

Renewable electricity in Scotland, Wales, Northern Ireland and the regions of England in 2016

Introduction

This article provides information and analysis on the amount of electricity from renewable sources, disaggregated below UK level. It includes information on capacity, generation and number of operational sites, as well as derived load factors (LFs), for the four UK countries, the nine English regions, and, from 2014, UK Local Authorities.^{1 2 3} It updates that published in the September 2016 edition of *Energy Trends*

These data are consistent with that published for the UK in Table 6.4 of the Digest of United Kingdom Energy Statistics 2017 (DUKES), and use similar categories⁴. These data cover all renewable electricity schemes, including those accredited under the Renewables Obligation (RO) Feed in Tariff (FiT) and Contracts for Differences support mechanisms, as well as those not eligible for support, such as pre-April 2002 large-scale hydro and energy from waste (non-CHP) schemes.

The tables in this, and previous *Energy Trends* articles, show snapshots of the position as at the time of publication, for the latest year (2016 in this case). Consistent time-series data for each year from 2003 (comparable to the data shown in Tables 1 to 3), and Local Authority data from 2014, are available as Excel spreadsheets at:

www.gov.uk/government/statistics/regional-renewable-statistics.

Key points – 2016:

- England had the most renewable capacity and generation, largely due to the three biomass units⁵ at Drax in Yorkshire and the Humber.
- Scotland had the highest capacity per £ of GVA.
- Yorkshire and the Humber had the highest generation per £ of GVA.
- The highest technology growth in capacity was solar PV, notably in the South-West, driven by large-scale schemes supported by the RO. Next highest was onshore wind, primarily in Scotland, followed by biomass and waste, with Yorkshire and the Humber the largest, and then offshore wind in the North West.
- The largest new schemes in 2016 were as follows - offshore wind: Burbo Bank Extension (200 MW); onshore wind: Dunmaglass (94 MW), Corriearth (69 MW), Dersalloch (69 MW); solar PV: Shotwick (72 MW), Swindon (61 MW), Sandridge (50 MW); biomass and waste: Brigg REP (55 MW), Snetterton (45 MW), Wilton International 11 (50 MW).
- For the second consecutive year (in 17 years), England had the highest onshore wind load factor (and Scotland the lowest due to significant outages and curtailments at some large Scottish wind farms).

UK country summary

Table 1 and Chart 1 show that there were 5,073 non-PV sites in England generating electricity from renewable sources, with 3,735 non-PV sites in Scotland, 834 in Wales and 1,093 in Northern Ireland. In addition, there were 677,632 PV sites reported for England, 53,027 for Scotland, 51,998 for Wales and 22,779 for Northern Ireland⁶.

¹ Offshore wind is allocated to the region to which its output is connected. The exception is Robin Rigg which comes ashore at Seaton, Cumbria but whose generation is associated with Scotland.

² Part of the tables published by the Department for Business, Energy & Industrial Strategy (BEIS) that show a range of renewable electricity data for the devolved administrations and regions of England: www.gov.uk/government/statistics/regional-renewable-statistics

³ Where disclosure of confidential generation data was likely at the site level, this has been addressed, where possible, by replacing this with data from publicly available sources. Where this is not possible, the data has been removed, and added to the unallocated row at the bottom of the Local Authority listings.

⁴ On occasion, it has been necessary to combine some renewable sources into categories so that information about individual sites provided in confidence (rather than from publicly available sources) to Ricardo Energy & Environment and (BEIS) is not disclosed.

⁵ The third biomass unit operated as high-range co-firing for most of the year, fully converting to biomass in late December 2016.

⁶ No geographical information was available for a further 94,654 PV schemes, 862 wind schemes, 321 hydro schemes and 143

