Renewable energy in 2011

Introduction

This article updates the information on renewable energy published in the June 2011 edition of Energy Trends, and in the 2011 edition of the Digest of UK Energy Statistics. It also presents additional information to that provided in the "Section 6 Renewables" section of this edition of Energy Trends, and discusses key policies that impact on the delivery of renewable energy.

Key messages

Renewable energy provisionally accounted for 3.8 per cent of energy consumption, as measured using the 2009 Renewable Energy Directive methodology. This is an increase from the revised 2010 position of 3.2 per cent.

The amount of electricity generated from renewables sources in 2011 was 34,410 GWh, a 33 per cent increase on 2010. Wind generation saw the largest increases – offshore wind up 68 per cent, and onshore wind up 45 per cent. Hydro generation also saw a large increase, up 56 per cent.

Generation capacity increased by 3.1 GW (33 per cent) to 12.3 GW. The main sources of this increase were: solar photovoltaics (up 0.9 GW); plant biomass (up 0.8 GW, mainly due to the conversion of Tilbury B power station to dedicated biomass); onshore wind (up 0.6 GW) and offshore wind (up 0.5 GW).

A number of weather factors had a major impact on renewable electricity generation during 2011; rainfall levels were 84 per cent higher than in 2010 (which was the driest year since 2003). Average windspeeds were 1.4 knots higher than in 2010. Whilst these factors affect the raw 2011 outputs of renewables, the key Renewable Energy Directive measure uses a normalisation approach to smooth the year on year impacts of differing wind and rain patterns.

There are various national and internationally agreed measures of the contribution renewable electricity makes to the generation mix. These show that in 2011:

- 9.7 per cent of electricity sales by licensed suppliers in the UK were from electricity generated from renewables eligible for the Renewables Obligation, up from 7.0 per cent in 2010 *(not normalised).*
- 8.7 per cent of electricity consumption, as measured using the 2009 Renewable Energy Directive methodology, came from eligible renewable sources *(normalised).*
- 9.2 per cent of electricity generation, as measured using the 2001 Renewables Directive methodology, came from eligible renewable sources; if normalisation is used (adopting the 2009 Renewable Energy Directive methodology) the proportion decreases to 8.6 per cent.
- 9.4 per cent of electricity generation measured against the "International Definition" came from renewables *(not normalised).*

Heat from renewable sources increased by 5 per cent during 2011 (to 1,220 ktoe).

Renewable biofuels for transport fell by 7 per cent (to 1,127 ktoe). They accounted for 3.5 per cent by volume of road transport fuels in 2011. Bioethanol, as a proportion of motor spirit, increased by 0.3 percentage points to 3.3 per cent, whilst biodiesel as a proportion of DERV fell by 0.5 percentage points to 3.6 per cent.

Data collection and methodology

The UK collection of renewable energy statistics began in 1989, when all relevant renewable energy sources were identified and, where possible, information was collected on the amounts of energy derived from each source.

The Renewable Energy STATisticS (RESTATS) database now contains 23 years of data from 1989 to 2011 and this database has been used to provide the detailed figures on renewable

sources of energy contained within this article and also within the forthcoming 2012 edition of the Digest of UK Energy Statistics, to be published on 26 July 2012.

EU Renewable Energy Directive

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 the EU's energy to come from renewable sources by 2020. During 2008 a Directive was negotiated on this basis and resulted in the agreement of country "shares" of this target being included in the final 2009 Renewable Energy Directive. For the UK, 15 per cent of **final energy consumption** - calculated on a net calorific basis, and with a cap on fuel used for air transport - should be accounted for by energy from renewable sources. This Directive super-ceded the 2001 Renewables Directive, which focused on electricity, and allocated the UK a 10 per cent target for the contribution of renewables as a proportion of electricity consumption during 2010. In reporting against this measure, normalised wind and rain is used. Some of the key policy measures that the UK have to increase renewable deployment are shown on pages 55 and 56 of this article.

The normalisation approach.

