Chapter 6
Renewable sources of energy

Key points

- **Electricity generation (table 6.4) in the UK from renewable sources increased by 19 per cent between 2016 and 2017, to 99.3 TWh.** High wind speeds in 2017, along with increased capacity resulted in a record year for wind generation.
- **Onshore wind was the leading technology in terms of capacity at 31.7 per cen**t. Although solar photovoltaics saw a further increase in capacity, it was insufficient to retain the leading technology status in 2017 with a 31.5 per cent share, (table 6.4).
- **Onshore wind generation increased by 39 per cent to 29.1 TWh with offshore increasing by 27 per cent to 20.9 TWh.** Higher wind speeds compared to 2016, combined with large increases in capacity (onshore 18 per cent, offshore 32 per cent) contributed to the large increases in generation (table 6.4).
- **Generation from hydro sources also increased, by 10 per cent to 5.9 TWh;** a slight increase in capacity more than offset lower rainfall compared to 2016.
- **Renewable heat increased by 3.6 per cent** due to increases in plant biomass and anaerobic digestion schemes supported by the Renewable Heat Incentive (RHI)

Progress against the Renewable Energy Directive

- **In 2017, 10.2 per cent of total energy consumption came from renewable sources (table 6.7);** up from 9.2 per cent in 2016 (revised). Renewable electricity represented 27.9 per cent of total generation; renewable heat 7.7 per cent of overall heat; and renewables in transport, 4.6 per cent.

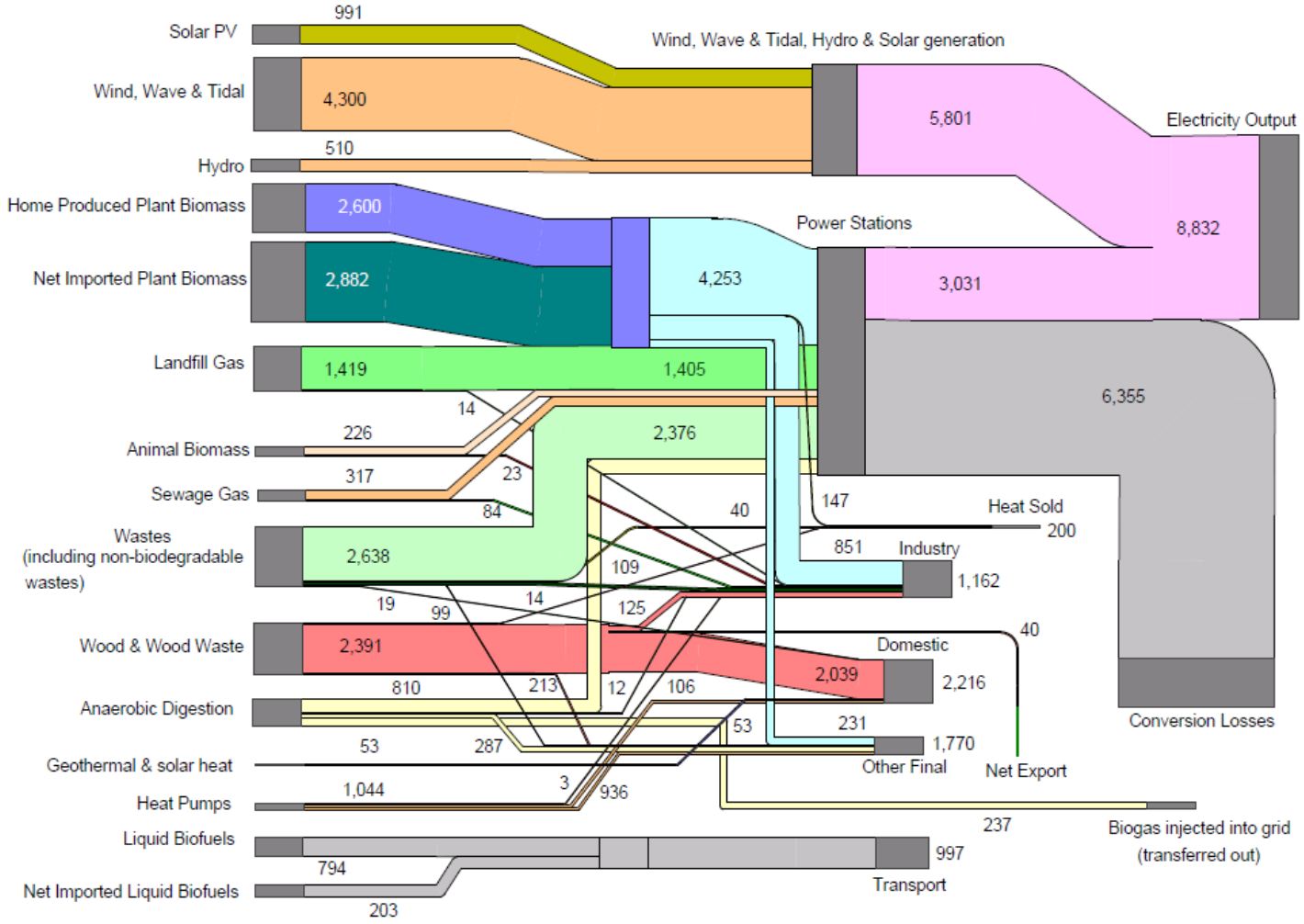
Introduction

6.1 This chapter presents statistics on supply, demand, and consumption for renewable sources of energy (tables 6.1 – 6.6) together with an update of the UK's progress against its renewable energy target for 2017. 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. A full list of tables is available at the end of the chapter (see the technical annex for descriptions of the sources of renewable energy).

6.2 Production and consumption of energy from renewable sources has been steadily increasing since 2000. The rise has been driven by 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).

6.3 The renewable energy flow chart over the page summarises the flows of renewables from fuel inputs through to consumption for 2017 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 2017 (thousand tonnes of oil equivalent)



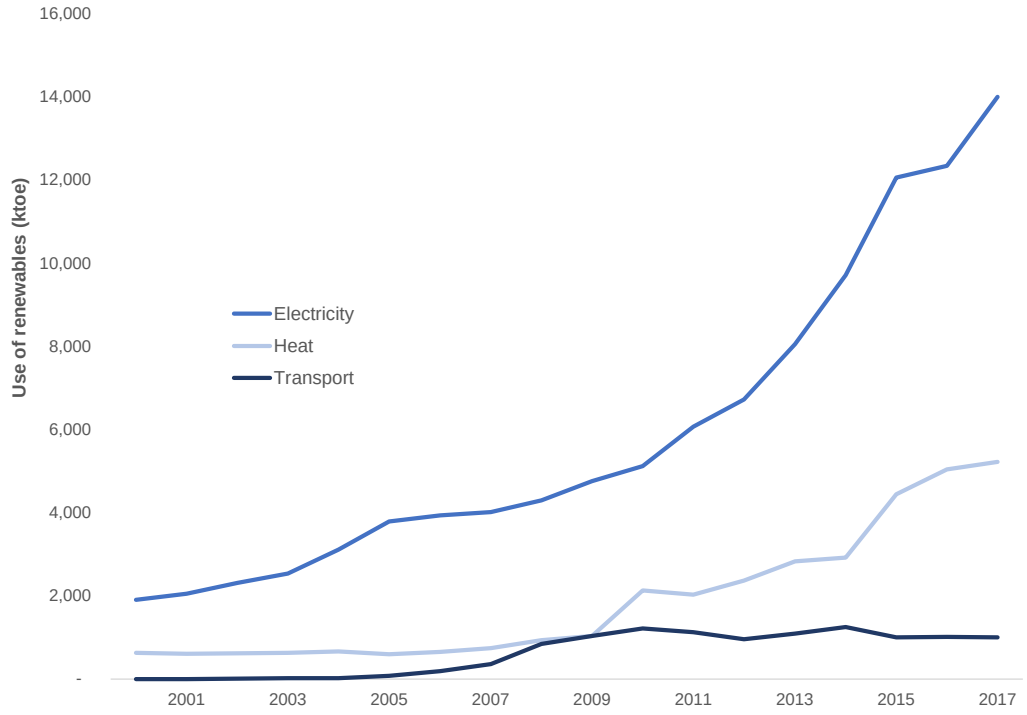
Note: This flow chart is based on data that appear in Tables 6.1 and 6.4

Renewable fuel demand (Tables 6.1 and 6.6)

6.4 The commodity balances tables for renewables (tables 6.1 to 6.3) show that a large proportion (87 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 (24 per cent in 2017, including wood and liquid biofuels). Plant biomass showed the largest proportion of imports at 54 per cent, mainly wood pellets for electricity generation.

6.5 Chart 6.1 and table 6.6 show 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 2017 increased by 9.9 per cent, to 20,216 ktoe. This growth was due to an increase in bio energy demand, particularly in plant biomass used for electricity generation and heating and also anaerobic digestion for generation. While the amount of renewable energy used for generating electricity and heat have been steadily climbing, the proportion of renewables used for electricity and heat has remained broadly stable in recent years (the proportion used for generating electricity has remained between 67 and 70 per cent since 2012).

