

## Renewable energy in 2016

### Introduction

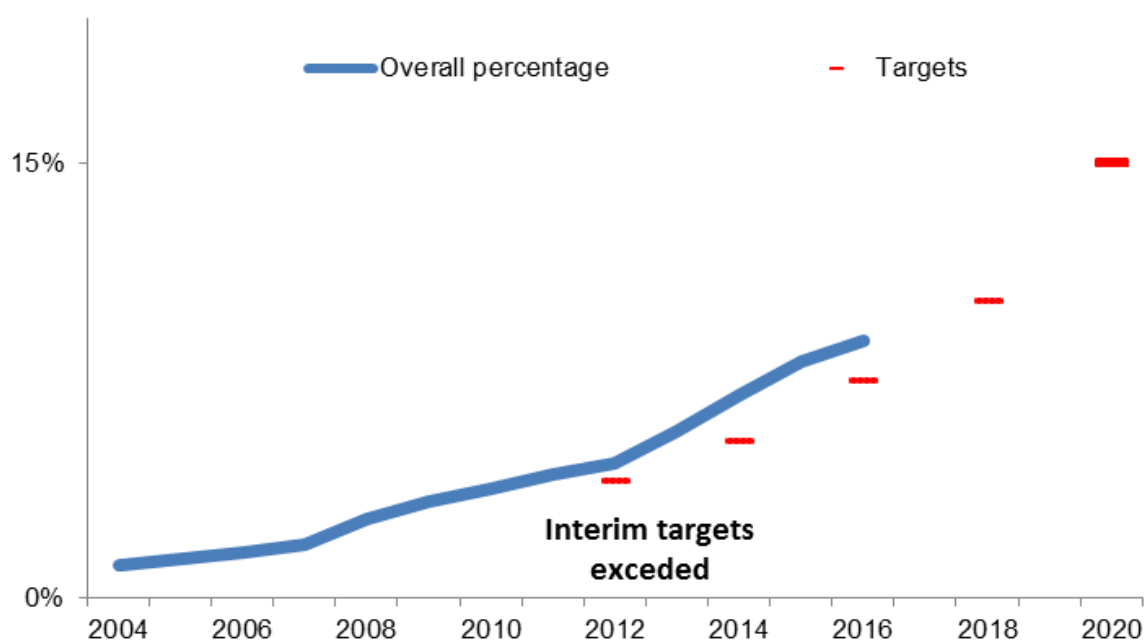
This article includes a first estimate of the UK's progress against the Renewable Energy Directive (RED) for 2016. It incorporates an update of the proportion of renewable electricity generation for 2016 previously published in the March 2017 issue of Energy Trends, and a first estimate of renewable heat generation. The first three sections describe trends in actual generation for electricity, heat, and renewable transport fuels in 2016. The subsequent sections relate to the methodology used to calculate progress against the Directive and UK progress for 2016. It also includes a brief comparison of member states' progress for 2015, the latest year for which data have been published.

### Key messages

*Progress against the Renewable Energy Directive (2009);*

- In 2016, renewable energy provisionally accounted for 8.9 per cent of final energy consumption, as measured using the 2009 Renewable Energy Directive (RED) methodology, an increase of 0.7 percentage points on 2015.
- The UK has now exceeded its third interim target; averaged over 2015 and 2016, at 8.5 per cent against its target of 7.5 per cent. Chart 1 shows current progress and all targets;

**Chart 1: Progress against Renewable Energy Directive and UK targets**



- Renewable electricity accounted for 24.6 per cent of total generation (as measured using the RED methodology), an increase of 2.3 percentage points compared to 2015.
- Renewable heat accounted for 6.2 per cent of total heat consumption, an increase of 0.7 percentage points on 2015.
- Renewable energy for transport accounted for 4.5 per cent of total transport energy, 0.1 percentage points higher than in 2015.

*Trends in Generation;*

- Total renewable energy increased by 706 ktoe (4.3 per cent), from 16,591 in 2015 to 17,296 ktoe in 2016.
- Renewable electricity generation fell by 0.2 TWh (0.2 per cent) to 83.2 TWh in 2016
- Electricity generation from solar photovoltaics increased by 2.9 TWh (38 per cent) to 10.4 TWh, a record.
- Total wind generation fell by 7.3 per cent to 37.4 TWh in 2016 as a result of lower wind speeds.
- 15 per cent of renewable heat generation in 2016 was supported by the Renewable Heat Incentive (RHI).

