Chapter 5
Electricity

Key points

- **In 2019, electricity consumption accounted for 17 per cent of the UK's final consumption.** This proportion has been relatively stable in recent years. (Table 1.1)

- **UK generation was 325 TWh in 2019, a decrease of 2.4 per cent compared to 2018** and the lowest value in more than twenty years. As well as lower demand, this was linked to higher net imports of electricity, up 11 per cent compared to 2018. (Table 5.1)

- **Total electricity demand was 346 TWh in 2019, 2.0 per cent lower than in 2018.** There were year on year decreases in electricity consumption for all sectors with consumption down 2.4 per cent for the industrial sector, down 1.2 per cent for the domestic sector and down 1.7 per cent for other final users (including commercial and transport use). (Table 5.1)

- **Fuel used for electricity generation totalled 59.9 Million tonnes of oil equivalent (Mtoe) in 2019. This was a decrease of 2.6 per cent compared to 2018** and the lowest value in more than twenty years. This partly reflects the lower electricity generation in 2019 as well as the shift in the generation mix to renewable alternatives. (Table 5.3)

- **The share of generation from fossil fuels fell to 43.1 per cent in 2019, with a record low share for coal of just 2.1 per cent of generation.** Gas's share of generation was slightly higher in 2019 at 40.6 per cent. The total generation from fossil fuels was 140 TWh, just over half the 276 TWh that was generated from fossil fuels in 2009. (Table 5.6)

- **Renewables' share of generation reached another record high in 2019 at 37.1 per cent. This is the first time they have accounted for more than one third of total generation.** This was driven by increased capacity, up 6.7 per cent in 2019 (de-rated to account for intermittency). Renewable generation in 2019 totalled 121 TWh, just 19 TWh lower than the total generation from fossil fuels. (Table 5.6)

- **Low carbon generation reached a record high share of 54.4 per cent in 2019, which was 1.8 pp higher than 2018.** The increase in low carbon share was not as large as the increase in renewable generation share because the nuclear share of generation fell, down to 17.3 per cent in 2019 as a result of outages and maintenance. (Table 5.6)

Introduction

5.1 This chapter presents statistics on electricity from generation through to sales, and includes 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 2020. A **full list** of tables is available at the end of the chapter.

5.2 **In 2019, electricity consumption accounted for 17 per cent of the UK's final energy consumption[1].** This proportion has been relatively stable in recent years.

5.3 Below is an energy flow chart for 2019, showing the flows of electricity from fuel inputs through to consumption. It illustrates the flow of primary fuels used to produce 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.

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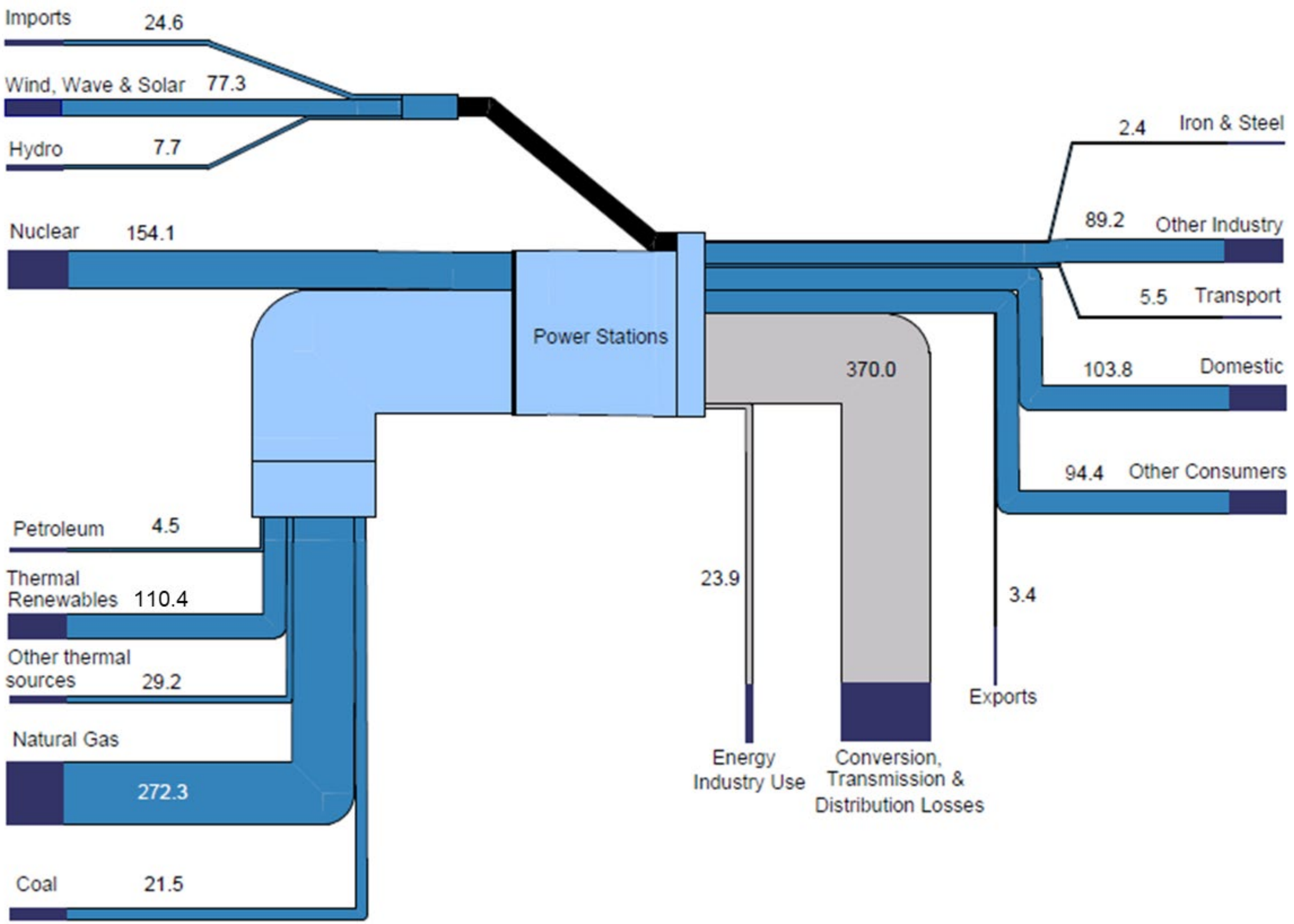
[1] *See section 1.16 for details.*

Electricity flow chart 2019 (TWh)



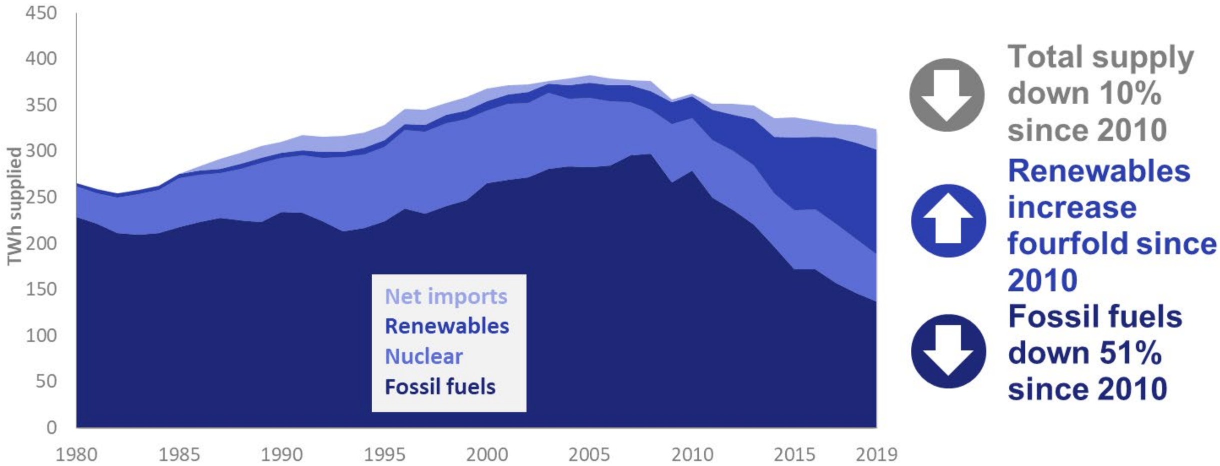
This flow chart is based on the data in Tables 5.1 (for imports, exports, use, losses and consumption) and 5.6 (fuel used).
1. Hydro includes generation from pumped storage while electricity used in pumping is included under Energy Industry Use.
2. Conversion, Transmission and Distribution Losses are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

Electricity supply (Table 5.1)

5.4 Total UK electricity supply in 2019 was 346 TWh, down slightly from 352 TWh in 2018. UK generation (including pumped storage) accounted for 93.9 per cent of total supply, which was slightly lower than the proportion in 2018 (down 0.7 percentage points (pp)). UK generation was 325 TWh in 2019, a decrease of 2.4 per cent compared to 2018 and the lowest value in more than twenty years. Net imports (imports minus exports) were 21.2 TWh in 2019, accounting for 6.1 per cent of total supply.

5.5 Electricity supply is driven by demand, as it is generated or imported as needed[2]. In recent years, demand for electricity has decreased as energy efficiency measures have improved and increased in number. The total electricity demand comprises energy industry use, losses in transmission or distribution and final consumption by end users. Total electricity demand was 346 TWh in 2019, a decrease of 2.0 per cent compared to 2018. Final consumption is a substantial proportion of total demand and in 2019 accounted for 85.4 per cent. A summary of UK supply is provided in Chart 5.1.

Chart 5.1: Electricity supply, 1980 - 2019



5.6 The UK is a net importer of electricity and total net imports continued to increase in 2019, up 11 per cent compared to 2018. In 2019 imports increased to 24.6 TWh (+15 per cent) and exports increased to 3.4 TWh (up 52 per cent). This included the first year of operation for the GB-Belgium interconnector which began operating on 31st January 2019. Table 5A below summarises interconnector capacity, net imports and utilisation while chart 2 shows the interconnectors' trade flows.