Generation from wind and hydro sources are very dependent on the weather (wind speeds and rainfall). In order to negate the effects of variable generation due to weather differentials from one year to the next, the 2009 Renewable Energy Directive measure specifies the normalisation of wind and hydro generation. Normalisation is carried out by calculating generation by applying an average load factor to current capacity. For wind, the load factor is calculated as the average of the past five years (including the present one), with current capacity taken as an 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. The generation figures obtained from this procedure replace the actual generation figures for wind and hydro in the RED calculation. The same method is now also applied to the 2001 Renewables Directive measure.

Renewable electricity generation

Section 6 of the March 2012 edition of Energy Trends contained provisional estimates for three key measures of the share of electricity obtained from renewable sources. These data have now been revised following receipt of new data, and two additional measures have been added. All five measures are shown in Table 1. On the "international definition basis" renewables provided 9.4 per cent of the electricity generated in the United Kingdom in 2011, a 2.6 percentage point increase on the 2010 proportion. Total electricity generation from renewables in 2011 amounted to 34,410 GWh, an increase of 8,565 GWh (33 per cent) on 2010. Chart 1 shows the growth in the proportion of electricity generation from renewable sources and also progress under the Renewables Obligation (RO), which is measured as a proportion of UK electricity sales; the RO measure grew by 2.7 percentage points to 9.7 per cent in 2011.

The 2001 EU Renewables Directive measures the renewable contribution of electricity as the proportion of renewable electricity generated (except from non-biodegradable waste) as a percentage of electricity consumption. The 2009 Renewable Energy Directive introduced a fourth measure, which involves normalising wind and hydro generation over 5 and 15 periods respectively, and measuring against gross electricity consumption. An additional fifth measure has also been proposed, applying the above normalising approach to the 2001 Renewables Directive measure. In 2010 the measures which were normalised showed larger growth than the non-normalised measures; this was to be expected as the very low rainfall and wind speeds were adjusted to take account of the higher load factors during the previous time periods. In 2011, the higher wind speeds and rain fall resulted in the normalised measures showing lower increases than non-normalised measures. The normalised Renewables Directive measure increased by 1.4 percentage points to 8.6 per cent, with the non-normalised measure increasing by 2.5 percentage points to 9.2 percent. The electricity component of the Renewable Energy Directive increased by 1.4 percentage points, to 8.7 per cent.

The normalised electricity component of the 2009 Renewable Energy Directive measure is also shown in this Chart 1; by comparing this line with the non-normalised lines, it clearly illustrates the impact that low wind speeds and little rain had on renewable electricity generation in 2010, and how this was reversed in 2011.

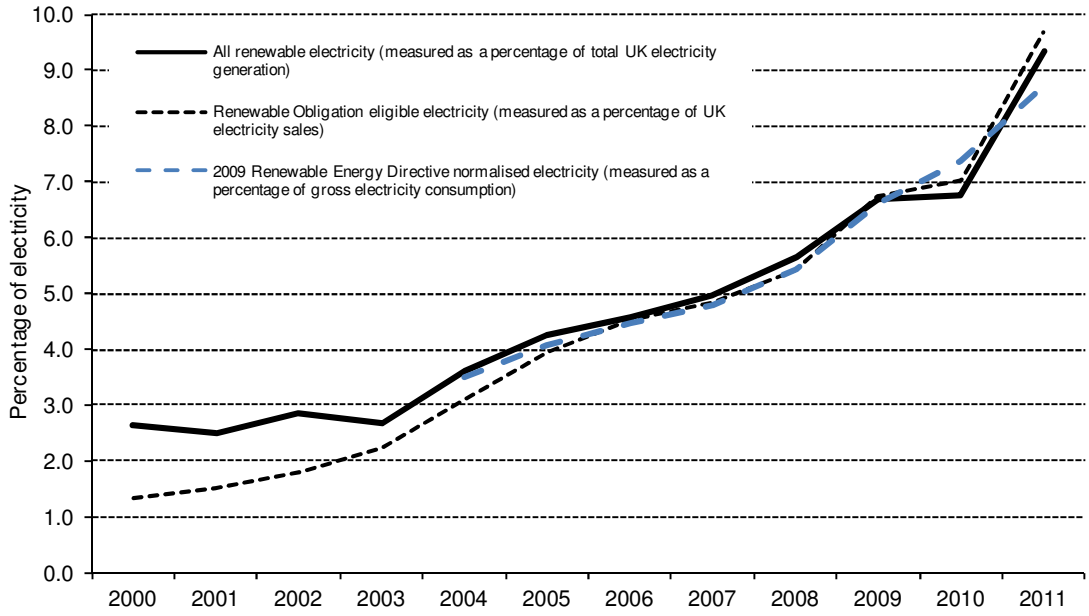
Table 1: Percentages of electricity derived from renewable sources

