made for some schemes. Where the value registered on a scheme's power export meter is greater than the Total Power Output (TPO) for the scheme, the total power exported is capped at the TPO of the scheme. This adjustment is necessary in some situations where schemes import power from another place and onward supply this power, with the onward supplied power passing through the power export meter. Mathematically, this is shown as:

TPO Exported = Value registered on power export meter

If Value registered on power export meter > TPO, then TPO Exported is set to equal TPO.

The QPO exported is the TPO exported that is deemed good quality. This is calculated by assuming that any power consumed by the scheme is good quality power (QPO). This means that only if the scheme's consumption of power is less than the QPO will QPO become available for export. Mathematically, the QPO exported is:

QPO Exported = QPO for the scheme – Electricity consumed by the scheme, where

Electricity consumed by the scheme = Total Power Output – TPO Exported

If QPO for the scheme < Electricity consumed by the scheme, then QPO Exported is set to zero.

Table 7E also sets out the recipients of exported power. In the 2015 edition of the Digest for the first time we rigorously followed up with Schemes to obtain data on recipients of exported power. This means that this follow-up was possible for years of operation 2014, 2015 and 2016.

Table 7E: Electrical exports from CHP (TPO)

GWh

	2014	**2015**	**2016**
To part of same qualifying group *(1)*	237	582r	775
To a firm NOT part of same qualifying group	14,424	9,365r	10,045
To an electricity supplier	9,321r	12,370r	17,662
Total	**23,982r**	**22,317r**	**28,483**

(1) A qualifying group is a group of two or more corporate consumers that are connected or related to each other, for example, as a subsidiary, or via a parent or holding company, or in terms of share capital.

Table 7F: Electrical exports from CHP (QPO)

GWh

	2014	**2015**	**2016**
To part of same qualifying group *(1)*	232	343r	267
To a firm NOT part of same qualifying group	4,807	3,908r	4,554
To an electricity supplier	2,325r	3,482r	3,820
Total	**7,364r**	**7,733r**	**8,641**

There has been a significant increase in the power exports in 2016 relative to 2015, and this is the case for both total power exports (TPO) and the power exports that can be considered Good Quality (QPO). This is consistent with the much higher Load Factor (Actual) and Load Factor (CHPQA) discussed above, where some large power exporting CHP schemes have generated more power than previously.

7.25 In 2016, 54 large schemes exported heat, with some exporting to more than one customer. In 2015 there were 52 schemes exporting heat. As Table 7G shows, together these schemes supplied 9,301 GWh of heat in 2016, which is an 8.7 per cent increase on the revised 2015 figure.

Table 7G: Heat exports from CHP

	2014	2015	2016
To part of same qualifying group *(1)*	511	760r	961
To a firm NOT part of same qualifying group	8,086	7,570r	8,099
To an electricity supplier	32	231r	242
Total	**8,629**	**8,560r**	**9,301**

(1) A qualifying group is a group of two or more corporate consumers that are connected or related to each other, for example, as a subsidiary, or via a parent or holding company, or in terms of share capital.

7.26 There are an estimated 10 schemes with mechanical power output. For those schemes, mechanical power accounts for 9 per cent of their total power capacity (Table 7H). These schemes are predominantly on petro-chemicals or steel sites, using by-product fuels in boilers to drive steam turbines. The steam turbine is used to provide mechanical rather than electrical power, driving compressors, blowers or fans, rather than an alternator. The number of operating schemes with mechanical power is one less than in 2015 due to the closure of the integrated steel operations at Redcar, which relied heavily on by-product fuel gases from the blast furnace and coke ovens.

Table 7H: CHP schemes with mechanical power output in 2016

	Unit	
Number of schemes		10
Total Power Capacity of these schemes (CHP_{TPC})	MWe	2,141
Mechanical power capacity of these schemes	MWe	203

Emissions savings

7.27 The calculation of carbon emissions savings from CHP is complex because CHP displaces a variety of fuels, technologies and sizes of plant. The methodology and assumptions used for calculating carbon emission savings are outlined in Energy Trends June 2003[4]. The figures compare CHP with the UK fossil fuel basket carbon intensity and the UK total basket carbon intensity, which includes nuclear and renewable generation. The carbon emission savings from CHP in 2016 as compared to the fossil fuel basket were 9.53 $MtCO_2$, which equates to 1.71 Mt CO_2 per 1,000 MWe installed capacity. Against the total basket, CHP saved 4.70 Mt CO_2 which equates to 0.84 Mt CO_2 per 1,000 MWe installed capacity.

7.28 Corresponding figures for 2014 and 2015 are shown in Table 7I. The 2014 and 2015 CO_2 savings are revised based on revisions to the relevant data for these years in Tables 7.1, 7.4, 7.6 and 7.9 and revisions to the CO_2 intensity of grid electricity. Absolute savings ($MtCO_2$) are sensitive to both the levels of CHP heat and power output and the CO_2 factor attributed to grid electricity that CHP electricity displaces. In spite of the fact that CHP outputs of heat and power, fuel consumption and fuel mix were broadly similar between 2015 and 2016, the absolute savings in 2016 were significantly lower than in 2015. This is explained by the provisional 2016 values for CO_2 intensity attributed to grid electricity being significantly lower in than in 2015, which was mainly due to a dramatic fall in the proportion of total electrity generation coming from coal. The relative savings ($MtCO_2$/MWe) in 2016 was also lower than in 2015 and this can be also attributed to the lower CO_2 intensities of grid electricity in 2016 compared to 2015, since the CHP load factor on CHPQA basis in 2016 was actually higher than in 2015.

4 http://webarchive.nationalarchives.gov.uk/20060213234600/http:/www.dti.gov.uk/energy/inform/energy_trends/index.shtml

Table 7I: Carbon dioxide savings due to CHP, absolute and per 1,000 MWe of installed good quality CHP capacity

	2014		2015		2016	
	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe	$MtCO_2$	$MtCO_2$/1000 MWe
Carbon savings against all fossil fuels	13.18	2.24	12.57	2.19	9.53	1.71
Carbon savings against all fuels (including nuclear and renewables)	7.81	1.33	6.46	1.13	4.7	0.84

Note: (1) The CO_2 savings in Table 7I assume that CHP generated electricity avoids the transmission and distribution losses associated with its conventionally generated equivalent. These losses are assumed to be 1.5% in the case of transmission losses and 6.0% in the case of distribution losses.

(2) The CO_2 savings quoted above for 2016 are based on preliminary CO_2 intensities, for that year, for the fossil fuel basket and the total fuel basket of conventional electricity generation. As such, they are subject to revision at a later date. The CO_2 savings quoted above for 2014 and 2015 have also been revised in response to changes in the CO_2 intensity factors for electricity for these years since reporting in DUKES 2016.The figures have also been revised to reflect revisions to CHP electricity and heat output and fuel consumption.

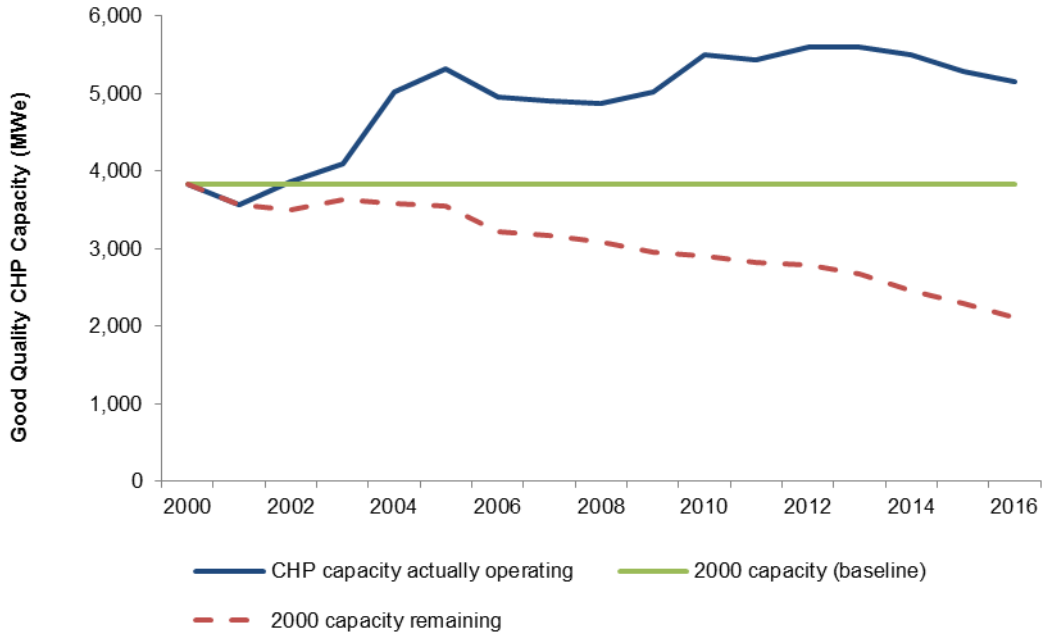
Government policy towards CHP

7.29 There are a range of support measures to incentivise the growth of Good Quality CHP in the UK. These include:

- Exemption from the Climate Change Levy (CCL) of all fuel inputs to, and electricity outputs from, Good Quality CHP. This exemption has been in place since the introduction of the CCL in 2001.
- From April 2013, exemption from Carbon Price Support (CPS) on fuel to CHP consumed for the generation of heat
- From April 2015, exemption from Carbon Price Support (CPS) on fuel to CHP consumed for the generation of Good Quality CHP electricity which is consumed on site
- Eligibility to Enhanced Capital Allowances for Good Quality CHP plant and machinery.
- Business Rates exemption for CHP power generation plant and machinery.
- Reduction of VAT (from 20 to 5 per cent) on domestic micro-CHP installations.
- Extension of the eligibility for Renewable Obligation Certificates (ROCs) to energy from waste plants that utilise CHP.
- Specific Renewable Heat Incentive (RHI) for biomass fuelled Good Quality CHP certified under CHPQA.
- Contract for Difference (CFD) for biomass fuelled CHP
- The zero-rating of heat under the Carbon Reduction Commitment Energy Efficiency Scheme (CRC), this means that allowances do not have to be purchased by a site covered by CRC for heat that it imports. This incentivises the use of CHP heat outputs.

7.30 Table 7.1 shows the installed Good Quality CHP capacity in each year. However, this table hides the underlying market activity that replaces older capacity as it is taken out of service over time. Chart 7.4 gives an idea of the scale of this activity since 2000 for CHP schemes certified under CHPQA. The dotted line shows how much of the Good Quality CHPQA capacity that was in place in 2000 remained in place in subsequent years, while the upper line shows the actual Good Quality CHPQA capacity in place in each year. For any year since 2000, the gap between these two lines represents the new Good Quality CHPQA capacity installed between 2000 and that year. By 2016 there had been just over 3.0 GWe of new Good Quality CHPQA capacity installed since 2000.

Chart 7.4: Underlying market activity – operating Good Quality CHP versus retained Good Quality CHP



International context

7.31 Phase III of EU ETS runs from 2013 until 2020. Under this phase there is no allocation made in respect of CO_2 emissions associated with the generation of electricity, including electricity generated by CHP. However, there is an allocation made in respect of EU ETS CO_2 emissions associated with measurable CHP heat consumption. The allocation is based upon harmonised benchmarks for heat production. In 2013 an EU ETS installation consuming CHP generated heat (not deemed at risk of carbon leakage) will have received 80% of the allocation determined using this benchmark, declining linearly to 30% by 2020. Where the installation consuming the heat is deemed at significant risk of carbon leakage, then it will receive 100% of the allocation determined using the benchmark for the duration of Phase III of EU ETS. If the consumer of the heat is not an EU ETS installation, then the allocation is given to the heat producer. The benchmark for heat adopted by the European Commission is based on the use of natural gas with a conversion efficiency of 90% (N.C.V.). This means that the benchmark allocation made for each MWh of heat generated by a CHP scheme which is subsequently is 0.224 tCO2[5].

5 Where the CHP supplies heat to an EU ETS Phase III sub-installation or installation and the sub-installation or installation produces a product that is product benchmarked, then an allocation is not made in respect of the heat supplied but in respect of the product produced.

Technical notes and definitions

7.32 These notes and definitions are in addition to the technical notes and definitions covering all fuels and energy as a whole in Chapter 1, paragraphs 1.28 to 1.61.

Data for 2016

7.33 The data are summarised from the results of a long-term project undertaken by Ricardo Energy & Environment on behalf of the Department of Business, Energy and Industrial Strategy (BEIS). Data are included for CHP schemes installed in all sectors of the UK economy.

7.34 Data for 2016 were based on data supplied to the CHPQA programme, information from the Iron and Steel Statistics Bureau (ISSB), information from Ofgem in respect of "Renewables Obligation Certificates" (ROCs), information from the CHP Sales database maintained by the CHPA and from a survey of anaerobic digestion (AD) sites. Ninety-five per cent of the total capacity is from schemes that have been certified under the CHPQA programme. Sewage Treatment Works and other AD schemes that do not provide returns to CHPQA have been included based on ROCs information from Ofgem returns. The data from these sources accounts for approximately 3.1 per cent of total electrical capacity. The balance of the capacity is for schemes covered by ISSB sources (<1 per cent), CHPA Sales Database (<1 per cent) and for schemes not covered by the above sources which were interpolated from historical data (<1 per cent).

Definitions of schemes

7.35 There are four principal types of CHP system:

- **Steam turbine,** where steam at high pressure is generated in a boiler. In **back pressure steam turbine systems**, the steam is wholly or partly used in a turbine before being exhausted from the turbine at the required pressure for the site. In **pass-out condensing steam turbine systems**, a proportion of the steam used by the turbine is extracted at an intermediate pressure from the turbine with the remainder being fully condensed before it is exhausted at the exit. (Condensing steam turbines without passout and which do not utilise steam are not included in these statistics as they are not CHP). The boilers used in such schemes can burn a wide variety of fuels including coal, gas, oil, and waste-derived fuels. With the exception of waste-fired schemes, a steam turbine plant has often been in service for several decades. Steam turbine schemes capable of supplying useful steam have electrical efficiencies of between 10 and 20 per cent, depending on size, and thus between 70 per cent and 30 per cent of the fuel input is available as useful heat. Steam turbines used in CHP applications typically range in size from a few MWe to over 100 MWe.

- **Gas turbine systems**, often aero-engine derivatives, where fuel (gas or gas-oil) is combusted in the gas turbine and the exhaust gases are normally used in a waste heat boiler to produce usable steam, though the exhaust gases may be used directly in some process applications. Gas turbines range from 30 kWe upwards, achieving electrical efficiency of 23 to 30 per cent (depending on size) and with the potential to recover up to 50 per cent of the fuel input as useful heat. They have been common in CHP since the mid 1980s. The waste heat boiler can include supplementary or auxiliary firing using a wide range of fuels, and thus the heat to power ratio of the scheme can vary.

- **Combined cycle systems**, where the plant comprises more than one prime mover. These are usually gas turbines where the exhaust gases are utilised in a steam generator, the steam from which is passed wholly or in part into one or more steam turbines. In rare cases reciprocating engines may be linked with steam turbines. Combined cycle is suited to larger installations of 7 MWe and over. They achieve higher electrical efficiency and a lower heat to power ratio than steam turbines or gas turbines. Recently installed combined cycle gas turbine (CCGT) schemes have achieved an electrical efficiency approaching 50 per cent, with 20 per cent heat recovery, and a heat to power ratio of less than 1:1.

- **Reciprocating engine systems** range from less than 100 kWe up to around 5 MWe, and are found in applications where production of hot water (rather than steam) is the main requirement, for example, on smaller industrial sites as well as in buildings. They are based on auto engine or

marine engine derivatives converted to run on gas. Both compression ignition and spark ignition firing is used. Reciprocating engines operate at around 28 to 33 per cent electrical efficiency with around 50 per cent to 33 per cent of the fuel input available as useful heat. Reciprocating engines produce two grades of waste heat: high grade heat from the engine exhaust and low grade heat from the engine cooling circuits.

- **Organic Rankine Cycle systems** operate on the same principle as steam turbines but, instead of using water steam as the working fluid, use organic substances with a lower boiling point and higher vapour pressure than water. This allows heat of a lower temperature to be converted into power via evaporation of the organic working fluid and expansion through a turbine. Low and medium temperature heat sources in the temperature range 80 to 350°C are exploited by ORC systems. The accessibility of low grade heat means that geothermal, industrial waste heat, biomass and solar heat sources can be exploited by ORC systems for the generation of power.

Determining fuel consumption for heat and electricity

7.36 In order to provide a comprehensive picture of electricity generation in the United Kingdom and the fuels used to generate that electricity, the energy input to CHP schemes has to be allocated between heat and electricity production. This allocation is notional and is not determinate.

7.37 The convention used to allocate the fuels to heat and electricity relates the split of fuels to the relative efficiency of heat and electricity supply. The efficiency of utility plant varies widely: electricity generation from as little as 25 per cent to more than 50 per cent and boilers from 50 per cent to more than 90 per cent. Thus it is around twice as hard to generate a unit of electricity as it is to generate a unit of heat. Accordingly, a simple convention can be implemented whereby twice as many units of fuel are allocated to each unit of electricity generated, as to each unit of heat supplied. This approach is consistent with the Defra Guidelines for Company Reporting on greenhouse gas emissions and for Negotiated Agreements on energy efficiency agreed between Government and industry as part of the Climate Change Levy (CCL) package. It recognises that, in developing a CHP scheme, both the heat customer(s) and the electricity generator share in the savings.

7.38 The assumption in this convention that it is twice as hard to generate a unit of electricity as heat, is appropriate for the majority of CHP schemes. However, for some types of scheme (for example in the iron and steel sector) this allocation is less appropriate and can result in very high apparent heat efficiencies. These, however, are only notional efficiencies.

The effects on the statistics of using CHPQA

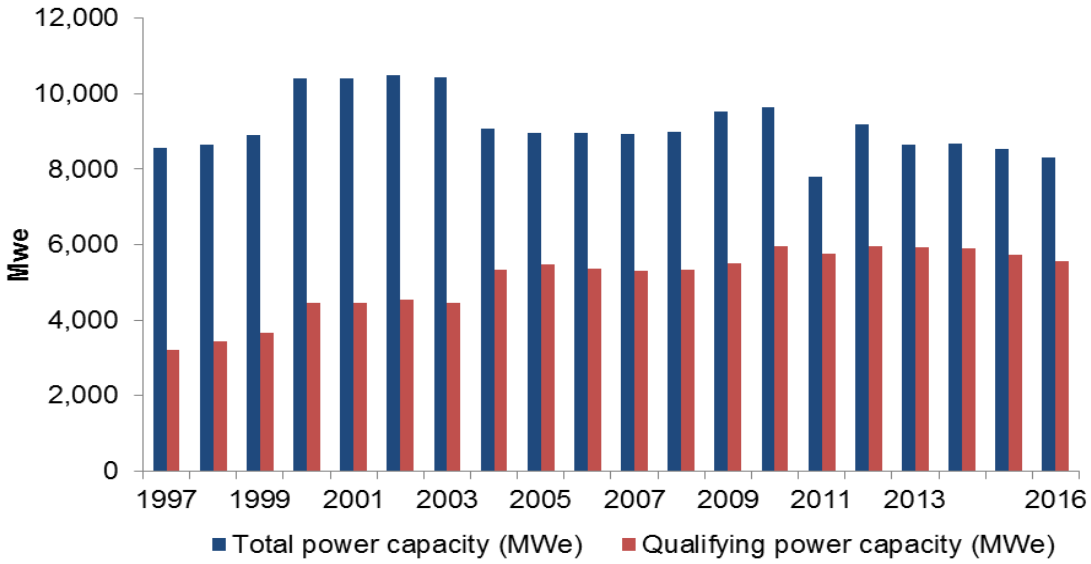
7.39 Paragraph 7.5 described how schemes were scaled back so that only CHP_{QPC} and CHP_{QPO} are included in the CHP statistics presented in this Chapter. This is illustrated in Table 7J where it is seen that 370 schemes were scaled back. For information, in 2015, 358 schemes were scaled back.