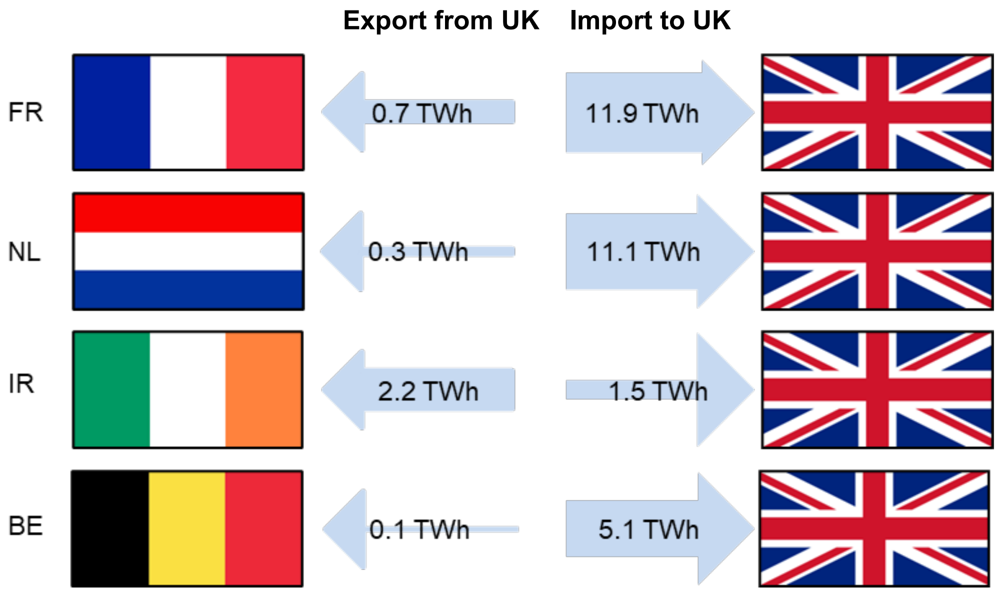
[2] *In the statistics there is a small difference between electricity supply and electricity demand due to different data collection methods. This is called the statistical difference. Further explanations of the statistical difference can be found in paragraphs 5.112 and in paragraph A.19 of DUKES Annex A.*

Table 5A: Net Imports via interconnectors 2017 to 2019

	France – GB[a]	Ireland – N. Ireland[b]	Nether-lands – GB[a]	Ireland – Wales[a]	Belgium - GB	Total
Capacity (MW)	2,000	540	1,000	500	1,000	5,040
Net Imports (GWh)						
2017	7,181	-110	6,858	831	0	14,760
2018	12,890	-471	6,185	504	0	19,108
2019	11,147	-825	5,695	180	4,973	21,170
Utilisation (%)[c]						
2017	67%	14%	83%	46%	0%	49%
2018	78%	26%	75%	47%	0%	53%
2019	72%	30%	73%	52%	59%	63%

a. Figures taken from the demand data available on the National Grid website at https://demandforecast.nationalgrid.com/efs_demand_forecast/faces/DataExplorer
b. Figures supplied by EirGrid
c. Utilisation is total imports and exports across the interconnector in the year divided by the total possible imports and exports.

Chart 5.2: Electricity imports and exports in 2019



5.7 For the French interconnector, net imports decreased 14 per cent in 2019 compared to 2018 to a total of 11.9 TWh. This was due to a 11 per cent decrease in imports and an 84 per cent increase in exports. The French interconnector had a utilisation of 72 per cent in 2019, which was 6 pp lower than in 2018.

5.8 For the interconnector with the Netherlands, the UK had net imports of 5.7 TWh in 2019, 7.9 per cent lower than in 2018. This was driven by a 5.4 per cent reduction in imports but a 71 per cent increase in exports, with utilisation down to 73 per cent.

5.9 For the Ireland-Wales interconnector, the UK remained a net importer in 2019, but net imports reduced by 64 per cent to 0.2 TWh. Imports decreased by 3.1 per cent compared to 2018 but exports increased 37 per cent. The interconnector's utilisation was slightly higher than in 2018 at 52 per cent.

5.10 The new interconnector with Belgium had net imports of 5.0 TWh, with a 59 per cent utilisation rate.

5.11 In contrast to the other interconnectors, the UK is a net exporter on the Ireland-Northern Ireland interconnector with net exports of 0.8 TWh. Imports decreased by 20 per cent while exports increased by 33 per cent, with the interconnector utilisation up 4 pp to 30 per cent.

Electricity demand and consumption (Table 5.1)

5.12 Total electricity demand in 2019 was lower than in 2018, down 2.0 per cent to 346 TWh. Most of this demand (295 TWh, 85.4 per cent) was from final consumption. The remaining demand was split between energy industry use (24 TWh, 6.9 per cent of demand) and losses (26 TWh, 7.6 per cent of demand).

5.13 Energy industry use decreased in 2019 to 24 TWh. Most of this demand was for electricity generation, which accounted for 62 per cent of energy industry use in 2019, a slightly higher share (up 2.0 pp) than in 2018. The lower demand for electricity generation included a substantial reduction in electricity demand for pumped storage, down 30 per cent compared to 2018. Pumped storage uses cheaper electricity to pump water to a higher reservoir. It can then be released later to generate electricity. Generation at pumped storage plants was substantially lower in 2019, reducing the amount of electricity used for pumping. There were also decreases in electricity demand for coke manufacture and for use in other fuel industries, in line with the changes in the fuel mix described in 5.32.

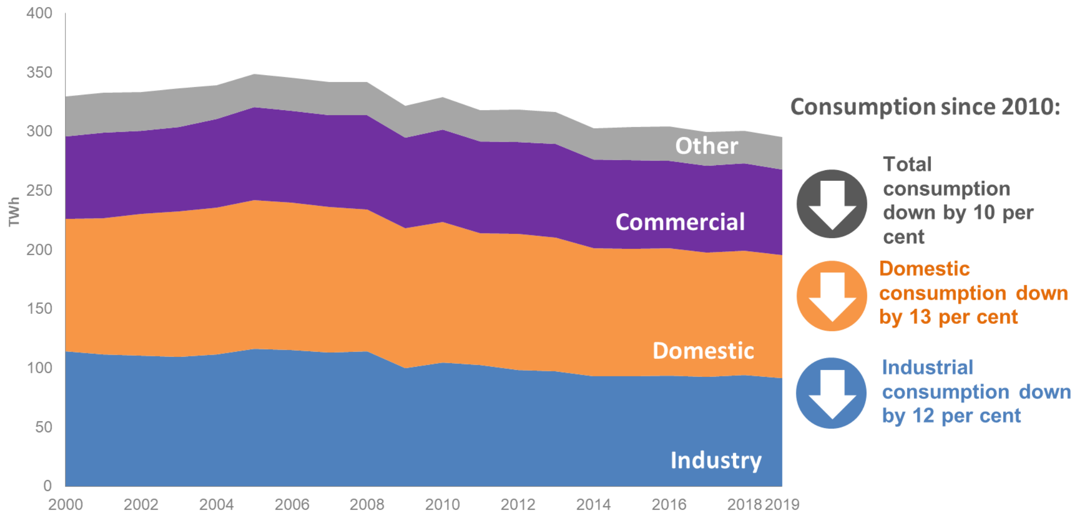
5.14 Losses decreased by 0.9 per cent in 2019 compared to 2018, to 26 TWh, in line with the lower generation. This was a 7.6 per cent share of the demand, similar (up 0.1 pp) to the share in 2018. Losses comprise three components[3]:

- Transmission losses (7.6 TWh) from the high voltage transmission system, which represented 29 per cent of the losses figure in 2019.
- Distribution losses (17.8 TWh), which occur between the gateways to the public supply system's network and the customers' meters accounted for 67 per cent of losses.
- Theft or meter fraud (just under 1.0 TWh) was 3.6 per cent of losses.

5.15 Final consumption by end users totalled 295 TWh in 2019, down 1.7 per cent compared to 2018. The breakdown across sector is shown in chart 5.3.

[3] *See paragraph 5.99 for further information on the calculation of losses.*

Chart 5.3: Final consumption of electricity by major sector, 2000-2019



5.16 There were year on year decreases in electricity consumption for all sectors in 2019 compared to 2018. Consumption was down 2.4 per cent for the industrial sector, down 1.2 per cent for the domestic sector and down 1.7 per cent for other final users (including the commercial sector and transport use).

5.17 Temperatures influence the actual level of electricity consumption, especially in the winter months as customers adjust heating levels in their homes and businesses. The average temperature in 2019 was similar to 2018 (down 0.1 degree) but this does not reflect the seasonal variations. In particular, 2019 had a much milder winter than 2018 which saw the 'Beast from the East' cold weather system. This milder weather reduced the demand for electricity in Quarter 1 of 2019, while the temperatures were relatively similar for the rest of the year and had more similar consumption patterns.

5.18 Domestic consumption decreased in 2019 compared to 2018, down 1.2 per cent for the full year to 104 TWh. Since the peak of domestic consumption in 2005 at 126 TWh, it has tended to decline each year. This has been linked to continuing energy efficiency improvements reducing demand. In 2019 there was a larger drop, as the milder winter led to a 6.6 per cent reduction in domestic consumption in the first quarter of 2019[4] while the remaining quarters were more similar in terms of temperature and electricity consumption patterns.

5.19 Industrial consumption was 92 TWh in 2019, a decrease of 2.4 per cent on 2018. This trend reflected lower productivity in the manufacturing sector, as measured by the Office for National Statistics Index of Production[5]. Since 2010, industrial consumption has declined 12 per cent, with year on year increases occurring in 2017 and 2018.

5.20 Commercial consumption totalled 72 TWh in 2019. This was a decrease of 2.1 per cent from 2018. As with the domestic consumption, this decrease is largely linked to changes in temperature, in particular the much milder temperatures in Quarter 1 of 2019.