	2005	2006	2007	2008	2009	2010	2011
Overall renewables percentage – International basis (Electricity generated from all renewables except non-biodegradable wastes, as a percentage of all **electricity generated** in the UK)	4.3	4.6	5.0	5.6	6.7	6.8	9.4
Percentage on a Renewables Obligation basis (Electricity generated from renewables eligible for the Renewables Obligation as a percentage of **electricity sales** by licensed suppliers in the UK)	3.9	4.5	4.8	5.4	6.7	7.0	9.7
Percentage on a 2009 Renewable Energy Directive basis (*Normalised* hydro & wind generation combined with actual generation from other sources except non-biodegradable wastes, as a percentage of UK **gross electricity consumption, calculated on a net calorific value basis**)	4.1	4.5	4.8	5.4	6.6	7.4	8.7
Percentage on a 2001 Renewables Directive basis (original methodology) (Electricity generated from renewable sources eligible under the 2001 EU Directive - i.e. all renewables except non-biodegradable wastes, as a percentage of UK **electricity demand**)	4.2	4.5	4.9	5.5	6.7	6.7	9.2
Percentage on a 2001 Renewables Directive basis (normalised methodology) (*Normalised* hydro & wind generation combined with actual generation from other sources except non-biodegradable wastes, as a percentage of UK **electricity demand**)	4.1	4.4	4.7	5.4	6.6	7.3	8.6

The largest absolute increase in generation came from onshore wind, rising by 3,235 GWh to 10,372 GWh (a 45 per cent increase on the previous year), reflecting increased installed capacity over the course of the year and also higher average wind speeds. Similar factors helped offshore wind generation contribute the second largest absolute increase, by 2,082 GWh to 5,126 GWh (68 per cent higher). There was a further 2,043 GWh increase in generation from hydro schemes, with the total contribution of hydro amounting to 5,686 GWh during the year, 56 per cent higher than during 2010. Additionally, co-firing of renewables with fossil fuels contributed 27 per cent more electricity, an increase of 631 GWh to 2,964 GWh in 2011.

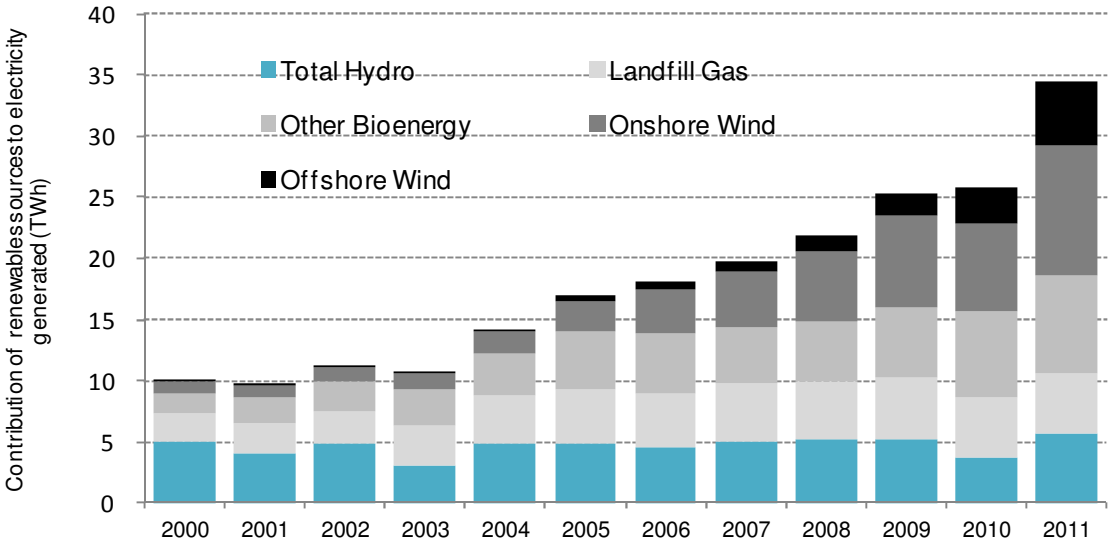
Other sources showing large increases – but from smaller initial levels - included solar photovoltaics (an increase of 219 GWh, 658 per cent higher), anaerobic digestion (147 GWh, 159 per cent higher), biodegradable municipal solid waste (141 GWh, 9 per cent higher), plant biomass (58 GWh, 4 per cent higher), and sewage sludge digestion (57 GWh, 8 per cent higher). There were small reductions in generation from landfill gas (35 GWh lower), and animal biomass (13 GWh lower).

