Renewable energy in 2012

Introduction

This article updates the information on renewable energy published in the June 2012 edition of Energy Trends, and in the 2012 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, including an early indication of the UK's progress against the Renewable Energy Directive, and discusses key policies that impact on the delivery of renewable energy.

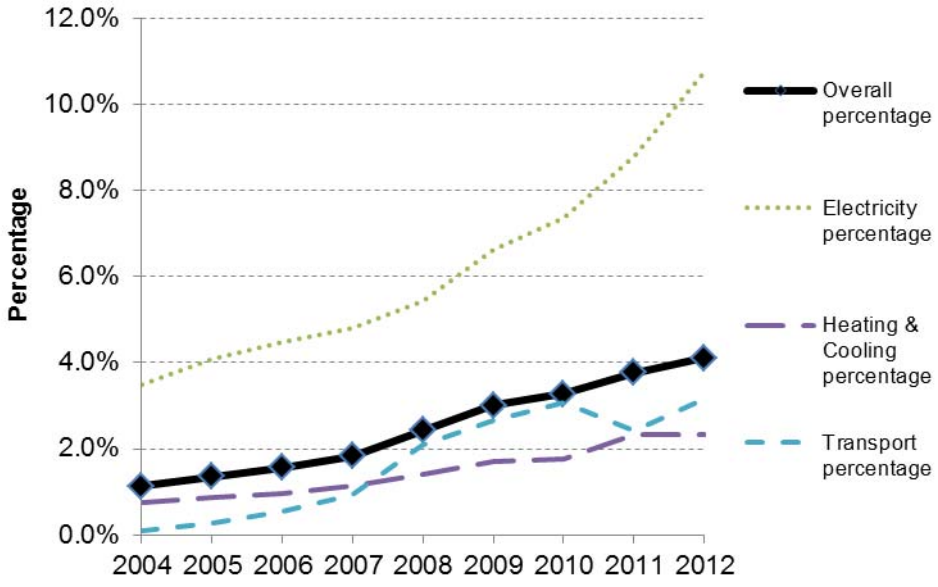
Key messages

In 2012 renewable energy provisionally accounted for 4.1 per cent of energy consumption, as measured using the 2009 Renewable Energy Directive methodology. This is an increase from the 2011 position of 3.8 per cent. There was a significant growth in the contribution of renewable electricity, the renewable heating contribution remained constant, but the renewable transport contribution fell. Whilst the 2012 figure is greater than the first interim target of 4.04 per cent as set out in the Directive, that target is defined as a 2011-2012 target. Calculating the average contribution across these two years shows that provisionally the UK achieved 3.94 per cent, thus falling short by 275 ktoe (or 3,200 GWh) of Directive compliant renewable energy.

The methodology for the derivation of interim targets was specified in the Directive. For the UK this resulted in a target of 4.04 per cent. DECC's normal practise in reporting deployment of renewables is to calculate rates to 1 decimal place, which recognises the uncertainty in estimates of both renewables and final energy consumption; methodology notes on the DECC statistics website give further details. As such whilst the estimate of 3.94 per cent is our best estimate, users should be aware that the uncertainty attached to this estimate would cover the 275 ktoe shortfall between this figure and the target.

The amount of electricity generated from renewables sources in 2012 was 41,258 GWh, a 19 per cent increase on 2011. Generation from solar photovoltaics was almost 4 times higher than in 2011, and plant biomass generation more than doubled. Wind generation also had large increases – offshore wind up 46 per cent, and onshore wind up 17 per cent, taking total wind generation to 19,584 GWh (47 per cent of the total), compared with 37 per cent for bioenergy, 13 per cent for hydro and 3 per cent for solar photovoltaics. The increases in wind generation were driven by growth in installed capacity rather than from increased operation from existing capacity (i.e. not from significant changes in load factors). Hydro generation fell by 7 per cent.