7.40 In 2016, the power output from these schemes was scaled back from a total of 35,880 GWh to 12,179 GWh. The total fuel input to these schemes was 114,919 GWh of which 61,089 GWh was regarded as being for power only. For 2015, the total power output was scaled back from 30,356 GWh to 11,760 GWh. The increase in power output from these schemes in 2016 relative to 2015 is consistent with the increase in the Load Factor (Actual) and TPO exports discussed above for 2016, where number of large schemes (whose Good Quality power outputs are also scaled back) generated more power in 2016 than in 2015.

Table 7J: CHP capacity, output and fuel use which has been scaled back in 2016

	Units	
Number of schemes requiring scaling back		370
Total Power Capacity of these schemes (CHP_{TPC})	MWe	6,554
Qualifying Power Capacity of these schemes (CHP_{QPC})	MWe	3,803
Total power output of these schemes (CHP_{TPO})	GWh	35,880
Qualifying Power Output of these schemes (CHP_{QPO})	GWh	12,179
Electricity regarded as "Power only" not from CHP (CHP_{TPO} - CHP_{QPO})	GWh	23,701
Total Fuel Input of these schemes (CHP_{TFI})	GWh	114,919
Fuel input regarded as being for "Power only" use i.e. not for CHP	GWh	61,089

Chart 7.5: Installed CHP capacity by year



Exports of heat

7.41 The figures quoted in Table 7G for exports of heat for 2014 are based on voluntary returns from schemes. As such, there is the potential for these figures to underestimate the true situation. More robust follow up with schemes on heat exports was implemented for year of operation 2015 onwards.

Typical Power and Heat Efficiencies and Heat to Power Ratios of Prime Movers

7.42 The figures quoted above in Table 6D are for CHP schemes. These schemes may contain supplementary boilers, supplementary firing and auxiliary firing. The figures are, therefore, not reflective of the power and heat efficiencies and the heat to power ratios of the prime mover when it is considered in isolation.

Contacts:
Richard Hodges
Ricardo Energy & Environment
Richard.Hodges@ricardo.com
01235 753 047

Liz Waters
BEIS Energy Statistics Team
elizabeth.waters@beis.gov.uk
0300 062 5735

7.1 CHP installations by capacity and size range

	2012	2013	2014	2015	2016
Number of Schemes	**1,942r**	**2,029r**	**2,076r**	**2,139r**	**2,182**
<= 100 kWe	571	602	608r	617r	627
> 100 kWe to 1 MWe	1,045r	1,083r	1,102r	1,132r	1,158
>1 MWe to 2 MWe	105	114	132	142r	151
> 2 MWe to 10 MWe	154	165	169	181r	180
> 10 MWe +	67	65	65	67r	66
Total Capacity	**5,965r**	**5,924r**	**5,892r**	**5,730**	**5,571**
<= 100 kWe	37	39	39	40	40
> 100 kWe to 1 MWe	260r	273r	280r	297	303
>1 MWe to 2 MWe	149	164	190	208	218
> 2 MWe to 10 MWe	723	759	781	826	824
> 10 MWe +	4,797	4,689	4,601	4,360	4,185

(1) A site may contain more than one CHP scheme; the capacity categories have changed since publication in the 2013 Digest.
(2) MicroCHP schemes installed under FIT are not included in these figures (or any subsequent figures in chapter 7). At the end of 2016 517 such schemes were registered on Ofgems Central FIT Register totalling 0.55MWe

7.2 Fuel used to generate electricity and heat in CHP installations

GWh

	2012	2013	2014	2015	2016
Fuel used to generate electricity *(1)*					
Coal *(2)*	543	420	386	137	113
Fuel oil	525	145	120	124r	133
Natural gas	36,203r	31,314r	30,615r	30,439r	31,294
Renewable fuels *(3)*	3,966	4,428	5,374	4,881r	5,414
Other fuels *(4)*	5,083	4,735	4,773	4,180r	4,194
Total all fuels	**46,321r**	**41,042r**	**41,268r**	**39,763r**	**41,148**
Fuel used to generate heat					
Coal *(2)*	1,491	1,592	863	439	371
Fuel oil	723	205	140	166r	147
Natural gas	33,642r	32,038r	29,781r	27,746r	28,820
Renewable fuels *(3)*	3,301	3,429	3,924	4,216r	4,395
Other fuels *(4)*	10,223	10,124	10,230	10,339r	9,244
Total all fuels	**49,380r**	**47,388r**	**44,939r**	**42,906r**	**42,978**
Overall fuel use					
Coal *(2)*	2,035	2,012	1,249	577	484
Fuel oil	1,248	350	260	291r	280
Natural gas	69,844r	63,352r	60,397r	58,186r	60,114
Renewable Fuel o/w;	7,268	7,856	9,298	9,097r	9,809
Bioliquid	*63*	*70*	*62*	*66*	*82*
Biomass	*3,112*	*3,363*	*4,042*	*3,179*	*3,727*
Waste	*1,307*	*1,205*	*1,691*	*2,011*	*2,223*
Biogas/Syngas	*2,785*	*3,218*	*3,504*	*3,842*	*3,778*
Other Fuels (3)	15,306	14,859	15,003	14,519r	13,439
Total all fuels	**95,701r**	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) See paragraphs 7.36 to 7.37 and the CHP methodology note on the BEIS website for an explanation of the method used to allocate fuel use between heat generation and electricity generation.
(2) Includes coke.
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas.

7.3 Fuel used by types of CHP installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	518	550	572	577	484
Gas turbine	-	-	-	-	-
Combined cycle	1,371	1,358	674	-	-
Reciprocating engine	6	1	1	-	-
Pass out condensing steam turbine	139	102	2	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	2,035	**2,012**	**1,249**	**577**	**484**
Fuel Oil					
Back pressure steam turbine	117	145	100	95	77
Gas turbine	0	5	3	1r	3
Combined cycle	987	56	16	25	65
Reciprocating engine	122	123	122	118r	119
Pass out condensing steam turbine	22	21	20	52r	16
Organic Rankine Cycle[1]	-	-	-	-	-
	1,248	**350**	**260**	**291r**	**280**
Natural Gas					
Back pressure steam turbine	1,305	2,544	2,079	832r	731
Gas turbine	9,411	8,683	8,492	8,555r	9,230
Combined cycle	49,365	42,164	39,617	36,956r	38,199
Reciprocating engine	9,390r	9,574r	9,988r	10,904r	11,326
Pass out condensing steam turbine	374	388	221	939r	629
Organic Rankine Cycle[1]	-	-	-	-	-
	69,844r	**63,352r**	**60,397r**	**58,186r**	**60,114**
Renewable Fuels *(2)*					
Back pressure steam turbine	1,527	1,484	1,081	894r	888
Gas turbine	6	12	12	12	12
Combined cycle	344	87	60	67	61
Reciprocating engine	2,815	3,226	3,492	3,828r	3,785
Pass out condensing steam turbine	2,576	3,049	4,654	4,153r	4,920
Organic Rankine Cycle[1]	-	-	-	....	....
	7,268	**7,856**	**9,298**	**7,773r**	**8,016**
Other Fuels *(3)*					
Back pressure steam turbine	3,175	1,581	1,634	0r	0
Gas turbine	209	155	153	212	245
Combined cycle	9,241	10,306	9,915	9,782r	9,534
Reciprocating engine	69	47	68	91r	106
Pass out condensing steam turbine	2,613	2,771	3,234	4,435r	3,509
Organic Rankine Cycle[1]	-	-	-	....	....
	15,306	**14,859**	**15,003**	**15,843**	**15,232**
Total - all fuels					
Back pressure steam turbine	6,642	6,303	5,466	2,398r	2,180
Gas turbine	9,626	8,854	8,659	8,779r	9,490
Combined cycle	61,309	53,972	50,281	46,830r	47,858
Reciprocating engine	12,401r	12,971r	13,670r	14,941r	15,335
Pass out condensing steam turbine	5,724	6,331	8,131	9,578r	9,073
Organic Rankine Cycle[1]	-	-	-	....	....
	95,701r	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.4 CHP - electricity generated by fuel and type of installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	62	63	67	66	56
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	165	101	113	-	-
Reciprocating engine	1	0	0	-	-
Pass-out condensing steam turbine	1	9	0	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	228	**173**	**179**	**66**	**56**
Fuel oil					
Back pressure steam turbine	14	17	13	12	10
Gas turbine	0	1	0	0	1
Combined cycle gas turbine	200	12	3	6	14
Reciprocating engine	41	42	42	41r	41
Pass-out condensing steam turbine	1	1	1	2	1
Organic Rankine Cycle[1]	-	-	-	-	-
	257	**72**	**59**	**61r**	**66**
Natural gas					
Back pressure steam turbine	126	168	172	83r	71
Gas turbine	2,262	2,034	1,953	1,966r	2,045
Combined cycle gas turbine	12,779	10,467	10,097	10,210r	10,428
Reciprocating engine	2,556r	2,628r	2,795r	3,087r	3,204
Pass-out condensing steam turbine	8	34	27	69r	34
Organic Rankine Cycle[1]	-	-	-	-	-
	17,731r	**15,331r**	**15,045r**	**15,415r**	**15,781**
Renewable Fuel					
Back pressure steam turbine	214	213	168	155r	154
Gas turbine	1	2	2	2	2
Combined cycle gas turbine	10	15	16	18	17
Reciprocating engine	839	971	1,056	1,153r	1,166
Pass-out condensing steam turbine	441	599	885	608r	780
Organic Rankine Cycle[1]	-	-	-	15	17
	1,506	**1,801**	**2,128**	**1,950r**	**2,136**
Other Fuels					
Back pressure steam turbine	214	82	106	0r	0
Gas turbine	38	29	21	35	38
Combined cycle gas turbine	2,060	1,967	1,935	1,785r	1,819
Reciprocating engine	18	11	16	19	28
Pass-out condensing steam turbine	174	127	206	227r	139
Organic Rankine Cycle[1]	-	-	-	-	5
	2,505	**2,215**	**2,284**	**2,066r**	**2,030**
Total - All Fuels					
Back pressure steam turbine	630	543	526	317r	291
Gas turbine	2,301	2,066	1,977	2,003r	2,086
Combined cycle gas turbine	15,214	12,561	12,164	12,019r	12,278
Reciprocating engine	3,455r	3,652r	3,909r	4,299r	4,439
Pass-out condensing steam turbine	626	770	1,119	906r	954
Organic Rankine Cycle[1]	-	-	-	-	22
Total	**22,226r**	**19,592r**	**19,695r**	**19,558r**	**20,070**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "…." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.5 CHP - electrical capacity by fuel and type of installation

MWe

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	20	20	21	22	22
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	175	197	128	-	-
Reciprocating engine	1	0	0	-	-
Pass-out condensing steam turbine	3	2	0	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	199	**220**	**150**	**22**	**22**
Fuel oil					
Back pressure steam turbine	6	6	5	4	5
Gas turbine	0	0	0	0	0
Combined cycle gas turbine	45	3	1	1	3
Reciprocating engine	6	7	6	6	7
Pass-out condensing steam turbine	1	1	1	2	0
Organic Rankine Cycle[1]	-	-	-	-	-
	58	**17**	**13**	**13r**	**15**
Natural gas					
Back pressure steam turbine	39	79	71	21r	21
Gas turbine	412	422	360	401	401
Combined cycle gas turbine	3,395	3,114	3,220	3,005r	2,881
Reciprocating engine	717r	763	825r	857r	886
Pass-out condensing steam turbine	7	9	9	42r	28
Organic Rankine Cycle[1]	-	-	-	-	-
	4,571	**4,387**	**4,485r**	**4,326r**	**4,217**
Renewable Fuel *(2)*					
Back pressure steam turbine	39	37	28	24r	24
Gas turbine	0	1	1	1	1
Combined cycle gas turbine	4	2	3	3	3
Reciprocating engine	195	230	236	320r	325
Pass-out condensing steam turbine	105	162	180	226r	230
Organic Rankine Cycle[1]	-	-	-	….	….
	344	**432**	**447**	**577r**	**587**
Other Fuels *(3)*					
Back pressure steam turbine	107	67	67	-r	0
Gas turbine	12	9	4	10	11
Combined cycle gas turbine	576	700	602	583r	549
Reciprocating engine	21	15r	18r	19	20
Pass-out condensing steam turbine	77	77	107	180r	149
Organic Rankine Cycle[1]	-	-	-	….	….
	793	**868r**	**798r**	**792r**	**731**
Total - All Fuels					
Back pressure steam turbine	211	210	192	72r	72
Gas turbine	425	431	364r	411	412
Combined cycle gas turbine	4,196	4,018	3,954	3,592r	3,436
Reciprocating engine	941	1,014r	1,085r	1,202r	1,238
Pass-out condensing steam turbine	193	251	297	449r	407
Organic Rankine Cycle[1]	-	-	-	….	5
Total	**5,965r**	**5,924r**	**5,892r**	**5,730r**	**5,571**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "…." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.6 CHP - heat generated by fuel and type of installation

GWh

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	405	434	432	423	366
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	745	776	381	-	-
Reciprocating engine	3	1	0	-	-
Pass-out condensing steam turbine	111	92	1	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	1,263	**1,302**	**813**	**423**	**366**
Fuel oil					
Back pressure steam turbine	98	121	78	71	60
Gas turbine	0	3	2	1	2
Combined cycle gas turbine	562	31	8	13	37
Reciprocating engine	35	36	35	34r	36
Pass-out condensing steam turbine	14	13	13	32	10
Organic Rankine Cycle[1]	-	-	-	-	-
	708	**204**	**136**	**151r**	**144**
Natural gas					
Back pressure steam turbine	1,183	2,082	1,716	635r	549
Gas turbine	4,689	4,506	4,365	4,265r	4,689
Combined cycle gas turbine	22,526	19,961	18,540	17,200r	17,784
Reciprocating engine	4,243r	4,443r	4,424r	4,868r	5,065
Pass-out condensing steam turbine	268	291	121	760r	496
Organic Rankine Cycle[1]	-	-	-	-	-
	32,909r	**31,283r**	**29,164r**	**27,728r**	**28,581**
Renewable Fuel *(2)*					
Back pressure steam turbine	712	758	554	344r	341
Gas turbine	3	2	2	2	2
Combined cycle gas turbine	70	34	30	34	31
Reciprocating engine	779	873	961	1,013r	1,013
Pass-out condensing steam turbine	757	1,113	1,423	1,634r	1,794
Organic Rankine Cycle[1]	-	-	-	....	....
	2,321	**2,780**	**2,970**	**3,090r**	**3,256**
Other Fuels *(3)*					
Back pressure steam turbine	2,820	1,458	1,519	0r	0
Gas turbine	108	83	62	91	115
Combined cycle gas turbine	4,839	5,564	5,243	5,528r	5,220
Reciprocating engine	17	15	20	26	36
Pass-out condensing steam turbine	1,704	1,660	2,030	3,225r	2,681
Organic Rankine Cycle[1]	-	-	-	....	....
	9,488	**8,781**	**8,874**	**8,870r**	**8,075**
Total - All Fuels					
Back pressure steam turbine	5,218	4,853	4,298	1,472r	1,316
Gas turbine	4,800	4,595	4,430	4,359r	4,807
Combined cycle gas turbine	28,741	26,366	24,201	22,775r	23,070
Reciprocating engine	5,077r	5,369r	5,441r	5,940r	6,149
Pass-out condensing steam turbine	2,854	3,168	3,587	5,651r	4,982
Organic Rankine Cycle[1]	-	-	-	....	99
Total	**46,690r**	**44,350r**	**41,957r**	**40,261r**	**40,423**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure
(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.7 CHP - heat capacity by fuel and type of installation

MWth

	2012	2013	2014	2015	2016
Coal					
Back pressure steam turbine	125	124	134	137	134
Gas turbine	-	-	-	-	-
Combined cycle gas turbine	283	301	169	-	-
Reciprocating engine	5	2	1	-	-
Pass-out condensing steam turbine	57	48	20	-	-
Organic Rankine Cycle[1]	-	-	-	-	-
	470	**474**	**324**	**137**	**134**
Fuel oil					
Back pressure steam turbine	40	42	32	31	34
Gas turbine	0	1	1	1	2
Combined cycle gas turbine	179	14	6	5	12
Reciprocating engine	12	8	7	6	8
Pass-out condensing steam turbine	5	5	5	15	6
Organic Rankine Cycle[1]	-	-	-	-	-
	236	**70**	**51**	**57**	**61**
Natural gas					
Back pressure steam turbine	465	829	751	212r	212
Gas turbine	1,763	1,781	1,662r	1,785	1,807
Combined cycle gas turbine	10,761	9,750	9,836	8,946r	8,667
Reciprocating engine	2,595r	2,758	2,991r	3,153r	3,257
Pass-out condensing steam turbine	133	145	241	330r	230
Organic Rankine Cycle[1]	-	-	-	-	-
	15,717r	**15,263**	**15,481r**	**14,426r**	**14,172**
Renewable Fuel *(2)*					
Back pressure steam turbine	161	155	129	107r	106
Gas turbine	2	4	4	4	4
Combined cycle gas turbine	1,627	258	12	14	12
Reciprocating engine	230	303	313	450r	447
Pass-out condensing steam turbine	546	737	905	1,232r	1,247
Organic Rankine Cycle[1]	-	-	-	....	....
	2,566	**1,456**	**1,363**	**1,828r**	**1,841**
Other Fuels *(3)*					
Back pressure steam turbine	944	586	593	0r	0
Gas turbine	48	32	7	20	23
Combined cycle gas turbine	1,856	3,578	1,991	1,946r	1,858
Reciprocating engine	17	15	18r	20r	21
Pass-out condensing steam turbine	691	694	2,401	1,689r	1,544
Organic Rankine Cycle[1]	-	-	-	....	....
	3,555	**4,904r**	**5,010r**	**3,675r**	**3,464**
Total - All Fuels					
Back pressure steam turbine	1,735	1,735	1,638	486r	486
Gas turbine	1,813	1,818	1,674	1,810	1,835
Combined cycle gas turbine	14,707	13,900	12,014	10,911	10,549
Reciprocating engine	2,857r	3,085r	3,330r	3,629r	3,733
Pass-out condensing steam turbine	1,432	1,628	3,573	3,267r	3,027
Organic Rankine Cycle[1]	-	-	-	....	43
Total	**22,545**	**22,167r**	**22,228r**	**20,123r**	**19,673**