Chart 1: Growth in electricity generation from renewable sources since 2000



Wind continued to be the leading individual technology for the generation of electricity from renewable sources during 2011 with 45 per cent of renewables generation coming from this source; a further 17 per cent came from hydro. However the combined generation from the variety of different bioenergy sources accounted for 38 per cent of renewable generation, with landfill gas accounting almost two-fifths of the biomass generation. Total generation from bioenergy sources was 8 per cent higher than in 2010, with wind being 52 per cent higher and hydro's contribution 56 per cent higher. Chart 2 shows the growth in generation, by main renewable source, since 2000.

Chart 2: Electricity generation by main renewable source since 2000



Note: Onshore Wind bar includes solar PV (0.25 TWh in 2011);
Hydro bar includes shoreline wave/tidal (0.001TWh in 2011)

Renewable electricity capacity

Total renewable electricity capacity at the end of 2011, as shown in Table 4 at the end of this article, amounted to 12.3 GW, compared with 9.2 GW in 2010; this excludes the capacity within conventional generation station that was used for co-firing (a further 0.3 GW). The largest contributor towards this 3.1 GW (33 per cent) capacity increase was 899 MW from solar PV, representing a more than 11 fold increase on the capacity installed at the end of 2010, resulting from the inclusion of this form of generation in the Feed-in Tariff scheme. Other main contributors to the increase were 829 MW from plant biomass (of which 750 MW was due to the conversion of Tilbury B's, previously coal-fired, power station to dedicated biomass in December 2011); 614 MW (+15 per cent) from onshore wind, and 497 MW (+37 per cent) from offshore wind. In capacity terms, wind was the leading technology at the end of 2011, with hydro second, followed by plant biomass and landfill gas. Fifty three per cent of renewable electricity capacity at the end of 2011 was from wind, 14 per cent from hydro, and around 9 per cent each from plant biomass and landfill gas.

Load factors

Load factors are usually calculated in terms of installed capacity, and express the average hourly quantity of electricity generated as a percentage of the average capacity at the beginning and end of the year. A summary of load factors for various technologies during 2009 to 2011 are presented in Table 2. In addition to the traditionally calculated load factors (which use a denominator capacity of the mean beginning and end year values), additional load factors are also calculated showing the load factors restricted to those schemes that have operated throughout the calendar year with an unchanged configuration. As mentioned earlier in this article, low wind speeds and rainfall had a major impact on load factors during 2010. The falling load factors for solar photovoltaics are due to large increases in capacity in the final months of both 2010 and 2011, which were not contributing to generation during the year. An unchanged configuration calculation is not currently available for this technology. The conversion of Tilbury B's previously coal-fired power station to dedicated biomass in December 2011 had a significant impact on reducing the traditional basis bioenergy load factor.

Table 2: Load factors for various renewable technologies

	Traditional basis			Unchanged configuration basis		
Technology	**2009**	**2010**	**2011**	**2009**	**2010**	**2011**
Onshore wind	27.4%	21.7%	27.3%	26.5%	21.6%	27.2%
Offshore wind	26.0%	30.4%	36.8%	32.1%	29.5%	35.0%
Solar photovoltaics	9.3%	7.3%	5.5%	n/a	n/a	n/a
Hydro	36.7%	25.4%	39.1%	38.2%	26.4%	41.7%
Bioenergy (excluding co-firing and non-biodegradable wastes)	54.9%	53.5%	43.1%	60.4%	59.8%	61.0%

The load factors reported above were partly calculated using data on ROCs produced by Ofgem. Ofgem reconcile their data on a financial year basis; at the time that this article was written the ROC data for 2011 was still provisional. In particular this can have an impact on the schemes included in the unchanged configuration definition as new data could include or remove particular schemes. This should be kept in mind if users subsequently reanalyse these results.