Table 1: Number of sites generating electricity from renewable sources, 2016¹

	Wind ²	Onshore Wind	Offshore Wind	Wave and tidal	Solar PV	Hydro	Landfill gas	Sewage gas	AD	Biomass and Waste ³	Total excluding PV	Total
England	3,761	3,737	24	2	677,632	277	363	166	283	221	5,073	682,705
East Midlands	389	386	3	-	80,595	25	39	15	42	25	535	81,130
East of England	851	845	6	-	96,257	6	69	14	40	21	1,001	97,258
North East	260	258	2	-	44,357	11	20	7	9	10	317	44,674
North West	471	464	7	-	79,117	52	49	24	28	39	663	79,780
London	31	31	-	-	21,658	-	5	10	5	13	64	21,722
South East	106	102	4	-	102,099	18	70	33	18	25	270	102,369
South West	745	745	-	1	112,190	106	39	18	49	18	976	113,166
West Midlands	162	162	-	-	63,574	20	30	20	60	36	328	63,902
Yorkshire and the Humber	746	744	2	1	77,785	39	42	25	32	34	919	78,704
Northern Ireland	935	935	-	-	22,779	66	16	2	59	15	1,093	23,872
Scotland	3,144	3,141	3	11	53,027	464	46	8	27	35	3,735	56,762
Wales	571	568	3	1	51,998	189	25	16	14	18	834	52,832
Other Sites	862	862	-	-	94,654	321	-	-	143	-	1,326	95,980
UK Total	9,273	9,243	30	14	900,090	1,317	450	192	526	289	12,061	912,151

For notes to Table 1 and 2, see below Table 3

Table 2: Installed capacity of sites generating electricity from renewable sources, 2016¹

	Wind ²	Onshore Wind	Offshore Wind	Wave and tidal	Solar PV	Hydro	Landfill gas	Sewage gas	AD	Biomass and Waste ³	MW Total
England	7,111.1	2,731.0	4,380.1	0.1	9,503.5	34.4	879.3	237.4	255.9	3,639.9	21,661.5
East Midlands	842.9	378.5	464.4	-	1,260.2	4.2	68.0	20.3	49.3	149.5	2,394.3
East of England	1,513.8	449.0	1,064.8	-	1,795.2	0.1	185.5	17.6	43.5	189.3	3,745.0
North East	460.2	393.8	66.4	-	191.0	7.8	45.0	11.5	16.2	158.8	890.4
North West	1,711.4	425.4	1,286.0	-	410.9	7.4	134.8	31.4	28.8	182.1	2,506.9
London	11.3	11.3	-	-	93.4	-	25.8	58.7	5.6	187.7	382.4
South East	1,170.1	100.6	1,069.5	-	1,849.3	0.7	166.6	32.0	19.5	298.5	3,536.7
South West	310.6	310.6	-	-	2,806.2	9.9	100.5	14.6	36.7	108.9	3,387.5
West Midlands	7.5	7.5	-	-	654.9	1.1	60.9	35.0	37.4	140.5	937.4
Yorkshire and the Humber	1,083.3	654.3	429.0	0.1	442.5	2.9	92.3	16.3	19.0	2,224.7	3,881.0
Northern Ireland	885.7	885.7	-	-	135.2	9.6	18.9	0.2	31.9	30.8	1,112.3
Scotland	6,462.2	6,274.9	187.4	13.0	256.2	1,533.0	116.3	7.2	30.1	225.8	8,643.9
Wales	1,541.2	815.2	726.0	0.4	843.1	161.0	47.3	12.5	5.8	99.7	2,711.0
Other Sites	216.7	216.7	0.0	0.0	1,160.8	96.9	0.0	0.0	96.6	-	1,570.9
UK Total	16,216.9	10,923.5	5,293.4	13.5	11,898.7	1,834.8	1,061.9	257.3	420.3	3,996.2	35,699.7
Co-firing ⁴					-			-		13.4	13.4

For notes to Table 1 and 2, see below Table 3.