Chart 1: Progress against Renewable Energy Directive



Generation capacity increased by 3.3 GW (27 per cent) to 15.5 GW. The main sources of this increase were onshore wind (up 1.3 GW), offshore wind (up 1.2 GW) and solar photovoltaics (up 0.7 GW).

A number of weather factors had a major impact on renewable electricity generation during 2012; average rainfall levels in hydro catchment areas were 24 per cent lower than in 2011, but at a similar level to the average between 2002 and 2011. Average windspeeds were 0.8 knots lower than in 2011, and 0.6 knots lower than the 10 year average. Whilst these factors affect the raw 2012 generation outputs of renewables, the 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, all of which grew to over 10 per cent for the first time in 2012.

Heat from renewable sources increased by 7 per cent during 2012 (to 1,409 ktoe).This includes heat supported by the Renewable Heat Incentive and Renewable Heat Premium Payment schemes.

Renewable biofuels for transport fell by 15 per cent (to 958 ktoe), accounting for 3.1 per cent by volume of road transport fuels in 2012. Bioethanol, as a proportion of motor spirit, increased by 0.8 percentage points to 4.1 per cent, whilst biodiesel as a proportion of DERV fell by 1.2 percentage points to 2.4 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 24 years of data from 1989 to 2012 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 2013 edition of the Digest of UK Energy Statistics, to be published on 25 July 2013.

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.

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 (i.e. excluding the energy required to evaporate the water content from the fuel), and with a cap on fuel used for air transport - should be accounted for by energy from renewable sources. Interim targets were set for each member state; the first interim

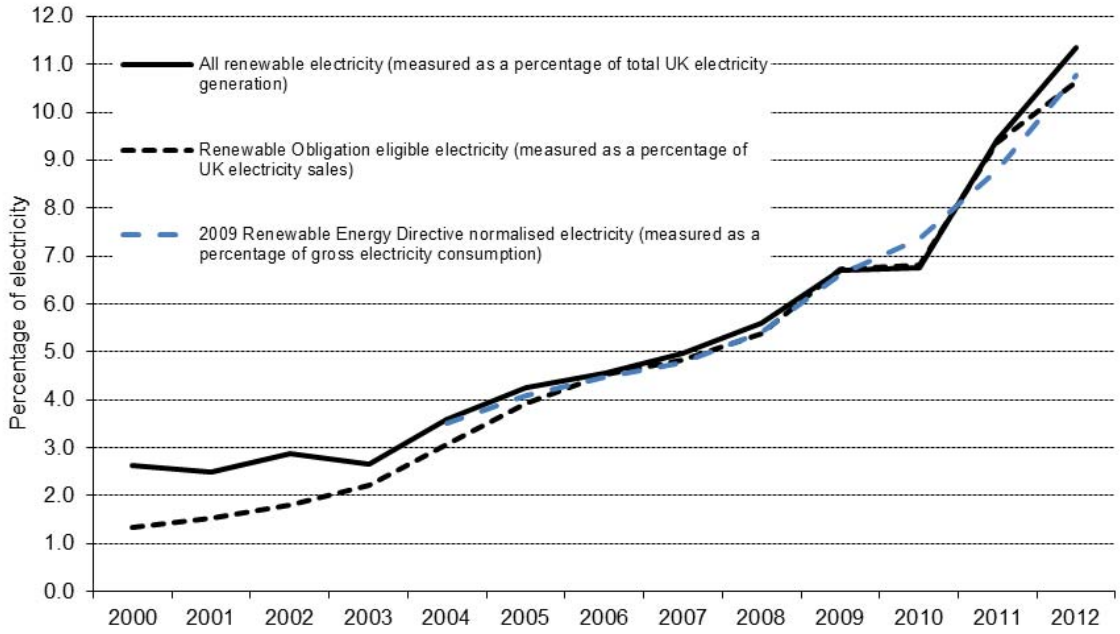
target for the UK was for an average of 4.04 per cent to be achieved across the two calendar years 2011 and 2012. This Directive super-ceded the 2001 Renewables Directive - which focused on electricity - and allocated the UK a 10 per cent target for renewable electricity for 2010. In reporting against these measures, 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.