Heat production

Around 14 per cent of renewable sources were used to generate heat during 2011. The four categories of renewable heat production in the United Kingdom are the direct combustion of various forms of bioenergy (88 per cent of the total), active solar heating, geothermal aquifers, and heat pumps. Together they produced energy equivalent to 1,220 thousand tonnes of oil equivalent in 2011, a 5 per cent increase during the year. Renewable heat sources accounted for around 2.2 per cent of total heat demand in 2011.

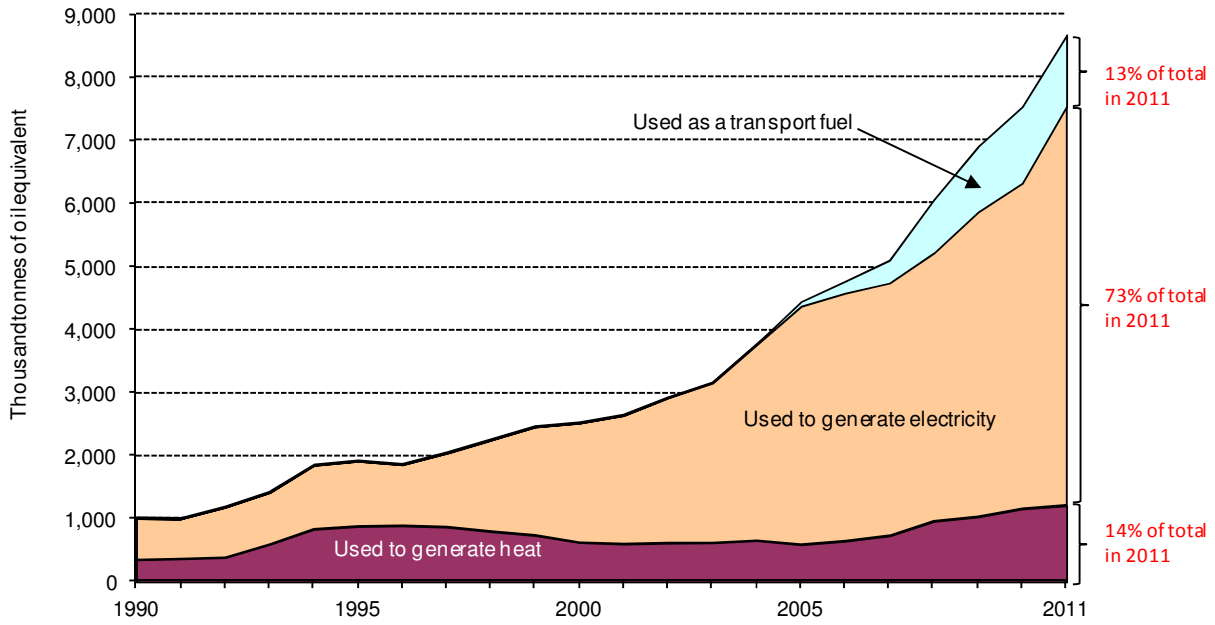
Renewables used to generate heat have shown some growth in recent years, following a decline that started more than 10 years ago as a result of tighter emission controls which discouraged on-site burning of biomass, especially wood waste. Further significant growth in this area is

anticipated, especially in the industrial and domestic wood use sectors, together with additional heat pumps, as a result of the Renewable Heat Incentive and Renewable Heat Premium Payment schemes; however they only had a minor impact during 2011. Domestic use of wood is the main contributor to renewables used for heat – comprising around 35 per cent of the renewable heat total. Non-domestic use of wood and wood waste, and plant biomass formed the next largest components, at around 23 per cent and 20 per cent respectively.