**Renewable electricity generation**

In 2016, renewable electricity generation represented 71 per cent of total renewable energy (on a fuel input basis; see table 5 at the end of this article). **Total renewable generation** fell by 0.2 TWh (0.2 per cent) to 83.2 TWh in 2016. **Total wind generation** fell by 7.3 per cent to 37.4 TWh; an increase in capacity (mostly for onshore wind) was more than offset by lower wind speeds compared to 2015, though wind speeds for that year had been the highest for the preceding 15 years. Onshore wind fell by 8.4 per cent to 21.0 TWh and offshore wind fell by 5.8 per cent. **Generation from hydro** also fell, by 14 per cent to 5.4 TWh in 2016, although 2015 had been a record year due to high rainfall (in the main hydro catchment areas)<sup>1</sup>. **Solar photovoltaic generation** showed the largest absolute increase of the renewable technologies (2.9 TWh or 38 per cent) due to additional capacity which increased by 25 per cent. For the second year, solar photovoltaics are the leading technology by capacity though is the fourth largest in generation terms. The largest increase in generation in percentage terms was **anaerobic digestion** which showed growth of 40 per cent to 2.1 TWh in 2016, a record, the result of increased capacity supported by the Feed in Tariff. Table 1 below shows electricity generation over the last three years by technology;

**Table 1**

<b>Generation (TWh)</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>Percentage share in 2016</b>
Onshore Wind	18.6	22.9	21.0	25.2%
Offshore Wind	13.4	17.4	16.4	19.7%
Shoreline wave/Tidal	0.0	0.0	0.0	0.0%
Solar photovoltaics	4.1	7.5	10.4	12.5%
Hydro Small scale	0.8	1.0	1.0	1.2%
Hydro Large scale	5.1	5.3	4.4	5.3%
Landfill gas	5.0	4.9	4.7	5.7%
Sewage sludge digestion	0.8	0.9	1.0	1.1%
Municipal solid waste combustion	1.9	2.6	2.7	3.3%
Co-firing with fossil fuels	0.1	0.2	0.1	0.1%
Animal Biomass	0.6	0.6	0.7	0.8%
Anaerobic Digestion	1.0	1.5	2.1	2.5%
Plant Biomass	13.1	18.6	18.8	22.6%
<b>Total generation</b>	<b>64.5</b>	<b>83.4</b>	<b>83.2</b>	<b>100.0%</b>

**Onshore wind continued to be the leading individual technology for the generation of electricity from renewable sources during 2016**, although its share of renewables generation continued to fall, from 28 per cent in 2015 to 25 per cent in 2016. Offshore wind's share of

<sup>1</sup> Weather data are available as part of this publication;  
[www.gov.uk/government/statistics/energy-trends-section-7-weather](http://www.gov.uk/government/statistics/energy-trends-section-7-weather)

renewables generation also fell slightly in 2016 to 20 per cent (from 21 per cent in 2015). The remaining technologies' shares were similar to 2015.

## Heat production

Renewable heat generation accounted for 23 per cent of total renewable sources in 2015 (see table 5 at the end of this article), up slightly (one and a half percentage points) on 2015. The four categories of renewable heat production in the United Kingdom are the direct combustion of various forms of bioenergy, (94 per cent of the total), active solar heating, geothermal, and heat pumps. Table 2 below shows the source mix.

**Table 2**

Heat generation (ktoe)	2014	2015	2016	Percentage share in 2016
Landfill gas	13.6	13.6	13.6	0.3%
Sewage sludge digestion	67.7	73.1	72.1	1.8%
Wood combustion - domestic	1,698.1	1,908.5	1,954.0	49.6%
Wood combustion - industrial	319.1	318.7	319.1	8.1%
Animal Biomass	34.5	30.7	23.0	0.6%
Anaerobic digestion	42.9	95.5	179.4	4.5%
Plant Biomass	561.2	837.7	1,102.2	28.0%
Biodegradable energy from waste	22.4	45.6	45.7	1.2%
Active solar heating	49.6	50.7	51.2	1.3%
Deep geothermal	0.8	0.8	0.8	0.0%
Heat Pumps	106.7	155.8	182.2	4.6%
<b>Total</b>	<b>2,916.6</b>	<b>3,530.6</b>	<b>3,943.3</b>	<b>100.0%</b>