5.21 Transport consumption increased to 5.5 TWh in 2019, up by 9.5 per cent compared to 2018. Rail accounted for 93.3 per cent of electricity consumption in the transport sector, with the remainder from road. Road consumption increased to 0.4 TWh in 2019, up by 52 per cent, which reflects the increased use of electric vehicles[6]. Despite the rise in electricity consumption for transport, oil remains the dominant fuel in this sector, with less than 1 per cent of UK energy demand for transport being met by electricity.

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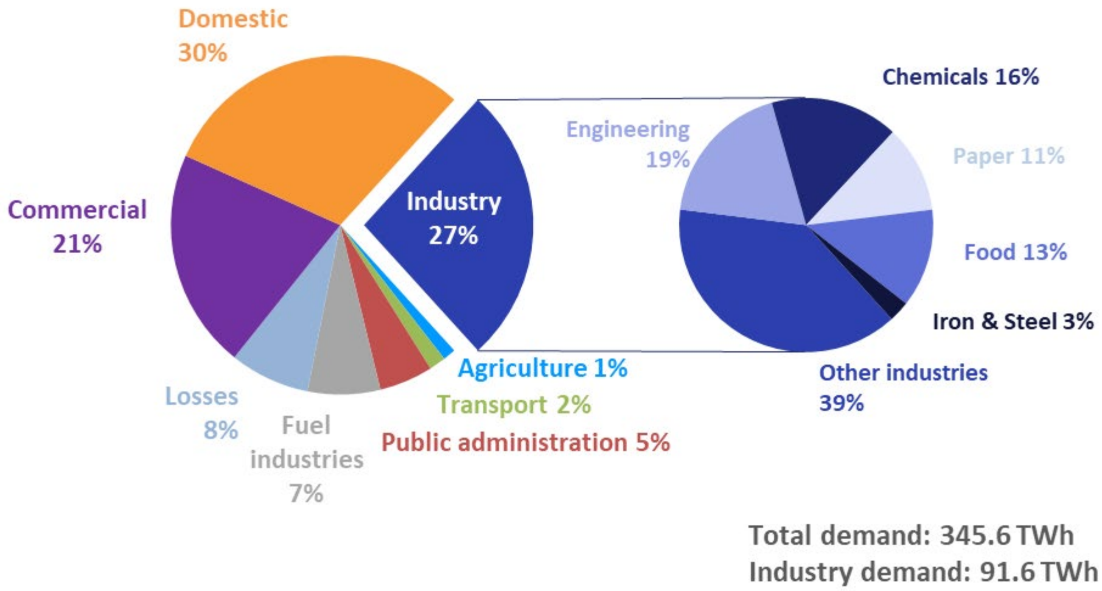
[4] *Quarterly data on electricity consumption is presented in Table 5.2 of Energy Trends:* *www.gov.uk/government/statistics/electricity-section-5-energy-trends*

[5] *Office for National Statistics (ONS) publishes the Index of Production available here:* *www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/indexofproduction/previousReleases*

[6] *Department for Transport publish statistics on number of vehicles by propulsion type here:* *www.gov.uk/government/collections/vehicles-statistics*

Chart 5.4: Electricity demand by sector 2019



5.21 When total electricity demand is split by sector, domestic demand has the largest share at 30.0%, followed by industrial demand at 26.5%. Chart 5.4 shows the full breakdown of the proportions of total electricity demand accounted for by each sector, including a breakdown of the demand for different industries. Key figures are:

- Domestic demand: 30.0 per cent of total demand (up 0.3 pp since 2018).
- Industrial demand: 26.5 per cent of total demand (down 0.1 pp on 2018).
- Commercial demand: 21.0 per cent of total demand (unchanged from 2018).
- Energy industries demand (for generating electricity): 6.9 per cent of total demand (down 0.4 pp on 2018).

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

5.22 The majority of electricity in the UK is supplied by the public distribution system (PDS), which includes the interconnected high voltage transmission network and the lower voltage distribution network. In recent years, the proportion of electricity supplied from the PDS has reduced. In 2019, 316 TWh of UK electricity was supplied by the PDS, down 2.2 per cent on 2018. Most of the electricity supplied from the PDS comes from Major Power Producers[7] (MPPs), who supplied 267 TWh in 2019. The remainder comes from transfers from other generators[8] selling surplus electricity into the PDS as well as from net imports. The volume of electricity transferred to the PDS by other generators increased substantially in 2019, up 8 per cent to 25 TWh.

5.23 The proportion of electricity supplied by MPPs decreased in 2019, offset by increased generation from other generators as well as higher net imports. The volume of supply from MPPs was down by 4.1 per cent compared to 2018, to 267 TWh. However, electricity supplied from other generators increased by 8.0 per cent to 55.6 TWh, of which 46 per cent was transferred to the PDS.

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[7] *Further information on the definitions of MPPs and other generators can be found in paragraph 5.89.*

[8] *Other generators are businesses that generate their own electricity and may export surplus to the grid, and microgeneration by the domestic and commercial sectors. This includes autogenerators.*

Additionally, net imports increased by 10.8 per cent compared to 2018, to 21 TWh[9], ensuring that supply met demand.

5.24 Electricity supplied by other generators has increased year on year since 2012 and this has reduced the proportion of electricity supplied from the PDS. The proportion of electricity supplied by the PDS was 91.2 per cent in 2019, down 0.4 pp compared to 2018 and down 2.6 pp over the last 5 years. The increased supply from other generators has been driven by higher autogeneration and local generation, partly as result of small-scale renewable schemes such as Feed-in Tariffs (FiTs).

5.25 Other generators and autogenerators produce electricity as part of their manufacturing or other commercial activities, principally for their own use. Overall final electricity consumption by other generators was 7.4 per cent in 2019, up 0.2 pp compared to 2018 and up 2.3 pp over the last 5 years. Within this, there are different trends for the individual sectors outlined below.

5.26 While total energy industry use decreased in 2019 compared to the previous year[10], the energy industry use by other generators increased by 9.2 per cent to 8.4 TWh in 2019. This increased the proportion of energy industry use by other generators to 35.1 per cent (up 5.2 pp on 2018). Other generators' consumption was particularly high for petroleum refineries, where 73.4 per cent of consumption came from other generation.

5.27 Other generators and autogenerators produce electricity as part of their manufacturing or other commercial activities, principally for their own use[11]. In 2019, 10.9 per cent of industrial demand for electricity was met by other generation, a similar proportion to 2018 (up 0.2 pp). In the commercial sector, 9.3 per cent of demand was met by other generation in 2019, which was up 0.7 pp compared to 2018.

5.28 Domestic electricity generation and consumption by households with microgeneration units (such as solar photovoltaic panels) increased sharply since the launch of Feed In Tariffs in April 2010 in Great Britain; the scheme closed to new entrants at the end of March 2019.[12]. In 2019, the domestic sector consumed 1.7 TWh of self-generated electricity, an increase of 5.4 per cent on 2018. Despite the increase, self-generated electricity still accounts for only 1.6 per cent of domestic consumption.

Combined Heat and Power (CHP) plants

5.29 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.

5.30 In 2019, CHP comprised 11.7 per cent of MPP's thermal electricity generation, and 62.2 per cent of thermal autogeneration. Table 5B summarises the quantity of CHP capacity and generation covered in Chapter 7 using statistics sourced from the CHPQA programme compared to other CHP plants not covered by the scheme.

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[9] For more information on net imports, imports and exports see paragraph 5.6.

[10] For more information on Energy Industry use see paragraph 5.13.

[11] See Table 5.4 for details of the fuels used by other generators to generate electricity and the quantities of electricity generated and consumed.

[12] See Chapter 6 on renewables paragraph 6.70 for further information on FiTs uptake.

Table 5B: Combined Heat and Power (CHP) electricity generation and capacity in 2019, compared to UK generation and capacity

		Generation (GWh)	Capacity (MW)
Major Power Producers (Thermal)	CHPQA (ch 7)	7,436	1,990
	CHP (not included in ch 7)	16,517	2,349
	Other thermal generation	180,359	62,220
	Total MPP thermal generation	204,312	66,559
Autogenerators (Thermal)	CHPQA (ch 7)	16,025	4,060
	CHP (not included in ch7)	6,050	495
	Other thermal generation	13,416	6,808
	Total thermal autogeneration	35,491	11,363
Transfers		83,202	n/a
Total		323,005	77,922

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

5.31 Fuel used for electricity generation totalled 59.9 Million tonnes of oil equivalent (Mtoe) in 2019. This was a decrease of 2.6 per cent compared to 2018[13] and the lowest value in more than twenty years. This partly reflects the lower electricity generation in 2019 (down 2.4 per cent) but was largely due to the shift in the generation mix to renewable alternatives, as detailed in Chart 5.5 overleaf. For wind, hydro and solar, the fuel used is assumed the same as the electricity generated, unlike thermal generation where conversion losses are incurred[14].

5.32 For MPPs, fuel use decreased to 48.8 Mtoe in 2019, a decrease of 4.3 per cent on 2018 (table 5.3). This is in line with a 4.1 per cent reduction in MPP generation in 2019 compared to 2018, as detailed in Table 5.2. Fuel use by other generators increased by 5.2 per cent to 11.1 Mtoe in 2019. This was driven by a substantial increase in thermal renewable fuel used, up 7.5 per cent to 4.8 Mtoe.

5.33 The amount of fossil fuel used in electricity generation decreased by 9.1 per cent in 2019 compared to 2018 to a total of 25.7 Mtoe. Coal use decreased by 56 per cent in 2019 to reach a new record low level of 1.9 Mtoe. There was also a small decrease in the amount of gas used, down 0.4 per cent to 23.4 Mtoe, the lowest value for gas since 2015. The main driver for the shift in generation between coal and gas 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 amount of carbon dioxide per GWh of electricity supplied than gas, this made generation from coal more expensive than gas. The shift away from coal generation also led to two more of the UK's coal generation plants closing in 2019, leaving only five coal-fired power stations in operation[15].