Liquid biofuels for transport

Liquid biofuels for transport comprised around 13 per cent of total renewable sources. Two road transport fuels, biodiesel and bioethanol, are sold blended with diesel and petrol. Figures from HM Revenue and Customs based on road fuel taxation statistics show that 925 million litres of biodiesel and 652 million litres of bioethanol were consumed in 2011; biodiesel consumption was 12 per cent lower than in 2010, whilst bioethanol consumption was 3 per cent higher. Biodiesel has a higher energy content than bioethanol meaning that the combined total energy content of these fuels equates to 1,128 ktoe. During 2011 biodiesel accounted for 3.6 per cent of diesel, and bioethanol 3.3 per cent of motor spirit; the combined contribution of biodiesel and bioethanol was 3.5 per cent by volume, 0.1 percentage points lower than in 2010.

Chart 3: Trends in the use of renewable energy for heat, electricity, and transport



All renewable fuels

When renewables used for transport and heat are combined with the use of renewable sources for electricity generation, renewable sources accounted for 4.1 per cent of the United Kingdom's total primary energy requirements in 2011, up from 3.3 per cent in 2010. Use of non-biodegradable wastes accounted for an additional 0.3 per cent of primary energy. The trends in the use of renewable energy for transport, heat and electricity are shown in Chart 3; data are shown in table 5 at the end of the article disaggregating the totals by various technologies.

On the basis proposed by Eurostat for measuring progress towards the 2009 Renewable Energy Directive, provisionally in the UK during 2011, 3.8 per cent of final energy consumption was from renewable sources. This is an increase from the revised 2010 figure of 3.2 per cent, and 3.0 per cent in 2009. The Eurostat methodology, as mentioned earlier in this article, measures energy based on a net calorific value basis, as opposed to a gross basis that is generally used in presenting data in Energy Trends and the Digest of UK Energy Statistics. The methodology also

includes a cap on energy required for aviation use and normalisation for wind and hydro electricity. In addition to the headline figure, the Directive monitors three constituent parts separately, and these are shown in Table 3. It should be noted that the overall figure is not a simple calculation based around the three constituent parts. The finalised 2011 figures for all member states will be published by Eurostat during 2013.

Table 3: Progress against the 2009 Renewable Energy Directive

	2005	2006	2007	2008	2009	2010	2011
Percentage of electricity from renewable sources (normalised)	4.1	4.5	4.8	5.4	6.6	7.4	8.7
Percentage of heating and cooling from renewable sources	0.9	1.0	1.1	1.4	1.7	1.7	2.2
Percentage of transport energy from renewable sources	0.3	0.5	0.9	2.1	2.6	3.0	2.9
Overall renewable consumption as a percentage of capped gross final energy consumption using net calorific values (normalised)	**1.4**	**1.6**	**1.8**	**2.4**	**3.0**	**3.2**	**3.8**

UK renewables policy

The United Kingdom has a number of policy measures to further increase renewables deployment. These include:

- Putting in place appropriate financial incentives to bring forward and support the take-up of renewable energy, including the "banded" Renewables Obligation (RO), Feed-in Tariffs (FiTs) for small scale (under 5 MW) electricity generation, the launch of the Renewable Heat Incentive (RHI) tariff scheme (for industry, commercial premises and the public sector) in November 2011, and the Renewable Heat Premium Payment Scheme (for households);
- Identifying and removing the most significant non-financial barriers to renewables deployment, including measures to improve existing grid connection arrangements; and
- Overcoming supply chain blockages and promoting business opportunities in the renewables sector in the UK.

The Renewables Obligation (RO)

The Renewables Obligation[1] is an obligation on electricity suppliers to source a specific and annually increasing proportion of electricity from eligible renewable sources or pay a penalty; this is intended to incentivise an increase in the level of renewable generating capacity and so contribute to our climate change targets.

The Office for Gas and Electricity Markets (Ofgem), which administers the RO, issues **Renewables Obligation Certificates** (ROCs) to qualifying renewables. These certificates may be sold by generators directly to licensed electricity suppliers or traders. ROCs can be traded separately from the electricity to which they relate. Suppliers present ROCs to Ofgem to demonstrate their compliance with the obligation.