Renewable electricity targets

Section 6 of the March 2013 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 at the end of this article. On the "international definition basis" renewables provided 11.3 per cent of the electricity generated in the United Kingdom in 2012, a 1.9 percentage point increase on the 2011 proportion. Total electricity generation from renewables in 2012, as shown in Table 3 at the end of this article, amounted to 41,258 GWh, an increase of 6,613 GWh (19 per cent) on 2011. Chart 2 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 1.2 percentage points to 10.6 per cent in 2012.

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 year 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 2011, higher average wind speeds and rain fall resulted in the normalised measures showing lower increases than non-normalised measures; however this pattern was reversed in 2012. The normalised Renewables Directive measure increased by 2.0 percentage points to 10.7 per cent, with the non-normalised measure increasing by 1.7 percentage points to 11.0 per cent, thus exceeding the 10 per cent target set in the Directive for 2010. The normalised electricity component of the Renewable Energy Directive increased by 2.0 percentage points, to 10.8 per cent. Future updates of this article will not report the 2001 Renewables Directive measure.

Chart 2: Growth in electricity generation from renewable sources since 2000



The normalised electricity component of the 2009 Renewable Energy Directive measure is also shown in Chart 2; by comparing this line with the non-normalised lines, it illustrates the impact that

low wind speeds and little rain had on renewable electricity generation in 2010, and how this was reversed in 2011, returning to more normal levels in 2012.

Renewable electricity generation

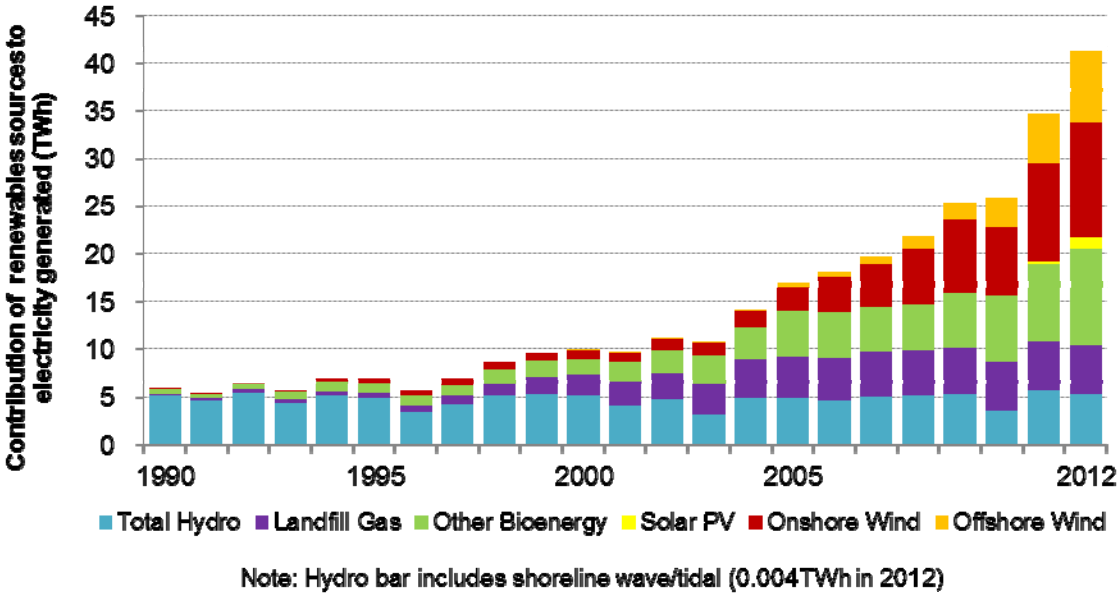
The largest absolute increase in generation came from plant biomass, rising by 2,348 GWh to 4,098 GWh, more than double the previous years contribution; this is due to the conversion of Tilbury B's, previously coal-fired, power station to dedicated biomass in December 2011. Greater capacity also increased generation from offshore wind - raising output by 2,337 GWh to 7,463 GWh (a 46 per cent increase on the previous year). Similar factors helped onshore wind generation contribute the third largest absolute increase, of 1,737 GWh to 12,121 GWh (17 per cent higher). Greater uptake of solar photovoltaics, supported by the Feed-in tariff scheme, led to generation in 2012 up four times on 2011 (by 944 GWh to 1,188 GWh). Generation from biodegradable waste increased by 540 GWh to 2,279 GWh (31 per cent higher).