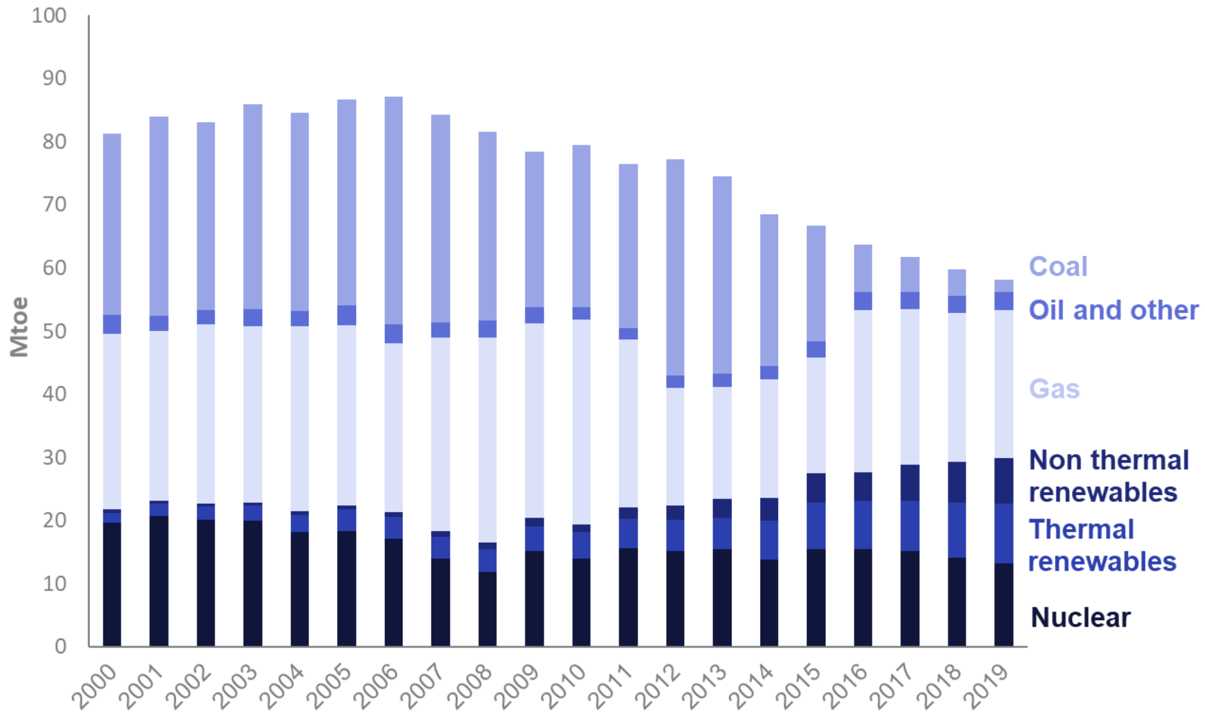
5.34 Bioenergy and other fuels were the only categories (apart from non-thermal renewables) where an increase in fuel use was seen between 2018 and 2019. In 2019, 9.5 Mtoe of bioenergy fuel was used, up 7.0 per cent since 2018. This is in line with increased capacity for bioenergy generation, as detailed in Paragraph 5.55. The use of other fuels also increased in 2019, up 10.0 per cent to 2.5 Mtoe in 2019. This includes the non-renewable component of waste.

[13] A historical series of fuel used in generation on a consistent, energy supplied, fuel input basis is available at Table 5.1.1.

[14] As an example, this means that if one unit of electricity produced from coal is switched to wind, the fuel used will show a fall from around three units (as coal's thermal efficiency is around one-third) to one unit.

[15] See table 5C for details of power plant closures in 2019.

Chart 5.5: Fuel used in generation by all generators, 2000 - 2019



5.35 The overall trends in generation are similar to those seen in fuel use, with a big decrease in fossil fuel generation and substantial growth in renewable generation. Total electricity generated was 325 TWh in 2019, a decrease of 2.4 per cent compared to 2018. This included 1.8 TWh of pumped storage generation. MPPs accounted for 83 per cent of this generation in 2019, which was 1.7 pp lower than in 2018.

5.36 Fossil fuel generation totalled 140 TWh in 2019. This was down 6.3 per cent compared to 2018 and the lowest value in more than twenty years. Over the decade, fossil fuel generation almost halved from 276 TWh in 2009. Most of the decrease was in coal generation, which was 6.9 TWh in 2009 and saw a 59 per cent decrease compared to 2018. For comparison, coal generation was 103 TWh in 2009. Gas generation was similar in 2018 and 2019, up by 0.3 per cent.

5.37 The decline in fossil fuel generation was made possible by the substantial growth in renewable generation and this trend continued in 2019. Renewable generation[16] increased by 9.5 per cent in 2019 compared to the previous year to reach 121 TWh. This was just 19 TWh lower than the total generation from fossil fuels. There were increases in each category of renewables as detailed below.

5.38 Generation from wind and solar[17] sources increased by 11 per cent in 2019 compared to 2018 to 77 TWh. This was driven by increases in capacity for these sources, with wind capacity up 10.7 per cent) and solar capacity up 2.1 per cent[18]. The increased generation was despite average weather conditions being less favourable in 2019 compared to 2018, with average wind speeds down 0.3 knots and average daily sun hours down by 0.3. Average wind speeds were the lowest they had been since 2012[19], reflecting the importance of the increased capacity for wind generation.

5.39 Hydro natural flow generation increased by 9.0 per cent in 2019 compared to 2018, to 5.9 TWh. Capacity for hydro generation was unchanged over this time, but average rainfall was up 7.3 per cent, increasing the level of generation.

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[16] Renewables include wind, natural flow hydro, solar, wave, tidal and bioenergy (including co-firing).

[17] Including generation from wave and tidal

[18] See 5.50 for more details on capacity.

[19] See Energy Trends tables 7.2 and 7.3 for details on weather conditions.

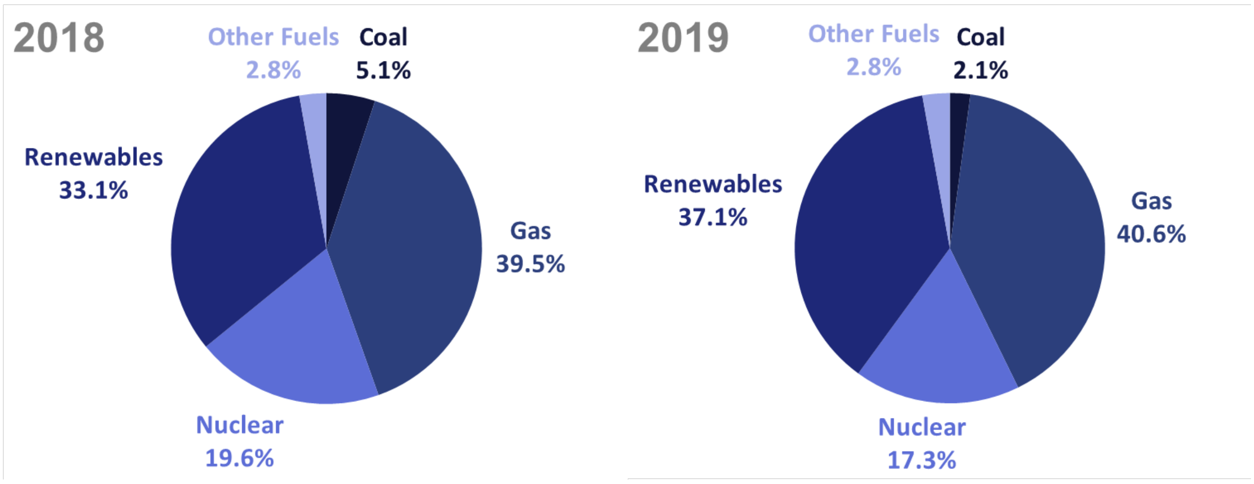
5.40 Thermal renewable generation[20], which covers bioenergy including biodegradable wastes, increased to 37 TWh in 2019, up 6.8 per cent on the previous year. This was partly attributable higher capacity for bioenergy generation, up by 4.7 per cent.

5.41 Nuclear generation fell 13.6 per cent to 56 TWh in 2019, which is the lowest level of nuclear generation since 2008. This was the result of a series of prolonged outages throughout the year which reduced the UK's operational nuclear capacity.

5.42 Not all electricity produced by generators is available for use by consumers, as power plants require a portion for their own works. In 2019, a total of 14.8 TWh was used on works, a 3.8 per cent decrease compared to 2018. The two largest decreases in use on works were for nuclear generators (down 14 per cent in line with the lower nuclear generation from nuclear) and a reduction of 30 per cent in the use of energy for pumped storage generation.

5.43 Subtracting the electricity used on works from the total generated gives the gross electricity supplied. In 2019 this totalled 310 TWh, down 2.3 per cent on 2018. When the electricity used in pumped storage generation is accounted for, the net electricity supplied in 2019 was 308 TWh.

Chart 5.6: Shares of electricity generation, by fuel[21]



5.44 The changes in generation in 2019 also led to changes in the shares of generation, as shown in Chart 5.6. These include a substantial decrease in the share of generation from fossil fuels and the renewable share of generation increasing to more than a third of the total.

5.45 The share of generation from fossil fuels fell to 43.1 per cent in 2019, down from 44.9 per cent in 2018, a difference of -1.8 pp. Most notably, coal's share of generation fell to 2.1 per cent in 2019, down 2.9 pp on the previous year to a record low share for coal. Gas's share of generation was slightly higher in 2019, up 1.1 pp to 40.6 per cent.

5.46 Renewables' share of generation reached another record high in 2019 at 37.1 per cent. This is the first time they have accounted for more than one third of total generation. The 2019 share was 4.0 pp higher than in 2018 and 30.4 pp higher than in 2009. This rise in renewables share was due to an increase in the share from wind and solar to 23.8 per cent (+2.9 pp on 2018) and an increased share for thermal renewables of 11.5 per cent (+1.0 pp on 2018) – both of these were record high levels. The share of generation from hydro natural flow has been relatively stable across the time series and was 1.8 per cent in 2019 (up 0.2 pp on 2018).