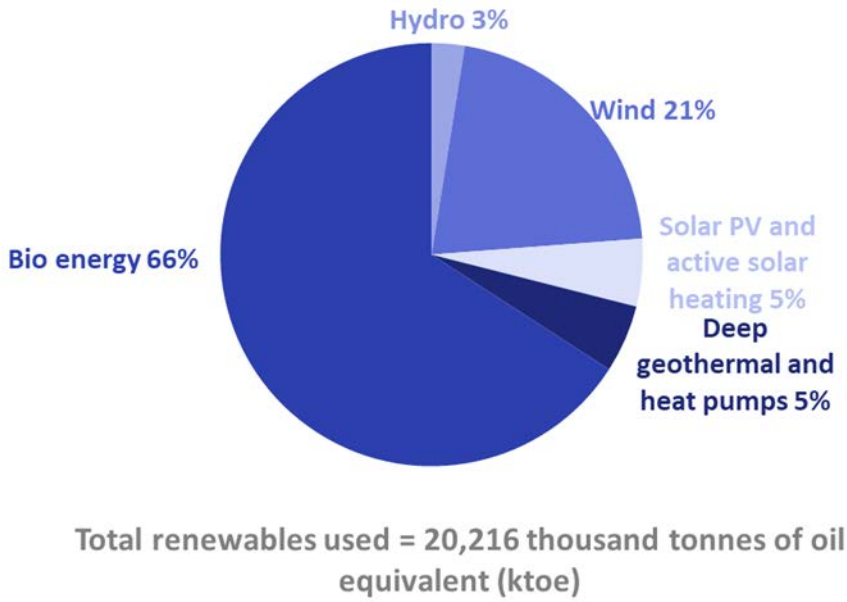
Chart 6.1: Demand for renewable energy by end use:



6.6 In 2017, 66 per cent of renewable energy demand was accounted for by bioenergy with wind accounting for 21 per cent. Chart 6.2 shows a comparison for the key renewables sources.

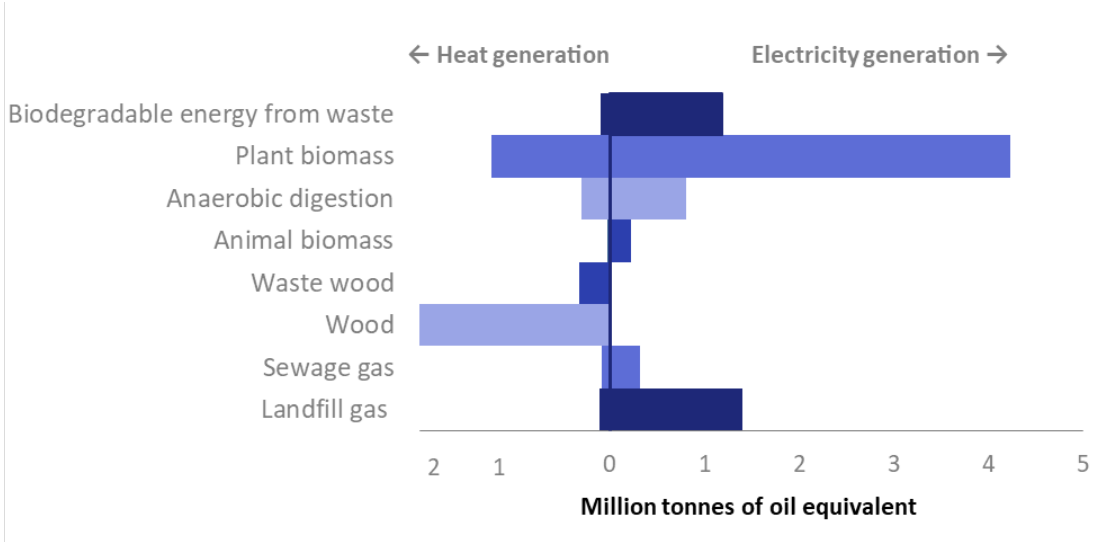
[1] For combustible fuels used to generate electricity, this refers to the energy value of the fuel source rather than the actual electricity generated. For heat generation and primary electricity sources (solar photovoltaics, wind, hydro, and wave and tidal), the output energy is deemed to be equal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

Chart 6.2: Renewable fuel use 2017



6.7 Whilst several renewable technologies are specific to either electricity generation or heat production, combustible fuels are used for both purposes. In 2017, 68 per cent of biomass was used in electricity generation. Chart 6.3 below shows a further breakdown of biomass by source and also how its use is split between heating and electricity generation.

Chart 6.3: Biomass fuel use 2017



6.8 Where biofuels are used for generation, a comparison is made in the electricity generation section (paragraph 6.14) between the fuel input split and actual output generation.

Overall Renewable Electricity (table 6.4)

6.9 Total **renewable capacity** increased between 2016 and 2017 by 14 per cent. Most of the increase in both capacity is due to increased wind capacity, accounting for 75 per cent of the increase in capacity.

6.10 In 2017, onshore wind regained the highest share of **capacity** and it also held the highest share of generation (at 31.7 per cent and 29 per cent respectively).

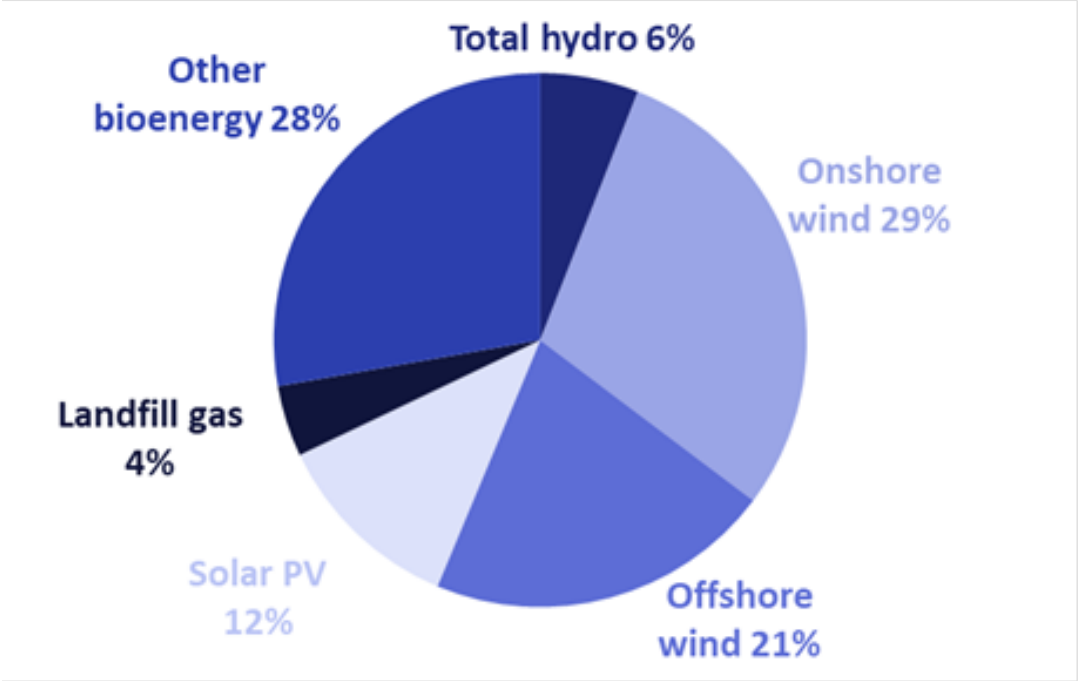
6.11 The main use of renewable energy is to generate electricity. In 2017, **electricity generated from renewables increased by 19 per cent** on 2016, from 83.1 TWh to 99.3 TWh.

6. 12 **Renewable sources provided 29.3 per cent of the electricity generated in the UK in 2017** compared to 24.5 per cent in 2016, an increase of 4.8 percentage points (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).

6.13 Taken together, onshore and offshore wind represented 79 per cent of the total increase in **generation**; onshore wind increased by 8.2 TWh (39 per cent) and offshore by 4.5 TWh (27 per cent). This was due to a combination of increased capacity and unusually high wind speeds. The third and fourth largest increases in generation (in absolute terms) were plant biomass (1.2 TWh) and solar photovoltaic (1.1 TWh). Landfill gas generation fell by 0.4 TWh, (8.9 per cent) to 4.3 TWh and cofiring with fossil fuels also fell by 54 per cent.

6.14 While bioenergy dominates on a fuel input basis (chart 6.2), hydroelectricity, wind power and solar together provide a larger contribution when the **output** of electricity is being measured as chart 6.4 shows;

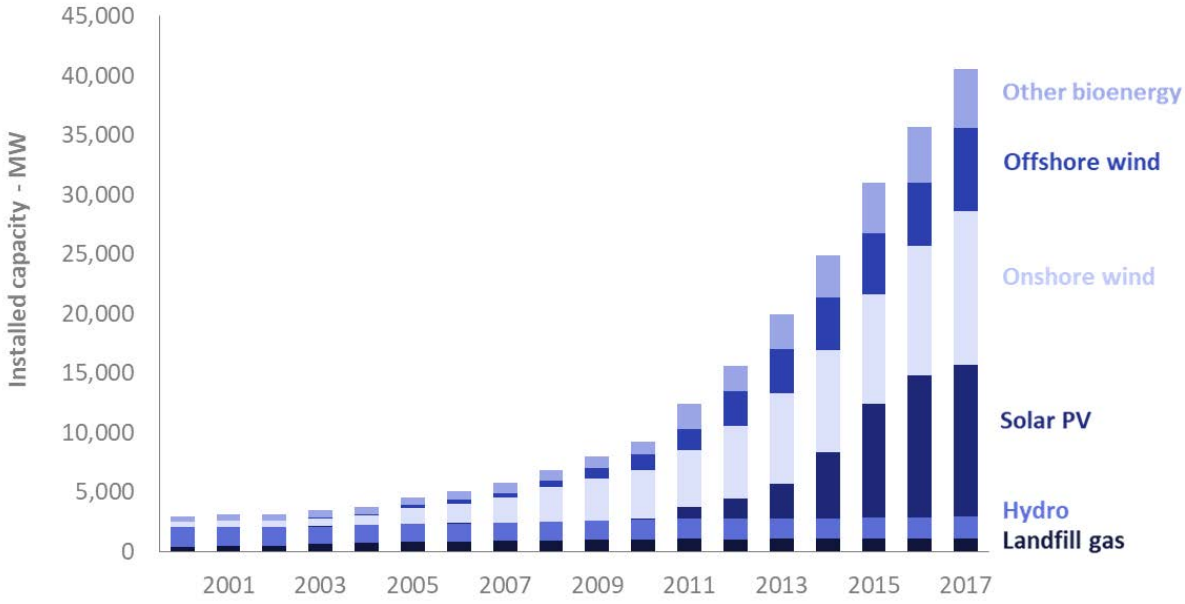
Chart 6.4: Electricity generation by fuel source 2017



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. 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 (6,355 ktoe in 2017), as the renewables flow chart illustrates.

