Renewable energy in 2015

Introduction

This article includes a first estimate of the UK's progress against the Renewable Energy Directive (RED) for 2015. It incorporates an update of the proportion of renewable electricity generation for 2015 previously published in the March 2016 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 2015. The subsequent sections relate to the methodology used to calculate progress against the Directive and UK progress for 2015. It also includes a brief comparison of member states' progress for 2014, the latest year for which data have been published. Where electricity is described in isolation, GWh are used, though for heat, transport, and electricity when included in overall energy, thousand tonnes of oil equivalent (ktoe) are used.

The following tables are included in this article;

Table 1	Actual renewable electricity generation in TWh
Table 2	Renewable heat generation in ktoe
Table 3	Overall progress against the RED targets.
Table 4	Proportion of renewable electricity generation using three measures
Table 5	Renewable electricity and heat generation and liquid biofuels consumption all measured in ktoe for comparison purposes

Key messages

Progress against the Renewable Energy Directive (2009);

- In 2015, renewable energy provisionally accounted for 8.3 per cent of final energy consumption, as measured using the 2009 Renewable Energy Directive (RED) methodology, an increase of 1.2 percentage points on 2014.
- Renewable electricity accounted for 22.3 per cent of total generation (as measured using the RED methodology), an increase of 4.5 percentage points compared to 2014.
- Renewable heat accounted for 5.6 per cent of total heat consumption, an increase of 0.8 percentage points on 2014.
- Renewable energy for transport accounted for 4.1 per cent of total transport energy, a decrease of 0.8 percentage points compared to 2014.

Trends in generation;

- Total renewable energy increased by 2,738 ktoe (20 per cent), from 13,918 in 2014 to 16,656 ktoe in 2015.
- Electricity generation from plant biomass increased by 5,482 GWh (42 per cent) to 18,587 GWh due to a third conversion at Drax Power Station.
- Onshore wind increased by 4,326 GWh (23 per cent) to 22,887 GWh due to an increase in capacity and high wind speeds.
- Solar photovoltaic generation increased by 3,521 GWh (87 per cent) due to an increase in capacity.
- 11 per cent of renewable heat generation is supported by the RHI.

Renewable electricity generation

In 2015, renewable electricity generation represented 73 per cent of total renewable energy (on an actual generation basis as opposed to using the RED methodology; see table 5 at the end of this article). Renewable generation increased by 19.0 TWh from 64.6 TWh in 2014 to 83.6 TWh in 2015, an increase of 29 per cent. Of this increase, 5.5 TWh was plant biomass which increased by 42 per cent. This was due to the conversion of a third unit at Drax Power Station to high-range co-firing (greater than 85 per cent biomass but less than 100 per cent). Table 1 below shows electricity generation over the last three years by technology;

Table 1

Actual generation (TWh)	2013	2014	2015	Percentage share in 2015
Onshore Wind	16.9	18.6	22.9	27.4%
Offshore Wind	11.5	13.4	17.4	20.9%
Shoreline wave/Tidal	0.0	0.0	0.0	0.0%
Solar photovoltaics	2.0	4.0	7.6	9.0%
Hydro Small scale	0.7	0.8	1.0	1.2%
Hydro Large scale	4.0	5.1	5.3	6.4%
Landfill gas	5.2	5.0	4.9	5.8%
Sewage sludge digestion	0.8	0.8	0.9	1.1%
Municipal solid waste combustion	1.6	1.9	2.8	3.3%
Co-firing with fossil fuels	0.3	0.1	0.2	0.2%
Animal Biomass	0.6	0.6	0.6	0.8%
Anaerobic Digestion	0.7	1.0	1.4	1.7%
Plant Biomass	8.9	13.1	18.6	22.2%
Total generation	**53.3**	**64.6**	**83.5**	**100.0%**

Solar photovoltaic showed the largest increase in percentage terms increasing by 87 compared to 2014. This represents an increase of 3.5 TWh to 7.6 TWh. This is driven by an increase in capacity (see table ET 6.1) particularly from larger schemes supported by the Renewables Obligation as well as smaller schemes under the Feed in Tariff (FiT) scheme.

Total wind generation increased by 8.3 TWh (26 per cent). This was partly due to an increase in capacity (see table ET 6.1), particularly for offshore wind, but also higher than average wind speeds (see table ET 7.2). Onshore wind increased by 4.3 TWh from 18.6 TWh to 22.9 TWh, an increase of 23 per cent. Offshore wind increased by less in absolute terms (by 4.0 TWh to 17.4 TWh) but showed higher growth in percentage terms, 30 per cent.