Renewables used to generate heat have grown in recent years, following a decline up to 2005 as a result of tighter emission controls which discouraged on-site burning of biomass, especially wood waste. Policies such as the Renewable Heat Incentive (RHI) and Renewable Heat Premium Payment (RHPP) schemes are designed to support renewable heat production. Around 15 per cent of renewable heat during 2016 was supported through the receipt of RHI payments (589 ktoe, or 6,852 GWh). Domestic use of wood is the main contributor to renewables used for heat – comprising around 50 per cent of the renewable heat total. Plant biomass represented 28 per cent of renewable heat and industrial wood 8.1 per cent. Heat pumps (mainly in the domestic sector) contributed 4.6 per cent of the renewable heat total.

## Liquid biofuels for transport

Liquid biofuels for transport comprised around 5.8 per cent of total renewable sources. Two road transport fuels, biodiesel and bioethanol, are sold blended with diesel and petrol.

In 2016, 708 million litres (582 ktoe) of biodiesel and 759 million litres (428 ktoe) of bioethanol were consumed in 2016; by volume, biodiesel consumption was 5.8 per cent higher than in 2015, whilst bioethanol consumption was 4.5 per cent lower. During 2016, biodiesel accounted for 2.4 per cent of diesel, and bioethanol 4.4 per cent of motor spirit; the combined contribution of biodiesel and bioethanol was 3.1 per cent by volume, 0.1 percentage points lower than in 2015. The Renewable Energy Directive introduced various sustainability criteria for transport biofuels; certain biofuels derived from waste products (for example, waste cooking oil) have extra weighting when monitoring progress against the transport component, but not the overall target, of the Directive.

## Progress against the Renewable Energy Directive

Table 3 shows the increasing share of renewable energy from electricity, heat and transport;

**Table 3: Progress against the 2009 Renewable Energy Directive**

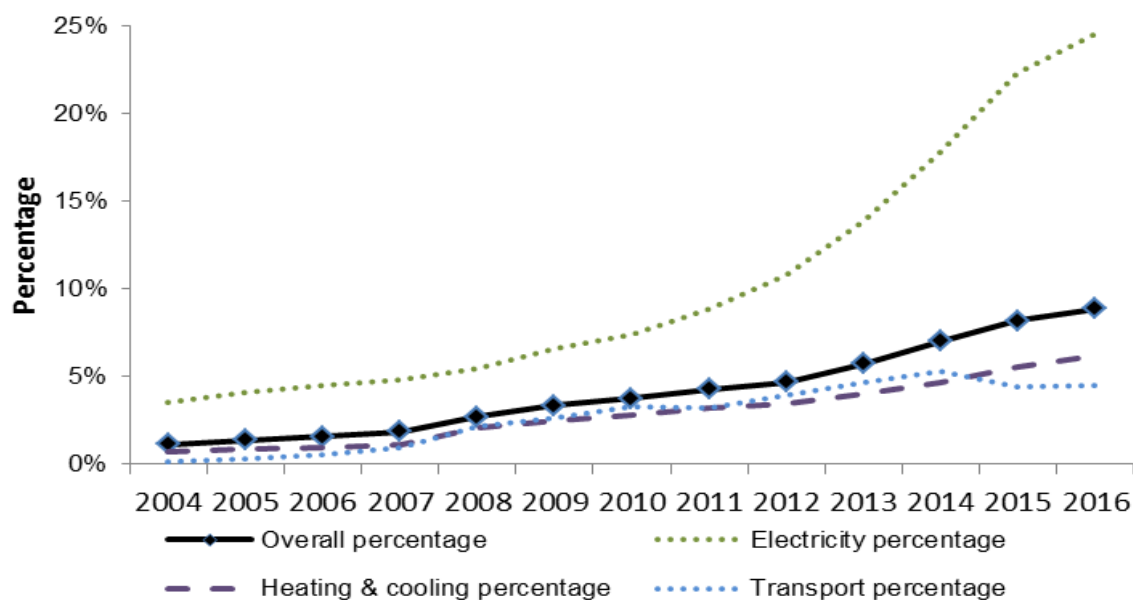
	2004	2010	2014	2015	2016
Percentage of electricity from renewable sources (normalised)	3.5%	7.4%	17.8%	22.3%	24.6%
Percentage of heating and cooling from renewable sources	0.7%	2.8%	4.7%	5.5%	6.2%
Percentage of transport energy from renewable sources	0.2%	3.3%	5.3%	4.4%	4.5%
Overall renewable consumption <sup>1,2</sup>	1.1%	3.8%	7.0%	8.2%	8.9%