Charts 6.5 and 6.6 show the long term trends in capacity and generation.

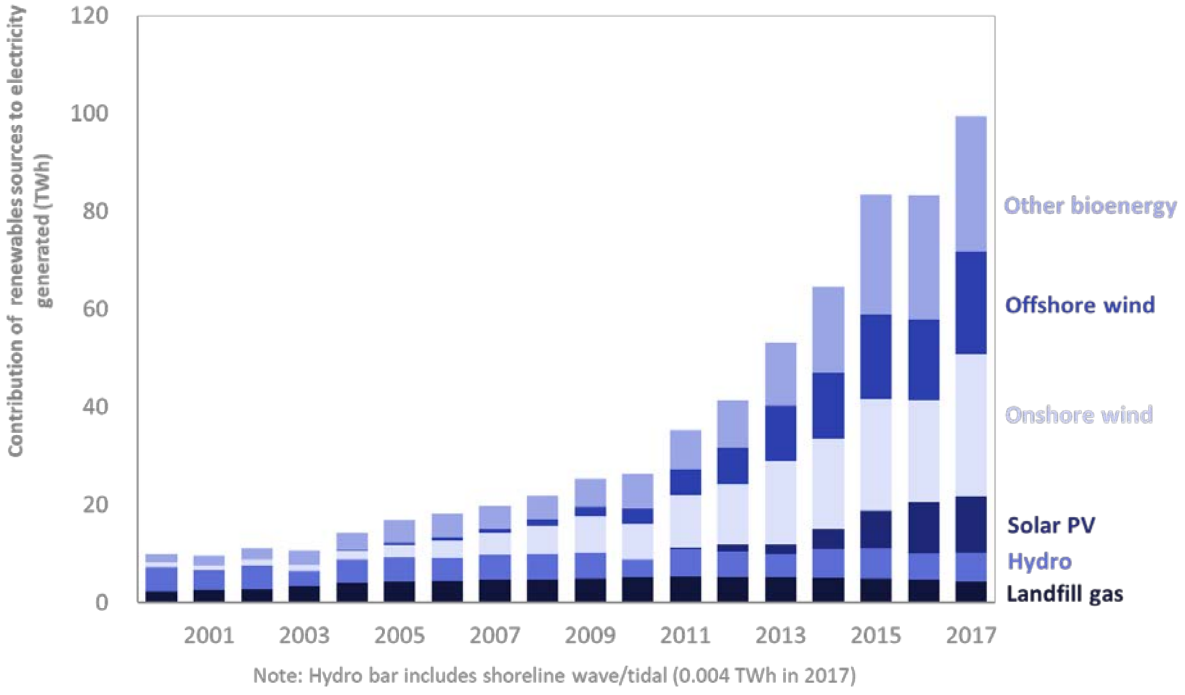
Chart 6.5: Electrical generating capacity of renewable energy plant



(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 (18.4 MW in 2017).

Chart 6.6: Electricity generation by main renewable sources



Load factors (table 6.5)

6.15 **Load factors** are the ratio of how much electricity was generated as a proportion of the total generating capacity. In 2015 and 2016, solar photovoltaics held the highest share of capacity and in 2017, represented the second highest share at 31.5 per cent. However, due to the low load factor for solar photovoltaics, its share of generation was just 12 per cent. Conversely, bioenergy showed the fourth lowest share of capacity (15 per cent) but the highest share of generation (32 per cent). The

load factor for bioenergy is correspondingly high. Table 6.B below shows the share of total generation and capacity and also their load factors for 2016;

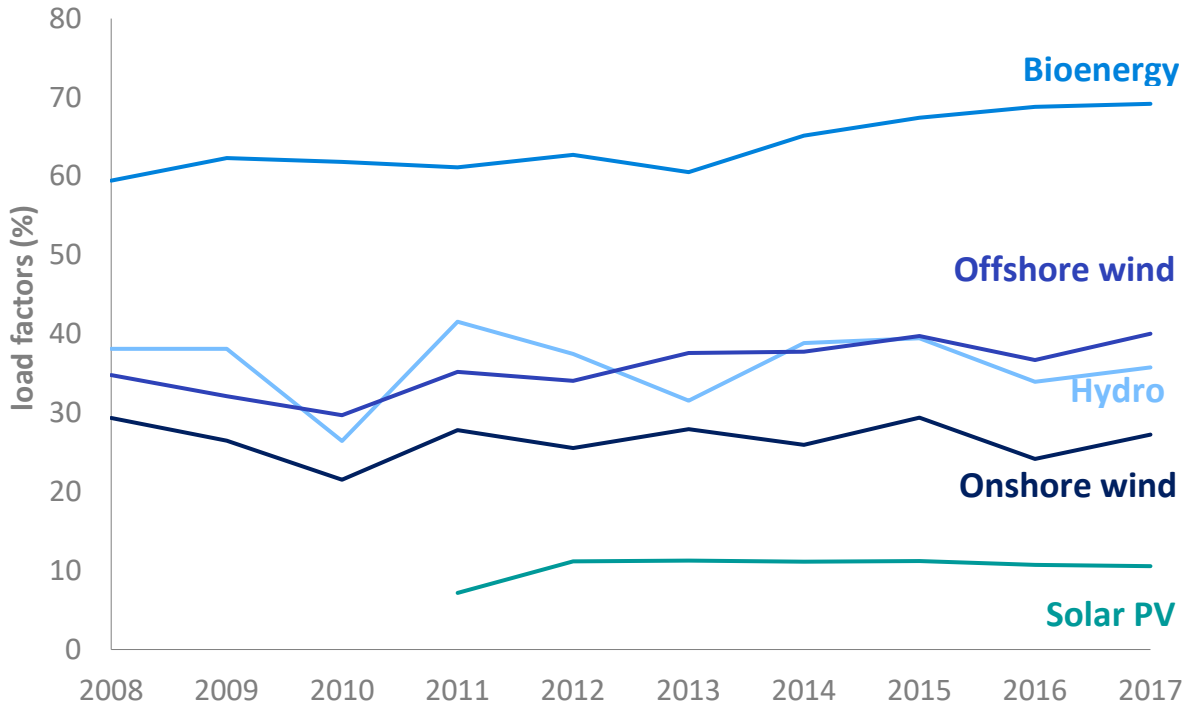
Table 6A Share of generation and capacity by leading technologies

	Share of total capacity	Share of total generation	Load factor
Onshore wind	31.7%	29.3%	28.0%
Solar photovoltaics	31.5%	11.6%	10.7%
Offshore wind	17.2%	21.1%	38.9%
Bioenergy	14.9%	32.1%	61.5%
Hydro	4.6%	6.0%	36.5%
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). Chart 6.7 shows how load factors have fluctuated since 2008.

6.17 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[2] for renewable electricity generation since 2008



[2] On an unchanged configuration basis

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

6.18 This section discusses trends in generation, capacity (table 6.4), and load factors (table 6.5), for the key technologies. Within renewables, load factors[3] 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 and only generate for a very short period. To remove this effect, 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.

6.19 In previous editions of The Digest, a description of the key technologies was included under the heading "Sources of Renewable Energy". This has now been moved to the methodology note to create a more comprehensive document relating to background information in renewables. It includes details of how renewable energy statistics are collected, estimated and ultimately summarised for inclusion in this chapter along with the renewables section of Energy Trends and other related publications. This document is available via the following link:
www.gov.uk/government/publications/renewable-energy-statistics-data-sources-and-methodologies

Wind[4]

6.20 **Total wind generation increased by 34 per cent to 50.0 TWh in 2017**. The high growth for both onshore and offshore wind was due to increased capacity (23 per cent), and also higher wind speeds compared to 2016. Wind speeds have fluctuated over the last three years, with record wind speeds in 2015 resulting in high levels of generation. In 2016, this reversed as wind speeds fell to the third lowest level since 2001, resulting in a slight decline in generation for that year. As wind speeds have reverted to being in line with the ten year mean in 2017, comparing generation with a year with unusually low wind speeds have contributed to the high levels of growth.

6.21 **Onshore wind saw the largest increase in generation, by 39 per cent to 29.1 TWh in 2017, a record**. Capacity also increased by more than offshore wind, by 2.0 GW (32 per cent) to 12.8 GW. New capacity includes Ray Wind Farm (54.4 MW), Bhlaraidh Wind Farm (110.4 MW), Brockloch Rig (Windy Standard 3) (61.5 MW), Brockaghboy Full (47.5 MW), Clyde Wind Farm Extension (Clyde 2) (172.8 MW) and Aikengall II, Wester Dod Community Wind Farm (60.8 MW). The higher wind speeds in 2017 are reflected in the load factors for onshore wind; the standard measure increased by 4.4 percentage points to 28.0 and on an unchanged configuration basis, by 3.1 percentage points to 27.3 per cent.

6.22 **Offshore wind generation increased by 4.5 GWh (27 per cent),** less than for onshore wind despite the higher percentage increase in capacity (32 per cent compared to 18 per cent for onshore). In absolute terms, offshore wind capacity increased by less than onshore; by 1.7 GW to 7.0 GW. New capacity includes Burbo Bank Extension (Burbo Bank 2, 259 MW), Dudgeon Offshore Wind Farm (402 MW), Race Bank (48.1 MW), Galloper Wind Farm (72 MW), Walney Offshore Wind Phase III (330 MW) and Rampion (182.85 MW). Using the standard measure for the load factor, this increased by 2.9 percentage points to 38.9 per cent, reflecting the higher wind speeds. This is lower than in 2015 which was a record high, in line with the exceptionally high wind speeds experienced that year. Interestingly, using the unchanged configuration measure, the load factor is the highest recorded (40.0 per cent) since the last highest value in 2015 (39.7 per cent). Wind speeds are much stronger off the coasts, and unlike wind over land, offshore breezes can be strong in the afternoon, matching the time when people are using the most electricity. This may have some bearing on these apparently odd results.