Other sources showing increases during the year included anaerobic digestion (an increase of 245 GWh, 88 per cent higher), landfill gas (62 GWh, 1 per cent higher) and animal biomass (28 GWh, 5 per cent higher).

There were reductions in generation from co-firing renewables with fossil fuels (1,181 GWh lower mainly due to Drax burning much less biomass with coal), hydro (406 GWh lower due to reduced rain fall) and sewage sludge digestion (44 GWh lower).

Onshore wind continued to be the leading individual technology for the generation of electricity from renewable sources during 2012 with 29 per cent of renewables generation coming from this source; a further 18 per cent came from offshore wind, and 13 per cent came from hydro. However the combined generation from the variety of different bioenergy sources accounted for 37 per cent of renewable generation, with landfill gas accounting for one-third of the bioenergy generation. Despite the large annual increase, just 3 per cent of renewable generation came from solar photovoltaics. Total generation from bioenergy sources was 15 per cent higher than in 2011, with wind being 26 per cent higher, whilst hydro's contribution was 7 per cent lower. Chart 3 shows the growth in generation, by main renewable source, since 1990.

Chart 3: Electricity generation by main renewable source since 1990



Note: Hydro bar includes shoreline wave/tidal (0.004TWh in 2012)

Renewable electricity capacity

Total renewable electricity capacity at the end of 2012, as shown in Table 3, amounted to 15.5 GW, compared with 12.3 GW in 2011; this excludes the capacity within conventional generation station that was used for co-firing (a further 0.2 GW). The largest contributor towards this 27 per cent capacity increase was 1,256 MW from onshore wind, with a further 1,157 MW from offshore wind; capacity from solar photovoltaics increased by 713 MW. In capacity terms, onshore wind accounted for 38 per cent of capacity, followed by offshore wind (19 per cent), solar photovoltaics and hydro (11 per cent each), plant biomass (8 per cent) and landfill gas (7 per cent).

Load factors

Load factors express the average hourly quantity of electricity generated as a percentage of the average capacity at the beginning and end of the year. Load factors for most technologies during 2010 to 2012 are presented in Table 4. As well as the traditionally calculated load factors, additional load factors are also calculated only for those schemes that have operated throughout the calendar year with an unchanged configuration. These differences are particularly prominent for plant biomass, where the large capacity (750MW) and operational changes in 2011 at the Tilbury generation station, and the fire there during 2012, reduced traditionally calculated load factors. Wind speeds and rainfall levels have also had a major impact on load factors.

The load factors reported in Table 4 draw on data on ROCs produced by Ofgem, but at the time that this article was written the ROC data for 2012 were 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 15 per cent of renewable sources were used to generate heat during 2012. The four categories of renewable heat production in the United Kingdom are the direct combustion of various forms of bioenergy (85 per cent of the total), active solar heating, geothermal aquifers, and heat pumps. Together they produced energy equivalent to 1,409 thousand tonnes of oil equivalent (or 16.4 TWh) in 2012, a 7 per cent increase during the year. Using the Renewable Energy Directive methodology, renewable heat sources accounted for 2.3 per cent of total heat demand in 2012, a similar proportion to 2011.