<sup>1</sup> Measured as a percentage of capped gross final energy consumption using net calorific values

<sup>2</sup> Cannot be directly calculated from the three separate measures

The proportion of renewable electricity is, calculated on a RED basis, 24.6 per cent for 2016, 2.3 percentage points higher than in 2015 and 0.3 percentage points higher than the initial estimate published in the March 2017 edition of Energy Trends. Although actual generation fell in 2016, the normalising effect of the RED methodology (see below) has resulted in an actual increase. Renewable heat also increased though to a lesser extent; from 5.5 per cent in 2015 to 6.2 per cent in 2016. The share of renewable energy in transport increased slightly, by 0.1 percentage point to 4.5 per cent. Chart 2 below shows

**Chart 2: Progress against Renewable Energy Directive**



## Renewable Energy Directive Methodology

Progress against the RED is measured using a defined methodology; full details are published by Eurostat and can be found in the “SHARES manual”;

<http://ec.europa.eu/eurostat/web/energy/data/shares>

However, some of the key adjustments are outlined below;

*Electricity Generation;*

Generation uses a normalisation approach for wind and hydro generation to negate the effects of variable wind speeds and rainfall from one year to the next. Normalised wind generation is calculated using the average load factor for the most recent five years and applying to the average of the start and end of year capacity. For Hydro, the load factor is the average of the past 15 years, applied to capacity at the end of the current year.

*Heat Generation;*

Net calorific values are used in the heat energy calculation in contrast to The Digest of UK Energy Statistics (DUKES) which uses Gross Calorific Values. Additionally, heat energy generated by heat pumps includes only those heat pumps meeting the minimum Seasonal Performance Factor (SPF) of 2.5.

*Renewable Energy for Transport*

Some liquid biofuels, mostly those derived from waste products, are awarded double credits under the Renewable Transport Fuel Obligation scheme<sup>2</sup>. This applies to the transport specific target of 10 per cent and not in the overall progress calculation.

*Overall calculation adjustment*

Final total energy consumption (i.e. the denominator) includes a cap on air transport fuel (6.18 per cent).

**Renewable electricity’ share of generation (different measures)**

In addition to the RED methodology for calculating renewable electricity’s share of total generation, using normalisation; it is also calculated on an International Basis (actual generation as a percentage of total generation), and on a Renewables Obligation (RO) basis (generation supported by the Renewables Obligation as a percentage of electricity sales).

In 2016, the lowest measure was on the International Basis at 24.5 per cent. On the RED basis, generation was higher at 24.6 per cent reflecting the normalisation of wind and hydro generation. The highest measure was the RO measure at 26.2 per cent. Table 4 below shows a comparison of the three different measures;

**Table 4**

	2004	2010	2014	2015	2016
International Basis <sup>1</sup>	3.6%	6.9%	19.1%	24.6%	24.5%
Renewable Obligation <sup>2</sup>	3.1%	7.2%	19.8%	26.1%	26.2%
2009 Renewable Energy Directive <sup>3</sup>	3.5%	7.4%	17.8%	22.3%	24.6%