(1) From 2015, Organic Rankine Cycle CHP schemes are included in the statistics
For 2015 and 2016, where there is a "...." entered against this category, the data are merged with the back pressure steam turbine technology category, in order to avoid disclosure

(2) Renewable fuels include: Biomass, sewage gas, other biogases, municipal solid waste and refuse derived fuels
(3) Other fuels include: process by-products, coke oven gas, blast furnace gas, gas oil and refinery gas

7.8 CHP capacity, output and total fuel use[(1)] by sector

	2012	2013	2014	2015	2016
Iron and steel and non ferrous metals					
Number of sites	6	6	6	6	5
Electrical capacity	81	81	81	81	40
Heat capacity	674	674	674	674	435
Electrical output	212	163	158	118	103
Heat output	1,764	1,701	1,776	1,506	1,026
Fuel use	2,766	2,885	2,743	2,720	1,798
of which : for electricity	484	435	395	316	269
for heat	2,282	2,450	2,348	2,404	1,529
Chemicals					
Number of sites	53	52	52	52r	52
Electrical capacity	1,539	1,461	1,437	1,183r	1,137
Heat capacity	5,139	4,828	4,878	4,458r	4,363
Electrical output	5,783	5,212	4,574	4,977r	4,802
Heat output	13,334	12,282	11,010	10,487r	10,421
Fuel use	27,646	25,189	22,685	22,110r	22,197
of which : for electricity	12,960	11,543	10,214	10,458r	10,505
for heat	14,686	13,646	12,470	11,652r	11,693
Oil and gas terminals and oil refineries					
Number of sites	11	11	10	9	9
Electrical capacity	2,380	2,380	2,278	2,235	2,226
Heat capacity	7,600	7,600	7,255	6,825	6,825
Electrical output	8,105	6,184	6,391	6,151r	6,722
Heat output	16,211	14,446	13,615	13,060r	13,904
Fuel use	31,340	26,634	25,759	24,164r	25,833
of which : for electricity	15,486	12,218	12,362	11,533r	12,350
for heat	15,854	14,416	13,397	12,631r	13,483
Paper, publishing and printing					
Number of sites	23	22	21	21	20
Electrical capacity	453	451	477	463r	364
Heat capacity	2,060	1,776	1,764	1,771	1,537
Electrical output	2,170	1,948	2,025	1,639r	1,670
Heat output	4,875	4,849	4,389	3,844r	3,799
Fuel use	9,448	9,221	8,831	7,349r	7,730
of which : for electricity	4,553	4,138	4,295	3,410r	3,676
for heat	4,895	5,082	4,536	3,939r	4,053
Food, beverages and tobacco					
Number of sites	49	54	59	61r	61
Electrical capacity	439	436	455	469r	469
Heat capacity	1,712	1,743	1,787	1,808r	1,808
Electrical output	2,146	2,117	2,266	2,257r	2,132
Heat output	4,046	4,277	4,291	4,119r	3,866
Fuel use	8,129	8,362	8,717	8,563r	8,081
of which : for electricity	4,177	4,172	4,487	4,471r	4,232
for heat	3,952	4,190	4,230	4,092r	3,849
Metal products, machinery and equipment					
Number of sites	19	19	20	21	21
Electrical capacity	68	43	43	46	46
Heat capacity	288	254	254	257	257
Electrical output	106	119	139	153r	159
Heat output	159	193	190	192r	214
Fuel use	603	462	625	654r	711
of which : for electricity	270	250	301	329r	336
for heat	332	212	324	325r	375

For footnotes see page 217

7.8 CHP capacity, output and total fuel use[(1)] by sector (continued)

	2012	2013	2014	2015	2016
Mineral products, extraction, mining and agglomeration of solid fuels					
Number of sites	8	8	8	8r	8
Electrical capacity	54	54	54	52r	52
Heat capacity	183	183	183	165r	165
Electrical output	102	104	109	131r	120
Heat output	494	526	530	550r	498
Fuel use	816	836	881	889r	827
of which : for electricity	236	230	253	289r	269
for heat	580	605	628	600r	558
Sewage treatment					
Number of sites	199	197	200	204r	208
Electrical capacity	173	164	165	222r	228
Heat capacity	241	240	245	372r	378
Electrical output	688	657	719	763r	788
Heat output	740	740	822	872r	891
Fuel use	2,458	2,391	2,601	2,832r	2,804
of which : for electricity	1,605	1,540	1,660	1,791r	1,804
for heat	853	851	941	1,041r	1,001
Other industrial branches *(2)*					
Number of sites	11	12	12	14r	15
Electrical capacity	46	50	50	76r	77
Heat capacity	254	274	274	229r	233
Electrical output	213	225	243	265r	345
Heat output	374	409	422	410r	390
Fuel use	1,182	812	845	920r	1,221
of which : for electricity	621	423	452	535r	841
for heat	562	389	393	385r	380
Total industry					
Number of sites	379	381	388	396r	399
Electrical capacity	5,234	5,119	5,039	4,827r	4,638
Heat capacity	18,151	17,571	17,312	16,559r	16,000
Electrical output	19,524	16,729	16,625	16,455r	16,841
Heat output	41,998	39,423	37,046	35,040r	35,009
Fuel use	84,388	76,792	73,685	70,201r	71,202
of which : for electricity	40,392	34,950	34,419	33,133r	34,283
for heat	43,996	41,842	39,266	37,069r	36,920
Transport, commerce and administration					
Number of sites	930r	956r	974r	1,003r	1,020
Electrical capacity	398r	419r	445r	480r	486
Heat capacity	1,674	1,729r	1,823r	1,945r	1,988
Electrical output	1,695r	1,742r	1,867r	1,830r	1,840
Heat output	2,982r	3,134r	3,028r	3,258r	3,277
Fuel use	6,925r	6,956r	7,377r	7,331r	7,397
of which : for electricity	3,691r	3,567r	4,106r	3,811r	3,839
for heat	3,234r	3,389r	3,272r	3,520r	3,558
Other *(3)*					
Number of sites	633r	692	714	740r	763
Electrical capacity	333	386	408	423r	447
Heat capacity	2,720	2,866	3,093	1,619r	1,685
Electrical output	1,007r	1,121	1,203	1,273r	1,389
Heat output	1,710r	1,793	1,884	1,964r	2,137
Fuel use	4,389r	4,683	5,144	5,137r	5,526
of which : for electricity	2,238r	2,525	2,744	2,820r	3,025
for heat	2,150r	2,158	2,401	2,317r	2,501
Total CHP usage by all sectors					
Number of sites	1,942r	2,029r	2,076r	2,139r	2,182
Electrical capacity	5,965r	5,924r	5,892r	5,730r	5,571
Heat capacity	22,545	22,167r	22,228r	20,123r	19,673
Electrical output	22,226r	19,592r	19,695r	19,558r	20,070
Heat output	46,690r	44,350r	41,957r	40,261r	40,423
Fuel use	95,701r	88,430r	86,207r	82,669r	84,125
of which : for electricity	46,321r	41,042r	41,268r	39,763r	41,148
for heat	49,380r	47,388r	44,939r	42,906r	42,978

(1) The allocation of fuel use between electricity and heat is largely notional and the methodology is outlined in the methodology note

(2) Other industry includes Textiles, clothing and footwear sector.

(3) Sectors included under Other are agriculture, community heating, leisure, landfill and incineration.

7.9 CHP - use of fuels by sector

GWh

	2012	2013	2014	2015	2016
Iron and steel and non ferrous metals					
Coal	-	-	-	-	-
Fuel oil	22	21	20	51	15
Natural gas	225	204	169	237	232
Blast furnace gas	1,892	2,169	2,114	2,001	1,317
Coke oven gas	599	489	440	431	220
Other fuels *(1)*	29	2	-	-	14
Total iron and steel and non ferrous metals	**2,766**	**2,885**	**2,743**	**2,720**	**1,798**
Chemicals					
Coal	1,699	1,697	1,033	359	331
Fuel oil	6	10	12	3r	4
Gas oil	5	4	6	4r	5
Natural gas	22,748	20,118	18,169	17,444r	17,829
Refinery gas	556	646	653	648	614
Renewable fuels *(2)*	52	90	92	663r	846
Other fuels *(1)*	2,579	2,623	2,720	2,990r	2,568
Total chemicals	**27,646**	**25,189**	**22,685**	**22,110r**	**22,197**
Oil and gas terminals and oil refineries					
Fuel oil	983	48	7	25	65
Gas oil	52	763	906	798r	687
Natural gas	21,260	18,484	17,847	16,380r	17,786
Refinery gas	3,774	3,872	3,996	4,264r	4,051
Other fuels *(1)*	5,272	3,466	3,003	2,698r	3,244
Total oil and gas terminals and oil refineries	**31,340**	**26,634**	**25,759**	**24,164r**	**25,833**
Paper, publishing and printing					
Coal	139	102	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	6	7	2	1r	1
Natural gas	7,455	6,298	5,402	4,917r	5,161
Renewable fuels *(2)*	1,643	2,516	2,786	2,189r	2,381
Other fuels *(1)*	204	298	641	241r	187
Total paper, publishing and printing	**9,448**	**9,221**	**8,831**	**7,349r**	**7,730**
Food, beverages and tobacco					
Coal	181	205	214	218	152
Fuel oil	116	148	100	94r	77
Gas oil	19	3	4	3r	15
Natural gas	7,642	7,653	7,885	7,812r	7,423
Renewable fuels *(2)*	171	354	515	436r	414
Other fuels *(1)*	-	-	-	-r	0
Total food, beverages and tobacco	**8,129**	**8,362**	**8,717**	**8,563r**	**8,081**
Metal products, machinery and equipment					
Coal	-	-	-	-	-
Fuel oil	89	89	89	89	89
Gas oil	0	0	0	0	0
Natural gas	439	332	364	399r	422
Renewable fuels *(2)*	75	41	172	166r	199
Other fuels *(1)*	-	-	-	-	-
Total metal products, machinery and equipment	**603**	**462**	**625**	**654r**	**711**

For footnotes see page 219

7.9 CHP - use of fuels by sector (continued)

GWh

	2012	2013	2014	2015	2016
Mineral products, extraction, mining and agglomeration of solid fuels					
Coal	-	-	-	-	-
Fuel oil	-	-	-	-	-
Gas oil	-	-	-	-	-
Natural gas	586	606	651	739r	677
Coke oven gas	230	230	230	150	150
Total mineral products, extraction, mining and agglomeration of solid fuels	**816**	**836**	**881**	**889r**	**827**
Sewage treatment					
Fuel oil	33	32	33	29r	28
Gas oil	32	17	26	37r	26
Natural gas	181	36	50	71r	121
Renewable fuels *(2)*	2,213	2,305	2,491	2,696r	2,630
Total sewage treatment	**2,458**	**2,391**	**2,601**	**2,832r**	**2,804**
Other industrial branches					
Fuel oil	-	-	-	-	-
Gas oil	14	0	0	2	3
Natural gas	762	803	837	821	730
Renewable fuels *(2)*	406	9	7	94r	475
Total other industrial branches	**1,182**	**812**	**845**	**918r**	**1,207**
Transport, commerce and administration					
Coal	-	-	-	-	-
Fuel oil	-	-	-	-	0
Gas oil	17	12	34	39r	52
Natural gas	6,019r	6,287r	6,255r	6,572r	6,613
Refinery gas	-	-	-	-	-
Renewable fuels *(2)*	884	657	1,088	719r	732
Other fuels *(1)*	5	-	0	0r	0
Total transport, commerce and administration	**6,925r**	**6,956r**	**7,377r**	**7,331r**	**7,397**
Other *(3)*					
Coal	16	7	3	-	-
Fuel oil	0	2	-	0	2
Gas oil	10	14	13	10r	13
Natural gas	2,528r	2,530	2,768	2,793r	3,119
Renewable fuels *(2)*	1,824	1,886	2,148	2,134r	2,133
Other fuels *(1)*	10	244	213	201r	273
Total other	**4,389r**	**4,683**	**5,144**	**5,139r**	**5,540**
Total - all sectors					
Coal	**2,035**	**2,012**	**1,249**	**577**	**484**
Fuel oil	**1,248**	**350**	**260**	**291r**	**280**
Gas oil	**156**	**820**	**992**	**895r**	**802**
Natural gas	**69,844r**	**63,352r**	**60,397r**	**58,186r**	**60,114**
Blast furnace gas	**1,892**	**2,169**	**2,114**	**2,001**	**1,317**
Coke oven gas	**829**	**719**	**670**	**581**	**370**
Refinery gas	**4,329**	**4,519**	**4,650**	**4,911r**	**4,665**
Renewable fuels *(2)*	**7,268**	**7,856**	**9,298**	**9,097r**	**9,809**
Other fuels *(1)*	**8,100**	**6,633**	**6,577**	**6,130r**	**6,285**
Total CHP fuel use	**95,701r**	**88,430r**	**86,207r**	**82,669r**	**84,125**

(1) Other fuels include: process by-products.
(2) Renewable fuels include: sewage gas, other biogases, municipal solid waste and refuse derived fuels.
(3) Sectors included under Other are agriculture, community heating, leisure, landfill and incineration.

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)(1)

Company Name	Scheme Location	Installed Capacity (MWe) (2)
Adm Erith Ltd	Erith Oil Works	14
Agrivert Ltd	Cassington Ad	2
Agrivert Ltd	Wallingford Ad	2
Atkins Power	Hedon Salads - Burstwick	7
Atkins Power	Hedon Salads - Newport	4
Balcas Limited	Laragh	3
Balcas Timber Ltd	Balcas Invergordon	9
Barkantine Heat & Power Company	Barkantine, Barkantine Heat & Power Company	1
Basf Performance Products	Water Treatments, Basf Plc	16
Birds Eye Limited	Birds Eye Limited, Lowestoft	3
Boortmalt	Boortmalt - Bury St Edmunds	5
Briar Chemicals Ltd	Briar Chemicals Ltd	4
British Sugar Plc	BURY ST EDMUNDS SUGAR FACTORY	77
British Sugar Plc	Cantley Sugar Factory	15
British Sugar Plc	Wissington Sugar Factory, British Sugar Plc (Chp 2)	93
Cambridge University Hospitals Foundation Trust	Addenbrookes Hospital	4
Cantelo Nurseries	Bradon Farm	10
Cargill Plc	Cargill Manchester Chp 2	28
Carillion Services Ltd, Ta Carillion Health	Queen Alexandra Hospital	3
Cereal Partners Uk	Cereal Partners Uk	5
Cereal Partners Uk	Cereal Partners Uk	5
Chichester Power Ltd	Chichester Power	8
City West Homes Limited	Pump House	3
Cleveland Potash Limited	Boulby Mine. Cleveland Potash Limited	13
Cofely IES	COFELY HUMBER ENERGY	46
Cofely Ltd	Trafford Park, Kellogg Company Of Great Britain	5
Cofely Ltd	Rampton Hospital	1
Community Energy	Citigen_2	9
Contourglobal Solutions (Northern Ireland) Ltd	KNOCKMORE HILL CHP, CONTOURGLOBAL SOLUTIONS (NORTH	15
Cyclerval Uk Ltd	Newlincs Efw, Newlincs Development Ltd	3
Cynergin Projects Limited	Villa Nursery Limited	1
Dalkia	FREEMAN HOSPITAL	4
Dalkia	ROYAL VICTORIA INFIRMARY	4
Dalkia Plc	Lincoln County Hospital	1
Dalkia Utilities Services	Eli Lilly & Co Ltd	10
De La Rue Overton	Overton Mill, De La Rue International Ltd	7
Ds Smith Paper Ltd	Kemsley Chp	81
Dsm Nutritional Products (Uk) Ltd	Dsm Dalry	46
Dwr Cymru Welsh Water	Cardiff Wwtw, Dwr Cymru Welsh Water	5
Dwr Cymru Welsh Water	Five Ford Wwtw	1
E.On	Nufarm Uk Limited	5
East Sussex Healthcare Trust	Eastbourne District General Hospital	1
Eco Sustainable Solutions Ltd	Eco Piddlehinton Ad	1
Engie	The Heat Station (Chp 2)	7
Engie	DOW CORNING CHP	27
Engie	Mod Main Building, Cofely Limited	5
Engie	Soas Chp, The Boiler House	1
Engie	Icc Energy Centre	3
Engie	Aston University Energy Centre, Aston University	3
Engie	Birmingham Childrens Hospital	2
Engie	Ldec-City Centre And Leicester East	3
Engie	Ldec-Leicester North	2
Enviroenergy	London Road Heat Station	11
Eon	Queens Medical Centre Nhs Trust	5
Eon Uk	Citigen Chp, Citigen (London) Limited	16
Esso Petroleum Company Limited	Fawley Cogen	316
Fine Organics Limited	Fine Organics Limited	4
Frimley Health Nhs Foundation Trust	Frimley Park Hospital	1
G4 Power Grid Ltd	Brookenby Power Station	2
Genzyme Ltd	Genzyme Ltd	1