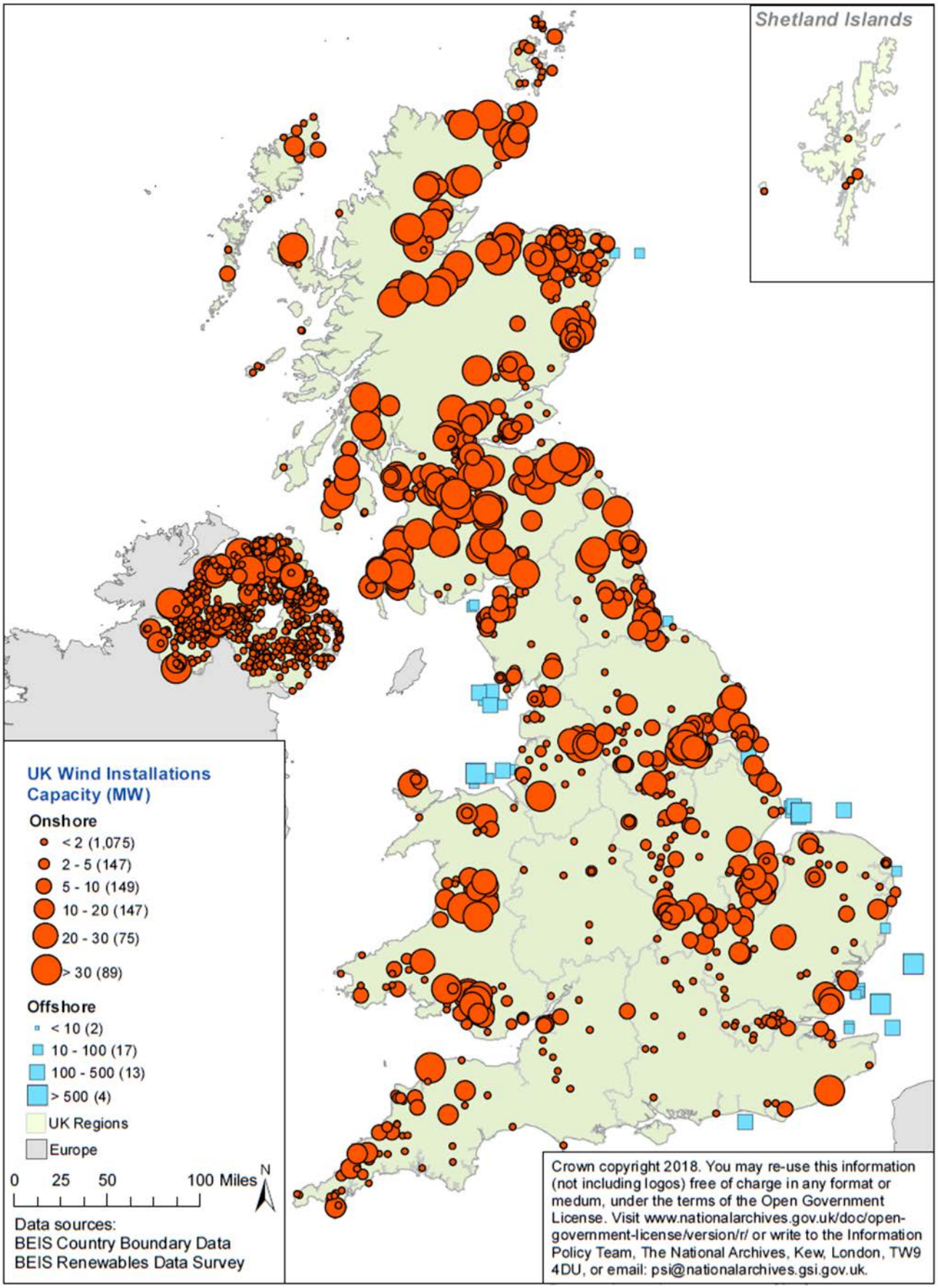
[3] For further details of how load factors are calculated, refer to the methodology note
[4] See paragraphs 6.76 to 6.6.82 for a description of onshore and offshore wind capacity and generation.

Table 6B: Number of operational wind turbines split by FiTs and non FiTs accredited sites, as at end of December 2017

	FiTs confirmed	Other sites	Total
Onshore Wind	7,511	2,106	9,617
Offshore Wind	-	38	38
Total	**7,511**	**2,144**	**9,655**

The map on the following page shows the location of wind farms operational at the end of 2017 along with an indication of capacity.

UK Onshore and Offshore Wind Capacity



Solar Photovoltaics

6.23 **Solar photovoltaic generation showed a more modest percentage growth in 2017 when compared to recent years; by 1.1 TWh (11 per cent) to 11.5 TWh.** This compares with a doubling of generation in 2014, 86 per cent growth in 2015, and 38 per cent in 2016. This is in line with a slowing in the growth of capacity which increased by just 7.3 per cent to 12.8 GW in 2017. New schemes include, Henley Hall (22 MW), Lough Road PV (32.13 MW) and Bann Road PV (includes second Bann record) (45.75 MW). Although solar photovoltaic capacity has not retained the largest share of total capacity, it still represents almost a third, and is only slightly less than onshore wind's share (31.5 per cent compared to 31.7 per cent).

6.24 The load factor for solar photovoltaics (on an unchanged configuration basis) decreased slightly in 2017, by 0.4 percentage points to 10.7, the lowest since 2011. This reflects the slightly lower hours of sunshine (4.1 hours compared to 4.2 for 2016). Compared to the ten year mean, hours of sunshine in 2017 were fewer for most months during the apart from January, November and December.

6.25 However, within months, fluctuations exist, and 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.

Hydro generation

6.26 **Generation from hydro increased in 2017, by 10 per cent to 5.9 TWh**, due to an increase in capacity, mostly for small scale generation; rainfall (in the main catchment areas) was slightly down on 2016. Whilst large-scale hydro (>5 MW) saw a 1.9 MW increase in growth due to some small MPP amendments, the growth of 37 MW for small-scale hydro (<=5 MW) is about half the rate of increase for 2016 (10% in 2017 compared to 19% in 2016); most of this increase came from schemes supported by the Feed in Tariff scheme.

Wave and Tidal

6.27 **Generation from wave and tidal in 2017, although relatively small, increased to 4 GWh**. This is due to increases in capacity; 2017 saw several new rigs installed EMEC Berth 5 (2 MW), Tocardo EMEC Array (1.45 MW), S G E Tidal Array (0.5 MW) and Billia Croo Berth 5 (0.96 MW).

Bioenergy

6.28 **Generation from bioenergy and wastes increased by 6.0 per cent to 31.9 TWh, whilst capacity increased by 5.1 per cent to 6.0 GW**. Of this increase, 69 per cent was from plant biomass, with 36 per cent from energy from waste and 22 per cent from anaerobic digestion.

6.29 **Generation from plant biomass showed the highest growth in absolute terms for bioenergy, by 1.2 TWh (6.6 per cent) to 20.1 TWh in 2017.** This is due to additional capacity which increased by 7.1 per cent to 3.1 MW. New stations include, Mersey Bioenergy Widnes Biomass CHP (20.2 MW), Margam REP (40 MW), MEPALCHP (14.37 MW) and Liberty Steel Lochaber (17.32 MW). Increasing efficiencies continue to be seen and attributed to the deployment of large scale dedicated biomass plant with improved performance. The load factor in 2017, 79 per cent, together with the same value recorded in 2016 represent the highest to date.

6.30 **Anaerobic digestion generation increased by 19 per cent to 2.5 TWh. Capacity increased to a lesser extent; by 7.9 per cent to 0.5 GW, the result of** 93 new sites being identified. Load factors continue to vary as full plant output is not fully achieved for between three and six months following commissioning. Load factors for 2017 are the highest yet at 63.2 (on an unchanged configuration basis).

6.31 **Energy from waste generation increased by 24 per cent to 3.4 TWh.** Capacity increased to a lesser extent, by 6.1 per cent to 1.1 GW. The disproportionately higher growth in generation is due to new capacity installed previously coming on line and generating at full output in 2017. This is reflected

in the load factor which increased by 2.8 percentage points to 37.2. New sites included this year are EnviRecover (15.5 MW), European Metal Recycling Ltd (17.4 MW) and Derby and Derbyshire Waste Treatment Centre. (13.85 MW).

6.32 **Generation from landfill gas fell for the sixth year in a row**, with an accelerating rate of decline in 2017; generation fell by 8.9 per cent to 4.3 TWh. This could be the result of lower gas abstraction efficiencies. Landfill operators respond to reducing gas yields by a combination of operating at lower turndown, and then removing plant when it is no longer economic to run. More recently, microgeneration schemes are operating at such sites.

6.33 **Animal biomass generation and capacity remain largely unchanged in 2017**; generation fell by 0.2 per cent to 0.6 TWh, with capacity remaining the same at 0.1 GW. **Sewage gas generation increased by 1.8 per cent to 1.0 TWh despite capacity falling by 4.6 per cent to 0.2 GW,** due to the closure of several sites.

6.34 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 6C below shows the comparative growth rates between 2016 and 2017 for bioenergy fuel inputs and generation outputs;

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

Growth between 2016 and 2017	Fuel use (table 6.6)	Generation (table 6.4)
Bioenergy:		
Landfill gas	-8.9%	-8.9%
Sewage sludge digestion	1.8%	1.8%
Biodegradable energy from waste *(8)*	6.0%	23.6%
Co-firing with fossil fuels	-25.5%	-54.1%
Animal Biomass *(3)*	-1.8%	-0.2%
Anaerobic digestion	18.6%	18.6%
Plant Biomass *(4)*	9.4%	6.6%
Total bioenergy	5.3%	6.0%

6.35 For most biofuels, growth in fuel use is similar to generation growth with the exception of energy from waste and co-firing. The high growth in generation from waste was due to high capacity increases in the preceding year coming on line. The lower growth in fuel input (5.3 per cent) could indicate a change in efficiencies or other factors.