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, relative market maturity, and potential for large scale deployment. A list of technologies eligible for the RO, and

[1] 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.

the level of ROCs received, is available at:
www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/ro_support/ro_support.aspx

Feed-in Tariffs (FiTs)
Feed-in tariffs are a financial support scheme for eligible low-carbon electricity technologies, aimed at small-scale installations with a capacity of less than 5 Megawatts (MW). FiTs support new anaerobic digestion (AD), solar photovoltaic, small hydro and wind, by requiring electricity suppliers to make payments (generation tariffs) to these generators based on the number of kilowatt hours (kWh) they generate. An additional guaranteed export tariff of 3.2p per kWh is paid for electricity generated that is not used on site and exported to the grid. The scheme also supports micro combined heat and power installations with an electrical capacity of 2kW or less, as a pilot programme.

A comprehensive review of the FiTs scheme was launched in February 2012 and had two parts, the first considered support for solar PV and the second other technologies and administrative issues. On 24 May 2012 DECC announced new tariffs for solar PV, to come into effect from 1 August 2012, with further announcements due later in the year relating to other technologies. Any changes implemented as a result of the review will only affect new entrants to the scheme and there is no intention to retrospectively adjust support levels. Policy information and statistical reports relating to FiTs can be found at:
www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/feedin_tariff/feedin_tariff.aspx and www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/fits/fits.aspx respectively.

Renewable Heat Incentive (RHI) and Renewable Heat Premium Payment (RHPP)
On 28 November 2011, the Renewable Heat Incentive opened for applications. The scheme provides tariffs for commercial, industrial and community renewable heating installations. For renewable heating in households the Renewable Heat Premium Payment was launched in August 2011 and extended in April 2012 to run until the end of the 2012/13 financial year. Details of the technologies supported by these schemes can be found at:
www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx

Renewable Transport Fuel Obligation (RTFO)
The Renewable Transport Fuel Obligation introduced in April 2008, placed a legal requirement on transport fuel suppliers (who supply more than 450,000 litres of fossil fuel per annum to the UK market) to ensure that 5 per cent (by volume) of their overall fuel sales are from a renewable source by 2013/14, with incremental levels starting from of 2.5 per cent (by volume) for 2008/09.

Regional statistics

A further renewable statistics article will be produced in the September 2012 edition of Energy Trends, containing a regional breakdown of the renewable electricity generation and capacity statistics. The data will also be available on the RESTATS website at:
https://restats.decc.gov.uk/cms/regional-renewable-statistics/

For further information on renewable energy statistics please contact any of the following

Julian Prime
DECC Energy Statistics
Tel: 0300 068 5054
E-mail: julian.prime@decc.gsi.gov.uk

James Hemingway
DECC Electricity Statistics
Tel: 0300 068 5042
E-mail: james.hemingway@decc.gsi.gov.uk

Steve Dagnall
AEA
Tel: 0870 190 6092
E-mail: steve.dagnall@aeat.co.uk

Table 4: Capacity of, and electricity generated from, renewable sources

	2009	2010	2011
Installed Capacity (MWe)			
Wind:			
Onshore	3,483.2	4,036.7	4,650.4
Offshore	941.2	1,341.2	1,838.0
Shoreline wave / tidal	2.5	2.6	3.1
Solar photovoltaics	26.5	76.9	975.8
Hydro:			
Small scale	178.6	187.7	204.7
Large scale *(1)*	1,458.5	1,452.9	1,470.9
Bioenergy:			
Landfill gas	984.9	1,024.6	1,066.7
Sewage sludge digestion	156.9	185.7	197.5
Municipal solid waste combustion *(2)*	417.6	461.0	577.4
Animal Biomass (non-AD) *(3)*	110.5	110.5	110.5
Anaerobic digestion	8.8	28.1	55.2
Plant Biomass *(4)*	299.8	330.2	1,159.5
Total bioenergy and wastes	1,978.6	2,140.0	3,166.8
Total	**8,069.1**	**9,238.0**	**12,309.7**
Co-firing (5)	207.7	266.2	338.2
Generation (GWh)			
Wind:			
Onshore *(6)*	7,564	7,137	10,372
Offshore	1,740	3,044	5,126
Shoreline wave / tidal *(7)*	1	2	1
Solar photovoltaics	20	33	252
Hydro:			
Small scale *(6)*	577	497	697
Large scale *(1)*	4,664	3,147	4,989
Bioenergy:			
Landfill gas	4,952	5,014	4,979
Sewage sludge digestion	598	698	755
Biodegradable municipal solid waste combustion *(8)*	1,509	1,597	1,739
Co-firing with fossil fuels	1,625	2,332	2,964
Animal Biomass *(3)*	637	627	614
Anaerobic digestion	30	92	239
Plant Biomass *(4)*	1,343	1,624	1,683
Total bioenergy	10,694	11,986	12,973
Total generation	**25,259**	**25,845**	**34,410**
Non-biodegradable wastes *(9)*	873	924	1,005
Total generation from sources eligible for the Renewable Obligation *(10)*	21,102	22,465	29,804