For footnotes see page 222

7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)[1] *(continued)*

Company Name	Scheme Location	Installed Capacity (MWe) *(2)*
Glasshouse Generation Limited	Glasshouse Energy Centre	11
Glaxosmithkline	GLAXOSMITHKLINE (ULVERSTON)	2
Glaxosmithkline	Glaxosmithkline Montrose	1
Glaxosmithkline	GLAXOSMITHKLINE, IRVINE	4
Glaxosmithkline	Barnard Castle	2
Glaxosmithkline Research & Development Ltd	GSK R & D Ware	4
Glaxosmithkline Research & Development Ltd	Stevenage R&D	4
Great Ormond Street Hospital	Great Ormond Street Hospital	1
Gsk	Glaxosmithkline, Ware	2
Heathcoat Fabrics Ltd	Heathcoat Fabrics Limited	1
Helix Agencies Limited	Natural History Museum	2
Helix Agencies Limited	Blackpool Victoria Hospital	1
Iggesund Paperboard (Workington) Ltd	Iggesund Paperboard (Workington) Ltd	50
Inbev Uk Ltd	Samlesbury Brewery, Inbev Uk Ltd	7
Inbev Uk Ltd	Magor Brewery, Inbev Uk Ltd	7
Ineos Runcorn (Tps) Limited	Runcorn Energy From Waste Facility, Ineos Runcorn (Tps) Ltd	37
Inovyn Chlorvinyls Ltd	Inovyn Chlorvinyls Ltd	10
Inovyn Chlorvinyls Ltd	Gas Engine Chp	2
Integrated Energy Utilities Limited	Stockethill Chp2	1
Integrated Energy Utilities Limited	Seaton Energy Centre, Aberdeen Heat & Power	2
Integrated Energy Utilities Ltd	Callendar Park Energy Centre, Falkirk Council	1
Integrated Energy Utilities Ltd	Tillydrone Chp	1
Jacobs Douwe Egberts	Jde Banbury	8
Jaguar Land Rover Limited	Castle Bromwich, Jaguar Land Rover Ltd	6
Jaguar Landrover	Landrover Group - Solihull North Works	3
Jaguar Landrover	Landrover - Solihull Paint Shop 21	3
James Cropper Plc	James Cropper Plc	7
John Thompson And Son Ltd	John Thompson & Sons Limited	4
Johnson Matthey	Johnson Matthey Enfield	3
Johnson Matthey	Johnson Matthey - Royston	6
Kodak Alaris Limited	Harrow Site, Kodak Alaris Limited	12
Lawrence Automotive Interiors (Vmc) Ltd	Browns Lane, Lawrence Automotive Interiors (Vmc) Ltd	3
London Borough Of Islington	Bunhill Heat And Power	2
Loughborough University	Central Park	2
Lucozade Ribena Suntory Ltd	Coleford	5
Medway Nhs Foundation Trust	Medway Hospital, Medway Maritime Hospital	1
Mill Nurseries Ltd	Mill Chp, Mill Nurseries	14
Nestle Uk Ltd	Nestle York	10
Nhs Grampian	Aberdeen Royal Infirmary	5
North Tees & Hartlepool Nhs Foundation Trust	University Hospital Of North Tees	2
Northumbrian Water	Levenmouth Waste Water Treatment Works	3
Northumbrian Water Ltd	Bran Sands (Biogas)	5
Northumbrian Water Ltd	Howdon Stw	6
Northwood & Wepa Ltd	Bridgend Chp	9
Novartis Grimsby Ltd	Novartis Grimsby Limited	8
P3P Energy Management Ltd. On Behalf Of Brehon Proper	Europa Nursery - Ash	15
P3ppartners LLP	Woodhouse Nurseries	3
Peel Utilities Holdings Limited	Media City, Utilities (Media City Uk) Ltd	2
Powell Energy	St. Georges Hospital	4
Preston Board And Packaging Ltd	Romiley Board	1
Reckitt Benckister	Kwe Hull	2
Reg Bio Power Ltd	Bentwaters Chp	6
Rotherham General Hospital Nhs Trust	Rotherham District General Hospital	1
Royal Devon And Exeter Foundation Trust	ROYAL DEVON AND EXETER HOSPITAL WONFORD	1
Rwe Npower	Basf Chp	98
RWE Npower Cogen Ltd	Markinch CHP	65
Ryobi Aluminium Casting (Uk) Ltd	Ryobi	1
Saria Ltd	Re-Food Ad Plant Saria Ltd	5
Scottish And Southern Energy	Slough Nurseries, G & C Properties	2
Sellafield Ltd	Combined Heat And Power Plant F238	193
Slough Heat & Power Ltd	Slough Power Station	21
Smurfit Kappa Ssk	Smurfit Kappa Ssk Limited	9

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7.10 Large scale CHP schemes in the United Kingdom
(operational at the end of December 2016)[1] *(continued)*

Company Name	Scheme Location	Installed Capacity
Solvay Solutions Uk Ltd	Oldbury	2
Southern Water Services	Ashford Stc	2
Southern Water Services	Millbrook Wtw, Southern Water	1
Southern Water Services	Budds Farm Wtw, Southern Water	2
Springfields Fuels Ltd	Springfields	12
Swansea University	Swansea University	2
Tata Chemicals Europe	Winnington Chp	103
Tate & Lyle Sugars Ltd	Thames Refinery, Tate And Lyle New Scheme	28
Thames Water Utilities Ltd	Maple Lodge Stw	4
Thames Water Utilities Ltd	Swindon Stw Chp 2015	1
Thames Water Utilities Ltd	Long Reach Stw	3
Thames Water Utilities Ltd	Mogden Stw	10
Thames Water Utilities Ltd	Beddington Stw	2
Thames Water Utilities Ltd	Deephams Stw 2016	3
Thames Water Utilities Ltd	Deephams Stw	3
Thames Water Utilities Ltd	Ryemeads Stw	1
Thames Water Utilities Ltd	Slough Stw Chp 2015	1
Thames Water Utilities Ltd	Oxford Stw	2
Thames Water Utilities Ltd	Crawley Stw	1
Thames Water Utilities Ltd	Reading (Island Road) Stw	1
Thames Water Utilities Ltd	Chertsey Stw	1
Thames Water Utilities Ltd	Riverside Stw	6
Thames Water Utilities Ltd	Beckton Stw Biogas Chp	6
Thames Water Utilities Ltd	Crossness Stw Biogas Chp	6
Thameswey Central Milton Keynes Ltd	Woking Town Centre Phase I	1
Thameswey Central Milton Keynes Ltd	Tcmk Phase 1 Chp No 2 Gas Engine	6
The University Of Birmingham	The University Of Birmingham Scheme Ref 740A	4
The University Of Bradford	Richmond Boiler House	2
Transport For London	PALESTRA, TRANSPORT FOR LONDON	1
University College London	University College London, Gower Street Heat And Power Ltd	3
University Of Aberdeen	OLD ABERDEEN CAMPUS	2
University Of Bristol	University Of Bristol Chp 2	1
University Of Dundee	University Of Dundee, Main Chp Boilerhouse	4
University Of East Anglia	University Of East Anglia	5
University Of Edinburgh Utilities Supply Company	Kings Buildings	3
University Of Edinburgh Utilities Supply Company	George Square Energy Centre	2
University Of Liverpool	University Of Liverpool Chp 2	7
University Of Reading	Whiteknights Energy Centre	1
University Of Southampton	UNIVERSITY OF SOUTHAMPTON	3
University Of Surrey	UNIVERSITY OF SURREY	1
University Of Sussex	UNIVERSITY OF SUSSEX	1
University Of Warwick	CHP BOILERHOUSE (CHP 2), UNIVERSITY OF WARWICK	4
University Of Warwick	Cryfield Energy Centre	4
University Of York	University Of York	3
Unversity Of Edinburgh Utilities Supply Company	Holyrood Energy Centre	1
Upm-Kymmene (Uk)	Upm Shotton	22
Veolia Environmental Services Plc	SHEFFIELD ERF	21
Vinnolit Hillhouse Ltd	Hillhouse International Business Park	5
Vital Energi	South Kensington Campus Chp Plant	9
Vital Energi	York Teaching Hospital	1
Vital Energi	Cheltenham General Hospital	1
Weetabix Ltd	Weetabix Limited	6
Wessex Water Services Ltd	Bristol Waste Water Treatment Works Scheme A	6
Total *(2)*		**2,036**
Electrical capacity of good quality CHP for these sites in total		**1,844**

(1) These are sites of 1 MW installed electrical capacity or more that either have agreed to be listed in the Ofgem register of CHP plants or whose details are publicly available elsewhere, or who have provided the information directly to BEIS It excludes CHP sites that have been listed as major power producers in Table 5.10.

(2) This is the total power capacity from these sites and includes all the capacity at that site, not just that classed as good quality CHP under CHPQA.

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Annexes

Annex A: Energy and commodity balances, conversion factors and calorific values

Annex B: Glossary and acronyms

Annex C: Further sources of UK energy publications

Annex D: Major events in the Energy Industry, 2015-2017

Department for Business, Energy and Industrial Strategy

Annex A

Energy and commodity balances, conversion factors and calorific values

Balance principles

A.1 This Annex outlines the principles behind the balance presentation of energy statistics. It covers these in general terms. Fuel specific details are given in the appropriate chapters of this publication.

A.2 Balances are divided into two types, each of which performs a different function.

a) *commodity balance* – a balance for each energy commodity that uses the units usually associated with that commodity. By using a single column of figures, it shows the flow of the commodity from its sources of supply through to its final use. Commodity balances are presented in the individual fuel chapters of this publication.

b) energy balance - presents the commodity balances in a common unit and places them alongside one another in a manner that shows the dependence of the supply of one commodity on another. This is useful as some commodities are manufactured from others. The layout of the energy balance also differs slightly from the commodity balance. The energy balance format is used in Chapter 1.

A.3 Energy commodities can be either primary or secondary. Primary energy commodities are drawn (extracted or captured) from natural reserves or flows, whereas secondary commodities are produced from primary energy commodities. Crude oil and coal are examples of primary commodities, whilst petrol and coke are secondary commodities manufactured from them. For balance purposes, electricity may be considered to be both primary electricity (for example, hydro, wind) or secondary (produced from steam turbines using steam from the combustion of fuels).

A.4 Both commodity and energy balances show the flow of the commodity from its production, extraction or import through to its final use.

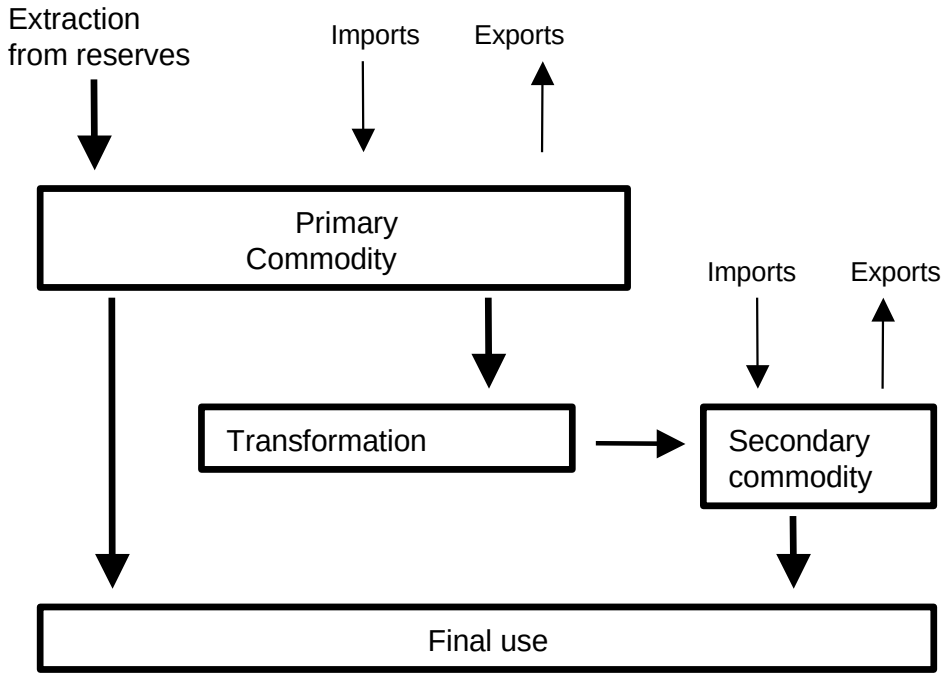
A.5 A simplified model of the commodity flow underlying the balance structure is given in Chart A.1. It illustrates how primary commodities may be used directly and/or be transformed into secondary commodities. The secondary fuels then enter final consumption or may also be transformed into another energy commodity (for example, electricity produced from fuel oil). To keep the diagram simple these “second generation” flows have not been shown.

A.6 The arrows at the top of the chart represent flows to and from the “pools” of primary and secondary commodities, from imports and exports and, in the case of the primary pool, extraction from reserves (eg the production of coal, gas and crude oil).

Commodity balances (Tables 2.1 to 2.3, 3.1 to 3.4, 4.1, 5.1, 5.2 and 6.1 to 6.3)

A.7 A commodity balance comprises a supply section and a demand section. The supply section gives available sources of supply (ie exports are subtracted). The demand section is divided into a transformation section, a section showing uses in the energy industries (other than for transformation) and a section covering uses by final consumers for energy or non-energy purposes. Final consumption for energy purposes is divided into use by sector of economic activity. The section breakdowns are described below.

Chart A.1: Energy flows



Supply

Production

A.8 Production, within the commodity balance, covers indigenous production (extraction or capture of primary commodities) and generation or manufacture of secondary commodities. Production is always gross, that is, it includes the quantities used during the extraction or manufacturing process.

Other sources

A.9 Production from other sources covers sources of supply that do not represent "new" supply. These may be recycled products, recovered fuels (slurry or waste coal), or electricity from pumped storage plants. The production of these quantities will have been reported in an earlier accounting period or have already been reported in the current period of account. Exceptionally, the *Other sources* row in the commodity balances for ethane, propane and butane is used to receive transfers of these hydrocarbons from gas stabilisation plants at North Sea terminals. In this manner, the supplies of primary ethane, propane and butane from the North Sea are combined with the production of these gases in refineries, so that the disposals may be presented together in the balances.

Imports and exports

A.10 The figures for imports and exports relate to energy commodities moving into or out of the United Kingdom as part of transactions involving United Kingdom companies. Exported commodities are produced in the United Kingdom and imported commodities are for use within the United Kingdom (although some may be re-exported before or after transformation). The figures thus exclude commodities either exported from or imported into HM Revenue and Customs bonded areas or warehouses. These areas, although part of the United Kingdom, are regarded as being outside of the normal United Kingdom's customs boundary, and so goods entering into or leaving them are not counted as part of the statistics on trade used in the balances.

A.11 Similarly, commodities that only pass through the United Kingdom on their way to a final destination in another country are also excluded. However, for gas these transit flows are included because it is difficult to identify this quantity separately, without detailed knowledge of the contract information covering the trade. This means that for gas, there is some over statement of the level of imports and exports, but the net flows are correct.

A.12 The convention in these balances is that exports are shown with a negative sign.

Marine bunkers

A.13 These are deliveries of fuels (usually fuel oil or gas oil) to ships of any flag (including the United Kingdom) for consumption during their voyage to other countries. Marine bunkers are treated rather like exports and shown with a negative sign.

Stock changes

A.14 Additions to (- sign) and withdrawals from stocks (+ sign) held by producers and transformation industries correspond to withdrawals from and additions to supply, respectively.

Transfers

A.15 There are several reasons why quantities may be transferred from one commodity balance to another:

- a commodity may no longer meet the original specification and be reclassified;
- the name of the commodity may change through a change in use;
- to show quantities returned to supply from consumers. These may be by-products of the use of commodities as raw materials rather than fuels.

A.16 A quantity transferred from a balance is shown with a negative sign to represent a withdrawal from supply and with a positive sign in the receiving commodity balance representing an addition to its supply. The transfers' row in Tables 1.1 to 1.3 should ideally sum to zero with transfers from primary oils to petroleum products amounting to a net figure of zero. Similarly the manufactured gases and natural gas transfers should sum to zero. However differences in calorific values between the transferred fuels can result in non-zero values.

Total supply

A.17 The total supply available for national use is obtained by summing the flows above this entry in the balance.

Total demand

A.18 The various figures for the disposals and/or consumption of the commodities are summed to provide a measure of the demand for them. The main categories or sectors of demand are described in paragraphs A.31 to A.42.

Statistical difference

A.19 Any excess of supply over demand is shown as a statistical difference. A negative figure indicates that demand exceeds supply. Statistical differences arise when figures are gathered from a variety of independent sources and reflect differences in timing, in definition of coverage of the activity, or in commodity definition. Differences also arise for methodological reasons in the measurement of the flow of the commodity eg if there are differences between the volumes recorded by the gas producing companies and the gas transporting companies. A non-zero statistical difference is normal and, provided that it is not too large, is preferable to a statistical difference of zero as this suggests that a data provider has adjusted a figure to balance the account.

Transformation

A.20 The transformation section of the balance covers those processes and activities that transform the original primary (and sometimes secondary) commodity into a form which is better suited for specific uses than the original form. Most of the transformation activities correspond to particular energy industries whose main business is to manufacture the product associated with them. Certain activities involving transformation take place to make products that are only partly used for energy needs (coke oven coke) or are by-products of other manufacturing processes (coke oven and blast furnace gases). However, as these products and by-products are then used, at least in part, for their energy content they are included in the balance system.

A.21 The figures given under the activity headings of this section represent the quantities used for transformation. The production of the secondary commodities will be shown in the Production row of the corresponding commodity balances. The transformation section of the energy balance shows, for each fuel, the net inputs for transformation uses. For example, Table 1.1 for 2016 shows that 1,384

thousand tonnes of oil equivalent of coal feeds into the production of 1,303 thousand tonnes of oil equivalent of coke, representing a loss of 81 thousand tonnes of oil equivalent in the manufacture of coke in 2016. In 2016, energy losses during the production of electricity and other secondary fuels amounted to 37.4 million tonnes of oil equivalent, (19 per cent of primary supply) shown in the transformation row in Table 1.1.

Electricity generation

A.22 The quantities of fuels burned for the generation of electricity are shown in their commodity balances under this heading. The activity is divided into two parts, covering the major power producers (for whom the main business is the generation of electricity for sale) and autogenerators (whose main business is not electricity generation but who produce electricity for their own needs and may also sell surplus quantities). The amounts of fuels shown in the balance represent the quantities consumed for the gross generation of electricity. Where a generator uses combined heat and power plant, the figures include only the part of the fuel use corresponding to the electricity generated.

A.23 In relation to autogenerators' data, the figures for quantities of fuel used for electricity generation appear under the appropriate fuel headings in the *Transformation* section heading for *Autogenerators,* whilst the electricity generated appears in the *Electricity* column under *Production*. A breakdown of the information according to the branch of industry in which the generation occurs is not shown in the balance but is given in Chapter 5, Table 5.4. The figures for energy commodities consumed by the industry branches shown under final consumption include all use of electricity, but exclude the fuels combusted by the industry branches to generate the electricity.

Heat generation

A.24 The quantities of fuel burned to generate heat that is sold under the provision of a contract to a third party are shown in their commodity balances under this heading. It includes heat that is generated and sold by combined heat and power plants and by community heating schemes (also called district heating).

Petroleum refineries

A.25 Crude oil, natural gas liquids and other oils needed by refineries for the manufacture of finished petroleum products are shown under this heading.

Coke manufacture and blast furnaces

A.26 Quantities of coal for coke ovens and all fuels used within blast furnaces are shown under this heading. The consumption of fuels for heating coke ovens and the blast air for blast furnaces are shown under *Energy industry use*.

Patent fuel manufacture

A.27 The coals and other solid fuels used for the manufacture of solid patent fuels are reported under this heading.

Other

A.28 Any minor transformation activities not specified elsewhere are captured under this heading.

Energy industry use

A.29 Consumption by both extraction and transformation industries to support the transformation process (but not for transformation itself) are included here according to the energy industry concerned. Typical examples are the consumption of electricity in power plants (eg for lighting, compressors and cooling systems) and the use of extracted gases on oil and gas platforms for compressors, pumps and other uses. The headings in this section are identical to those used in the transformation section with the exception of *Pumped storage*. In this case, the electricity used to pump the water to the reservoir is reported. This section also includes consumption by those parts of the iron and steel industry which behave like an energy industry i.e. they are involved in the transformation processes (see paragraph A.20 of Annex A). In 2016, energy industry use amounted to 11.9 million tonnes of oil equivalent of energy (5.9 per cent of primary demand), down 4.8 per cent on 2015, reflecting the reduced energy needed as coal production fell and less coke manufacture. This series broadly follows the trend in UK energy production, so has generally been falling since 2000.