Hydro generation increased by 6.7 per cent from 5.9 TWh in 2014 to 6.3 TWh in 2015 due to increased rainfall in the main hydro catchment areas (see table ET 7.4), the highest since 2011.

Onshore wind continued to be the leading technology with a 27 per cent share, followed by plant biomass (22 per cent), offshore wind (21 per cent), and solar photovoltaic increased its share from 6.3 per cent to 9.1 per cent.

Heat production

Renewable heat generation accounted for 21 per cent of total renewable sources in 2015 (see table 5 at the end of this article), up slightly (one percentage point) on 2014. 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)	2013	2014	2015	Percentage share in 2015
Landfill gas	13.6	13.6	13.6	0.4%
Sewage sludge digestion	68.3	67.7	73.1	2.1%
Wood combustion - domestic	1,790.3	1,698.1	1,906.2	53.9%
Wood combustion - industrial	374.2	501.4	790.8	22.4%
Animal Biomass	29.1	34.5	30.7	0.9%
Anaerobic digestion	18.5	42.9	95.5	2.7%
Plant Biomass	346.0	379.0	359.4	10.2%
Biodegradable energy from waste	30.1	23.3	45.7	1.3%
Active solar heating	47.9	49.6	50.7	1.4%
Deep geothermal	0.8	0.8	0.8	0.0%
Heat Pumps	116.5	142.5	168.3	4.8%
Total	**2,835.3**	**2,953.5**	**3,534.8**	**100.0%**

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 11 per cent of renewable heat during 2015 was supported through the receipt of RHI payments (372 ktoe, or 4,329 GWh). Domestic use of wood is the main contributor to renewables used for heat – comprising around 54 per cent of the renewable heat total. Non-domestic use of wood and wood waste, and plant biomass formed the next largest components, at 17 per cent and 14 per cent respectively. Heat pumps (mainly in the domestic sector) contributed 4.8 per cent of the renewable heat total.

Liquid biofuels for transport

Liquid biofuels for transport comprised around 6.2 per cent of total renewable sources. Two road transport fuels, biodiesel and bioethanol, are sold blended with diesel and petrol. Up until 2014, biofuel volumes were sourced from The HMRC Hydrocarbon Oils Bulletin and although table 6.2 still reports HMRC data, for the purposes of this article and the Digest of UK Energy Statistics[1], the data are sourced from The Renewable Transport Fuel obligation (RTFO) statistics published by The Department for Transport[2]. From September's edition of Energy Trends, RTFO will also be included in table 6.2.

In 2015, 674 million litres (554 ktoe) of biodiesel and 797 million litres (449 ktoe) of bioethanol were consumed in 2015; biodiesel consumption was 29 per cent lower than in 2014, whilst bioethanol consumption was 2.1 per cent lower (by volume). During 2015, biodiesel accounted for 2.3 per cent of diesel, and bioethanol 4.6 per cent of motor spirit; the combined contribution of biodiesel and bioethanol was 3.2 per cent by volume, 0.7 percentage points lower than in 2014. 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

Progress against the RED is measured using a defined methodology. The key adjustments made to actual generation are as follows;

Electricity Generation;

Generation is 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 which differs to 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[3]. This applies to the transport specific target of 10 per cent and not in the overall progress calculation. Calorific values are on a net basis as opposed to gross as used in DUKES.