(1) Excluding pumped storage stations. Capacities are as at the end of December.

(2) Includes waste tyres and hospital waste.

(3) Includes the use of poultry litter and meat & bone.

(4) Includes the use of straw combustion and short rotation coppice energy crops.

(5) 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.

(6) Actual generation figures are given where available, but otherwise are estimated using a typical load factor or the design load factor, where known.

(7) Includes electricity from the EMEC test facility.

(8) Biodegradable part only.

(9) Non-biodegradable part of municipal solid waste plus waste tyres, hosptal waste and general industrial waste.

(10) See pages 56 and 57 for definition and coverage.

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

	Thousand tonnes of oil equivalent		
	2009	2010	2011
Used to generate electricity *(3)*			
Wind:			
Onshore	650.4	613.7	891.8
Offshore	149.6	261.7	440.7
Shoreline wave / tidal (4)	0.1	0.2	0.1
Solar photovoltaics	1.7	2.9	21.6
Hydro:			
Small scale	49.6	42.7	60.0
Large scale *(5)*	401.0	270.6	429.0
Bioenergy:			
Landfill gas	1,624.2	1,644.5	1,633.1
Sewage sludge digestion	196.1	228.8	247.6
Biodegradable municipal solid waste combustion	624.5	659.0	717.3
Co-firing with fossil fuels	533.0	765.0	972.0
Animal Biomass *(6)*	222.2	229.0	215.3
Anaerobic digestion	9.7	30.3	78.5
Plant Biomass *(7)*	367.3	412.3	620.3
Total bioenergy	3,576.9	3,968.8	4,484.1
Total	**4,829.3**	**5,160.5**	**6,327.4**
Non-biodegradable wastes *(8)*	368.6	388.4	422.0
Used to generate heat			
Active solar heating	69.5	87.0	109.3
Bioenergy:			
Landfill gas	13.6	13.6	13.6
Sewage sludge digestion	51.0	57.8	66.1
Wood combustion - domestic	375.2	391.8	425.0
Wood combustion - industrial	223.4	255.7	280.6
Animal Biomass *(9)*	38.3	40.3	-
Anaerobic digestion	2.0	4.8	9.8
Plant Biomass *(10)*	223.8	266.4	249.1
Biodegradable municipal solid waste combustion *(6)*	31.3	25.6	32.7
Total bioenergy	958.5	1,055.9	1,076.8
Geothermal aquifers	0.8	0.8	0.8
Heat Pumps	10.9	21.2	32.5
Total	**1,039.7**	**1,165.0**	**1,219.5**
Non-biodegradable wastes *(8)*	140.4	131.5	204.0
Renewable sources used as transport fuels			
as Bioethanol	180.4	355.4	367.5
as Biodiesel	858.1	859.0	760.0
Total	**1,038.5**	**1,214.4**	**1,127.5**
Total use of renewable sources and wastes			
Solar heating and photovoltaics	71.2	89.8	131.0
Onshore wind	650.4	613.7	891.8
Offshore wind	149.6	261.7	440.7
Shoreline wave / tidal	0.1	0.2	0.1
Hydro	450.6	313.3	489.0
Bioenergy	4,535.4	5,024.8	5,561.0
Geothermal aquifers	0.8	0.8	0.8
Heat Pumps	10.9	21.2	32.5
Transport biofuels	1,038.5	1,214.4	1,127.5
Total	**6,907.5**	**7,539.9**	**8,674.4**
Non-biodegradable wastes *(8)*	509.0	520.0	626.0
All renewables and wastes	**7,416.4**	**8,059.9**	**9,300.4**

(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.