Table 3: Generation of electricity from renewable sources, 2016¹

	Wind ²	Onshore Wind	Offshore Wind	Wave and tidal	Solar PV	Hydro	Landfill gas	Sewage gas	AD	Biomass and Waste ⁵	GWh Total
England	19,456.0	5,564.2	13,891.8	-	8,466.7	100.2	3,960.9	871.9	1,311.5	20,442.3	54,609.6
East Midlands	2,302.2	804.6	1,497.5	-	1,139.0	14.5	281.6	92.8	260.5	690.0	4,780.6
East of England	4,489.7	939.8	3,549.9	-	1,641.4	0.3	838.0	67.7	243.1	879.8	8,160.0
North East	1,016.7	828.4	188.4	-	146.7	30.4	148.9	27.7	57.0	518.2	1,945.6
North West	4,450.1	885.1	3,565.1	-	353.2	20.1	466.9	121.0	113.8	749.9	6,275.0
London	14.9	14.9	-	-	79.8	-	165.5	140.8	29.7	617.5	1,048.1
South East	3,686.7	214.7	3,472.0	-	1,709.1	1.9	850.7	136.0	96.9	968.9	7,450.2
South West	589.6	589.6	-	-	2,481.5	22.2	467.4	56.1	193.5	138.0	3,948.3
West Midlands	14.2	14.2	-	-	539.2	3.0	313.8	155.8	215.3	444.6	1,685.9
Yorkshire and the Humber	2,891.9	1,272.9	1,619.0	-	376.8	7.9	428.1	74.0	101.6	15,435.5	19,315.9
Northern Ireland	1,732.3	1,732.3	-	-	110.3	23.6	93.7	0.6	186.0	178.2	2,324.7
Scotland	12,340.5	11,838.1	502.4	0.0	221.6	4,765.0	492.8	32.0	125.5	1,232.4	19,209.8
Wales	3,400.9	1,389.4	2,011.5	-	714.0	307.5	155.5	45.8	31.5	484.2	5,139.3
Other Sites	437.5	437.5	-	-	907.8	198.5	-	-	397.9	-	1,941.7
UK Total	37,367.3	20,961.6	16,405.7	0.0	10,420.4	5,394.8	4,702.9	950.3	2,052.3	22,337.2	83,225.1

Notes to Tables 1 to 3

Components may not add exactly to totals because of rounding.

1 As at 31 December 2016.

2 Offshore Wind is allocated to regions/countries where the cabling comes ashore.

3 Six of these sites are sites that co-fire renewables with fossil fuels (see also note 4, below).

4 This is the proportion of non-fossil fuelled capacity used for co-firing of renewables based on the proportion of generation accounted for by the renewable source. This estimate has not been disaggregated into regional values since the figure will vary annually, and is not dedicated renewable capacity.

5 Includes bioenergy sources co-fired with fossil fuels.

Special feature – UK renewable electricity

In capacity terms, England had more than two and a half times more renewable electricity capacity than Scotland (Table 2 and Chart 3). This is mainly because of England’s considerable bioenergy (87 per cent of the UK’s bioenergy capacity) and PV capacity (80 per cent of the UK’s PV capacity). For similar reasons, generation from renewable sources in England during 2016 was almost three times higher than Scotland, with the higher utilisation rates of bioenergy offset by the lower rates of, the more intermittent, solar PV which accounted for 16 per cent of English renewable generation (Table 3, Chart 7).

Regional analysis by technology

In England, the number of renewable sites (excluding PV) in each region varies from 64 in London to 1,001 in the East of England (Table 1 and Chart 2). The highest capacity in England (including PV) is in Yorkshire and the Humber, followed by East of England and the South East (Table 2 and Chart 4). In Yorkshire and the Humber, 57 per cent of capacity is from biomass and waste (mostly from Drax dedicated biomass), 28 per cent from wind and 11 per cent is from PV. In the East of England, 48 per cent of capacity is from PV and 40 per cent is from wind (28 per cent offshore and 12 per cent onshore). In the South East, 52 per cent of capacity is from PV, 33 per cent from wind (30 per cent offshore and 3 per cent onshore) and 8 per cent from biomass and waste.