Different measures of electricity generation (tables 6.4 and 6.7)

6.36 The share of renewable energy Generation from **renewable sources claiming Renewable Obligation Certificates (ROCs)** in 2017, at 71.3 TWh, was 8.6 per cent greater than in 2016 and a record. RO supported generation has increased by over 65 TWh since its introduction in 2002, an increase of a factor of twelve[5]. As a proportion of total electricity sales, RO supported generation increased (by 2.3 percentage points) to 25.1 per cent.

6.37 Renewable Energy Directive measure also increased; by 3.5 percentage points to 27.9 per cent. This growth is less than the share measured on the international basis due to the effect of the "normalisation" process for wind and hydro generation which effectively smooths the effects of particularly high or low wind speeds or rainfall. Table 6C and chart 6.7 show the three measures. Chart 6.8 shows how the low wind speeds in 2016 resulted in renewables' share of generation level between 2015 and 2016 on the international basis, before increasing again in 2017 along with wind speeds.

[5] 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 6D: Percentages of electricity derived from renewable sources

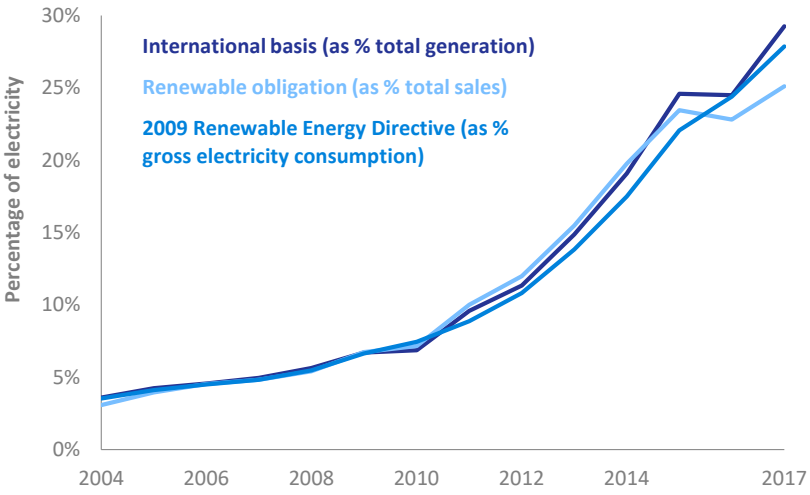
	2004	2010	2015	2016	2017
International Basis[1]	3.6%	6.9%	24.6%	24.5%	29.3%
Renewable Obligation[2]	3.1%	7.2%	23.5%	22.8%	25.1%
2009 Renewable Energy Directive[3]	3.5%	7.4%	22.1%	24.4%	27.9%

[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 6.8: Growth in electricity generation from renewable sources since 2004



Renewable heat (table 6.6)

6.38 **Renewable heat generation increased by 3.6 per cent in 2017 to 5,222 ktoe.** Of this increase 83 per cent was plant biomass (151 ktoe). The largest increase in percentage terms was **biodegradable energy from waste which increased by 53 per cent**, although this remains a relatively small share of overall renewable heat (1.8 per cent).

6.39 **Renewable energy from heat pumps has seen a sizeable revision** following a BEIS led study to estimate the amount of heat generated by reversible air to air heat pumps. This had not previously been included in renewable heat statistics as it was unknown the proportion of time they were being operated in heat mode (as opposed to cooling mode which is not included in renewable heat). An estimate was established for 2015, resulting in an upward revision from 156 ktoe to 1,007 ktoe. The full research paper is available via the following link:
www.gov.uk/government/publications/renewable-energy-from-reversible-air-to-air-heat-pumps[6]

Heat from heat pumps actually fell from 2016 to 2017, by 2.0 per cent due to lower sales in 2016. A time lag is factored into the estimates for each year to allow for the lag between installation and generation at full output, hence sales effects in one year can filter through into the following year.

6.40 **Around 14 per cent of renewable heat was supported by the Renewable Heat Incentive (RHI) or Renewable Heat Premium Payment (RHPP) in 2017, compared to 15 per cent in 2016**. The fall is due to the inclusion of reversible air to air heat pumps (see paragraph 6.39) which, although are included in overall renewable heat, are not supported by the RHI, thus increasing the denominator (total renewable heat) but not the numerator (RHI supported heat). Excluding reversible air to air heat pumps, the proportion of RHI supported heat would have increased to 17 per cent. Further information on the RHI and RHPP schemes can be found in paragraphs 6.75 to 6.77.

[6] The research focussed on reporting UK progress against the renewable energy directive. This excludes heat pumps not meeting the minimum seasonal performance factor of 2.5 (see paragraph 6.39). All heat pumps are included in table 6.6 and hence the upward revision is larger.

6.41 **Around 26 per cent of renewable sources were used to generate heat in 2017**, higher than the 23 per cent for 2016, as reported in DUKES 2017. This is due to the greater contribution of renewable heat from reversible air to air heat pumps.

6.42 **Domestic wood combustion retained the largest share of renewable heat at 40 per cent**, despite the upward revision for heat pumps, however, lower than the 50 per cent share as reported in DUKES 2017 for the year 2016. Plant biomass represented 24 per cent and heat pumps 20 per cent. Non-bioenergy renewable heat sources include solar thermal, deep geothermal and heat pumps, and combined these accounted for 21 per cent, compared to 5.9 per cent for 2016 (as reported in DUKES 2017).

Liquid biofuels for transport (tables 6.1 and 6.6)[7]

6.43 Biofuels are made from recently-living biological material[8] and can be waste products, residues, or sourced from crops. The biofuels added to petrol are bioethanol, biomethanol and MTBE (methyl tern-butyl ether), and those added to diesel are FAME (fatty acid methyl ester), HVO (hydrotreated vegetable oil), pure plant oil.

6.44 **In 2017, 697 million litres of biodiesel[9] were consumed, 1.4 per cent lower than in 2016.** It is estimated that 524 million litres of biodiesel were produced in the UK in 2017, 36 per cent higher than in 2016. Of this, about 53 million litres are known to have been used for non-transport applications or exported. Therefore, at least 226 million litres of biodiesel were imported in 2017. The total annual capacity for biodiesel production in the UK in 2017 is estimated to be around 684 million litres.

6.45 **Consumption of bioethanol fell in 2017, by 0.8 per cent to 752 million litres**. The UK capacity for bioethanol production at the end of 2017 remained unchanged from 2016 at around 910 million litres, although actual production was estimated to be 645 million litres. Of UK production, 431 million litres was known to be used for non-transport applications, or exported, so at least 539 million litres was imported.

6.46 During 2017, biodiesel accounted for 2.3 per cent of diesel, and bioethanol 4.5 per cent of motor spirit. The combined contribution of liquid biofuels for transport was 3.1 per cent, unchanged from 2016.

6.47 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 fell by 1.2 per cent (to 997 ktoe) between 2016 and 2017 with the majority of the decrease being due to biodiesel. In 2017, liquid biofuels for transport comprised 4.9 per cent of total renewable sources, 0.6 percentage points less than 2016.

6.48 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 2017. 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 biofuels 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 6.71 to 6.74.

[7] See paragraphs 6.114 to 6.115 for a description of liquid biofuels.
[8] 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
[9] The most usual way for biodiesel to be sold is for it to be blended with ultra-low sulphur diesel fuel.

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

6.49 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.

6.50 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[10], and 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 2018 edition of Energy Trends. D**uring 2017, 10.2 per cent of final energy consumption was from renewable sources, an increase of 0.9 percentage points on 2016**. The UK has exceeded its first three interim targets (the third was 7.5 averaged over 2015 and 2016, and the UK achieved 8.8 per cent). The fourth interim target is 10.2 per cent averaged across 2017 and 2018 and will be reported in early 2020.

6.51 Overall renewable sources, excluding non-biodegradable wastes, provided 10.7 per cent of the UK's total primary energy requirements in 2017 (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 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.

Table 6E: Percentages of energy derived from renewable sources since 2013

	2013	2014	2015	2016	2017
Eligible renewable energy sources as a percentage of capped gross final energy consumption (ie the basis for the Renewable Energy Directive)	5.7%	7.0%	8.4%	9.2%	10.2%
Renewable energy as a percentage of primary energy demand	5.9%	7.3%	9.1%	9.2%	10.7%

Revisions to published data and new reporting

6.52 Renewables data have been revised back to 2015, 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.

6.53 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 2015, and including a reconciliation of different sources of survey and administrative data sources.

6.54 The most notable revision is for heat pumps which now include heat generated by reversible air to air heat pumps. The upward revision to table 6.6 is greater than for table 6.7 which is calculated on the basis specified in the Renewable Energy Directive which excludes those heat pumps not meeting

[10] 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

the minimum seasonal performance factor of 2.5. A special feature article was published in the March 2018 edition of Energy Trends summarising the impact on directive reporting: www.gov.uk/government/publications/energy-trends-march-2018-special-feature-article-the-contribution-of-reversible-air-to-air-heat-pumps-towards-the-renewable-energy-directive

Paragraph 6.39 in this chapter of DUKES shows the impact on table 6.6.

6.55 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.

Technical Notes

European and UK Renewable Energy Policy Context

EU Renewable Energy Directive

6.56 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

UK Renewables Policy

6.57 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)

6.58 The Renewables Obligation (RO) came into effect in April 2002[11]. It places an obligation on UK electricity suppliers to present a certain number of Renewables Obligation Certificates (ROCs) to Ofgem, the administrator of the scheme, in respect of each megawatt hour of electricity supplied each year. The Obligation is intended to incentivise an increase in the level of renewable generating capacity and so contribute to our renewable energy and climate change targets. RO eligible sources include wind energy, bioenergy (including landfill gas, sewage gas, biomass, anaerobic digestion. advanced conversion technologies and energy from waste), hydro, photovoltaics, wave and tidal energy and deep geothermal. Ofgem issues 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 or make a payment into a buy-out fund.