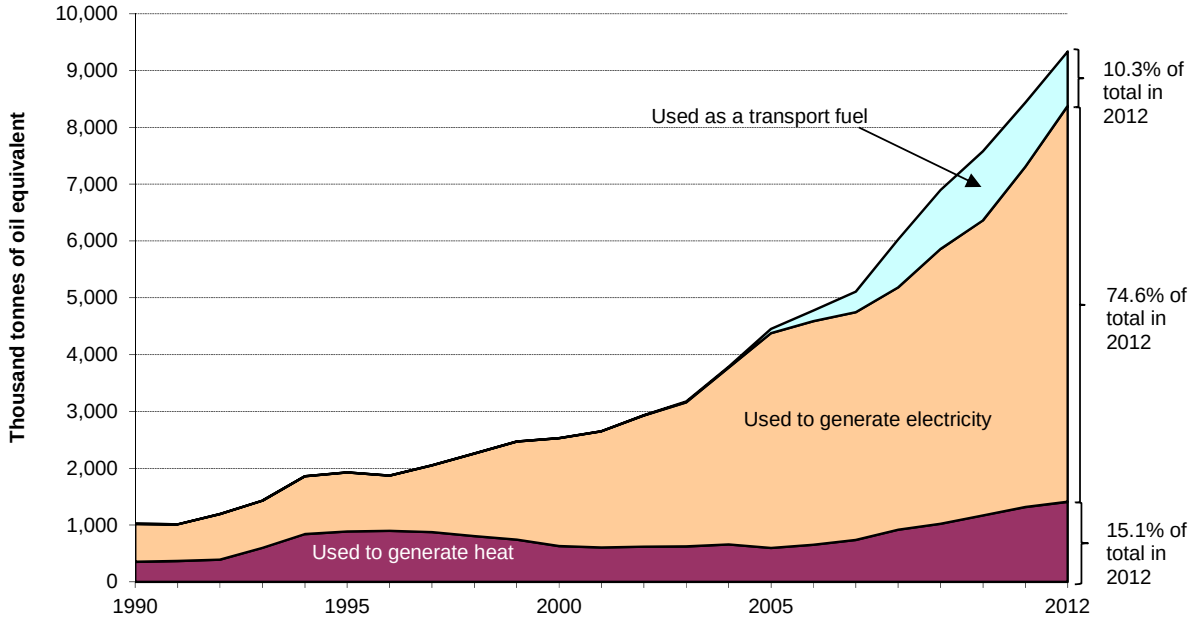
Renewables used to generate heat have shown some growth in recent years, following a decline up to 2005 as a result of tighter emission controls which discouraged on-site burning of biomass, especially wood waste. Policies such as the Renewable Heat Incentive (RHI) and Renewable Heat Premium Payment (RHPP) schemes are designed to support renewable heat production. Around 1 per cent of renewable heat was supported by the RHI during 2012 (13 thousand tonnes of oil equivalent, or 152 GWh). Domestic use of wood is the main contributor to renewables used for heat – comprising around 32 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 22 per cent and 20 per cent respectively. Heat pumps (mainly in the domestic sector) contributed around 4 per cent of the renewable heat total, calculated using the methodology published in March 2013 for measuring the output of heat pumps as part of the Renewable Energy Directive.

Liquid biofuels for transport

Liquid biofuels for transport comprised around 10 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 634 million litres of biodiesel and 775 million litres of bioethanol were consumed in 2012; biodiesel consumption was 31 per cent lower than in 2011, whilst bioethanol consumption was 19 per cent higher. Biodiesel has a higher energy content than bioethanol meaning that the combined total energy content of these fuels equates to 958 thousand tonnes of oil equivalent, 15 per cent lower than in 2011. During 2012 biodiesel accounted for 2.4 per cent of diesel, and bioethanol 4.1 per cent of motor spirit; the combined contribution of biodiesel and bioethanol was 3.1 per cent by volume, 0.4 percentage points lower than in 2011. The fall in the consumption of biodiesel is likely to result

from policy changes introduced in April 2012. Credits under the Renewable Transport Fuel Obligation were doubled for some types of biodiesel (such as waste cooking oil), meaning that less needs to be blended with diesel; and the reduced duty rate on cooking oil used for biodiesel ended, increasing duty payable by 20 pence per litre. The Renewable Energy Directive introduced various sustainability criteria for transport biofuels; certain biofuels derived from waste products have extra weighting when monitoring progress against the transport component, but not the overall target, of the Directive. During 2012 around 83 per cent of transport biofuel consumption was from sustainable sources.