Losses

A.30 This heading covers the intrinsic losses that occur during the transmission and distribution of electricity and gas (including manufactured gases). Other metering and accounting differences for gas and electricity are within the statistical difference, as are undeclared losses in other commodities.

Final consumption

A.31 *Final consumption* covers both final energy consumption (by different consuming sectors) and the use of energy commodities for non-energy purposes, that is *Non energy use*. Final consumption occurs when the commodities used are not for transformation into secondary commodities. The energy concerned disappears from the account after use. Any fuel used for electricity generation by final consumers is identified and reported separately within the transformation section. When an enterprise generates electricity, the figure for final consumption of the industrial sector to which the enterprise belongs includes its use of the electricity it generates itself (as well as supplies of electricity it purchases from others) but does not include the fuel used to generate that electricity.

A.32 The classification of consumers according to their main business follows, as far as practicable, the *Standard Industrial Classification (SIC2007).* The qualifications to, and constraints on, the classification are described in the technical notes to Chapter 1. Table 1G in Chapter 1 shows the breakdown of final consumers used, and how this corresponds to the SIC2007.

Industry

A.33 Two sectors of industry (iron and steel and chemicals) require special mention because the activities they undertake fall across the transformation, final consumption and non-energy classifications used for the balances. Also, the data permitting an accurate allocation of fuel use within each of these major divisions are not readily available.

Iron and steel

A.34 The iron and steel industry is a heavy energy user for transformation and final consumption activities. Figures shown under final consumption for this industry branch reflect the amounts that remain after quantities used for transformation and energy sector own use have been subtracted from the industry's total energy requirements. Use of fuels for transformation by the industry may be identified within the transformation section of the commodity balances.

A.35 The amounts of coal used for coke manufacture by the iron and steel industry are in the transformation section of the coal balance. Included in this figure is the amount of coal used for coke manufacture by the companies outside of the iron and steel industry, ie solid fuel manufacturers. The corresponding production of coke and coke oven gas may be found in the commodity balances for these products. The use of coke in blast furnaces is shown in the commodity balance for coke, and the gases produced from blast furnaces and the associated basic oxygen steel furnaces are shown in the production row of the commodity balance for blast furnace gas.

A.36 Fuels used for electricity generation by the industry are included in the figures for electricity generation by autogenerators and are not distinguishable as being used by the iron and steel sector in the balances. Electricity generation and fuel used for this by broad industry group are given in Table 5.4.

A.37 Fuels used to support coke manufacture and blast furnace gas production are included in the quantities shown under *Energy industry use.* These gases and other fuels do not enter coke ovens or blast furnaces, but are used to heat the ovens and the blast air supplied to furnaces.

Chemicals

A.38 The petro-chemical industry uses hydrocarbon fuels (mostly oil products and gases) as feedstock for the manufacture of its products. Distinguishing the energy use of delivered fuels from their non-energy use is complicated by the absence of detailed information. The procedures adopted to estimate the use are described in paragraphs A.41 and A.42 under *Non energy use*.

Transport

A.39 Figures under this heading are almost entirely quantities used strictly for transport purposes. However, the figures recorded against road transport may include some fuel that is actually consumed

in some “off-road” activities. Similarly, figures for railway fuels may include some amounts of burning oil not used directly for transport purposes. Transport sector use of electricity includes electricity used by rail companies (both over and underground) for traction purposes, and electricity used by electric road vehicles. The electricity used for non-traction purposes in industries classified to SIC2007 Groups 49 to 51 is included within the commercial sector. Fuels supplied to cargo and passenger ships undertaking international voyages are reported as *Marine bunkers* (see paragraph A.13). Supplies to fishing vessels are included under “agriculture”.

Other sectors

A.40 The classification of all consumers groups under this heading, except *domestic and transport*, follows *SIC2007* and is described in Table 1G in Chapter 1. The consistency of the classification across different commodities cannot be guaranteed because the figures reported are dependent on what the data suppliers can provide.

Non energy use

A.41 The non energy use of fuels may be divided into two types. They may be used directly for their physical properties eg lubricants or bitumen used for road surfaces, or by the petro-chemical industry as raw materials for the manufacture of goods such as plastics. In their use by the petro-chemical industry, relatively little combustion of the fuels takes place and the carbon and/or hydrogen they contain are largely transferred into the finished product. However, in some cases heat from the manufacturing process or from combustion of by-products may be used. Data for this energy use are rarely available. Depending on the feedstock, non energy consumption is either estimated or taken to be the deliveries to the chemicals sector.

A.42 Both types of non energy use are shown under the *Non energy use* heading at the foot of the balances.

The energy balance (Tables 1.1 to 1.3)

Principles

A.43 The energy balance conveniently presents:

- an overall view of the United Kingdom’s energy supplies;
- the relative importance of each energy commodity;
- dependence on imports;
- the contribution of our own fossil and renewable resources;
- the interdependence of commodities on one another.

A.44 The energy balance is constructed directly from the commodity balances by expressing the data in a common unit, placing them beside one another and adding appropriate totals. Heat sold is also included as a fuel. However, some rearrangements of the commodity balance format is required to show transformation of primary into secondary commodities in an easily understood manner.

A.45 Energy units are widely used as the common unit, and the current practice for the United Kingdom and the international organisations which prepare balances is to use the tonne of oil equivalent or a larger multiple of this unit, commonly thousands. One tonne of oil equivalent is defined as 10^7 kilocalories (41.868 gigajoules). The tonne of oil equivalent is another unit of energy like the gigajoule, kilocalorie or kilowatt hour, rather than a physical quantity. It has been chosen as it is easier to visualise than the other units. Due to the natural variations in heating value of primary fuels such as crude oil, it is rare that one tonne of oil has an energy content equivalent to one tonne of oil equivalent, however it is generally within a few per cent of the heating value of a tonne of oil equivalent. The energy figures are calculated from the natural units of the commodity balances by multiplying by the factors representing the calorific (heating) value of the fuel. The gross calorific values of fuels are used for this purpose. When the natural unit of the commodity is already an energy unit (electricity in kilowatt hours, for example) the factors are just constants, converting one energy unit to another.

A.46 Most of the underlying definitions and ideas of commodity balances can be taken directly over into the energy balance. However, production of secondary commodities and, in particular, electricity

are treated differently and need some explanation. The components of the energy balance are described below, drawing out the differences of treatment compared with the commodity balances.

Primary supply

A.47 Within the energy balance, the production row covers only extraction of primary fuels and the generation of primary energy (hydro, nuclear, wind, solar photovoltaics). Note the change of row heading from *Production* in the commodity balances to *Indigenous production* in the energy balance. Production of secondary fuels and secondary electricity are shown in the transformation section and not in the indigenous production row at the top of the balance.

A.48 For fossil fuels, indigenous production represents the marketable quantity extracted from the reserves. Indigenous production of *Primary electricity* comprises hydro-electricity, wind, photovoltaics and nuclear energy. The energy value for hydro-electricity is taken to be the energy content of the electricity produced from the hydro power plant and not the energy available in the water driving the turbines. A similar approach is adopted for electricity from wind generators and photovoltaics. The electricity is regarded as the primary energy form because there are currently no other uses of the energy resource "upstream" of the generation. The energy value attached to nuclear electricity is discussed in paragraph A.52.

A.49 The other elements of the supply part of the balance are identical to those in the commodity balances. In particular, the sign convention is identical, so that figures for exports and international marine bunkers carry negative signs. A stock build carries a negative sign to denote it as a withdrawal from supply whilst a stock draw carries a positive sign to show it as an addition to supply.

A.50 The *Primary supply* is the sum of the figures above it in the table, taking account of the signs, and expresses the national requirement for primary energy commodities from all sources and foreign supplies of secondary commodities. It is an indicator of the use of indigenous resources and external energy supplies. Both the amount and mixture of fuels in final consumption of energy commodities in the United Kingdom will differ from the primary supply. The "mix" of commodities in final consumption will be much more dependent on the manufacture of secondary commodities, in particular electricity.

Transformation

A.51 Within an energy balance the presentation of the inputs to and outputs from transformation activities requires special mention, as it is carried out using a compact format. The transformation section also plays a key role in moving primary electricity from its own column in the balance into the electricity column, so that it can be combined with electricity from fossil fuelled power stations and the total disposals shown.

A.52 Indigenous production of primary electricity comprises nuclear electricity, hydro electricity, electricity from wind generation and from solar photovoltaics. Nuclear electricity is obtained by passing steam from nuclear reactors through conventional steam turbine sets. The heat in the steam is considered to be the primary energy available and its value is calculated from the electricity generated using the average thermal efficiency of nuclear stations, currently 40.0 per cent (in 2016) in the United Kingdom. The electrical energy from hydro and wind is transferred from the *Primary electricity* column to the *Electricity* column using the *transfers* row because this electricity is in the form of primary energy and no transformation takes place. However, because the form of the nuclear energy is the steam from the nuclear reactors, the energy it contains is shown entering electricity generation and the corresponding electricity produced is included with all electricity generation in the figure, in the same row, under the *Electricity* column.

A.53 Quantities of fuels entering transformation activities (fuels into electricity generation and heat generation, crude oil into petroleum product manufacture (refineries), or coal into coke ovens) are shown with a negative sign to represent the input and the resulting production is shown as a positive number.

A.54 For electricity generated by Major power producers, the inputs are shown in the *Major power producers'* row of the *coal, manufactured fuel, primary oils, petroleum products, gas, bioenergy and waste* and *primary electricity* columns. The total energy input to electricity generation is the sum of the values in these first seven columns. The *Electricity* column shows total electricity generated from these inputs and the transformation loss is the sum of these two figures, given in the *Total* column.

A.55 Within the transformation section, the negative figures in the *Total* column represent the losses in the various transformation activities. This is a convenient consequence of the sign convention chosen for the inputs and outputs from transformation. Any positive figures represent a transformation gain and, as such, are an indication of incorrect data.

A.56 In the energy balance, the columns containing the input commodities for electricity generation, heat generation and oil refining are separate from the columns for the outputs. However, for the transformation activities involving solid fuels this is only partly the case. Coal used for the manufacture of coke is shown in the coke manufacture row of the transformation section in the coal column, but the related coke and coke oven gas production are shown combined in the *Manufactured fuels* column. Similarly, the input of coke to blast furnaces and the resulting production of blast furnace gas are not identifiable and have been combined in the *Manufactured fuels* column in the *Blast furnace* row. As a result, only the net loss from blast furnace transformation activity appears in the column.

A.57 The share of each commodity or commodity group in primary supply can be calculated from the table. This table also shows the demand for primary as well as foreign supplies. Shares of primary supplies may be taken from the *Primary supply* row of the balance. Shares of fuels in final consumption may be calculated from the final consumption row.

Energy industry use and final consumption

A.58 The figures for final consumption and energy industry use follow, in general, the principles and definitions described under commodity balances in paragraphs A.29 to A.42.

Standard conversion factors

1 tonne of oil equivalent (toe)	= 10^7 kilocalories
	= 396.83 therms
	= 41.868 GJ
	= 11,630 kWh
100,000 British thermal units (Btu)	= 1 therm

This Digest follows UK statistical practice and uses the term "billion" to refer to one thousand million or 10^9

The following prefixes are used for multiples of joules, watts and watt hours:

kilo (k)	= 1,000	or 10^3
mega (M)	= 1,000,000	or 10^6
giga (G)	= 1,000,000,000	or 10^9
tera (T)	= 1,000,000,000,000	or 10^{12}
peta (P)	= 1,000,000,000,000,000	or 10^{15}

WEIGHT

1 kilogramme (kg)	= 2.2046 pounds (lb)
1 pound (lb)	= 0.4536 kg
1 tonne (t)	= 1,000kg
	= 0.9842 long ton
	= 1.102 short ton (sh tn)
1 Statute or long ton	= 2,240 lb
	= 1.016 t
	= 1.120 sh tn

VOLUME

1 cubic metre (cu m)	= 35.31 cu ft
1 cubic foot (cu ft)	= 0.02832 cu m
1 litre	= 0.22 Imperial gallons (UK gal)
1 UK gallon	= 8 UK pints
	= 1.201 US gallons (US gal)
	= 4.54609 litres
1 barrel	= 159.0 litres
	= 34.97 UK gal
	= 42 US gal

LENGTH

1 mile	= 1.6093 kilometres
1 kilometre (km)	= 0.62137 miles

TEMPERATURE

1 scale degree Celsius (C)	= 1.8 scale degrees Fahrenheit (F)

For conversion of temperatures: $^oC = 5/9 (^oF - 32)$; $^oF = 9/5\ ^oC + 32$

Average conversion factors for petroleum 2016

	Litres per tonne
Crude oil:	
Indigenous	1,199
Imported	1,181
Average of refining throughput	1,192
Ethane	2,730
Propane	1,944
Butane	1,737
Naphtha	1,488
Aviation gasoline	1,406
Motor spirit:	
All grades	1,368
Super[1]	1,359
Premium[1]	1,370
Middle distillate feedstock	..
Kerosene:	
Aviation turbine fuel	1,253
Burning oil	1,248

	Litres per tonne
DERV fuel:	
0.005% or less sulphur	1,194
Gas /Marine diesel oil	1,171
Fuel oil (1% or less sulphur)	
All grades:	1,016
Light:	..
Medium	..
Heavy:	..
Lubricating oils:	
White	1,150
Greases	..
Bitumen	977
Petroleum coke	..
Petroleum waxes	1,184
Industrial spirit	1,247
White spirit	1,251

Note: The above conversion factors, which for refined products have been compiled by BEIS using data from UK Petroleum Industry Association companies, apply to the year 2016. The litres to tonnes conversions are made at a standard temperature of 15^oC.

[1] Based on 2015 deliveries due to incomplete 2016 delivery data

.. Denotes commercially sensitive because too few companies are producting this to be able to report it.

Fuel conversion factors for converting fossil fuels to carbon dioxide

	kg CO_2 per tonne	kg CO_2 per kWh	kg CO_2 per litre
Gases			
Natural Gas		0.184	
LPG		0.214	1.506
Liquid fuels			
Gas oil	3190	0.254	2.715
Fuel oil	3216	0.267	
Burning oil	3150	0.245	2.520
Naptha	3131	0.236	
Petrol	3135	0.239	2.290
Diesel	3164	0.249	2.650
Aviation spirit	3128	0.238	2.221
Aviation turbine fuel	3150	0.245	2.514
Solid fuels			
Industrial coal	2414	0.321	
Domestic coal	2633	0.315	
Coking coal	3070	0.347	

All emission factors are based on a Gross Calorific Value basis

The information above is based on the 2017 Greenhouse gas conversion factors for company reporting, available at: www.gov.uk/government/collections/government-conversion-factors-for-company-reporting. The information on this website also provide emission factors on a Net Calorific Basis.

The figures are derived by Ricardo E&E based on data contained in the 2016 edition of this Digest, available at: www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes together with information from the National Atmospheric Emissions Inventory. More information on the Inventory is available at: http://naei.beis.gov.uk/reports/. For liquid fuels, the "kg CO_2 per tonne" figure remains fairly constant on a year to year basis, so it is possible to derive "kg CO_2 per kWh" and "kg CO_2 per litre" figures for other years using the average conversion factors for petroleum data contained annually in Annex A of the Digest.

A.1 Estimated average calorific values of fuels 2016

	GJ per tonne net	GJ per tonne gross
Coal:		
All consumers (weighted average) *(1)*	25.8	27.2
Power stations *(2)*	23.9	25.2
Coke ovens *(1)*	30.2	31.8
Low temperature carbonisation plants and manufactured fuel plants	26.9	28.4
Collieries	27.5	29.0
Agriculture	28.1	29.5
Iron and steel	28.9	30.4
Other industries (weighted average)	25.4	26.7
Non-ferrous metals	23.8	25.1
Food, beverages and tobacco	28.0	29.4
Chemicals	25.2	26.5
Textiles, clothing, leather etc.	28.1	29.5
Pulp, paper, printing etc.	23.0	24.2
Mineral products	26.5	27.9
Engineering (mechanical and electrical engineering and vehicles)	28.0	29.5
Other industries	31.1	32.8
Domestic		
House coal	28.6	30.1
Anthracite and dry steam coal	32.6	34.4
Other consumers	25.1	26.4
Imported coal (weighted average)	26.1	27.5
Exports (weighted average)	30.6	32.2
Coke (including low temperature carbonisation cokes)	29.8	29.8
Coke breeze	29.8	29.8
Other manufactured solid fuels	31.1	32.7

	GJ per tonne net	GJ per tonne gross	Moisture content
Renewable sources:			
Domestic wood *(3)*	14.7	16.3	20%
Industrial wood *(4)*	19.0	20.3	0%
Straw	13.4	15.7	15%
Poultry litter (5)	7.6	9.5	20%
Meat and bone	16.8	19.0	11%
General industrial waste	15.2	16.0	5%
Hospital waste	13.3	14.0	5%
Municipal solid waste *(6)*	6.8	9.8	30%
Refuse derived waste *(6)*	13.0	18.5	30%
Short rotation coppice *(7)*	12.6	14.2	30%
Tyres	30.4	32.0	5%
Wood pellets	16.9	18.3	10%
Biodiesel	37.2	38.7	4%
Bioethanol	26.8	29.7	10%
Petroleum:			
Crude oil (weighted average)	43.4	45.7	
Petroleum products (weighted average)	43.9	46.2	
Ethane	46.6	50.7	
Butane and propane (LPG)	45.9	49.3	
Light distillate feedstock for gasworks	45.5	47.9	
Aviation spirit and wide cut gasoline	45.0	47.4	
Aviation turbine fuel	43.9	46.2	
Motor spirit	44.8	47.1	
Burning oil	43.9	46.2	
Gas/diesel oil	42.6	45.3	
DERV	42.9	45.7	
Fuel oil	40.7	43.3	
Power station oil	40.7	43.3	
Non-fuel products (notional value)	40.9	43.1	

	MJ per cubic metre net	MJ per cubic metre gross
Natural gas produced *(8)*	36.1	40.1
Natural gas consumed *(9)*	35.7	39.6
Coke oven gas	16.2	18.0
Blast furnace gas	3.0	3.0
Landfill gas *(10)*	19-23	21-25
Sewage gas *(10)*	19-23	21-25
Anaerobic Digestion - farm/food food *(7)*	19-24	21-26

(1) Applicable to UK consumption - based on calorific value for home produced coal plus imports and, for "All consumers" net of exports.

(2) Home produced plus imports

(3) On an "as received" basis; seasoned logs at 20% moisture content. On a "dry" basis 20.3 GJ per tonne.

(4) Data reported on an oven dry basis of 20.3 GJ per tonne.

(5) The calorific value of poultry litter typically ranges on a net basis from 5 GJ/tonne to 10 GJ/tonne depending upon the moisture content of the fuel. For poultry manure, much lower calorific values should be used.

(6) Average figure based on survey returns.

(7) On an "as received" basis; at 30% moisture content. On a "dry" basis 18.6 GJ per tonne.

(8) The gross calorific value of natural gas can also be expressed as 11.126 kWh per cubic metre. This value represents the average calorific value seen for gas when extracted. At this point it contains not just methane, but also some other hydrocarbon gases (ethane, butane, propane). These gases are removed before the gas enters the National Transmission System for sale to final consumers.