6.59 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

[11] 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.

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. In 2018, following a public consultation, the Government announced its intention to introduce measures to control the cost of biomass conversions and co-firing under the RO. Full details are available at www.gov.uk/government/consultations/controlling-the-costs-of-biomass-conversion-and-co-firing-under-the-renewables-obligation

6.60 The RO scheme closed to new capacity on 31 March 2017 although various grace periods are available which extend the closure date in certain specified situations. Existing generating stations will continue to receive support for 20 years, up to 2037. 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, and the level of ROCs received, is available on Ofgem's website at: www.ofgem.gov.uk/publications-and-updates/renewables-obligation-guidance-generators

6.61 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.

Contracts for Difference (CfDs)

6.62 The Contracts for Difference (CfD) has replaced the RO for new low carbon electricity generating stations. The CfD scheme tackles the risks and uncertainties of the underlying economics of different forms of electricity generation by offering long term contracts for low carbon energy. Support is provided in the form of a private law contract between a generator and the Low Carbon Contracts Company (a government-owned company).

6.63 Generators must sell their electricity to the market as usual, but in addition generators receive a top-up payment to a fixed and secure price (known as a "strike price") for each unit of electricity they generate. This certainty allows investors to be confident about the returns of their capital in advance of investing billions into new infrastructure schemes. It also encourages banks to lend at cheaper rates because the projects are less risky. When market prices are higher than the strike price, generators must pay back the difference. This provides protection to consumers when electricity prices are high.

6.64 CfDs are awarded to the cheapest projects via a competitive auction mechanism. To date, two auctions have awarded support to over 9GW of new renewable electricity projects, with the next auction planned for spring 2019. Further details are available at: www.gov.uk/government/publications/contracts-for-difference/contract-for-difference

Feed-in Tariffs (FiTs)

6.65 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.

6.66 Provisionally, overall 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

6.67 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 up to March 2019; providing value for money for the consumers that fund it through their electricity bills.

Feed in Tariff Supported Capacity

6.68 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 977 MW of FiT supported renewable capacity was installed. For 2012, 892 MW of capacity was added and in 2013, 622 MW. In 2014, 999 MW of capacity was added, while in 2015, a further 1,738 MW of FiT capacity was installed, with 83 per cent of this new capacity coming from solar photovoltaics (PV). A further 724 MW of solar PV capacity was installed in 2016, of which 71 per cent of this new capacity came from PV. In 2017, 212 MW of new capacity was installed, with PV accounting for 68 per cent of this.

6.69 **The greatest increase in FiT capacity in percentage terms in 2017 was from solar photovoltaics**, from 4,893 MW at the end of 2016 to 5,038 MW at the end of 2017. Onshore wind increased from 702 MW at the end of 2016 to 732 MW at the end of 2017, while hydro capacity increased from 183 MW to 220 MW. There was no change in the capacity of anaerobic digestion remaining stable at 289 MW. At the end of 2017, solar PV represented 80 per cent of commissioned FiTs capacity (down from 81 per cent at the end of 2016), with onshore wind stable at 12 per cent, and anaerobic digestion 4.6 per cent (down from 4.8 per cent) and hydro increased from 3.0 to 3.5 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).[12]

6.70 Table 6F shows the number of sites generating renewable electricity at the end of 2017. There were 936,273 sites, although this figure is dominated by small-scale solar PV installations confirmed on FiTs.

[12] At the end of 2017, 5,959 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.

Table 6F: Number of sites generating renewable electricity, as at end of December 2017 (excluding co-firing)[13]

	FiTs confirmed	Other sites	Total
Onshore Wind	7,511	2,106	9,617
Offshore Wind	-	38	38
Marine energy	-	18	18
Solar PV	809,655	113,746	923,401
Hydro	1,140	346	1,486
Landfill gas	-	464	464
Sewage sludge digestion	-	194	194
Energy from waste	-	54	54
Animal biomass (non-AD)	-	6	6
Anaerobic digestion	429	194	623
Plant biomass	-	372	372
Total	**818,7353**	**117,538**	**936,273**

Renewable Transport Fuel Obligation (RTFO)

6.71 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 in subsequent years. 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.

6.72 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.

6.73 The Renewable Transport Fuels and Greenhouse Gas Emissions Regulations, made in 2018, have introduced an increase in the obligation to ensure that 7.25 per cent (by volume) of fuel comes from a renewable source in 2018, rising incrementally through 9.75% in 2020 to 12.4% in 2032. The Regulations also aim to increase the supply of the fuels of the greatest future strategic importance to the UK, through the introduction of an obligation to provide a proportion of 'development' fuels and by setting a maximum limit for supply of fuels made from crops.

6.74 Further information on the RTFO policy can be found at:
www.gov.uk/government/collections/renewable-transport-fuels-obligation-rtfo-orders#guidance

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.

[13] 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 Heat Incentive and Premium Payment

6.75 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.

6.76 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.

6.77 Table 6G below shows the breakdown of technologies accredited to the domestic scheme, over the period 9 April 2014 (launch date) to 31 December 2017, with average installed capacity and heat paid out for under the scheme. In total there were 60,093 accreditations, with 2,289,573 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 6G: Domestic Renewable Heat Incentive accreditations, average capacity installed and estimated heat generation to December 2017

Technology	Number of accreditations	Average (mean) capacity installed (kW)	Heat paid out under the scheme (MWh)
Air source heat pump	30,177	10.1	665,236
Ground source heat pump	8,820	13.5	358,459
Biomass systems	12,523	26.6	1,230,844
Solar thermal	8,573	-	35,032
Total	**60,093**	**-**	**2,289,573**

Sources of Renewable Energy

Since the 2017 edition of The Digest, the majority of the background on sources of renewable energy have been moved to the methodology note which can be accessed via the following link: www.gov.uk/government/collections/renewables-statistics#methodology

This now incorporates background information along with the data sources and methodology employed to produce renewable energy statistics.

Contacts:

Liz Waters
BEIS Energy Statistics Team
elizabeth.waters@beis.gov.uk
0300 068 5735

Will Spry
BEIS Energy Statistics Team
william.spry@beis.gov.uk
0207 215 5394

6.1 Commodity balances 2017

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	394	2,037	1,594	2,600	346	1,419
Other sources	-	-	-	-	-	-
Imports	29	22	-	2,935	-	-
Exports	-71	-20	-	-53	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-237	-	-	-
Total supply (2)	**352**	**2,039**	**1,358**	**5,482**	**346**	**1,419**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**352**	**2,039**	**1,358**	**5,482**	**346**	**1,419**
Transformation	**14**	**-**	**1,036**	**4,400**	**317**	**1,405**
Electricity generation	-	-	1,036	4,253	317	1,405
Major power producers	-	-	174	3,332	-	-
Autogenerators	-	-	862	921	317	1,405
Heat generation	14	-	-	147	-	-
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	**338**	**2,039**	**322**	**1,082**	**29**	**14**
Industry	**125**	**-**	**35**	**851**	**26**	**14**
Unclassified	-	-	12	43	-	-
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	40	-	11	139	-	14
Chemicals	-	-	-	5	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	9	38	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	3	609	-	-
Other industries	85	-	-	18	26	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**213**	**2,039**	**287**	**231**	**3**	**-**
Domestic	-	2,039	-	-	-	-
Public administration	-	-	-	-	3	-
Commercial	9	-	-	197	-	-
Agriculture	204	-	287	33	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

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

(2) Including non-biodegradable wastes, which accounted for 1,359 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 2017 (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
2,642	1,044	1,044	510	4,300	794	18,725	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	490	3,475	Imports
-	-	-	-	-	-287	-431	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-237	Transfers
2,642	**1,044**	**1,044**	**510**	**4,300**	**997**	**21,532**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
2,642	**1,044**	**1,044**	**510**	**4,300**	**997**	**21,532**	**Total demand**
2,415	**991**	**-**	**510**	**4,300**	**-**	**15,388**	**Transformation**
2,376	991	-	510	4,300	-	15,187	Electricity generation
898	256	-	359	3,526	-	8,545	Major power producers
1,477	735	-	150	774	-	6,642	Autogenerators
40	-	-	-	-	-	200	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**
227	**53**	**1,044**	**-**	**-**	**997**	**6,145**	**Final consumption**
109	**-**	**3**	**-**	**-**	**-**	**1,162**	**Industry**
77	-	3	-	-	-	135	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	203	Mineral products
-	-	-	-	-	-	5	Chemicals
2	-	-	-	-	-	2	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	47	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	611	Paper, printing, etc
31	-	-	-	-	-	159	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**997**	**997**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	997	997	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
118	**53**	**1,041**	**-**	**-**	**-**	**3,986**	**Other**
19	52	106	-	-	-	2,216	Domestic
68	0	-	-	-	-	72	Public administration
31	0	936	-	-	-	1,173	Commercial
-	-	-	-	-	-	525	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	-	

6.2 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	331r	2,121r	1,371r	1,948r	337r	1,556
Other sources	-	-	-	-	-	-
Imports	38	41	-	3,032	-	-
Exports	-17	-109	-	-9	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-165	-	-	-
Total supply (2)	**352r**	**2,054r**	**1,206r**	**4,971r**	**337r**	**1,556**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**352r**	**2,054r**	**1,206r**	**4,971r**	**337r**	**1,556**
Transformation	**14r**	**-**	**913r**	**4,030r**	**312**	**1,542**
Electricity generation	-	-	913r	3,895r	312	1,542
Major power producers	-	-	210	3,233	-	-
Autogenerators	-	-	703r	662r	312	1,542
Heat generation	14r	-	-	135r	-	-
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	**337r**	**2,054r**	**293r**	**941r**	**25r**	**14**
Industry	**125r**	**-**	**35r**	**807r**	**25r**	**14**
Unclassified	-	-	12	27r	-	-
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	40r	-	11	139r	-	14
Chemicals	-	-	-	10r	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	9r	16r	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	3	591r	-	-
Other industries	85r	-	-	24r	25r	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**213r**	**2,054r**	**258r**	**134r**	**0**	**-**
Domestic	-	2,054r	-	-	-	-
Public administration	-	-	-	-	0	-
Commercial	8r	-	-	112r	-	-
Agriculture	204r	-	258r	22r	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).
(2) Including non-biodegradable wastes, which accounted for 1,268 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.