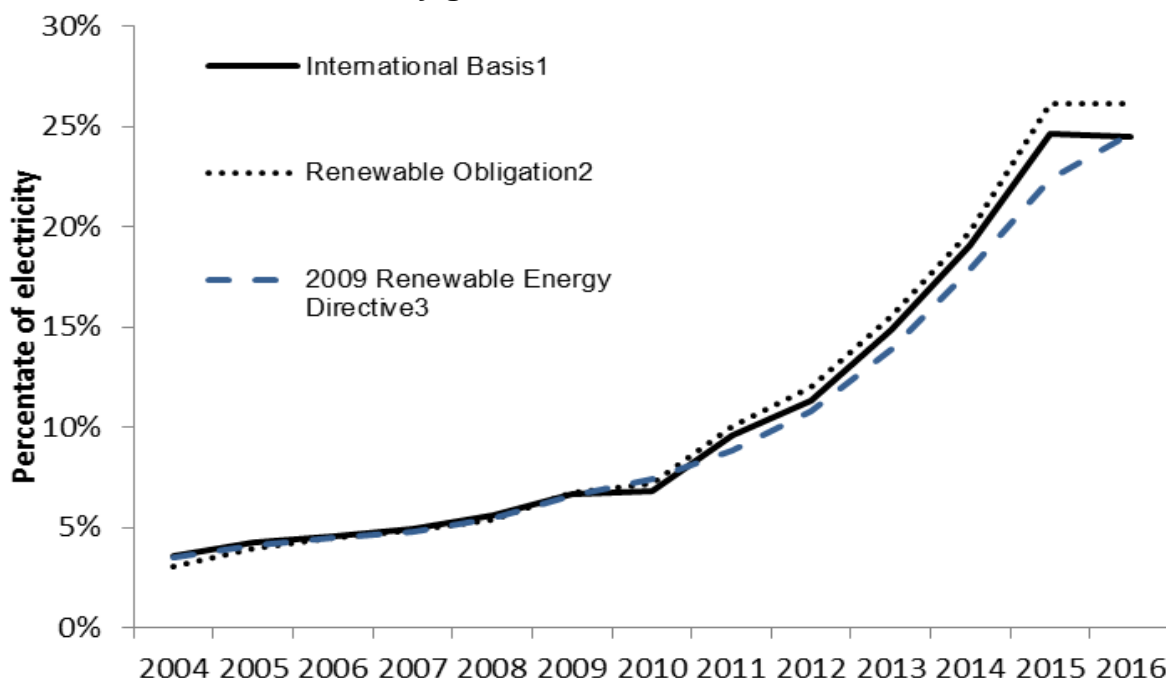
<sup>1</sup> All renewable electricity as a percentage of total UK electricity generation

<sup>2</sup> Measured as a percentage of UK electricity sales

<sup>3</sup> 2009 Renewable Energy Directive measured as a percentage of gross electricity consumption

Load factors in 2016 (see table ET 6.1) for wind and hydro generation were low compared to the previous year and to the long term mean due to low wind speeds, and low rainfall in the main catchment areas (see tables ET 7.2 and ET 7.4 respectively for weather data). This fall in generation due to these weather effects were damped by the normalisation process and in such years, the proportion calculated on a RED basis will tend to diverge from the alternate measures. Chart 3 shows this divergence;

<sup>2</sup> [www.gov.uk/guidance/renewable-transport-fuels-obligation](http://www.gov.uk/guidance/renewable-transport-fuels-obligation)

**Chart 3: Growth in electricity generation from renewable sources since 2004**

### Member state comparison of progress against the Directive

The UK has now exceeded its third interim target; averaged over 2015 and 2016, at 8.5 per cent against its target of 7.5 per cent. The Third Progress Report, based on 2013 and 2014, was published in January 2016<sup>3</sup> and the fourth, including progress against the third interim target, is due to be published by Eurostat early in 2018.

Eurostat publishes data on how countries are progressing towards their RED (final and interim) targets. The latest comparative data relates to 2015<sup>4</sup>. The 2015 RED percentage for all EU countries combined was 16.7 per cent, a 0.6 percentage point increase on 2014, and requiring a 3.3 percentage increase to reach the 20 per cent target in 2020. Once again Norway, who report data to Eurostat despite not being a member of the EU, achieved the highest proportion of renewable energy at 69.4 per cent, the same as in 2014. Sweden had the second highest proportion of renewable energy at 53.9 per cent, a 0.2 percentage point increase on 2014. From 2014 to 2015, the UK increased its share by 0.6 percentage points, the tenth highest increase of member states.

In 2014, a third of the member states had exceeded their 2020 targets; Bulgaria, the Czech Republic, Estonia, Croatia, Italy, Lithuania, Romania, Finland and Sweden. In 2015, a further two countries had exceeded theirs; Denmark at 30.8 per cent (target 30 per cent), and Hungary at 14.5 per (target 13 per cent).

The finalised 2015 figures for all member states will be published by Eurostat in early 2018, alongside the fourth progress report.

The UK is now challenged to increase its share of renewable energy by a further 6.8 percentage points to meet its 2020 target of 15 per cent, the fourth highest increase required behind The Netherlands, France, and Ireland. Though taking into account 2016's result, this is now reduced to 6.1 percentage points. The UK's fourth interim target is 10.2 per cent averaged across 2017 and 2018 and an initial estimate will be published in June 2019.