[20] *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 have remained in thermal renewables.*

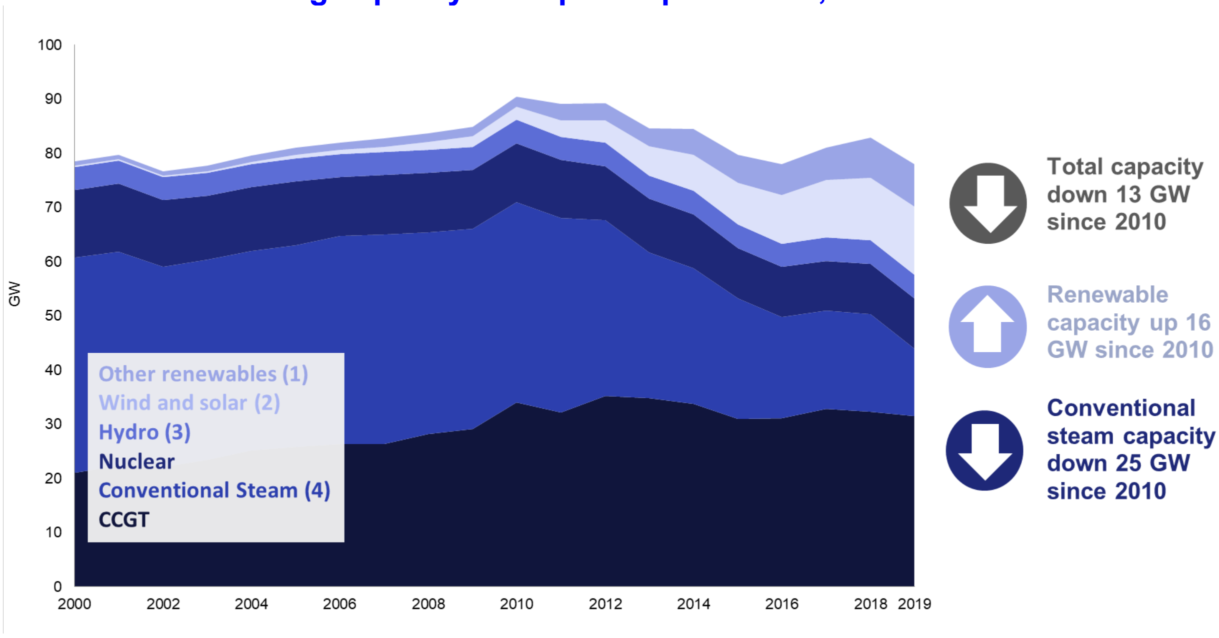
[21] *Further information on this and the alternative input basis of comparing fuel use can be found in paragraph 5.96.*

5.47 Low carbon generation consists of renewable and nuclear generation and the rise in renewables share of generation also drove an increase in the share of generation from low carbon sources. Low carbon generation reached a record high share of 54.4 per cent in 2019, which was 1.8 pp higher than 2018. The increase in low carbon share was not as large as the increase in the share for renewable generation because the nuclear share of generation declined to 17.3 per cent in 2019, down 2.3 pp on 2018. This was the lowest share of generation from nuclear since 2010, primarily as a result of outages and maintenance.

Plant capacity (Tables 5.7, 5.8 and 5.9)

5.48 Electricity generation capacity is the maximum power available to the UK at any one time. Capacity is provided by MPPs[22] 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).

Chart 5.7: Generating capacity of all power producers, 2000-2019



1. *'Other renewables' includes bioenergy.*
2. *Wind included from 2007*
3. *'Hydro' includes natural flow and pumped storage.*
4. *'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.*

5.49 Total capacity for all generators decreased to 77,920 MW in 2019. This was a decrease of 6.0 per cent on the 82,909 MW capacity in 2018. While there were increases in renewable capacity, this was more than offset by decreases in capacity for fossil fuel generation.

5.50 Total renewable capacity increased by 6.7 per cent in 2019 to reach 22,005 MW, though this has been de-rated to account for intermittency. This drove large increases in generation from renewable sources as detailed in paragraph 5.36. Renewable capacity accounted for more than a quarter of all generating capacity in 2019, 28.2 per cent, which was an increase of 3.4 pp compared to 2018. Capacity was stable or increased for all types of renewable generation, as detailed below.

5.51 Wind capacity (de-rated) increased to 10,361 MW, an increase of 11 per cent on 2018. This increased wind's share of capacity to 13.3 per cent in 2019 (up 2.0 pp).

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[22] *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 5.100. Renewables installed capacity figures are given in table 6.4.*

5.52 Solar capacity (de-rated) increased in 2019 to 2,269 MW, up by 2.1 per cent compared to 2018. Overall, solar accounted for 2.9 per cent of generation capacity in 2019.

5.53 Capacity for hydro generation was unchanged in 2019, with natural flow hydro capacity at 1,619 MW (de-rated for small scale generation) and capacity for pumped storage generation at 2,744 MW. The capacity for pumped storage has not changed since 2007. Hydro capacity was 5.6 per cent of generation capacity in 2019.

5.54 Generation capacity of renewables other than hydro, wind and solar increased to 7,756 MW in 2019, up 4.4 per cent compared to 2018. This represented 10.0 per cent of total generation capacity in 2019, an increase of 1.0 pp. The majority of this was bioenergy capacity, with 22 MW of wave and tidal stream capacity.

5.55 Fossil fuel conventional steam capacity decreased by 34.8 per cent in 2019, to 10,216 MW. This represented 13.1 per cent of all generators' capacity in 2019, a decrease of 5.8 pp compared to 2018. Two large coal fired power stations closed in 2019, Aberthaw B (1,500 MW) and Cottam (2,000 MW). This decreased MPP conventional steam capacity, while there was a slight increase in capacity for other generators.

5.56 Combined Cycle Gas Turbine stations (CCGT) had a total capacity of 31,469 MW in 2019, a decrease of 2.5 per cent compared to 2018. This was linked to the closure of Deeside (500 MW) and Barry (235 MW of CCGT capacity). Despite the decrease, CCGT continued to account for 40.4 per cent of generation capacity in 2019. This was the largest share of generation capacity and was higher than the share in 2018 (up 1.5 pp).

Table 5C: Major Power Producers thermal capacity opened, closed, converted, increased or reduced (as at end of May 2020), since end-2010

Site	Fuel	Status	Previous Capacity (MW)	New Capacity (MW)	Year of closure/opening, capacity change or conversion
Langage	CCGT	Opened	0	905	2010
Severn Power	CCGT	Opened	0	850	2010
Staythorpe C	CCGT	Opened	0	1,752	2010
Barkip	Waste	Opened	0	3	2011
Blackburn	CCGT	Opened	0	60	2011
Fife	CCGT	Closed	123	0	2011
Grain CHP	CCGT	Opened	0	1,517	2011
Riverside	Waste	Opened	0	80	2011
Teesside	CCGT/OCGT[1]	Partially Closed	1,875	45	2011
Tilbury B	Coal	Converted	1,063	0	2011
Tilbury B	Biomass	Converted	0	750	2011
Derwent	CCGT	Mothballed	228	0	2012
Grain A	Oil	Closed	1,300	0	2012
Kingsnorth A	Coal/Oil	Closed	1,940	0	2012
Oldbury	Nuclear[2]	Closed*	434	0	2012
Pembroke B	CCGT	Opened	0	2,199	2012
Shotton	CCGT	Closed	210	0	2012
Wylfa (Reactor 2)	Nuclear[3]	Partially Closed	980	490	2012
Cockenzie	Coal	Closed	1,152	0	2013
Didcot A	Coal/Gas	Closed	1,958	0	2013
Drax	Coal[4]	Partially Converted	3,960	3,300	2013
Drax	Biomass[4]	Partially Converted	0	660	2013
Fawley	Oil	Closed	1,036	0	2013
Ironbridge	Coal[5]	Converted	1,000	0	2013
Ironbridge	Biomass[5]	Converted	0	370	2013
Keadby	CCGT	Mothballed	749	0	2013
Kings Lynn	CCGT	Mothballed	340	0	2013
Roosecote	CCGT	Closed*	229	0	2013
Teesside	OCGT[1]	Closed	45	0	2013
Tilbury B	Biomass	Closed*	750	0	2013
West Burton	CCGT	Opened	0	1,332	2013
Barking	CCGT	Closed	1,000	0	2014
Drax	Coal[4]	Partially Converted	3,300	2,640	2014
Drax	Biomass[4]	Partially Converted	660	1,320	2014
Ferrybridge C	Coal	Partially Closed	1,960	980	2014
Glanford Brigg	CCGT/OCGT[6]	Partially Closed	150	99	2014
Littlebrook D	Oil	Closed	1,370	0	2014
Markinch CHP	Biomass	Opened	0	60	2014
Runcorn	Waste	Opened	0	86	2014
Blackburn Meadows	Biomass	Opened	0	33	2015