Chart 4: 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 4.4 per cent of the United Kingdom's total primary energy requirements in 2012, up from 4.0 per cent in 2011. 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 4; data are shown in Table 5 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 2012, 4.1 per cent of final energy consumption was from renewable sources. This is an increase from the 2011 figure of 3.8 per cent, and 3.3 per cent in 2010. 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 2. It should be noted that the overall figure is not a simple calculation based around the three constituent parts. The finalised 2012 figures for all member states will be published by Eurostat during 2014. The Renewable Energy Directive introduced interim targets for member states to achieve on their route to attaining the 2020 proportion. For the UK the target for 2011-2012 is for the average proportion of renewables to be 4.04 per cent in these two years; the provisional figures indicate that despite increases during the year, the UK has not met this target, achieving 3.94 per cent. A further 275 thousand tonnes of oil equivalent - or 3,200 GWh - of Directive compliant renewable energy during the two years was required to meet the target.

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 Renewable Heat Incentive (RHI) tariff scheme (for industry, commercial premises and the public sector), the Renewable Heat Premium Payment Scheme (for households), and the Renewable Transport Fuel Obligation (RTFO);
- 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, details of the RO banding review, and the level of ROCs received, is available at:
www.gov.uk/calculating-renewable-obligation-certificates-rocs

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 4.64p 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 completed in December 2012. It had two parts, the first considered support for solar PV and the second other technologies and administrative issues. In May 2012 DECC announced new tariffs for solar PV, which came into effect on 1 August 2012, and in July 2012 it announced changes to tariffs for other technologies which came into effect on 1 December 2012. Changes implemented as a result of the review only affect new entrants to the scheme. Policy information and statistical reports relating to FiTs can be found at:

[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.

www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/feed-in-tariffs-scheme and www.gov.uk/government/organisations/department-of-energy-climate-change/series/feed-in-tariff-statistics

Renewable Heat Incentive (RHI) and Renewable Heat Premium Payment (RHPP)
The Renewable Heat Incentive opened for applications in November 2011. 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; phase 1 ran until March 2012, with phase 2 and the phase 2 extension running during the 2012/13 and 2013/14 financial years respectively. Details of the technologies supported by these two schemes, and statistical reports relating to the RHI and RHPP can be found at:
www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi,
www.gov.uk/renewable-heat-premium-payment-scheme, and
www.gov.uk/government/organisations/department-of-energy-climate-change/series/renewable-heat-incentive-renewable-heat-premium-payment-statistics respectively.

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 4.75 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. The Department for Transport publish policy and statistical reports on the scheme at:
www.gov.uk/government/publications/rtfo-guidance and
www.gov.uk/government/organisations/department-for-transport/series/biofuels-statistics

Regional statistics

A further renewable statistics article will be produced in the September 2013 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/

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Table 1: Percentages of electricity derived from renewable sources

	2005	2006	2007	2008	2009	2010	2011	2012
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	11.3
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	6.8	9.4	10.6
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	8.8	10.8
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	9.3	11.0
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	8.7	10.7

Table 2: Progress against the 2009 Renewable Energy Directive

	2005	2006	2007	2008	2009	2010	2011	2012
Percentage of **electricity** from renewable sources (normalised)	4.1	4.5	4.8	5.4	6.6	7.4	8.8	10.8
Percentage of **heating and cooling** from renewable sources	0.9	1.0	1.1	1.4	1.7	1.8	2.3	2.3
Percentage of **transport** energy from renewable sources	0.3	0.5	0.9	2.1	2.6	3.1	2.4	3.2
Overall renewable consumption as a percentage of capped gross final energy consumption using net calorific values (normalised) [not directly calculated from the three percentages	**1.4**	**1.6**	**1.8**	**2.4**	**3.0**	**3.3**	**3.8**	**4.1**