(9) UK produced and imported gas. This weighted average of calorific values will approximate the average for the year of gas entering the National Transmission System. It can also be expressed as 11.007 kWh per cubic metre.

(10) Calorific value varies depending on the methane content of the gas

Note: The above estimated average calorific values apply only to the year 2016. For calorific values of fuels in earlier years see Tables A.2 and A.3 and previous issues of this Digest. See the notes in Chapter 1, paragraph 1.55 regarding net calorific values. 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 calorific values for coal other than imported coal are based on estimates provided by the main coal producers, but with some exceptions as noted on Table A.2. The calorific values for petroleum products have been calculated using the method described in Chapter 1, paragraph 1.31. Data reported in this Digest in 'thousand tonnes of oil equivalent' have been prepared on the basis of 1 tonne of oil equivalent having an energy content of 41.868 gigajoules (GJ), (1 GJ = 9.478 therms) - see notes in Chapter 1, paragraph 1.28.

A.2 Estimated average gross calorific values of fuels 1980, 1990, 2000, 2010 and 2014 to 2016

GJ per tonne (gross)

	1980	1990	2000	2010	2014	2015	2016
Coal							
All consumers *(1)(2)*	25.6	25.5	26.2	25.8	26.0	26.0	26.0
All consumers - home produced plus imports minus exports *(1)*	..	..	27.0	27.1	27.0	27.0	27.2
Power stations *(2)*	23.8	24.8	25.6	24.9	25.1	25.1	25.2
Power stations - home produced plus imports *(1)*	..	..	26.0	25.8	26.2	26.2	26.2
Coke ovens *(2)*	30.5	30.2	31.2	30.5	31.8	31.8	31.8
Coke ovens - home produced plus imports *(1)*	..	..	30.4	30.5	31.8	31.8	31.8
Low temperature carbonisation plants and manufactured fuel plants	19.1	29.2	30.3	30.2	28.5	28.5	28.4
Collieries	27.0	28.6	29.6	29.3	29.0	29.0	29.0
Agriculture	30.1	28.9	29.2	28.0	29.5	29.5	29.5
Iron and steel industry *(3)*	29.1	28.9	30.7	30.4	30.4	30.4	30.4
Other industries *(1)*	27.1	27.8	26.7	27.7	26.7	26.8	26.7
Non-ferrous metals	..	23.1	25.1	25.4	25.1	25.1	25.1
Food, beverages and tobacco	28.6	28.1	29.5	28.6	29.4	29.4	29.4
Chemicals	25.8	27.3	28.7	26.7	26.5	26.5	26.5
Textiles, clothing, leather and footwear	27.5	27.7	30.4	29.5	29.5	29.5	29.5
Pulp, paper, printing, etc.	26.5	27.9	28.7	24.1	24.2	24.2	24.2
Mineral products *(4)*	..	28.2	27.0	27.6	27.9	27.9	27.9
Engineering *(5)*	27.7	28.3	29.3	29.5	29.5	29.5	29.5
Other industry *(6)*	28.4	28.5	30.2	32.6	32.7	32.6	32.8
Unclassified	..	27.1	..	..	..	..	..
Domestic							
House coal	30.1	30.2	30.9	29.8	30.1	30.1	30.1
Anthracite and dry steam coal	33.3	33.6	33.5	34.7	34.3	34.3	34.4
Other consumers	27.5	27.5	29.2	25.5	26.4	26.4	26.4
Transport - Rail	..	..	..	30.3	30.2	30.2	30.2
Imported coal *(1)*	..	28.3	28.0	27.9	27.4	27.4	27.5
of which Steam coal	..	..	26.6	26.5	26.5	26.5	26.5
Coking coal	..	..	30.4	32.1	31.8	31.8	31.8
Anthracite	..	..	31.2	31.0	31.7	31.5	31.6
Exports *(1)*	..	29.0	32.0	32.3	32.2	32.2	32.2
of which Steam coal	..	..	31.0	31.2	31.2	31.2	31.2
Anthracite	..	..	32.6	33.2	32.5	32.5	32.5
Coke *(7)*	28.1	28.1	29.8	29.8	29.8	29.8	29.8
Coke breeze	24.4	24.8	24.8	29.8	29.8	29.8	29.8
Other manufactured solid fuels *(1)*	27.6	27.6	30.8	32.6	32.7	32.7	32.7
Petroleum							
Crude oil *(1)*	45.2	45.6	45.7	45.7	45.7	45.7	45.7
Liquified petroleum gas	49.6	49.3	49.1	49.2	49.4	49.3	49.3
Ethane	52.3	50.6	50.7	50.7	50.7	50.7	50.7
LDF for gasworks/Naphtha	47.8	47.9	47.6	47.8	47.7	47.8	47.9
Aviation spirit and wide-cut gasoline (AVGAS and AVTAG)	47.2	47.3	47.3	47.4	47.4	47.4	47.4
Aviation turbine fuel (AVTUR)	46.4	46.2	46.2	46.2	46.3	46.2	46.2
Motor spirit	47.0	47.0	47.0	47.1	47.1	47.2	47.1
Burning oil	46.5	46.2	46.2	46.2	46.2	46.2	46.2
Vaporising oil	45.9	45.9	..	..	..	..	..
Gas/diesel oil (8)	45.5	45.4	45.6	45.3	45.3	45.3	45.3
DERV (8)	..	..	..	45.6	45.7	45.7	45.7
Fuel oil	42.8	43.2	43.1	43.3	43.4	43.4	43.3
Power station oil	42.8	43.2	43.1	43.3	43.4	43.4	43.3
Non-fuel products (notional value)	42.2	43.2	43.8	43.1	43.2	43.0	43.1
Petroleum coke (Power stations)	..	..	..	30.9	30.1	28.6	28.6
Petroleum coke (Other)	..	39.5	35.8	35.8	35.8	35.8	35.8
Natural Gas *(9)*	..	38.4	39.4	40.0r	39.7r	40.2r	40.1
Renewable sources							
Domestic wood	..	..	10.0	13.9	14.9	16.3	16.3
Industrial wood	..	..	11.9	13.7	18.6	20.3	20.3
Straw	..	..	15.0	15.8	15.8	15.8	15.7
Poultry litter	..	..	8.8	9.1	9.1	9.1	9.5
Meat and bone	..	..	17.3	20.0	20.0	20.0	19.0
General industrial waste	..	..	16.0	16.0	16.0	16.0	16.0
Hospital waste	..	..	14.0	14.0	14.0	14.0	14.0
Municipal solid waste	..	..	9.5	9.5	9.2	9.6	9.8
Refuse derived waste	..	..	18.6	18.5	18.5	18.5	18.5
Short rotation coppice	..	..	10.6	11.1	13.0	14.2	14.2
Tyres	..	..	32.0	32.0	32.0	32.0	32.0
Wood pellets	..	..	..	17.2	16.7	18.3	18.3
Biodiesel	..	..	..	38.7	38.7	38.7	38.7
Bioethanol	..	..	..	29.7	29.7	29.7	29.7

(1) Weighted averages.

(2) Home produced coal only.

(3) From 2001 onwards almost entirely sourced from imports.

(4) Based on information provided by the British Cement Industry Association; almost all coal used by this sector in the latest 4 years was imported.

(5) Mechanical engineering and metal products, electrical and instrument engineering and vehicle manufacture.

(6) Includes construction.

(7) Since 1995 the source of these figures has been the ISSB.

(8) DERV included within gas/diesel oil until 2005.

(9) Natural Gas figures are shown in MJ per cubic metre.

A.3 Estimated average net calorific values of fuels 1980, 1990, 2000, 2010 and 2014 to 2016

GJ per tonne (net)

	1980	1990	2000	2010	2014	2015	2016
Coal							
All consumers *(1)(2)*	24.3	24.2	24.9	24.5	24.7	24.7	24.7
All consumers - home produced plus imports minus exports *(1)*	..	..	25.6	25.7	25.6	25.7	25.8
Power stations *(2)*	22.6	23.6	24.3	23.6	23.9	23.9	23.9
Power stations - home produced plus imports *(1)*	..	..	24.7	24.5	24.9	24.9	24.9
Coke ovens *(2)*	29.0	28.7	29.6	29.0	30.2	30.2	30.2
Coke ovens - home produced plus imports *(1)*	..	..	28.9	29.0	30.2	30.2	30.2
Low temperature carbonisation plants and manufactured fuel plants	18.1	27.7	28.8	28.7	27.1	27.0	26.9
Collieries	25.7	27.2	28.1	27.9	27.5	27.5	27.5
Agriculture	28.6	27.5	27.8	26.6	28.1	28.1	28.1
Iron and steel industry *(3)*	27.6	27.5	29.2	28.9	28.9	28.9	28.9
Other industries *(1)*	25.7	26.4	25.4	26.3	25.4	25.4	25.4
Non-ferrous metals	..	21.9	23.8	24.1	23.8	23.8	23.8
Food, beverages and tobacco	27.2	26.7	28.0	27.2	28.0	28.0	28.0
Chemicals	24.5	25.9	27.2	25.4	25.2	25.2	25.2
Textiles, clothing, leather and footwear	26.1	26.3	28.9	28.0	28.1	28.1	28.1
Pulp, paper, printing, etc.	25.2	26.5	27.3	22.9	23.0	23.0	23.0
Mineral products *(4)*	..	26.8	25.7	26.3	26.5	26.5	26.5
Engineering *(5)*	26.3	26.9	27.8	28.0	28.0	28.0	28.0
Other industry *(6)*	27.0	27.1	28.7	31.0	31.1	31.0	31.1
Unclassified	..	25.7	..	..	..	..	..
Domestic							
House coal	28.6	28.7	29.4	28.3	28.6	28.6	28.6
Anthracite and dry steam coal	31.6	31.9	31.9	32.9	32.6	32.6	32.6
Other consumers	26.1	26.1	27.7	24.3	25.1	25.1	25.1
Transport - Rail	..	..	..	28.8	28.7	28.7	28.7
Imported coal *(1)*	..	26.9	26.6	26.5	26.0	26.0	26.1
of which Steam coal	..	..	25.3	25.2	25.2	25.2	25.2
Coking coal	..	..	28.9	29.0	30.2	30.2	30.2
Anthracite	..	..	29.6	29.5	30.1	30.0	30.0
Exports *(1)*	..	27.6	30.4	30.7	30.6	30.6	30.6
of which Steam coal	..	..	29.4	29.6	29.6	29.6	29.6
Anthracite	..	..	30.9	31.6	30.9	30.9	30.9
Coke *(7)*	28.1	28.1	29.8	29.8	29.8	29.8	29.8
Coke breeze	24.4	24.8	24.8	29.8	29.8	29.8	29.8
Other manufactured solid fuels *(1)*	26.2	26.2	29.3	31.0	31.0	31.1	31.1
Petroleum							
Crude oil *(1)*	42.9	43.3	43.4	43.4	43.4	43.4	43.4
Liquified petroleum gas	46.2	46.0	46.0	46.0	46.0	46.0	45.9
Ethane	48.1	46.6	46.6	46.6	46.6	46.6	46.6
LDF for gasworks/Naphtha	45.4	45.5	45.3	45.4	45.3	45.4	45.5
Aviation spirit and wide-cut gasoline (AVGAS and AVTAG)	44.8	44.9	44.9	45.0	45.0	45.0	45.0
Aviation turbine fuel (AVTUR)	44.1	43.9	43.9	43.9	44.0	43.9	43.9
Motor spirit	44.7	44.7	44.7	44.7	44.8	44.8	44.8
Burning oil	44.2	43.9	43.9	43.9	43.9	43.9	43.9
Vaporising oil	43.6	43.6	..	..	..	..	..
Gas/diesel oil (8)	42.8	42.7	42.9	42.6	42.6	42.6	42.6
DERV (8)	..	..	..	42.9	42.9	42.9	42.9
Fuel oil	40.2	40.6	40.5	40.7	40.7	40.8	40.7
Power station oil	40.2	40.6	40.5	40.7	40.7	40.8	40.7
Non-fuel products (notional value)	40.1	41.0	41.6	40.9	40.9	40.9	40.9
Petroleum coke (Power stations)	..	..	..	29.3	28.6	27.2	27.2
Petroleum coke (Other)	..	37.5	34.0	34.0	34.0	34.0	34.0
Natural Gas *(9)*	..	34.6	35.5	36.0r	35.7r	36.1r	36.1
Renewable sources							
Domestic wood	..	..	..	12.3	13.3	14.7	14.7
Industrial wood	..	..	..	12.1	17.3	19.0	19.0
Straw	..	..	..	13.4	13.4	13.4	13.4
Poultry litter	..	..	..	7.6	7.6	7.6	7.6
Meat and bone	..	..	..	16.8	16.8	16.8	16.8
General industrial waste	..	..	..	15.2	15.2	15.2	15.2
Hospital waste	..	..	..	13.3	13.3	13.3	13.3
Municipal solid waste	..	..	..	6.7	6.5	6.7	6.8
Refuse derived waste	..	..	..	13.0	13.0	13.0	13.0
Short rotation coppice	..	..	..	9.3	11.4	12.6	12.6
Tyres	..	..	..	30.4	30.4	30.4	30.4
Wood pellets	..	..	..	16.8	15.3	16.9	16.9
Biodiesel	..	..	..	37.2	37.2	37.2	37.2
Bioethanol	..	..	..	26.8	26.8	26.8	26.8

For footnotes see table A.2

The net calorific value of natural gas is the gross calorific value x 0.9.

Annex B
Glossary and Acronyms

Anthracite	Within this publication, anthracite is coal classified as such by UK coal producers and importers of coal. Typically it has a high heat content making it particularly suitable for certain industrial processes and for use as a domestic fuel.
Associated gas	Natural gas found in association with crude oil in a reservoir, either dissolved in the oil or as a cap above the oil.
Autogeneration	Generation of electricity by companies whose main business is not electricity generation, the electricity being produced mainly for that company's own use.
Aviation spirit	A light hydrocarbon oil product used to power piston-engined aircraft power units.
Aviation turbine fuel	The main aviation fuel used for powering aviation gas-turbine power units (jet aircraft engine).
Backflows	These are finished or semi-finished products, which are returned from final consumers to refineries for processing, blending or sale. They are usually by-products of petrochemical manufacturing.
BEIS	Department for Business, Energy and Industrial Strategy
Benzole	A colourless liquid, flammable, aromatic hydrocarbon by-product of the iron and steel making process. It is used as a solvent in the manufacture of styrenes and phenols but is also used as a constituent of motor fuel.
BETTA	British Electricity Trading and Transmission Arrangements (BETTA) refer to changes to electricity generation, distribution and supply licences. On 1 April 2005, the England and Wales trading arrangements were extended to Scotland by the British Electricity Trading and Transmission Arrangements creating a single GB market for trading of wholesale electricity, with common arrangements for access to and use of GB transmission system. From 1 April 2005, NGC has become the System Operator for the whole of GB. BETTA replaced NETA on 4 April 2005.
Biodiesel	(FAME - biodiesel produced to BS EN 14214). Produced from vegetable oils or animal fats by mixing them with ethanol or methanol to break them down.
Bioenergy	Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter.
Bioethanol	Created from crops rich in starch or sugar by fermentation, distillation and finally dehydration.
Biogas	Energy produced from the anaerobic digestion of sewage and industrial waste.

Biomass Renewable organic materials, such as wood, agricultural crops or wastes, and municipal wastes. Biomass can be burned directly or processed into biofuels such as ethanol and methane

Bitumen The residue left after the production of lubricating oil distillates and vacuum gas oil for upgrading plant feedstock. Used mainly for road making and construction purposes.

Blast furnace gas Mainly produced and consumed within the iron and steel industry. Obtained as a by-product of iron making in a blast furnace, it is recovered on leaving the furnace and used partly within the plant and partly in other steel industry processes or in power plants equipped to burn it. A similar gas is obtained when steel is made in basic oxygen steel converters; this gas is recovered and used in the same way.

Breeze Breeze can generally be described as coke screened below 19 mm (¾ inch) with no fines removed but the screen size may vary in different areas and to meet the requirements of particular markets.

BG British Gas

BOS Basic Oxygen Steel furnace gas

BNFL British Nuclear Fuels plc.

BRE Building Research Establishment

Burning oil A refined petroleum product, with a volatility in between that of motor spirit and gas diesel oil primarily used for heating and lighting.

Butane Hydrocarbon (C_4H_{10}), gaseous at normal temperature but generally stored and transported as a liquid. Used as a component in Motor Spirit to improve combustion, and for cooking and heating (see LPG).

Calorific values (CVs) The energy content of a fuel can be measured as the heat released on complete combustion. The SI (Système International) derived unit of energy and heat is the Joule. This is the energy in a given quantity of the fuel and is often measured in GJ per tonne. The energy content can be expressed as an upper (or gross) value and a lower (or net) value. The difference between the two values is due to the release of energy from the condensation of water in the products of combustion. Gross calorific values are used throughout this publication.

Carbon Emission Reduction Target (CERT) The Carbon Emissions Reduction Target (CERT) follows on from the Energy Efficiency Commitment (EEC). CERT requires gas and electricity suppliers to achieve targets for a reduction in carbon emissions generated by the domestic sector.

CCA Climate Change Agreement. Climate Change Agreements allow energy intensive business users to receive a 65 per cent discount from the Climate Change Levy (CCL), in return for meeting energy efficiency or carbon saving targets. The CCL is a tax on the use of energy in industry, commerce and the public sector. The aim of the levy is to encourage users to improve energy efficiency and reduce emissions of greenhouse gases.