<sup>3</sup> <https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports>

<sup>4</sup> <http://ec.europa.eu/eurostat/web/energy/data/shares>

Special feature – Renewable energy in 2016

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**Table 5: Renewable sources used to generate electricity and heat, and for transport fuels <sup>(1)</sup> <sup>(2)</sup>**

	Thousand tonnes of oil equivalent		
	2014	2015	2016
<b>Used to generate electricity <sup>(3)</sup></b>			
Wind:			
Onshore	1,595.4	1,968.6	1,802.4
Offshore	1,152.6	1,498.1	1,410.6
Shoreline wave / tidal <sup>(4)</sup>	0.2	0.2	0.0
Solar photovoltaics	348.6	648.8	896.0
Hydro:	-	-	-
Small scale	71.8	84.6	87.4
Large scale <sup>(5)</sup>	434.5	456.9	376.5
Bioenergy:	-	-	-
Landfill gas	1,650.8	1,598.0	1,542.4
Sewage sludge digestion	275.5	293.3	311.7
Biodegradable energy from waste	682.1	905.2	1,117.4
Co-firing with fossil fuels	25.1	37.8	24.6
Animal Biomass <sup>(6)</sup>	224.8	235.3	230.1
Anaerobic digestion	335.4	482.4	673.1
Plant Biomass <sup>(7)</sup>	2,912.9	3,847.6	3,871.0
Total bioenergy	6,106.6	7,399.6	7,770.4
<b>Total</b>	<b>9,709.7</b>	<b>12,056.9</b>	<b>12,343.3</b>
Non-biodegradable energy from waste <sup>(8)</sup>	688.4	911.5	1,123.7
<b>Used to generate heat</b>			
Active solar heating	49.6	50.7	51.2
Bioenergy:			
Landfill gas	13.6	13.6	13.6
Sewage sludge digestion	67.7	73.1	72.1
Wood combustion - domestic	1,698.1	1,908.5	1,954.0
Wood combustion - industrial	319.1	318.7	319.1
Animal Biomass <sup>(9)</sup>	34.5	30.7	23.0
Anaerobic digestion	42.9	95.5	179.4
Plant Biomass <sup>(10)</sup>	561.2	837.7	1,102.2
Biodegradable energy from waste <sup>(6)</sup>	22.4	45.6	45.7
Total bioenergy	2,759.6	3,323.3	3,709.1
Deep geothermal	0.8	0.8	0.8
Heat Pumps	106.7	155.8	182.2
<b>Total</b>	<b>2,916.6</b>	<b>3,530.6</b>	<b>3,943.3</b>
Non-biodegradable wastes <sup>(8)</sup>	158.4	158.5	167.6
<b>Renewable sources used as transport fuels</b>			
as Bioethanol	458.8	449.1	427.8
as Biodiesel	783.8	554.1	581.7
<b>Total</b>	<b>1,242.7</b>	<b>1,003.1</b>	<b>1,009.5</b>
<b>Total use of renewable sources and wastes</b>			
Solar heating and photovoltaics	398.1	699.5	947.2
Onshore wind	1,595.4	1,968.6	1,802.4
Offshore wind	1,152.6	1,498.1	1,410.6
Shoreline wave / tidal	0.2	0.2	0.0
Hydro	506.3	541.6	463.9
Bioenergy	8,866.2	10,722.9	11,479.4
Deep geothermal	0.8	0.8	0.8
Heat Pumps	106.7	155.8	182.2
Transport biofuels	1,242.7	1,003.1	1,009.5
<b>Total</b>	<b>13,869.0</b>	<b>16,590.6</b>	<b>17,296.1</b>
Non-biodegradable energy from waste <sup>(8)</sup>	846.8	1,070.0	1,291.3
<b>All renewables and wastes</b>	<b>14,715.8</b>	<b>17,660.6</b>	<b>18,587.5</b>

(1) Includes some waste of fossil fuel origin.

(2) See the Digest of UK Energy Statistics for technical notes and definitions of the categories.

(3) For wind, solar PV and hydro, the figures represent the energy content of the electricity's bioenergy the figures represent the energy content of the fuel used.

(4) 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 glass.

(9) Includes heat from farm waste digestion, and meat and bone combustion.

(10) Includes heat from straw, energy crops, paper and packaging.