Table 3: Capacity of, and electricity generated from, renewable sources

	2010	2011	2012
Installed Capacity (MWe)			
Wind:			
Onshore	4,045.1	4,637.6	5,893.5
Offshore	1,341.2	1,838.0	2,995.2
Shoreline wave / tidal	2.6	3.1	6.7
Solar photovoltaics	94.1	993.0	1,705.5
Hydro:			
Small scale	187.0	204.4	215.3
Large scale *(1)*	1,452.9	1,470.9	1,470.9
Bioenergy:			
Landfill gas	1,008.2	1,050.3	1,036.0
Sewage sludge digestion	192.7	197.5	198.7
Energy from waste *(2)*	427.5	543.9	592.9
Animal Biomass (non-AD)*(3)*	110.5	110.5	110.5
Anaerobic digestion	38.1	66.1	110.0
Plant Biomass *(4)*	315.1	1,148.8	1,202.7
Total bioenergy and wastes	2,092.2	3,117.1	3,250.8
Total	**9,215.0**	**12,264.2**	**15,537.9**
Co-firing (5)	266.2	338.2	203.5
Generation (GWh)			
Wind:			
Onshore *(6)*	7,140	10,384	12,121
Offshore	3,044	5,126	7,463
Shoreline wave / tidal *(7)*	2	1	4
Solar photovoltaics	40	244	1,188
Hydro:			
Small scale *(6)*	483	701	653
Large scale *(1)*	3,092	4,989	4,631
Bioenergy:			
Landfill gas	5,037	5,092	5,154
Sewage sludge digestion	697	764	720
Energy from waste *(8)*	1,597	1,739	2,279
Co-firing with fossil fuels	2,332	2,964	1,783
Animal Biomass *(3)*	627	615	643
Anaerobic digestion	151	278	523
Plant Biomass *(4)*	1,594	1,749	4,098
Total bioenergy	12,037	13,200	15,198
Total generation	**25,838**	**34,645**	**41,258**
Non-biodegradable energy from wastes *(9)*	919	1,000	1,311
Total generation from sources eligible for the Renewable Obligation *(10)*	21,838	28,903	32,763

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

(2) Includes capacity for municipal solid waste, waste tyres, hospital waste, and general industrial 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, hospital waste and general industrial waste.

(10) See page 55 for definition and coverage.

Table 4: Load factors for renewable electricity generation

Per cent

	2010	2011	2012
Load factors - based on average beginning and end of year capacity *(1)*			
Wind	23.7	29.9	29.0
Onshore wind	21.7	27.3	26.2
Offshore wind	30.3	36.8	35.2
Shoreline wave / tidal	8.4	3.8	8.3
Solar photovoltaics	7.5	5.1	10.0
Hydro	24.9	39.2	35.8
Hydro (small scale)	30.2	40.9	35.4
Hydro (large scale)	24.2	39.0	35.8
Bioenergy (excludes cofiring and non-biodegradable wastes)	55.3	44.9	48.0
Landfill gas	58.2	56.5	56.2
Sewage sludge digestion	45.5	44.7	41.3
Energy from waste (3)	44.9	40.9	45.6
Animal Biomass (4)	64.8	63.5	66.2
Anaerobic Digestion	69.0	60.9	67.6
Plant Biomass (5)	60.7	27.3	39.7
All renewable technologies (excluding cofiring and non-biodegradable wastes)	31.2	33.7	32.3
Load factors - for schemes operating on an unchanged configuration basis *(2)*			
Wind	23.3	29.3	28.0
Onshore wind	21.6	27.2	25.6
Offshore wind	29.5	35.0	33.7
Hydro	26.4	41.7	35.3
Hydro (small scale)	29.4	43.2	36.0
Hydro (large scale)	26.1	41.5	35.3
Bioenergy (excludes cofiring and non-biodegradable wastes)	59.8	61.0	62.5
Landfill gas	57.7	59.5	58.6
Sewage sludge digestion	51.9	53.5	48.0
Energy from waste *(3)*	68.9	63.0	68.1
Animal Biomass *(4)*	59.6	68.9	66.2
Anaerobic Digestion	51.5	56.1	65.4
Plant Biomass *(5)*	65.8	60.9	67.4
All renewable technologies (excluding cofiring and non-biodegradable wastes)	31.9	37.3	35.9