Site	Fuel	Status	Previous Capacity (MW)	New Capacity (MW)	Year of closure/opening, capacity change or conversion
Drax	Coal[4]	Partially Converted	2,640	1,980	2015
Drax	Biomass[4]	Partially Converted	1,320	1,980	2015
Ferrybridge Multi-Fuel	Waste	Opened	0	79	2015
Ironbridge	Biomass[5]	Closed	370	0	2015
Lynemouth	Coal	Mothballed	420	0	2015
Wylfa (Reactor 1)	Nuclear[3]	Closed	490	0	2015
Carrington	CCGT	Opened	0	910	2016
Ferrybridge C	Coal	Closed	980	0	2016
Killingholme A and B	CCGT/OCGT[7]	Partially Closed	900	600	2016
Longannet	Coal	Closed	2,260	0	2016
Rugeley	Coal	Closed	448	0	2016
Wilton 11	Waste	Opened	0	55	2016
Uskmouth	Coal	Mothballed	220	0	2017
Ballylumford B	OCGT	Closed	540	0	2018
Deeside	CCGT	Closed	498	0	2018
Drax	Coal[4]	Converted	1,980	1,320	2018
Drax	Biomass[4]	Converted	1,980	2,640	2018
Eggborough	Coal	Closed	1,960	0	2018
Lynemouth	Biomass	Converted	0	420	2018
Peterborough	CCGT/OCGT[8]	Partially Closed	360	245	2018
Barry	CCGT/OCGT[9]	Closed	375	0	2019
Aberthaw B	Coal	Closed	1,559	0	2019
Five Oaks	Oil	Closed	9	0	2019
Cottam	Coal	Closed	2,000	0	2019
Knapton	CCGT[10]	Closed	42	0	2019
Ferrybridge Multi-Fuel 2	Waste	Opened	0	77	2019
Aberthaw GT	Oil	Closed	51	0	2020
Fiddler's Ferry	Coal	Closed	1,510	0	2020

* site was mothballed before closure

1. Reduced capacity from 1,875 MW (CCGT 1,830 MW / OCGT 45 MW) to 45 MW (OCGT) in 2011 before closing in 2013.
2. Reactor 2 with capacity of 217 MW closed on 30 June 2011, reactor 1 with capacity of 217 MW closed on 29 February 2012.
3. Reactor 2 closed on 30 April 2012, reactor 1 closed on 31 December 2015 (both with a capacity of 490 MW).
4. Partly converted to biomass. Two 660 MW units were converted to biomass, one in 2013 and 2014, before a third unit (also 660 MW) was converted to high-range co-firing (85% to <100% biomass) in 2015. A fourth unit (660 MW) was then converted in August 2018. Overall capacity remains at 3,960 MW (coal 1,320 MW, biomass 2,640 MW).
5. Converted from coal to dedicated biomass in 2013 (at 740 MW), before reducing to 370 MW in April 2014 after a fire at one of the biomass units.
6. Operated as a CCGT at 360 MW until 2018, but now operating as an OCGT (245 MW) with the steam side being decommissioned.
7. Operated as a CCGT until March 2018, before running as an OCGT for one year. The site was then closed in March 2019.
8. Operated as a CCGT at 360 MW until 2018, but has since operated as an OCGT at 245 MW, with the steam side being decommissioned.
9. Operated as a CCGT until March 2018, before running as an OCGT for one year. The site was then closed in March 2019.
10. Gas turbine on site sold. Currently no generating capacity

5.57 Since 2010, MPPs proportion of capacity has reduced from 92 per cent to 85 per cent in 2019. This declining trend is a result of MPP plant closures and a steady increase in small-scale renewable capacity from other generators.

5.58 The overall decrease in generation capacity was driven by a decrease in MPP capacity, down by 7.9 per cent in 2019 to a total of 66,559 MW. By contrast there was a 6.5 per cent increase in capacity for other generators, up to 11,361 MW in 2019. The overall capacity changes were driven by increased renewables capacity (up 7.4 per cent for MPPs and 5.3 per cent for other generators) offset by a decrease in MPP capacity for fossil fuel conventional steam generation, which was down 44 per cent compared to 2018.

5.59 MPP generating capacity in the UK decreased overall, with decreases for England and Wales (down 9.4 per cent) and for Northern Ireland (down 11.1 per cent) but an increase for Scotland (up 3.4 per cent. The changes in capacity have affected the breakdown of capacity between the countries of the UK, with the share for England and Wales down 1.4 pp and the share for Scotland up 1.5 pp. These changes are summarised in Table 5D below.

5.60 The countries' capacity changes were driven by the closure of fossil fuel plants and increases in renewable capacity. Coal fired conventional steam capacity in 2019 was down 45 per cent in England and Wales and down 34 per cent in Northern Ireland compared to 2018. Over the same time period, renewables capacity increased by 6.3 per cent in England and Wales, 5.7 per cent in Scotland and 9.8 per cent in Northern Ireland (Table 5.8).

Table 5D: MPP Capacity Summary, 2016 to 2019

	2016	2017	2018	2019	% Change 2019 vs 2018
Capacity (MW)[1]					
England and Wales	57,787	60,099	61,050	55,341	-9.4%
Scotland	7,880	8,372	8,779	9,074	3.4%
Northern Ireland	2,298	2,369	2,412	2,144	-11.1%
Total	**67,965**	**70,840**	**72,241**	**66,559**	-7.9%
Share (%)[2]					
England & Wales	85.0%	84.8%	84.5%	83.1%	-1.4%
Scotland	11.6%	11.8%	12.2%	13.6%	1.5%
Northern Ireland	3.4%	3.3%	3.3%	3.2%	-0.1%

[1] Capacity data for MPP by grid country is taken from Table 5.8

[2] Share is calculated as the country's capacity divided by the total capacity

5.61 The capacity of other generators (non MPPs) increased by 6.5 per cent in 2019, to 11,361 MW. This was driven by increases in capacity for generation in the chemicals, paper, printing and publishing and other industrial sectors. Decreases were seen for the generation capacity for oil and gas terminals, oil refineries (down 5.6 per cent) and for the iron and steel sector (down 0.9 per cent). Table 5.9 gives a full breakdown of the generating capacity for generators other than MPPs according to the industrial classification of the generator[23].

[23] *For CHP, schemes are classified according to the sector that receives most of the heat (as opposed to the sector in which the CHP operator was considered to operate.*

Plant loads, demand and efficiency for MPPs (Table 5.10)

5.62 Looking at the maximum load (demand) on the electricity grid compares winter periods rather than calendar years[24]. The maximum load (demand) in the UK during the winter of 2019/20 was 48,230 MW, which occurred on 20th November 2019, in the half-hour ending 17:30. This was 3.8 per cent higher than the maximum seen in the previous winter, which occurred on 23rd January 2019. In Great Britain the maximum demand at this time was 46,802 MW, which was 4.1 per cent lower than the maximum the previous winter. For Northern Ireland, the simultaneous maximum load at this time was 1,428 MW, which was 11.3 per cent lower than the previous year.

5.63 For the 2019/20 winter, the maximum demand was 72.5 per cent of the UK MPP capacity[25], which was 1.4 pp lower than in 2018/19. For Great Britain the maximum demand met was 72.7 per cent of MPP capacity, an increase of 2.8 pp compared to 2018. The increased percentage of capacity is driven by a decrease in MPP capacity in Great Britain, as the maximum load was lower than in 2018/19. In Northern Ireland, the maximum demand met was 66.6 per cent of MPP capacity, a decrease of 0.2 pp compared to 2018/19. These percentages do not include the capacities available via the interconnectors with neighbouring grid systems nor demand for electricity via these interconnectors.

5.64 As Northern Ireland operates from a separate electricity grid to Great Britain, its own maximum load occurred at a different time, on 2nd December 2019 in the half-hour ending at 17:30. The load was 1,560 MW[26], which was 7.6 per cent lower than the previous winter.

5.65 Plant load factors[27] measure how intensively each type of plant has been used, with a higher value demonstrating a higher intensity of use. For all plants in 2019, the load factor was 35.4 per cent, a decrease of 3.3 pp compared to 2018. While nuclear plants continued to have the highest plant load factor at 62.9 per cent in 2019, this was 9.9 pp lower than in 2018 because of the reduction in supply because of plant outages. The reduced supply of electricity from coal in 2019 resulted in a coal-fired power station load factor of 7.8 per cent, which was 6.4 pp lower than in 2018. This is a new low for coal-fired stations. Load factors for natural flow hydro and wind (as well as other renewables) can be found in table 6.5[28], with a summary of the trends on an unchanged configuration basis[29] provided below.

5.66 In 2019, the overall wind load factor was 32.0 per cent, an increase of 0.6 pp on 2018. When split by type of wind generation, the load factor for onshore wind was 26.6 per cent (up 0.2 pp) while the load factor for offshore wind was 40.4 per cent, up 0.3 pp compared to 2019. These increases came despite lower average wind speeds. The solar photovoltaic load factor was stable in 2019 at 11.2 per cent (down 0.1 pp) in line with slightly lower average sun hours. There was an increase in the hydro load factor in 2019, up by 3.0 pp compared to 2018 to 36.2 per cent. This was linked to an increase in rainfall in 2019.

5.67 Thermal efficiency measures the efficiency with which the heat energy in fuel is converted into electrical energy. The efficiencies presented here are calculated using gross calorific values to obtain the energy content of the fuel inputs[30]. The largest change in efficiency was for nuclear generation, which has generally remained between 38 and 40 per cent over the last decade, but was 36.5 per cent

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24 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 5.78), England, Wales and Scotland are covered by a single network and a single maximum load is shown for Great Britain for 2006 to 2016.

25 The MPP capacity is 66.559 MW, as measured at the end of December 2019. It is taken from Table 5.7.

26 Data supplied by EirGrid.

27 The plant load factors for All plants and Conventional Thermal and other stations contain revisions back to 2010, ensuring that both the capacity and supply values are for MPPs only.

28 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 and are used in Table 6.5.

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

30 For more information on gross and net calorific values, see paragraph 5.103.

in 2019, a decrease of 3.3 pp. This may be linked to lower efficiency from more frequent outages. Gas efficiency for CCGT generators remained consistent in 2019 at 48.8 per cent (-0.2pp on 2018) while coal generators saw a decrease in efficiency of 2.2pp to 31.9 per cent.

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

5.68 **The total installed capacity of major UK power stations was 80,374 MW**[31] at the end of May 2020. 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 showing renewable sources and smaller (<1 MW) Combined Heat and Power (CHP) plants. 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.

5.69 Table 5.12 shows capacity of the transmission and distribution networks for Great Britain, Northern Ireland and the UK as a whole. The UK transmission network connected capacity reduced each year from 2012 to 2015 due to closures and conversions of coal, oil and gas plants but has remained relatively consistent since then. Across the UK in 2019, transmission capacity was 70,809 MW, a decrease of 2.4 per cent on 2018.