6.2 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	947r	1,066r	463r	3,204r	580	16,378r	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	631r	3,742r	Imports
-	-	-	-	-	-203	-338	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-165	Transfers
2,454	**947r**	**1,066r**	**463r**	**3,204r**	**1,008r**	**19,617r**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
2,454	**947r**	**1,066r**	**463r**	**3,204r**	**1,008r**	**19,617r**	**Total demand**
2,288r	**895r**	**-**	**463r**	**3,204r**	**-**	**13,661r**	**Transformation**
2,241	895r	-	463r	3,204r	-	13,466r	Electricity generation
790	175	-	340	2,641	-	7,389	Major power producers
1,451	720r	-	124	563r	-	6,077r	Autogenerators
46r	-	-	-	-	-	195r	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**
166r	**52**	**1,066r**	**-**	**-**	**1,008r**	**5,955r**	**Final consumption**
90r	**-**	**4**	**-**	**-**	**-**	**1,099r**	**Industry**
76r	-	4	-	-	-	120r	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	203r	Mineral products
-	-	-	-	-	-	10r	Chemicals
2	-	-	-	-	-	2	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	25r	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	594r	Paper, printing, etc
12r	-	-	-	-	-	147r	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**1,008r**	**1,008r**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	1,008r	1,008r	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
76r	**52**	**1,061r**	**-**	**-**	**-**	**3,848r**	**Other**
14r	51r	97r	-	-	-	2,215r	Domestic
50r	0	-	-	-	-	51r	Public administration
13r	0r	964r	-	-	-	1,097r	Commercial
-	-	-	-	-	-	485r	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	**-**	

6.3 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	365r	2,021r	956r	1,899r	318r	1,612
Other sources	-	-	-	-	-	-
Imports	50	35	-	2,836	-	-
Exports	-73	-138	-	-37	-	-
Marine bunkers	-	-	-	-	-	-
Stock change *(1)*	-	-	-	-	-	-
Transfers	-	-	-84	-	-	-
Total supply (2)	**343r**	**1,918r**	**872r**	**4,698r**	**318r**	**1,612**
Statistical difference *(3)*	-	-	-	-	-	-
Total demand	**343r**	**1,918r**	**872r**	**4,698r**	**318r**	**1,612**
Transformation	**14r**	**-**	**722r**	**4,021r**	**293**	**1,598**
Electricity generation	-	-	722r	3,888r	293	1,598
Major power producers	-	-	209	3,381	-	-
Autogenerators	-	-	513r	507r	293	1,598
Heat generation	14r	-	-	133r	-	-
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	**328r**	**1,918r**	**150r**	**678r**	**25r**	**14**
Industry	**116r**	**-**	**39**	**599r**	**25r**	**14**
Unclassified	-	-	14	4r	-	-
Iron and steel	-	-	-	-	-	-
Non-ferrous metals	-	-	-	-	-	-
Mineral products	40r	-	17	150r	-	14
Chemicals	-	-	-	1r	-	-
Mechanical engineering, etc	-	-	-	-	-	-
Electrical engineering, etc	-	-	-	-	-	-
Vehicles	-	-	-	-	-	-
Food, beverages, etc	-	-	5	10r	-	-
Textiles, leather, etc	-	-	-	-	-	-
Paper, printing, etc	-	-	3	403r	-	-
Other industries	76r	-	-	31r	25r	-
Construction	-	-	-	-	-	-
Transport	**-**	**-**	**-**	**-**	**-**	**-**
Air	-	-	-	-	-	-
Rail	-	-	-	-	-	-
Road	-	-	-	-	-	-
National navigation	-	-	-	-	-	-
Pipelines	-	-	-	-	-	-
Other	**213r**	**1,918r**	**110r**	**79r**	**-**	**-**
Domestic	-	1,918r	-	-	-	-
Public administration	-	-	-	-	-	-
Commercial	8r	-	-	57r	-	-
Agriculture	204r	-	110r	22r	-	-
Miscellaneous	-	-	-	-	-	-
Non energy use	**-**	**-**	**-**	**-**	**-**	**-**

(1) Stock fall (+), stock rise (-).
(2) Including non-biodegradable wastes, which accounted for 1,049 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 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
2,020	699r	1,007r	541r	3,463r	325	15,227r	Production
-	-	-	-	-	-	-	Other sources
-	-	-	-	-	792r	3,714r	Imports
-	-	-	-	-	-117	-366	Exports
-	-	-	-	-	-	-	Marine bunkers
-	-	-	-	-	-	-	Stock change *(1)*
-	-	-	-	-	-	-84	Transfers
2,020	**699r**	**1,007r**	**541r**	**3,463r**	**999r**	**18,491r**	**Total supply** *(2)*
-	-	-	-	-	-	-	**Statistical difference** *(3)*
2,020	**699r**	**1,007r**	**541r**	**3,463r**	**999r**	**18,491r**	**Total demand**
1,865r	**648r**	**-**	**541r**	**3,463r**	**-**	**13,165r**	**Transformation**
1,817	648r	-	541r	3,463r	-	12,971r	Electricity generation
471	121	-	422	2,860	-	7,463	Major power producers
1,346	527r	-	120	604r	-	5,508r	Autogenerators
48r	-	-	-	-	-	195r	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**
156r	**52**	**1,007r**	**-**	**-**	**999r**	**5,326r**	**Final consumption**
79r	**-**	**4**	**-**	**-**	**-**	**875r**	**Industry**
69	-	4	-	-	-	91r	Unclassified
-	-	-	-	-	-	-	Iron and steel
-	-	-	-	-	-	-	Non-ferrous metals
-	-	-	-	-	-	220r	Mineral products
-	-	-	-	-	-	1r	Chemicals
2	-	-	-	-	-	2	Mechanical engineering, etc
-	-	-	-	-	-	-	Electrical engineering, etc
-	-	-	-	-	-	-	Vehicles
-	-	-	-	-	-	15r	Food, beverages, etc
-	-	-	-	-	-	-	Textiles, leather, etc
-	-	-	-	-	-	407r	Paper, printing, etc
9r	-	-	-	-	-	140r	Other industries
-	-	-	-	-	-	-	Construction
-	-	-	-	-	**999r**	**999r**	**Transport**
-	-	-	-	-	-	-	Air
-	-	-	-	-	-	-	Rail
-	-	-	-	-	999r	999r	Road
-	-	-	-	-	-	-	National navigation
-	-	-	-	-	-	-	Pipelines
77r	**52**	**1,003r**	**-**	**-**	**-**	**3,451r**	**Other**
17r	51r	94r	-	-	-	2,080r	Domestic
48r	0	-	-	-	-	49r	Public administration
11r	0r	909r	-	-	-	986r	Commercial
-	-	-	-	-	-	336r	Agriculture
-	-	-	-	-	-	-	Miscellaneous
-	**-**	**-**	**-**	**-**	**-**	**-**	

6.4 Capacity of, and electricity generated from, renewable sources

	2013	2014	2015	2016	2017
Installed Capacity (MW) [1]					
Wind:					
Onshore	7,586	8,573	9,212r	10,880r	12,847
Offshore	3,696	4,501	5,093	5,293	6,988
Marine energy (wave and tidal stream)	8	9	9	13	18
Solar photovoltaics	2,937	5,528	9,601r	11,912r	12,776
Hydro:					
Small scale	232	253	300	359r	396
Large scale [2]	1,477	1,477	1,477	1,477	1,479
Bioenergy:					
Landfill gas	1,050	1,058	1,061	1,062	1,066
Sewage gas	201	230	231	257	245
Energy from waste [3]	545	680	930r	1,028r	1,091
Animal biomass [4]	111	111	111	129	129
Anaerobic digestion	163	243	336r	426r	460
Plant biomass[5]	1,955	2,258	2,604r	2,852r	3,055
Total bioenergy and wastes	4,025	4,579	5,273r	5,755r	6,047
Total	19,961	24,920	30,966r	35,690r	40,551
Co-firing [6]	39	14	21	13	6
Generation (GWh)					
Wind:					
Onshore [7]	16,925	18,555	22,852r	20,857r	29,088
Offshore	11,472	13,405	17,423	16,406	20,916
Marine energy (wave and tidal stream)[8]	5	2	2	0	4
Solarphotovoltaics	2,010	4,054	7,533r	10,411r	11,525
Hydro:					
Small scale[7]	675	835	983r	1,011r	1,322
Large scale[2]	4,026	5,053	5,314	4,379	4,606
Bioenergy:					
Landfill gas	5,175	5,033	4,872	4,703	4,284
Sewage gas	766	840	894	950	967
Biodegradable energy from waste[9]	1,648	1,900	2,582r	2,740r	3,386
Co-firing with fossil fuels	337	124	183	117	54
Animal biomass[4]	628	614	648	650	649
Anaerobic digestion	713	1,023	1,485r	2,082r	2,470
Plant biomass[5]	8,832	13,086	18,592r	18,822r	20,059
Total bioenergy	18,100	22,619	29,257r	30,064r	31,869
Total generation	53,213	64,522	83,364r	83,127r	99,330
Non-biodegradable wastes[10]	1,480	1,901	2,584r	2,741r	3,387
Total generation from sources eligible for the Renewable Obligation[11]	47,539	57,569	68,066r	65,680r	71,298