(1) Calculated as the average hourly quantity of electricity generated as a percentage of the average capacity at the beginning and end of the year.

(2) Load factors calculated as above but restricted to those schemes that have operated throughout the calendar year with an unchanged configuration.

(3) Calculation is based on biodegradable energy from waste generation but all energy from 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.

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

Thousand tonnes of oil equivalent

	2010	2011	2012
Used to generate electricity *(3)*			
Wind:			
Onshore	614.0	892.9	1,042.2
Offshore	261.7	440.7	641.7
Shoreline wave / tidal (4)	0.2	0.1	0.3
Solar photovoltaics	3.4	21.0	102.1
Hydro:			
Small scale	41.6	60.3	56.2
Large scale *(5)*	265.9	429.0	398.2
Bioenergy:			
Landfill gas	1,652.0	1,670.1	1,690.3
Sewage sludge digestion	228.6	250.5	236.0
Biodegradable energy from waste	659.0	717.3	959.3
Co-firing with fossil fuels	765.0	764.6	400.5
Animal Biomass *(6)*	238.9	224.0	225.0
Anaerobic digestion	49.6	91.1	171.4
Plant Biomass *(7)*	412.3	526.9	1,045.3
Total bioenergy	4,005.4	4,244.6	4,727.9
Total	**5,192.0**	**6,088.5**	**6,968.7**
Non-biodegradable energy from waste *(8)*	385.1	418.6	557.7
Used to generate heat			
Active solar heating	97.5	122.4	153.1
Bioenergy:			
Landfill gas	13.6	13.6	13.6
Sewage sludge digestion	57.8	66.1	72.1
Wood combustion - domestic	379.6	425.4	456.3
Wood combustion - industrial	255.7	281.9	303.3
Animal Biomass *(9)*	40.3	35.8	31.5
Anaerobic digestion	4.8	9.8	15.1
Plant Biomass *(10)*	270.0	288.5	275.1
Biodegradable energy from waste *(6)*	25.9	33.0	32.2
Total bioenergy	1,047.7	1,154.0	1,199.1
Deep geothermal	0.8	0.8	0.8
Heat Pumps	23.6	39.1	56.1
Total	**1,169.7**	**1,316.3**	**1,409.2**
Non-biodegradable wastes *(8)*	135.0	147.7	138.6
Renewable sources used as transport fuels			
as Bioethanol	355.4	367.5	436.9
as Biodiesel	861.9	760.0	520.9
Total	**1,217.3**	**1,127.5**	**957.8**
Total use of renewable sources and wastes			
Solar heating and photovoltaics	101.0	143.4	255.3
Onshore wind	614.0	892.9	1,042.2
Offshore wind	261.7	440.7	641.7
Shoreline wave / tidal	0.2	0.1	0.3
Hydro	307.4	489.3	454.4
Bioenergy	5,053.0	5,398.6	5,927.0
Deep geothermal	0.8	0.8	0.8
Heat Pumps	23.6	39.1	56.1
Transport biofuels	1,217.3	1,127.5	957.8
Total	**7,579.0**	**8,532.4**	**9,335.6**
Non-biodegradable energy from waste *(8)*	520.1	566.4	696.3
All renewables and wastes	**8,099.2**	**9,098.7**	**10,032.0**

(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.