5.70 Since 2011 the distribution network capacity increased annually, mainly as a result of increased embedded renewable generation being installed. In 2019 the UK distribution network capacity totalled 32,875 MW, which was an increase of 3.6 per cent compared to 2018. In 5 years, the distribution network capacity has increased substantially, up by 54 per cent.

5.71 The biggest changes in transmission capacity were for coal (down 31 per cent) and OCGT (down 18 per cent), alongside a substantial increase for offshore wind capacity, up 21 per cent. This is in line with the plant closures for coal and OGCT presented in Table 5C. For the distribution network, there were large increases in offshore wind capacity (up 22 per cent), OCGT capacity (up 18 per cent) and other fuels capacity (up 17 per cent), with a 14 per cent decrease in oil generation capacity.

5.72 In 2019 the total installed capacity (for both transmission and distribution networks) for the UK was 104 GW, slightly lower than in 2018 (down 0.6 per cent). Of the total UK capacity, 96.3 per cent of the UK's capacity was connected in Great Britain and 3.7 per cent in Northern Ireland. For Great Britain, it is estimated that 69 GW was connected to the transmission network, equivalent to 66.2 per cent of the Great Britain total capacity. From the Northern Ireland total capacity (3.8 GW), 56.7 per cent was estimated as connected to the transmission network.

Carbon dioxide emissions from power stations

5.73 **It is estimated that carbon dioxide emissions from power stations accounted for 16.3 per cent of the UK's total carbon dioxide emissions in 2019**. The overall emissions per GWh of electricity generated decreased in 2019 as the mix of fuels used changed, moving away from coal-fired generation and generating more from gas and renewable sources.

5.74 Emissions vary by type of fuel used to generate the electricity and emissions estimates per unit of electricity generation for 2017 to 2019 are shown in Table 5E below.

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[31] *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 2019. See paragraph 5.101 for more information on the measures of capacity.*

Table 5E: Estimated carbon dioxide emissions per GWh of electricity supplied 2017 to 2019 [1,2]

Fuel	Emissions (tonnes of carbon dioxide per GWh electricity supplied)		
	2017	2018	2019[3]
Coal	918	921	985
Gas	380	377	371
All fossil fuels	488	480	446
All fuels (including nuclear and renewables)	239	222	198

1 The carbon intensity figures presented in Table 5E are different to those produced for the Greenhouse Gas Inventory (GHGI). The differences arise because of methodology differences, including geographical coverage and treatment of auto generators but are principally due to the GHGI presenting figures based on a 5-year rolling average whereas those in Table 5E 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 2019 being 309,927 GWh.

3. The 2019 emissions figures are provisional.

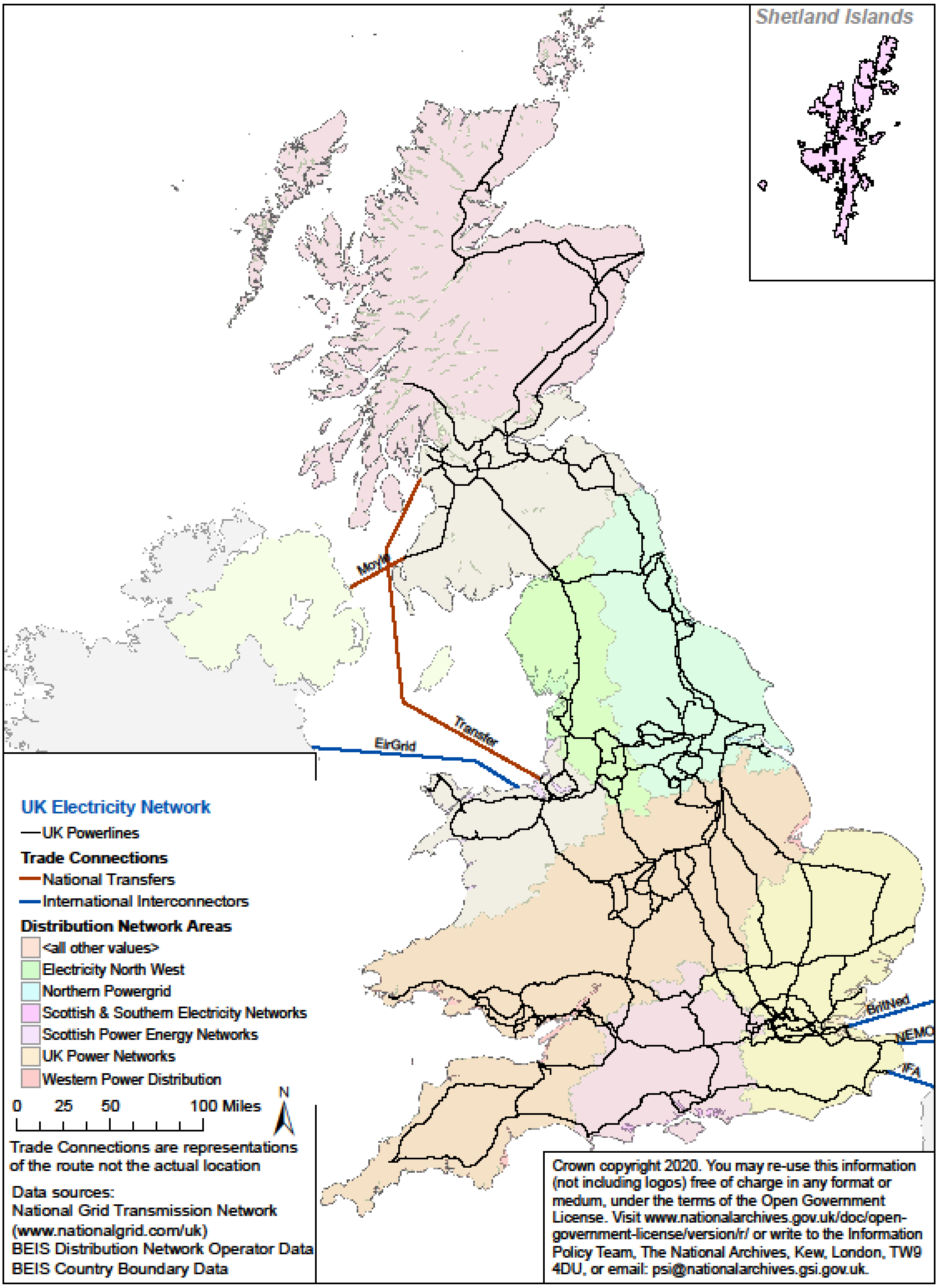
Sub-national electricity data

5.75 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.

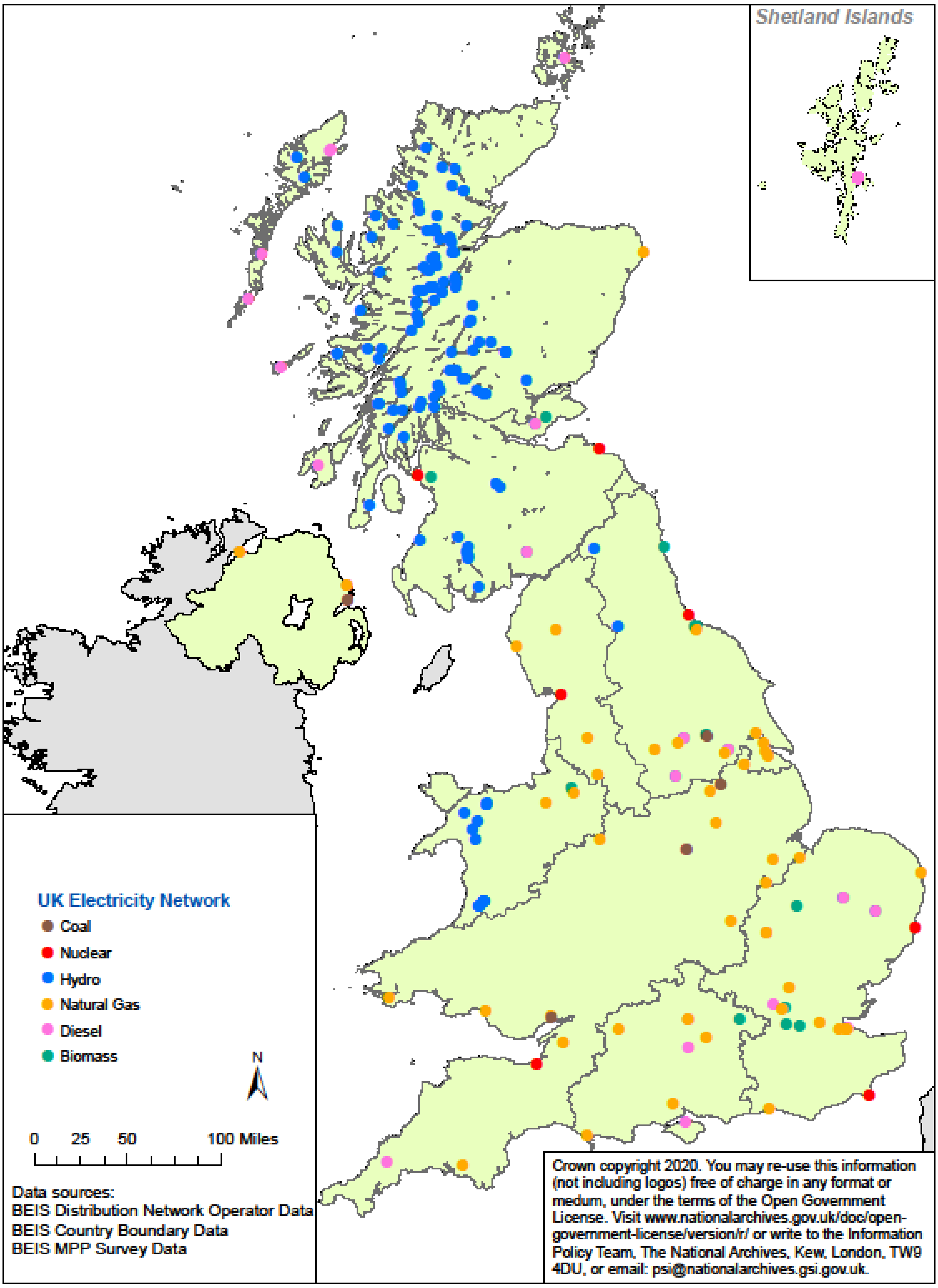
Electricity price and market penetration

5.76 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.