(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

	2013	2014	2015	2016	2017
Load factors - based on average beginning and end of year capacity (1)					
Wind	31.9	30.0	33.6r	27.8r	31.7
Onshore	28.4	26.2	29.3r	23.6r	28.0
Offshore	39.1	37.3	41.5r	36.0r	38.9
Marine energy (wave and tidal stream)	6.5	3.0	2.6r	0.0r	3.0
Solar photovoltaics	9.8	10.9	11.4r	11.0r	10.7
Hydro	31.6	39.1	41.0r	34.0r	36.5
Small scale	34.4	39.3	40.6r	34.9r	40.0
Large scale	31.1	39.1	41.1r	33.8r	35.6
Bioenergy (excludes cofiring and non-biodegradable wastes)	56.4	59.7	67.4r	61.8r	61.5
Landfill gas	56.5	54.5	52.5r	50.4r	46.0
Sewage sludge digestion	42.3	44.4	44.2r	44.3r	43.9
Energy from waste (3)	35.6	35.4	36.6r	31.9r	36.5
Animal biomass (4)	64.9	63.4	66.9r	61.7r	57.3
Anaerobic digestion	57.5	57.6	58.6r	62.2r	63.6
Plant Biomass (5)	64.6	70.9	87.3r	78.5r	77.5
All renewable technologies (excluding cofiring and non-biodegradable wastes)	33.9	32.8	34.0r	28.4r	29.7
Load factors - for schemes operating on an unchanged configuration basis (2)					
Wind	31.0	29.8	33.3	28.8	31.6
Onshore	27.9	25.9	29.4	24.2	27.3
Offshore	37.6	37.8	39.7	36.7r	40.0
Solar photovoltaics	11.3	11.1	11.2	10.8r	10.6
Hydro	31.6	38.8	39.5	33.9	35.8
Small scale	36.1	39.7	41.9	34.7	37.9
Large scale	31.2	38.8	39.2	33.8	35.6
Bioenergy (excludes cofiring and non-biodegradable wastes)	60.5	65.1	67.4r	68.8r	69.2
Landfill gas	57.5	55.2	52.6	49.9	45.8
Sewage sludge digestion	49.8	48.0	48.2	43.1	46.1
Energy from waste (3)	35.3	35.5	35.7r	34.4r	37.2
Animal biomass (4)	70.4	63.4	66.9	57.2	57.3
Anaerobic digestion	61.5	57.5	55.4r	60.5r	63.2
Plant biomass (5)	60.6	70.5	74.4r	79.0r	79.0
All renewable technologies (excluding cofiring and non-biodegradable wastes)	36.1	37.8	38.2r	33.0r	33.5

(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

	2013	2014	2015	2016	2017
Used to generate electricity *(3)*					
Wind:					
Onshore	1,455.3	1,595.4	1,965r	1,793r	2,501.1
Offshore	986.4	1,152.6	1,498	1,411	1,798.5
Marine energy (4)	0.4	0.2	0	-	0.4
Solar photovoltaics	172.8	348.6	648r	895r	991.0
Hydro:					
Small scale	58.0	71.8	85	87	113.7
Large scale *(5)*	346.2	434.5	457	377	396.0
Bioenergy:					
Landfill gas	1,697.2	1,650.8	1,598	1,542	1,405.0
Sewage gas	251.2	275.5	293	312	317.3
Biodegradable energy from waste	564.7	682.1	905	1,117	1,184.6
Co-firing with fossil fuels	53.7	25.1	38	25	18.3
Animal biomass *(6)*	226.4	224.8	235	230	225.9
Anaerobic digestion	233.9	335.4	487r	683r	810.0
Plant biomass *(7)*	2,008.3	2,912.9	3,850r	3,871	4,234.6
Total bioenergy	5,035.3	6,106.6	7,407r	7,780r	8,195.7
Total	8,054.5	9,709.7	12,059r	12,342r	13,996.3
Non-biodegradable wastes *(8)*	513.1	688.4	912	1,124	1,190.9
Used to generate heat					
Active solar heating	47.9	49.6	51	51	52.1
Bioenergy:					
Landfill gas	13.6	13.6	14	14	13.6
Sewage gas	68.3	67.7	73	72	84.2
Wood	1,787.7	1,698.1	1,918r	2,054r	2,039.4
Waste wood	315.4	319.1	319	319	319.1
Animal biomass *(9)*	29.1	34.5	31	23	23.0
Anaerobic digestion	18.5	42.9	119r	270r	298.9
Plant biomass *(10)*	418.8	561.2	838	1,102	1,252.9
Biodegradable energy from waste *(6)*	29.7	22.4	67r	69r	93.8
Total bioenergy	2,681.1	2,759.6	3,378r	3,923r	4,124.9
Deep geothermal	0.8	0.8	1	1	0.8
Heat Pumps	96.5	106.7	1,007r	1,066r	1,044.4
Total	2,826.3	2,916.6	4,436r	5,040r	5,222.2
Non-biodegradable wastes *(8)*	154.7	158.4	137r	144r	168.5
Renewable sources used as transport fuels					
Bioethanol	462.2	458.8	448r	428	424.5
Biodiesel	629.4	783.8	550r	582	572.7
Total	1,091.6	1,242.7	998r	1,010	997.1
Total use of renewable sources and wastes					
Solar heating and photovoltaics	220.7	398.1	698r	946r	1,043.0
Onshore wind	1,455.3	1,595.4	1,965r	1,793r	2,501.1
Offshore wind	986.4	1,152.6	1,498	1,411	1,798.5
Marine energy (wave and tidal stream)	0.4	0.2	0	-	0.4
Hydro	404.3	506.3	541r	463r	509.7
Bioenergy	7,716.4	8,866.2	10,784r	11,702r	12,320.6
Deep geothermal	0.8	0.8	1	1	0.8
Heat pumps	96.5	106.7	1,007r	1,066r	1,044.4
Transport biofuels	1,091.6	1,242.7	998r	1,010	997.1
Total	11,972.4	13,869.0	17,493r	18,392r	20,215.6
Non-biodegradable wastes *(8)*	667.8	846.8	1,049r	1,268r	1,359.4
All renewables and wastes *(11)*	12,640.2	14,715.8	18,542r	19,660r	21,575.0

(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

	2013	2014	2015	2016	2017
Electricity generation component:					
Normalised hydro generation *(1) (2)*	445	448	383r	427r	470
Normalised wind generation *(3)*	2,228	2,714	3,222r	3,499r	4,199
Electricity generation from renewables other than wind, hydro, and compliant biofuels	1,730	2,295	3,174r	3,506r	3,732
Electricity generation from compliant biofuels	-	-	1	2	3
Total renewable generation from all compliant sources	4,402	5,457	6,779r	7,432r	8,401
Total Gross Electricity Consumption *(2)*	31,798	30,587	30,721r	30,454r	30,135
Percentage of electricity from renewable sources	13.8%	17.8%	22.1%	24.4%	27.9%
Heat component:					
Renewable energy for heating and cooling	2,387	2,468	3,469r	4,034r	4,254
Total Gross energy consumption for heating and cooling	59,180	52,997	55,243r	55,823r	54,979
Percentage of heating and cooling energy from renewable sources	4.0%	4.7%	6.3%	7.2%	7.7%
Transport component (excluding air transport):					
Road transport renewable electricity	1	1	2	3r	4
Non-road transport renewable electricity	81	90	-r	-r	0
Biofuels (restricted to those meeting sustainability criteria from 2011) *(4)*	1,045	1,176	943	993r	921
Total electricity consumption in transport	374	387	388r	403r	411
Total petrol and diesel consumption in transport	36,777	37,270	38,186r	39,101r	39,142
Total transport component numerator (including weighted components) *(5)*	1,824	2,090	1,780r	2,004r	1,906
Total transport component denominator (including weighted components) (5)	38,894	39,653	40,248r	41,386r	41,323
Percentage of transport energy from renewable sources *(5)*	4.7%	5.3%	4.4%	4.8%	4.6%
Overall directive target:					
Renewables used for:					
Electricity generation	4,321	5,366	6,777r	7,429r	8,397
Heating and Cooling	2,387	2,468	3,469r	4,034r	4,254
Transport biofuels (restricted to those meeting sustainability criteria from 2011)	1,127	1,267	945r	996r	925
Total Final Consumption of Renewable Energy ["Row A"]	7,835	9,101	11,191r	12,459r	13,575
Final Electricity Consumption *(6)*	26,820	25,648	25,703r	25,719r	25,463
Transport Final Energy Consumption (including air transport) *(7)*	50,107	50,720	51,507r	52,575r	52,950
Heating and Cooling Final Energy Consumption	59,170	52,988	55,234r	55,813r	54,969
Total Final Energy Consumption *(8)*	136,097	129,356	132,444r	134,107r	133,381
plus Distribution losses for electricity	2,283	2,360	2,466r	2,296r	2,212
plus Distribution losses for heat	0	0	-	-	1
plus Consumption of electricity in the electricity and heat generation sectors	1,535	1,417	1,432	1,314r	1,326
plus Consumption of heat in the electricity and heat generation sectors	0	0	-	-	1
Gross Final Energy Consumption (GFEC)	139,915	133,133	136,342r	137,717r	136,922
of which Air transport	11,812	11,798	11,188r	11,283r	11,659
Air transport as a proportion of GFEC	8.44%	8.86%	8.21%	8.19%	8.52%
Air transport cap specificed in Directive	6.18%	6.18%	6.18%	6.18%	6.18%
Capped air transport	8,647	8,228	8,426r	8,511r	8,462
Capped Gross Final Energy Consumption (CGFEC) ["Row B"] *(9)*	136,750	129,562	133,581r	134,945r	133,725
Headline Directive percentage : Renewable Energy Consumption as a percentage of Capped Gross Final Energy Consumption ["Row A" divided by "Row B"]	5.7%	7.0%	8.4%	9.2%	10.2%

(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.