[1] To be published 28th July 2015

[2] www.gov.uk/government/collections/biofuels-statistics

[3] www.gov.uk/guidance/renewable-transport-fuels-obligation

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

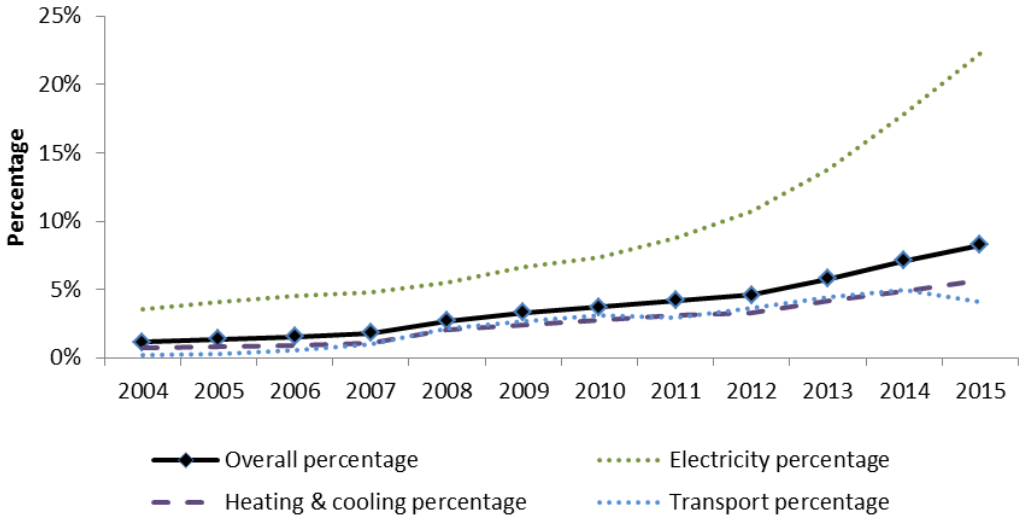
Table 3 shows the increasing share of renewable energy from electricity, heat and transport;

Table 3: Progress against the 2009 Renewable Energy Directive

	2004	2010	2013	2014	2015
Percentage of electricity from renewable sources (normalised)	3.5%	7.4%	13.8%	17.9%	22.3%
Percentage of heating and cooling from renewable sources	0.7%	2.7%	4.1%	4.9%	5.6%
Percentage of transport energy from renewable sources	0.2%	3.1%	4.4%	4.9%	4.1%
Overall renewable consumption as a percentage of capped gross final energy consumption using net calorific values (normalised) [not directly calculated from the three percentages above]	1.1%	3.7%	5.8%	7.1%	8.3%

The proportion of renewable electricity is, calculated on a RED basis remains unchanged since the initial estimate in the March 2016 edition of Energy Trends at 22.3 per cent. This is an increase of 4.5 percentage points compared to 2014 Renewable heat also increased though to a lesser extent; from 4.8 per cent in 2014 to 5.6 per cent. Renewable energy in transport as a share of total transport energy decreased by 0.7 percentage points in 2015 to 4.2 per cent. This was due to a reduction in biofuel consumption combined with an increase in total transport energy (the denominator).

Chart 1: Progress against Renewable Energy Directive



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).

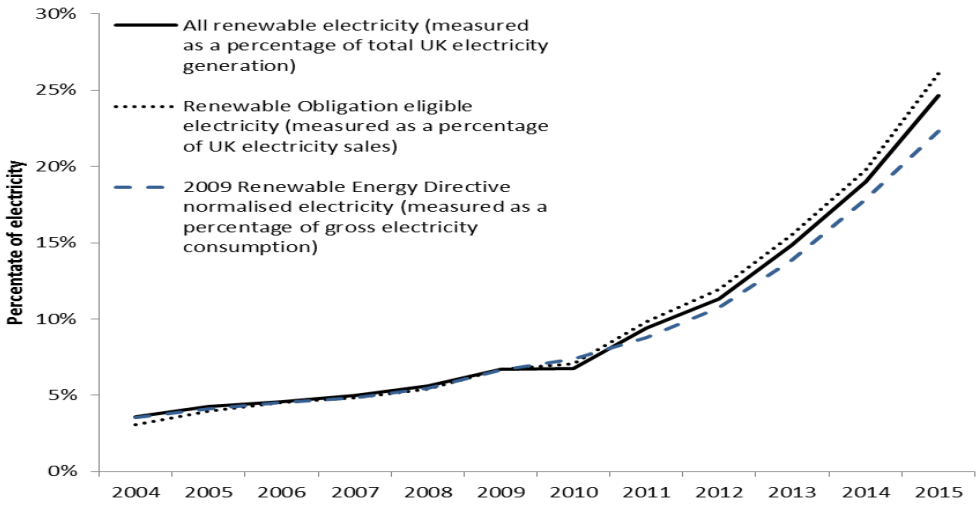
In 2015, the three measures ranged from 22.3 per cent on a RED basis to 26.1 per cent on the RO basis. Table 4 below shows a comparison of the three different measures;

Table 4

	2004	2010	2013	2014	2015
International Basis	3.6%	6.8%	14.9%	19.0%	24.6%
Renewable Obligation	3.1%	7.0%	15.5%	19.8%	26.1%
2009 Renewable Energy Directive	3.5%	7.4%	13.8%	17.9%	22.3%

Load factors in 2015 (see table ET 6.1) for wind and hydro generation were high compared to the previous year and to the long term mean due to high wind speeds and high rainfall in the main catchment areas (see tables ET 7.2 and ET 7.4 respectively for weather data). This increased 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 2 below shows this divergence tendency;

Chart 2: Growth in electricity generation from renewable sources since 2004



Member state comparison of Progress against the Directive

The UK exceeded its second interim target; averaged over 2013 and 2014, at 6.34 per cent against its target of 5.14 per cent. The Third Progress Report, based on 2013 and 2014, was published in January 2016[4].