UK Distribution Network Operating Areas and GB Power Lines Map
Major Power Producers in the UK (operational May 2020)



Major Power Producers in the UK (operational May 2019)



Data sources:
BEIS Distribution Network Operator Data
BEIS Country Boundary Data
BEIS MPP Survey Data

List of DUKES electricity tables

Table	Description	Period
5.1	Commodity balances for UK electricity	1998-2019
5.2	Commodity balances for electricity (separates out the *public* distribution system for electricity from the electricity generated and consumed by *autogenerators*)	1998-2019
5.3	Fuels used to generate electricity in the UK (by MPP/other and fuel)	1996-2019
5.4	Fuels consumed for electricity generation (autogeneration) by main industrial groups	1996-2019
5.5	Electricity supply, consumption and sales (links between DUKES tables and long-term trends data)	1996-2019
5.6	Electricity fuel use, generation and supply (by MPP/other and fuel type)	1996-2019
5.7	Plant capacity (MPPs, other and all, by type)	1996-2019
5.8	Major Power Producers Plant capacity (by region & type)	1999-2019
5.9	Capacity of other generators (by sector)	1996-2019
5.10	Plant loads, demand and efficiency	1996-2019
5.11	List of major power producers (power stations) in operation	May 2020
5.12	Plant installed capacity, by connection (GB, NI, by plant type)	2011-2019
	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	1970-2019

Structure of the UK electricity industry

5.77 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.

5.78 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.

5.79 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.

5.80 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.

5.81 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.

5.82 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

5.83 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 written version of this Digest cover only the most recent years, these notes also cover data for earlier years that are available on the BEIS energy statistics website.

Electricity generation from renewable sources

5.84 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

5.85 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

5.86 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.

5.87 The definition of MPPs was amended in 2008 to include major wind farm companies, but this change only applies to data for 2007 onwards. Many 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.

5.88 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 were included as MPPs for the first time in 2015.

5.89 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. 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.

5.90 **Major power producers at the end of 2019 were[32]:**

AES Ballylumford Ltd†*, AES Kilroot Power Ltd, Anesco Ltd, Baglan Generating Ltd†, Banks Renewables Limited, BayWa R.E Ltd, Black Hill Wind Ltd, British Energy Generation Ltd (Eng & Wales), British Solar Renewables Ltd, Calon Energy Ltd†, Carrington Power Ltd, Centrica Barry Ltd, Centrica Brigg Ltd, Coolkeeragh ESB Ltd, Corby Power Ltd, Coryton Energy Company Ltd, Cubico Sustainable Investments Ltd, Drax Power Ltd†, E.ON UK plc, Ecotricity Ltd, EDF Energy (Cottam Power) Ltd†*, EDF Energy Renewables Ltd, Eneco Wind UK Ltd*, EP Langage Ltd†*, EP SHB Ltd, EPR Ely Ltd, EPR Eye Ltd, EPR Glanford Ltd, EPR Scotland Ltd, EPR Thetford Ltd, Falck Renewables Wind Ltd, Fellside Heat and Power Ltd*, Ferrybridge Mulitfuel Energy Ltd, First Hydro Company, Fred Olsen Renewables Ltd, FS Shotwick Ltd*, GLID Wind Farms Topco†, Greencoat Solar I LLP*, Greencoat UK Wind Plc†*, Indian Queens Power Ltd*, John Laing Environmental Assets Group, Kentish Flats Ltd, Lightsource Renewable Energy Ltd†*, Londonwaste Ltd†, Lynemouth Power Ltd, Magnox Electric Ltd, Marchwood Power Ltd, Octopus Investments Ltd, Orsted Burbo (UK) Ltd†, Peel Energy Ltd*, Pennant Walters Ltd*, Peterborough Power Ltd†, REG Windpower Ltd, Renewable Energy Solutions Services Ltd†*, Renewable Energy Systems (Aviva)†, Renewable Energy Systems (OI)*, Renewable Energy Systems (Penmanshiel)*, Renewable Energy Systems (TRIG)*, Renewable Energy Systems Limited (Glenmont)†*, Riverside Resource Recovery Ltd*, Rocksavage Power Company Ltd, RWE Npower (Kielder), RWE Npower Ltd, RWE Npower Renewables Ltd, RWE Npower Renewables Ltd (Offshore)*, RWE Renewables*, Saltend Cogeneration Company Ltd*, Scira Offshore Energy Ltd, Scotia Wind (Craigengelt) Ltd*, Scottish & Southern Energy plc†*, Scottish & Southern Energy Plc (Fiddlers Ferry)†*, Scottish & Southern Energy Plc (Medway and Keadby), Scottish & Southern Energy plc (Networks), Scottish Power Renewables UK Ltd, Seabank Power Ltd*, SembCorp Utilities (UK) Ltd, SembCorp Utilities (UK) Ltd (Wilton 10), Severn Power Ltd, SIMEC Uskmouth Power Ltd, Slough Heat and Power Ltd, South East London Combined Heat and Power Ltd, Spalding Energy Company Ltd, Statkraft Energy Ltd, Statkraft Wind UK Ltd, SUEZ Recycling and

32 ** company reports wind generation and † company reports solar generation*

Recovery (UK) Ltd (Wilton 11)*, Temporis Capital Ltd, Third Energy UK Gas Ltd, Toucan Energy Services Ltd, Uniper UK Ltd†, Ventient Energy Services Ltd, Viridor Waste Management Ltd*, VPI Immingham LLP, Wadlow Energy Ltd, Willmount Ltd,Wise Energy Ltd and WPO UK Services Ltd†.

5.91 **Major wind farm companies were added to the list of MPPs in 2007. At the end of 2019 these comprised:**

Banks Renewables Limited, BayWa R.E Ltd, Black Hill Wind Ltd, Ecotricity Ltd, EDF Energy Renewables Ltd, Eneco Wind UK Ltd, Falck Renewables Wind Ltd, Fred Olsen Renewables Ltd, GLID Wind Farms Topco, Greencoat Solar I LLP, Greencoat UK Wind Plc, John Laing Environmental Assets Group, Kentish Flats Ltd, Orsted Burbo (UK) Ltd, Peel Energy Ltd, Pennant Walters Ltd, REG Windpower Ltd, Renewable Energy Systems (Aviva), Renewable Energy Systems (OI), Renewable Energy Systems (Penmanshiel), Renewable Energy Systems (TRIG), Renewable Energy Systems Limited (Glenmont), RWE Npower Renewables Ltd, RWE Npower Renewables Ltd (Offshore), RWE Renewables, Scira Offshore Energy Ltd, Scotia Wind (Craigengelt) Ltd, Scottish & Southern Energy plc, Scottish Power Renewables UK Ltd, Statkraft Wind UK Ltd, Temporis Capital Ltd, Ventient Energy Services Ltd, Wadlow Energy Ltd, Willmount Ltd, WPO UK Services Ltd.

5.92 **Major solar farm companies were added to the list of MPPs in 2016. At the end of 2019 these comprised:**

Anesco Ltd, British Solar Renewables Ltd, Cubico Sustainable Investments Ltd, Ecotricity Ltd, Eneco Wind UK Ltd, FS Shotwick Ltd, Greencoat Solar I LLP, Kentish Flats Ltd, Lightsource Renewable Energy Ltd, Octopus Investments Ltd, REG Windpower Ltd, Renewable Energy Solutions Services Ltd, Renewable Energy Systems (TRIG), Scotia Wind (Craigengelt) Ltd, Scottish & Southern Energy plc, Toucan Energy Services Ltd, Wise Energy Ltd.

Types of station

5.93 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 fuel 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 generates 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.

Solar generators use photovoltaic cells and modules to directly convert solar energy into electricity, using both direct and diffuse radiation.

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

5.94 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

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

5.95 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 one percentage point in 2018) compared with the fuel input basis. This is because of the higher conversion efficiency of gas. Fuel input is set to match electricity output for non-thermal renewables.

Public distribution system

5.96 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

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

Losses

5.98 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 (328,737 GWh in 2019).

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

5.99 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.

5.100 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. These factors are 0.43 for wind, 0.365 for small scale hydro and 0.17 for solar photovoltaics. Further information on this can be found at: www.legislation.gov.uk/uksi/1990/264/made?view=plain.

Load factors

5.101 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 5.77) 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

5.102 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

5.103 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 – 2019:	12 months ended 31 December

5.104 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	1 January 2017
2017	31 December 2017
2018	30 December 2018
2019	29 December 2019

Monthly and quarterly data

5.105 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 generation 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) and a quarterly table of electricity imports and exports (Quarterly Table 5.6). These quarterly tables are also available from BEIS's energy statistics web site. See Annex C for more information about *Energy Trends*.

Data collection

5.106 For MPPs, as defined in paragraphs 5.88 to 5.94, the data for the tables in this Digest are obtained from the results of monthly surveys sent to each company, covering generating capacity, fuel use, generation and sales of electricity (where a generator also supplies electricity).

5.107 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.

5.108 A sample of companies that generate electricity mainly for their own use (known as autogenerators or autoproducers – see paragraph 5.87, 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.

5.109 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

5.110 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 5.105 and 5.106, above. Sales data based on calendar years will always have included more electricity consumption than the slightly shorter statistical year of exactly 52 weeks.

5.111 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 2019, for about five per cent of consumption of electricity supplied by the public distribution system, the sector figures are partially estimated.

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