CCL	Climate Change Levy. The Climate Change Levy is a tax on the use of energy in industry, commerce and the public sector, with offsetting cuts in employers' National Insurance Contributions and additional support for energy efficiency schemes and renewable sources of energy. The aim of the levy is to encourage users to improve energy efficiency and reduce emissions of greenhouse gases.
CO_2	Carbon dioxide. Carbon dioxide contributes about 60 per cent of the potential global warming effect of man-made emissions of greenhouse gases. Although this gas is naturally emitted by living organisms, these emissions are offset by the uptake of carbon dioxide by plants during photosynthesis; they therefore tend to have no net effect on atmospheric concentrations. The burning of fossil fuels, however, releases carbon dioxide fixed by plants many millions of years ago, and thus increases its concentration in the atmosphere.
Co-firing	The burning of biomass products in fossil fuel power stations
Coke oven coke	The solid product obtained from carbonisation of coal, principally coking coal, at high temperature. It is low in moisture and volatile matter. Used mainly in iron and steel industry.
Coke oven gas	Gas produced as a by-product of solid fuel carbonisation and gasification in coke ovens, but not from low temperature carbonisation plants. Synthetic coke oven gas is mainly natural gas which is mixed with smaller amounts of blast furnace and basic oxygen steel furnace gas to produce a gas with almost the same qualities as coke oven gas.
Coking coal	Within this publication, coking coal is coal sold by producers for use in coke ovens and similar carbonising processes. The definition is not therefore determined by the calorific value or caking qualities of each batch of coal sold, although calorific values tend to be higher than for steam coal. Not all coals form cokes. For a coal to coke it must exhibit softening and agglomeration properties, ie the end product must be a coherent solid.
Colliery methane	Methane released from coal seams in existing and abandoned deep mines and from coal beds which is piped to the surface and consumed at the colliery or transmitted by pipeline to consumers.
Combined Cycle Gas Turbine (CCGT)	Combined cycle gas turbine power stations combine gas turbines and steam turbines which are connected to one or more electrical generators in the same plant. The gas turbine (usually fuelled by natural gas or oil) produces mechanical power (to drive the generator) and heat in the form of hot exhaust gases. These gases are fed to a boiler, where steam is raised at pressure to drive a conventional steam turbine, which is also connected to an electrical generator.
Combined Heat and Power (CHP)	CHP is the simultaneous generation of usable heat and power (usually electricity) in a single process. The term CHP is synonymous with cogeneration and total energy, which are terms often used in the United States or other Member States of the European Community. The basic elements of a CHP plant comprise one or more prime movers driving electrical generators, where the steam or hot water generated in the process is utilised via suitable heat recovery equipment for use either in industrial processes or in community heating and space heating.
CHPQA	Combined Heat and Power Quality Assurance Scheme

Conventional thermal power stations	These are stations which generate electricity by burning fossil fuels to produce heat to convert water into steam, which then powers steam turbines.
Cracking/conversion	A refining process using combinations of temperature, pressure and in some cases a catalyst to produce petroleum products by changing the composition of a fraction of petroleum, either by splitting existing longer carbon chains or combining shorter carbon chain components of crude oil or other refinery feedstocks. Cracking allows refiners to selectively increase the yield of specific fractions from any given input petroleum mix depending on their requirements in terms of output products.
CRC	Carbon Reduction Commitment. The CRC Energy Efficiency scheme is a mandatory scheme aimed at improving energy efficiency and cutting emissions in large public and private sector organistaions.
Crude oil	A mineral oil consisting of a mixture of hydrocarbons of natural origins, yellow to black in colour, of variable density and viscosity.
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DERV	Diesel engined road vehicle fuel used in internal combustion engines that are compression-ignited.
DFT	Department for Transport
Distillation	A process of separation of the various components of crude oil and refinery feedstocks using the different temperatures of evaporation and condensation of the different components of the mix received at the refineries.
DNC	Declared net capacity and capability are used to measure the maximum power available from generating stations at a point in time.
DNO	Distribution Network Operator
Downstream	Used in oil and gas processes to cover the part of the industry after the production of the oil and gas. For example, it covers refining, supply and trading, marketing and exporting.
DUKES	Digest of United Kingdom Energy Statistics, the Digest provides essential information for everyone, from economists to environmentalists and from energy suppliers to energy users.
EHCS	English House Condition Survey
Embedded Generation	Embedded generation is electricity generation by plant which has been connected to the distribution networks of the public electricity distributors rather than directly to the National Grid Company's transmission systems. Typically they are either smaller stations located on industrial sites, or combined heat and power plant, or renewable energy plant such as wind farms, or refuse burning generators. The category also includes some domestic generators such as those with electric solar panels.
Energy use	Energy use of fuel mainly comprises use for lighting, heating or cooling, motive power and power for appliances. See also non-energy use.

ESA European System of Accounts. An integrated system of economic accounts which is the European version of the System of National Accounts (SNA).

Ethane A light hydrocarbon gas (C_2H_6) in natural gas and refinery gas streams (see LPG).

EU-ETS European Union Emissions Trading Scheme. This began on 1st January 2005 and involves the trading of emissions allowances as means of reducing emissions by a fixed amount.

EUROSTAT Statistical Office of the European Commission.

Exports For some parts of the energy industry, statistics on trade in energy related products can be derived from two separate sources. Firstly, figures can be reported by companies as part of systems for collecting data on specific parts of the energy industry (eg as part of the system for recording the production and disposals of oil from the UK continental shelf). Secondly, figures are also available from the general systems that exist for monitoring trade in all types of products operated by HM Revenue and Customs.

Feed-In Tariffs The Feed-in Tariffs (FITs) scheme was introduced on 1 April 2010 to encourage deployment of small-scale (less than 5MW) low-carbon electricity generation. People with a qualifying technology receive a guaranteed payment from an electricity supplier of their choice for the electricity they generate and use, as well as a guaranteed payment for unused surplus electricity they export back to the grid.

Feedstock In the refining industry, a product or a combination of products derived from crude oil, destined for further processing other than blending. It is distinguished from use as a chemical feedstock etc.

Final energy consumption Energy consumption by final user – ie which is not being used for transformation into other forms of energy.

Fossil fuels Coal, natural gas and fuels derived from crude oil (for example petrol and diesel) are called fossil fuels because they have been formed over long periods of time from ancient organic matter.

Fuel oils The heavy oils from the refining process; used as fuel in furnaces and boilers of power stations, industry, in domestic and industrial heating, ships, locomotives, metallurgic operation, and industrial power plants etc.

Fuel oil - Light Fuel oil made up of heavier straight-run or cracked distillates and used in commercial or industrial burner installations not equipped with pre-heating facilities.

Fuel oil - Medium Other fuel oils, sometimes referred to as bunker fuels, which generally require pre-heating before being burned, but in certain climatic conditions do not require pre-heating.

Fuel oil - Heavy Other heavier grade fuel oils which in all situations require some form of pre-heating before being burned.

Fuel poverty A household is said to be in fuel poverty if they have required fuel costs that are above average (the national median level), and were they to spend that amount they would be left with a residual income below the official poverty line

Gas diesel oil The medium oil from the refinery process; used as a fuel in diesel engines (ie internal combustion engines that are compression-ignited), burned in central heating systems and used as a feedstock for the chemical industry.

GDP Gross Domestic Product.

GDP deflator An index of the ratio of GDP at current prices to GDP at constant prices. It provides a measure of general price inflation within the whole economy.

Gigajoule (GJ) A unit of energy equal to 10^9 joules.

Gigawatt (GW) A unit of electrical power, equal to 10^9 watts.

Green Deal A scheme by which energy-saving improvements can be made to a home or business without having to pay all the costs up front; energy-saving improvements include:

- insulation - eg loft or cavity wall insulation
- heating
- draught-proofing
- double glazing
- renewable energy technologies - eg solar panels or wind turbines

Heat pumps Heat pumps use a heat exchanger (much like that installed in fridges and freezers – although running in reverse) to take heat from the ground or air and convert it into heating in the home (either radiators, underfloor heating or warm air heating systems and hot water). Ground source heat pumps use pipes which are buried in the ground to extract heat. Air source heat pumps absorb heat from the outside air. Heat pumps need electricity to run, but the heat they extract from the ground or air is constantly being renewed naturally.

Heat sold Heat (or steam) that is produced and sold under the provision of a contract. Heat sold is derived from heat generated by Combined Heat and Power (CHP) plants and from community heating schemes without CHP plants.

HMRC HM Revenue and Customs.

Imports Before the 1997 edition of the Digest, the term "arrivals" was used to distinguish figures derived from the former source from those import figures derived from the systems operated by HM Revenue and Customs. To make it clearer for users, a single term is now being used for both these sources of figures (the term imports) as this more clearly states what the figures relate to, which is goods entering the UK.

Indigenous production The extraction or capture of primary fuels: for oil this includes production from the UK Continental Shelf, both onshore and offshore.

Industrial spirit Refined petroleum fractions with boiling ranges up to 200ºC dependent on the use to which they are put – e.g. seed extraction, rubber solvents, perfume etc.

International Energy Agency (IEA) The IEA is an autonomous body located in Paris which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

ISSB	International Steel Statistics Bureau
Joules	A joule is a generic unit of energy in the conventional SI system. It is equal to the energy dissipated by an electrical current of 1 ampere driven by 1 volt for 1 second; it is also equal to twice the energy of motion in a mass of 1 kilogram moving at 1 metre per second.
Kilowatt (kW)	1,000 watts
Landfill gas	The methane-rich biogas formed from the decomposition of organic material in landfill.
LDF	Light distillate feedstock
LDZ	Local distribution zone
Liquefied Natural Gas (LNG)	Natural gas that has been converted to liquid form for ease of storage or transport.
Liquefied Petroleum Gas (LPG)	Gas, usually propane or butane, derived from oil and put under pressure so that it is in liquid form. Often used to power portable cooking stoves or heaters and to fuel some types of vehicle, eg some specially adapted road vehicles, forklift trucks.
Lead Replacement Petrol (LRP)	An alternative to Leaded Petrol containing a different additive to lead (in the UK usually potassium based) to perform the lubrication functions of lead additives in reducing engine wear.
Lubricating oils	Refined heavy distillates obtained from the vacuum distillation of petroleum residues. Includes liquid and solid hydrocarbons sold by the lubricating oil trade, either alone or blended with fixed oils, metallic soaps and other organic and/or inorganic bodies.
Magnox	A type of gas-cooled nuclear fission reactor developed in the UK, so called because of the magnesium alloy used to clad the uranium fuel.
Major Power Producers (MPPs)	Companies whose prime purpose is the generation of electricity.
Megawatt (MW)	1,000 kilowatts. MWe is used to emphasise when electricity is being measured. MWt is used when heat ("thermal") is being measured.
Micro CHP	Micro CHP is a new technology that is expected to make a significant contribution to domestic energy efficiency in the future.
Motor spirit	Blended light petroleum product used as a fuel in spark-ignition internal combustion engines (other than aircraft engines).
NAEI	National Atmospheric Emissions Inventory
Naphtha	(Light distillate feedstock) – Petroleum distillate boiling predominantly below 200ºC.
National Allocation Plan (NAP)	Under the EU Emissions Trading Scheme (EU-ETS) Directive each EU country must have a National Allocation Plan which lays down the overall contribution of the EU-ETS participants (the "cap") for the country and the allowances that each sector and each individual installation covered under the Directive is allocated, effectively stating how much that sector can emit over the trading period of the scheme.

Natural gas	Natural gas is a mixture of naturally occurring gases found either in isolation, or associated with crude oil, in underground reservoirs. The main components are methane, ethane, propane and butane. Hydrogen sulphide and carbon dioxide may also be present, but these are mostly removed at or near the well head in gas processing plants.
Natural gas - compressed	Natural gas that has been compressed to reduce the volume it occupies to make it easier to transport other than in pipelines. Whilst other petroleum gases can be compressed such that they move into liquid form, the volatility of natural gas is such that liquefaction cannot be achieved without very high pressures and low temperatures being used. As such, the compressed form is usually used as a "half-way house".
Natural gas liquids (NGLs)	A mixture of liquids derived from natural gas and crude oil during the production process, including propane, butane, ethane and gasoline components (pentanes plus).
NDA	Nuclear Decommissioning Authority
NETA	New Electricity Trading Arrangements - In England and Wales these arrangements replaced "the pool" from 27 March 2001. The arrangements are based on bi-lateral trading between generators, suppliers, traders and customers and are designed to be more efficient, and provide more market choice.
NFFO	Non Fossil Fuel Obligation. The 1989 Electricity Act empowers the Secretary of State to make orders requiring the Regional Electricity Companies in England and Wales to secure specified amounts of electricity from renewable sources.
NFPA	Non Fossil Purchasing Agency
NIE	Northern Ireland Electricity
NI NFFO	Northern Ireland Non Fossil Fuel Obligation
Non-energy use	Includes fuel used for chemical feedstock, solvents, lubricants, and road making material.
NO_X	Nitrogen oxides. A number of nitrogen compounds including nitrogen dioxide are formed in combustion processes when nitrogen in the air or the fuel combines with oxygen. These compounds can add to the natural acidity of rainfall.
NUTS	Nonmenclature of Units for Territorial Statistics
OFGEM	The regulatory office for gas and electricity markets
OFT	Office of Fair Trading
ONS	Office for National Statistics
Orimulsion	An emulsion of bitumen in water that was used as a fuel in some power stations until 1997.
OTS	Overseas Trade Statistics of the United Kingdom

Patent fuel	A composition fuel manufactured from coal fines by shaping with the addition of a binding agent (typically pitch). The term manufactured solid fuel is also used.
Petrochemical feedstock	All petroleum products intended for use in the manufacture of petroleum chemicals. This includes middle distillate feedstock of which there are several grades depending on viscosity. The boiling point ranges between 200°C and 400°C.
Petroleum cokes	Carbonaceous material derived from hydrocarbon oils, uses for which include metallurgical electrode manufacture and in the manufacture of cement.
Photovoltaics	The direct conversion of solar radiation into electricity by the interaction of light with the electrons in a semiconductor device or cell.
PILOT	Phase 2 (PILOT) is the successor body to the Oil & Gas Industry Task Force (OGITF) and was established on 1 January 2000, to secure the long-term future of the oil and gas industry in the UK. A forum that brings together Government and industry to address the challenges facing the oil and gas industry. One outcome of PILOT's work is the published Code of Practice on Supply Chain Relationships.
Plant capacity	The maximum power available from a power station at a point in time.
Plant loads, demands and efficiency	Measures of how intensively and efficiently power stations are being used.
PPRS	Petroleum production reporting system. Licensees operating in the UK Continental Shelf are required to make monthly returns on their production of hydrocarbons (oil and gas) to BEIS. This information is recorded in the PPRS, which is used to report flows, stocks and uses of hydrocarbon from the well-head through to final disposal from a pipeline or terminal (see DUKES internet annex F on the BEIS energy statistics website for further information).
Primary electricity	Electricity obtained other than from fossil fuel sources, e.g. nuclear, hydro and other non-thermal renewables. Imports of electricity are also included.
Primary fuels	Fuels obtained directly from natural sources, e.g. coal, oil and natural gas.
Process oils	Partially processed feedstocks which require further processing before being classified as a finished product suitable for sale. They can also be used as a reaction medium in the production process.
Propane	Hydrocarbon containing three carbon atoms (C_3H_8), gaseous at normal temperature, but generally stored and transported under pressure as a liquid.
RD	Renewables Directive – this proposes that EU Member States adopt national targets that are consistent with the overall EU target of 20 per cent of energy from renewables by 2020.
Refinery fuel	Petroleum products produced by the refining process that are used as fuel at refineries.

Reforming	Processes by which the molecular structure of different fractions of petroleum can be modified. It usually involves some form of catalyst, most often platinum, and allows the conversion of lower grades of petroleum product into higher grades, improving their octane rating. It is a generic term for processes such as cracking, cyclization, dehydrogenation and isomerisation. These processes generally led to the production of hydrogen as a by-product, which can be used in the refineries in some desulphurization procedures.
Renewable energy sources	Renewable energy includes solar power, wind, wave and tide, and hydroelectricity. Solid renewable energy sources consist of wood, straw, short rotation coppice, other biomass and the biodegradable fraction of wastes. Gaseous renewables consist of landfill gas and sewage gas. Non-biodegradable wastes are not counted as a renewables source but appear in the Renewable sources of energy chapter of this Digest for completeness.
Reserves	With oil and gas these relate to the quantities identified as being present in underground cavities. The actual amounts that can be recovered depend on the level of technology available and existing economic situations. These continually change; hence the level of the UK's reserves can change quite independently of whether or not new reserves have been identified.
RESTATS	The Renewable Energy Statistics database for the UK.
Ricardo-AEA	Formerly known as AEA Energy & Environment.
RO	Renewables Obligation – this is an obligation on all electricity suppliers to supply a specific proportion of electricity from eligible renewable sources.
ROCs	Renewables Obligation Certificates
Seasonal Performance Factor	The Seasonal Performance Factor (SPF) of a heat pump is the total useful heat delivered during a year divided by the annual electricity consumption of the pump. The SPF gives an indication of the efficiency of the pump, with values greater than 1 implying that more useful heat is produced than the electricity used to power the pump.
Secondary fuels	Fuels derived from natural primary sources of energy. For example electricity generated from burning coal, gas or oil is a secondary fuel, as are coke and coke oven gas.
SI (Système International)	Refers to the agreed conventions for the measurement of physical quantities**.**
SIC	The United Kingdom Standard Industrial Classification of Economic Activities (SIC) is used to classify business establishments and other standard units by the type of economic activity in which they are engaged. It provides a framework for the collection, tabulation, presentation and analysis of data and its use promotes uniformity. In addition, it can be used for administrative purposes and by non-government bodies as a convenient way of classifying industrial activities into a common structure. The system is identical to the EUROSTAT System NACE at the four digit class level and the United Nations system ISIC at the two digit Divisional level.

SO_2	Sulphur Dioxide. Sulphur dioxide is a gas produced by the combustion of sulphur-containing fuels such as coal and oil.
SRO	Scottish Renewable Orders
Steam coal	Within this publication, steam coal is coal classified as such by UK coal producers and by importers of coal. It tends to be coal having lower calorific values; the type of coal that is typically used for steam raising.
Synthetic coke oven gas	Mainly a natural gas, which is mixed with smaller amounts of blast furnace, and BOS (basic oxygen steel furnace) gas to produce a gas with almost the same quantities as coke oven gas.
Tars	Viscous materials usually derived from the destructive distillation of coal which are by-products of the coke and iron making processes.
Temperature correction	The temperature corrected series of total inland fuel consumption indicates what annual consumption might have been if the average temperature during the year had been the same as the average for the years 1981 to 2010.
Terawatt (TW)	1,000 gigawatts
Therm	A common unit of measurement similar to a tonne of oil equivalent which enables different fuels to be compared and aggregated.
Thermal efficiency	The thermal efficiency of a power station is the efficiency with which heat energy contained in fuel is converted into electrical energy. It is calculated for fossil fuel burning stations by expressing electricity generated as a percentage of the total energy content of the fuel consumed (based on average gross calorific values). For nuclear stations it is calculated using the quantity of heat released as a result of fission of the nuclear fuel inside the reactor.
Thermal sources of electricity	These include coal, oil, natural gas, nuclear, landfill gas, sewage gas, municipal solid waste, farm waste, tyres, poultry litter, short rotation coppice, straw, coke oven gas, blast furnace gas, and waste products from chemical processes.
Tonne of oil equivalent (toe)	A common unit of measurement which enables different fuels to be compared and aggregated
TWh	Terawatt hour
UKCS	United Kingdom Continental Shelf
UKPIA	UK Petroleum Industry Association. The trade association for the UK petroleum industry.
UKSA	UK Statistics Authority
Ultra low sulphur Diesel (ULSD)	A grade of diesel fuel which has a much lower sulphur content (less than 0.005 per cent or 50 parts per million) and of a slightly higher volatility than ordinary diesel fuels. As a result it produces fewer emissions when burned, and initially enjoyed a lower rate of hydrocarbon oil duty in the UK than ordinary diesel to promote its use, although duty rates on standard diesel and ULSD have since been equalised. Virtually 100 per cent of sales of DERV fuel in the UK are ULSD.