Eurostat publishes data on how all countries are progressing towards their RED (final and interim) targets. The latest comparative data relates to 2014. The 2014 RED percentage for all EU countries combined was 16.0 per cent, an increase of 1.0 percentage point compared to 2013. Sweden achieved the highest share of energy from renewable sources at of the member states with 53 per cent. From 2013 to 2014, the UK increased its share by 1.4 percentage points, the sixth highest increase across member states.

A third of the member states have now exceeded their 2020 targets; Bulgaria, the Czech Republic, Estonia, Croatia, Italy, Lithuania, Romania, Finland and Sweden.

The finalised 2015 figures for all member states will be published by Eurostat during 2017.

[4] https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports

Taking account of the 2015 result, the UK is now challenged to increase its share of renewable energy by a further 6.7 per cent to meet its 2020 target of 15 per cent. The UK's third interim target is 7.47 per cent averaged across 2015 and 2016 and an initial estimate will be published in June 2017.

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Table 5: Renewable sources used to generate electricity and heat, and for transport fuels [1 (2)]

Thousand tonnes of oil equivalent

	2013	2014	2015
Used to generate electricity *(3)*			
Wind:			
Onshore	1,455.2	1,596.0	1,967.9
Offshore	986.4	1,152.6	1,498.1
Shoreline wave / tidal (4)	0.5	0.2	0.2
Solar photovoltaics	172.7	347.4	650.1
Hydro:	-	-	-
Small scale	58.3	72.2	83.8
Large scale *(5)*	346.2	434.5	456.9
Bioenergy:	-	-	-
Landfill gas	1,692.4	1,654.6	1,598.0
Sewage sludge digestion	249.6	277.4	291.1
Biodegradable energy from waste	564.7	689.9	982.4
Co-firing with fossil fuels	53.7	25.1	37.8
Animal Biomass *(6)*	226.4	224.8	235.3
Anaerobic digestion	238.2	334.1	468.6
Plant Biomass *(7)*	2,009.1	2,912.9	3,847.6
Total bioenergy	5,034.1	6,118.9	7,460.7
Total	**8,053.4**	**9,721.8**	**12,117.8**
Non-biodegradable energy from waste *(8)*	513.1	696.2	988.7
Used to generate heat			
Active solar heating	47.9	49.6	50.7
Bioenergy:			
Landfill gas	13.6	13.6	13.6
Sewage sludge digestion	68.3	67.7	73.1
Wood combustion - domestic	1,790.3	1,698.1	1,906.2
Wood combustion - industrial	374.2	501.4	790.8
Animal Biomass *(9)*	29.1	34.5	30.7
Anaerobic digestion	18.5	42.9	95.5
Plant Biomass *(10)*	346.0	379.0	359.4
Biodegradable energy from waste *(6)*	30.1	23.3	45.7
Total bioenergy	2,670.1	2,760.6	3,315.0
Deep geothermal	0.8	0.8	0.8
Heat Pumps	116.5	142.5	168.3
Total	**2,835.3**	**2,953.5**	**3,534.8**
Non-biodegradable wastes *(8)*	155.0	159.3	158.6
Renewable sources used as transport fuels			
as Bioethanol	462.2	458.8	449.1
as Biodiesel	629.4	783.8	554.1
Total	**1,091.6**	**1,242.7**	**1,003.1**
Total use of renewable sources and wastes			
Solar heating and photovoltaics	220.6	396.9	700.8
Onshore wind	1,455.2	1,596.0	1,967.9
Offshore wind	986.4	1,152.6	1,498.1
Shoreline wave / tidal	0.5	0.2	0.2
Hydro	404.5	506.7	540.7
Bioenergy	7,704.2	8,879.6	10,775.7
Deep geothermal	0.8	0.8	0.8
Heat Pumps	116.5	142.5	168.3
Transport biofuels	1,091.6	1,242.7	1,003.1
Total	**11,980.3**	**13,917.9**	**16,655.7**
Non-biodegradable energy from waste *(8)*	668.1	855.5	1,147.3
All renewables and wastes	**12,648.4**	**14,773.4**	**17,803.0**

(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) 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.