Ultra low sulphur Petrol (ULSP)	A grade of motor spirit with a similar level of sulphur to ULSD (less than 0.005 per cent or 50 parts per million). ULSP initially enjoyed a lower rate of hydrocarbon oil duty in the UK than ordinary petrol to promote its use, although duty rates on standard petrol and ULSP have since been equalised. It has quickly replaced ordinary premium grade unleaded petrol in the UK market place.
Upstream	A term to cover the activities related to the exploration, production and delivery to a terminal or other facility of oil or gas for export or onward shipment within the UK.
VAT	Value added tax
Watt (W)	The conventional unit to measure a rate of flow of energy. One watt amounts to 1 joule per second.
White spirit	A highly refined distillate with a boiling range of about 150ºC to 200ºC used as a paint solvent and for dry cleaning purposes etc.

Annex C

Further sources of United Kingdom energy publications

Some of the publications listed below give shorter term statistics, some provide further information about energy production and consumption in the United Kingdom and in other countries, and others provide more detail on a country or fuel industry basis. The list also covers recent publications on energy issues and policy, including statistical information, produced or commissioned by BEIS. The list is not exhaustive and the titles of publications and publishers may alter. All titles can be found on the GOV.UK website.

Department for Business, Energy and Industrial Strategy publications on energy statistics

Energy Statistics

Monthly, quarterly and annual statistics on production and consumption of overall energy and individual fuels in the United Kingdom together with energy prices is available in MS Excel format at: www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics

Energy Trends

A quarterly publication covering all major aspects of energy. It provides a comprehensive picture of energy production and use and contains analysis of data and articles covering energy issues. Available at: www.gov.uk/government/collections/energy-trends.

Energy Prices

A quarterly publication containing tables, charts and commentary covering energy prices to domestic and industrial consumers for all the major fuels as well as presenting comparisons of fuel prices in the European Union and G7 countries. Available at: www.gov.uk/government/collections/quarterly-energy-prices.

Energy Flow Chart

An annual publication illustrating the flow of primary fuels from home production and imports to their eventual final uses. They are shown in their original state and after being converted into different kinds of energy by the secondary fuel producers. The 2016 edition of the chart shows the flows for 2015. Available at: www.gov.uk/government/collections/energy-flow-charts.

UK Energy in Brief

An annual publication summarising the latest statistics on energy production, consumption and prices in the United Kingdom. The figures are taken from “Digest of UK Energy Statistics”. Available at: www.gov.uk/government/collections/uk-energy-in-brief

Energy Consumption in the United Kingdom

Energy consumption in the United Kingdom brings together statistics from a variety of sources to produce a comprehensive review of energy consumption and changes in efficiency, intensity and output since the 1970s, with a particular focus on trends since 1990. The information is presented in five sections covering overall energy consumption and energy consumption in the transport, domestic, industrial and service sectors. Available at: www.gov.uk/government/collections/energy-consumption-in-the-uk

Sub-National Energy Consumption statistics

Sub-National data are produced by BEIS to emphasise the importance of local and regional decision making for energy policy in delivering a number of national energy policy objectives. Data is available at: www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about/statistics

Fuel Poverty statistics

An annual report detailing the latest statistics on fuel poverty. Available at: www.gov.uk/government/collections/fuel-poverty-statistics

Household Energy Efficiency statistics

BEIS publishes a range of information relating to the Energy Company Obligation (ECO) and Green Deal (GD). The headline release presents monthly updates of ECO measures and quarterly updates of in-depth ECO statistics, carbon savings and the Green Deal schemes. The detailed report presents annual updates on in-depth Green Deal statistics and insulation levels. Data is available at: www.gov.uk/government/collections/household-energy-efficiency-national-statistics

National Energy Efficiency Data-framework (NEED)

BEIS has constructed a National Energy Efficiency Data-framework (NEED) to enable detailed statistical analysis of energy efficiency. The data framework matches the gas and electricity consumption data collected for BEIS sub-national energy consumption statistics and records of energy efficiency measures in the Homes Energy Efficiency Database (HEED) run by the Energy Saving Trust (EST), as well as typographic data about dwellings and households. Data is available at: www.gov.uk/government/collections/national-energy-efficiency-data-need-framework

UK Greenhouse Gas Emissions statistics

Emissions data are produced by BEIS to show progress against the UK's goals, both international and domestic, for reducing greenhouse gas emissions. Data is available at: www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics

UK Energy and CO2 emissions projections

The Updated Energy Projections (UEP) are published annually by BEIS. They provide updated projections and analysis of energy use and carbon dioxide emissions in the UK. The UEP exercise incorporates all firm environmental policy measures and is based on updated assumptions consistent with the most recent UK Budget announcements. The latest report is available at: www.gov.uk/government/collections/energy-and-emissions-projections

Department for Business, Energy and Industrial Strategy policy publications on energy and climate change

Energy Act 2016
The Energy Act 2016 was given Royal Assent on 12 May 2016. The Act is available at: www.legislation.gov.uk/ukpga/2016/20/contents/enacted

Annual Energy Statement
The Annual Energy Statement fulfilled the commitment in the Coalition Programme for the Government to present an annual statement of energy policy to Parliament. The first statement was delivered to Parliament on 27 June 2010, with subsequent statements delivered on 23 November 2011, 29 November 2012 and 31 October 2013. The last Statement, delivered on 6 November 2014, is available at: www.gov.uk/government/publications/annual-energy-statement-2014

Energy Act 2013
The Energy Act 2013 was given Royal Assent on 18 December 2013. The Act is available at: www.legislation.gov.uk/ukpga/2013/32/contents

Energy Act 2011
The Energy Act 2011 was given Royal Assent on 18 October 2011. The Act is available at: www.legislation.gov.uk/ukpga/2011/16/contents

Electricity Market Reform (EMR) White Paper
On 12 July 2011 'Planning our electric future: a White Paper for secure, affordable and low-carbon electricity' was published. The White Paper sets out key measures to attract investment, reduce the impact on consumer bills, and create a secure mix of electricity sources including gas, new nuclear, renewables, and carbon capture and storage. The White Paper is available at: www.gov.uk/government/publications/planning-our-electric-future-a-white-paper-for-secure-affordable-and-low-carbon-energy

Energy Act 2010
The Energy Act 2010 was given Royal Assent on 8 April 2010. The Act is available at: www.legislation.gov.uk/ukpga/2010/27/contents

UK Low Carbon Transition Plan
The UK Low Carbon Transition Plan was published on 15 July 2009. The Plan is available at: www.gov.uk/government/publications/the-uk-low-carbon-transition-plan-national-strategy-for-climate-and-energy

Energy Act 2008
The Energy Act 2008 was granted Royal Assent on 26 November 2008. The Act is available at: www.legislation.gov.uk/ukpga/2008/32/contents

Climate Change Act 2008
The Climate Change Act 2008 was granted Royal Assent on 26 November 2008. The Act is available at: www.legislation.gov.uk/ukpga/2008/27/contents

Other publications including energy information

General

Eurostat Regional Yearbook (annual); *Statistical Office of the European Commission – Eurostat*
Eurostat Yearbook (annual); *Statistical Office of the European Commission - Eurostat*
Eurostatistics (monthly); *Statistical Office of the European Commission – Eurostat*
Overseas Trade Statistics (OTS) of the United Kingdom; *H.M. Revenue and Customs*
- OTS trade with EU countries (monthly)
- OTS trade with non-EU countries (monthly)

UK Index of production (monthly); *Office for National Statistics*
United Kingdom Minerals Yearbook; *British Geological Survey*

Energy

BP Statistical Review of World Energy (annual); *BP*
Energy Balance Sheets; *Statistical Office of the European Commission – Eurostat*
Energy Statistics; *Statistical Office of the European Commission – Eurostat*
Energy Balances (annual); *United Nations Statistical Office*
Energy Statistics Yearbook (annual); *United Nations Statistical Office*
World Energy Statistics and Balances (annual); *International Energy Agency*

Coal

Annual Reports and Accounts of The Coal Authority and the private coal companies; (*apply to the Headquarters of the company concerned)*
Coal Information (annual); *International Energy Agency*
Coal Statistics (quarterly); *International Energy Agency*

Oil and Gas

Annual Reports and Accounts of National Grid, Centrica and the independent oil and gas supply companies; (contact *the Headquarters of the company concerned directly)*
National Grid – Gas Ten Year Statement - (annual); *National Grid*
Oil and Gas Information (annual); *International Energy Agency*
Oil and Gas Statistics (quarterly); *International Energy Agency*
Petroleum Review (monthly); *Energy Institute*

Electricity

Annual Reports and Accounts of the Electricity Supply Companies, Distributed Companies and Generators; (*apply to the Headquarters of the company concerned)*
Annual Report and Accounts of The Office of Gas and Electricity Markets; *OFGEM*
Electricity Information (annual); *International Energy Agency*
Electricity Statistics (quarterly); *International Energy Agency*
National Grid – Electricity Ten Year Statement - (annual); *National Grid*

Renewables

Renewables Information (annual); *International Energy Agency*

Prices

Energy Prices and Taxes (quarterly); *International Energy Agency*

Useful energy related websites

The BEIS section of the GOV.UK website can be found at: www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy

Other Government web sites

Department for Communities and Local Government.	www.gov.uk/government/organisations/department-for-communities-and-local-government
Department for Environment, Food and Rural Affairs	www.gov.uk/government/organisations/department-for-environment-food-rural-affairs
Department for Transport	www.gov.uk/government/organisations/department-for-transport
HM Government Online (GOV.UK)	www.gov.uk/
HM Revenue & Customs	www.gov.uk/government/organisations/hm-revenue-customs
Northern Ireland Executive	www.northernireland.gov.uk/
Ofgem (The Office of Gas and Electricity Markets)	www.ofgem.gov.uk/
The Scottish Government	www.gov.scot/
The Scottish Parliament	www.parliament.scot/
UK Parliament	www.parliament.uk/
UK Statistics Authority	www.statisticsauthority.gov.uk/
Welsh Government	http://gov.wales/

Other useful energy related web sites

BP	www.bp.com/
British Geological Survey	www.bgs.ac.uk/
BRE (Building Research Establishment)	www.bre.co.uk/
The Coal Authority	www.gov.uk/government/organisations/the-coal-authority
Energy Institute	www.energyinst.org/home
Energy Networks Association	www.energynetworks.org/
Energy UK	www.energy-uk.org.uk/
Europa (European Union Online)	http://europa.eu/
Eurostat (European statistics)	http://ec.europa.eu/eurostat
Interconnector	www.interconnector.com/
International Energy Agency (IEA)	www.iea.org/
International Steel Statistics Bureau (ISSB)	www.issb.co.uk/
National Grid	www2.nationalgrid.com/
Oil & Gas UK	http://oilandgasuk.co.uk/
Renewable UK	www.renewableuk.com/
Ricardo Energy & Environment	http://ee.ricardo.com/
The Stationery Office	www.tso.co.uk/
UK-AIR: Air Information Resource	https://uk-air.defra.gov.uk/
UK Petroleum Industry Association	www.ukpia.com/home.aspx
United Nations Statistics Division	https://unstats.un.org/home/
US Department of Energy	https://energy.gov/
US Energy Information Administration	www.eia.gov/

Annex D

Major events in the Energy Industry

2017

Electricity

The foundation stone for the new ElecLink electricity connection between Britain and France was laid in February 2017. The interconnector will run through the Channel Tunnel between Sellindge in the UK and Les Mandarins in France, and will provide 1000MW of electricity, enough capacity to power up to 2 million homes.

Energy Efficiency

Homes across Great Britain will get extra support to make their homes cheaper and easier to keep warm thanks to reforms that came into force in April 2017. Changes to the Energy Company Obligation (ECO) will make sure energy companies give support to people struggling to meet their heating bills, with plans announced to extend the scheme from April 2017 to September 2018.

Smart Meters

A Smart Meters bill was included in the Queen's speech in June 2017 to allow the Government to continue to oversee the successful completion of the rollout of smart meters and protect consumers, leading to £5.7 billion of net benefits to Britain.

2016

Energy Policy

The Energy Bill received Royal Assent in May 2016. In summary the Bill:

- Creates the framework to formally establish the Oil and Gas Authority (OGA) as an independent regulator, taking the form of a government company, so that it can act with greater flexibility and independence. It gives the OGA new powers including: access to external meetings; data acquisition and retention; dispute resolution; and sanctions. It also enables the transfer of the Secretary of State of the Department for Business, Energy and Industrial Strategy (BEIS) existing regulatory powers in respect of oil and gas to the OGA. The Secretary of State's environmental regulatory functions in relation to oil and gas are not transferred to the OGA.

- Enables more comprehensive charging of the offshore oil and gas industry in relation to environmental regulatory functions carried out by BEIS.

- Makes local communities the primary decision makers on new onshore wind developments, alongside measures taken by the Department for Communities and Local Government. It removes the need for the Secretary of State of BEIS consent for large onshore wind farms (over 50 megawatt) in England and Wales under the Electricity Act 1989.

- Brings forward the early closure of the Renewables Obligation subsidy scheme to new onshore wind developments in Great Britain.

2016 (continued)

Electricity

The Government gave development consent to the Hornsea Project Two offshore wind farm off the coast of Yorkshire in August 2016. Once built, the windfarm will deliver 1,800 megawatts of low carbon electricity to around 1.8 million UK homes.

The Government gave consent in January 2016 for a new electric line connection, which will form a major part of the infrastructure needed for the transmission of electricity from Hinkley Point C nuclear power station. The project will be the first scheme to use the new T-pylon, which resulted from a competition held in 2011 by the Royal Institute of British Architects, BEIS and National Grid to explore the potential for a new generation of pylon design

Nuclear

Following a comprehensive review of the Hinkley Point C project, and a revised agreement with EDF, the Government in September 2016 decided to proceed with the first new nuclear power station for a generation. A new legal framework will be imposed on future foreign investment in Britain's critical infrastructure, which will include nuclear energy and apply after Hinkley.

2015

Climate Change

A new global climate agreement was agreed at the United Nations conference on climate change in Paris in December 2015. For the first time ever 195 countries, including the world's largest emitters, have committed to act together to combat climate change and be held equally accountable. The agreement sets out a clear long-term goal of net zero emissions by the end of the century, showing that the world is committed to decarbonising. Progress against this goal will be independently assessed in 2018 and every five years thereafter.

Coal

Kellingley Colliery located at Beal in North Yorkshire, closed on 18 December 2015, marking the end of deep-pit coal mining in the UK.

Electricity

The Government gave approval in October 2015 for the construction of the Ferrybridge Multifuel 2 Power Station at Knottingley, West Yorkshire. If built, the power station will be capable of producing up to 90MWe of electricity, by burning fuel derived from refuse and industrial and commercial waste, such as wood, which would have originally ended up in landfill.

The Government gave approval in September 2015 for the construction of a new gas power plant in Sutton Bridge, Lincolnshire. If built, the station will produce up to 1.8 GW of electricity.

The Government gave approval in August 2015 for the construction of an offshore windfarm off the UK North East coast. If built, Dogger Bank Teesside A and B Offshore wind project will include up to 400 wind turbines in total, across two offshore wind generating stations, each with an installed capacity of up to 1.2 GW. Onshore elements will be located in Redcar and Cleveland, with the potential to generate enough green electricity to power up to 1.8 million British homes.

The Government approved the construction of two gas-fired power generation plants in July 2015 by Progress Power Ltd in Eye, Suffolk, and by Hirwaun Power Limited near Aberdare in South Wales. Both plants will have a generating capacity of up to 299 megawatts of electrical output.

2015 (continued)

Planning consent was given in June 2015 for the construction of the world's first tidal lagoon. If built, turbines in the proposed six-mile horseshoe shaped sea wall around Swansea Bay in Wales could generate around 500GWh per year of low carbon electricity.

The Government gave consent to the Dogger Bank Creyke Beck A and B offshore wind project off the coast of Yorkshire in February 2015. Once built it will generate enough electricity to power almost 2 million homes.

Energy Policy

The Government set out in November 2015 their vision for an energy system that puts consumers first, delivers more competition, reduces the burden on bill-payers and ensures enough electricity generation to power the nation, supported by 4 key policy priorities:

- Consultation on ending unabated coal-fired power stations by 2025
- New gas-fired power stations a priority
- Commitment to offshore wind support completes commitment to secure, low-carbon, affordable electricity supplies
- Move towards a smarter energy system

A new Energy Bill was proposed in the Queen's Speech in May 2015 which will:

- Ensure there will be affordable and reliable energy for businesses and families;
- Give the Oil and Gas Authority the powers it needs to become a robust, independent and effective regulator, and enable it to maximise the economic recovery of oil and gas from UK waters.
- Change the law to give local communities the final say on wind farm applications.

The Infrastructure Act became law in February 2015 enshrining new measures to make it easier, quicker and simpler to get Britain building. The legislation will give local people the right to buy a stake in renewable energy projects, as well as boosting energy security and economic growth by extracting domestic shale gas, which has the potential to create jobs, making the UK less reliant on imports from abroad and so help tackle climate change.

Fuel Poverty

A new Fuel Poverty strategy, the first for over a decade, was launched in March 2015 which outlines the challenges and actions for the next 15 years to ensure Government take the right steps to tackle fuel poverty and to get help to those who need it most. A new legally binding target, in force since December 2014, forms a key part of the new strategy; it requires that as many fuel poor homes as reasonably practicable, achieve a minimum energy efficiency rating of a Band C, by 2030. The strategy also set out interim milestones: to lift as many fuel poor homes in England as is reasonably practicable to Band E by 2020; and Band D by 2025 .

BEIS news stories including press releases, speeches and statements are available here.

For major events in earlier years see the full version of this annex on the BEIS section of the GOV.UK website at:
www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

Standard conversion factors

This Digest uses the tonne of oil equivalent (toe) as the common unit of energy for comparing and aggregating fuels. The following table gives factors for converting between this unit and alternative units of energy found in this and other publications. (See Chapter 1, Technical notes and definitions and Annex A).

	to: Thousand toe	Terajoules (TJ)	Gigawatt hours (GWh)	Million therms
from:	multiply by			
Thousand toe	1	41.868	11.630	0.39683
Terajoules (TJ)	0.023885	1	0.27778	0.0094778
Gigawatt hours (GWh)	0.085985	3.6000	1	0.034121
Million therms	2.5200	105.51	29.307	1

A selection of estimated average gross calorific values

The following selection of estimated average gross calorific values apply to 2016. (For further information and more detailed calorific values see Annex A).

Solid fuels	**GJ per tonne**	**Renewable sources**	**GJ per tonne**
Coal		Domestic wood	16.3
All consumers (weighted average)	27.2	Industrial wood	20.3
Power stations (including imports)	25.2	Municipal solid waste	9.8
Iron and steel	30.4		
Other industries (weighted average)	26.7	**Petroleum**	
Imported coal (weighted average)	27.5	Crude oil (weighted average)	45.7
Exported coal (weighted average)	32.2	Petroleum products (weighted average)	46.2
		Motor spirit	47.1
Coke	29.8	Gas/diesel oil	45.3
Coke breeze	29.8	DERV	45.7
Other manufactured solid fuel	32.7	Fuel oil	43.3
Gases			
Natural gas (produced)	40.1		
Landfill gas	21-25		
Sewage gas	21-25		

Department for Business, Energy & Industrial Strategy
1 Victoria Street, London SW1H 0ET
www.gov.uk/beis