Chart 1: Number of sites by country¹

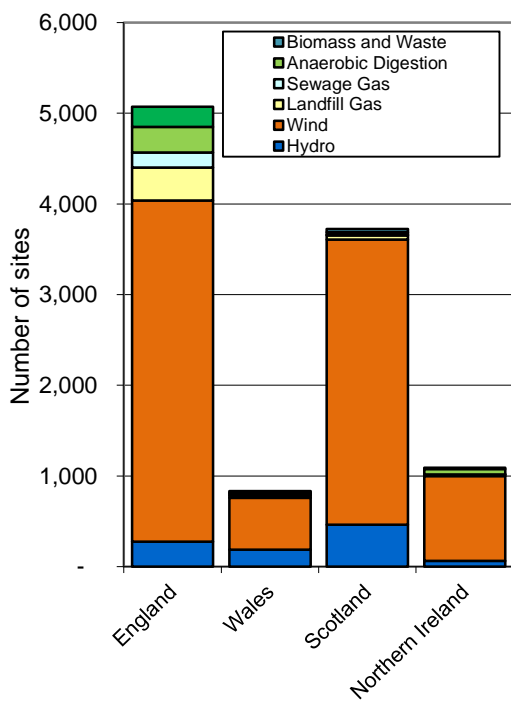
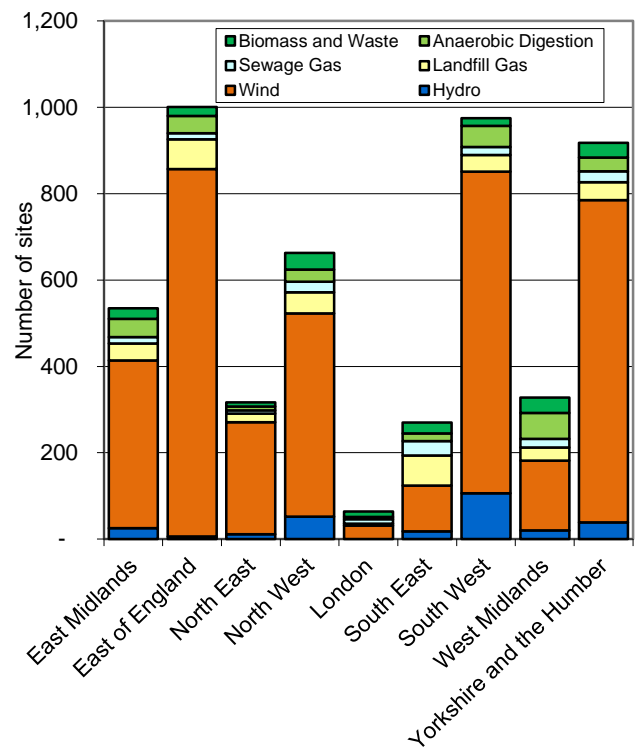


Chart 2: Number of sites by English region¹



1. Excludes Solar PV, due to the high numbers of small-scale schemes, disproportionate to all other technologies. Wave and Tidal are included with offshore wind.

The East of England has 17 per cent of the UK's landfill gas capacity. The South East (with 16 per cent of the UK's landfill gas capacity), and the North West (with 13 per cent of the UK's landfill gas capacity), are the other English regions with notably large shares. The East of England, North West and the South East regions together accounted for 46 per cent of UK generation from landfill gas.

England has 80 per cent of the total UK solar capacity and 81 per cent of the total UK generation. The South West accounts for 24 per cent of the total UK solar capacity (24 per cent of the generation), the South East 16 per cent (16 per cent of the generation) and the East of England 15 per cent (16 per cent of the generation), reflecting the construction of more schemes in areas with higher than average solar irradiance⁷.

In 2016, England had the most wind capacity and generation, at 44 per cent and 52 per cent of the UK, respectively. Almost two-thirds of this is offshore (4.4 GW), which also represents 83 per cent of the UK's 5.3 GW of offshore capacity. Until 2016, England's Westermost Rough (in the North Sea) utilised the largest turbines, at 6 MW each; however, these have now been superseded by the 8 MW turbines of the Burbo Bank Extension (in the Irish Sea). Figure 1 displays how wind installations are spread across the UK.

Scotland had 40 per cent of the UK's wind capacity and 33 per cent of the output (Tables 2 and 3; Charts 5a, 5b, 9a and 9b). Of Scotland's wind capacity, 97 per cent was from onshore wind, up one percentage point on 2015; this comprises 3,141 sites, including the UK's largest, Whitelee, at 539 MW. Other regions with high shares of UK wind are: the North West, with 7.9 per cent of offshore (10 per cent of generation), including the first 200 MW of the extension to the existing 90 MW at Burbo Bank⁸, and 2.6 per cent of onshore capacity (2 per cent of generation); Wales, with 5 per cent of onshore capacity (4 per cent of generation) and 4.5 per cent of offshore capacity (5 per cent of generation); East of England, with 6.6 per cent of offshore capacity (9 per cent of generation), including Greater Gabbard (504 MW) and Sheringham Shoal (316 MW), and 2.8 per cent of onshore capacity (3 per cent of generation) (Tables 2 and 3).

Ninety-two per cent of UK generation from sewage in 2016 took place in England. The major sewage gas generating regions were: the West Midlands (16 per cent), London (15 per cent), the South East (14 per cent) and the North West (13 per cent). This is reflected in capacity terms with London being the highest (23 per cent), followed by the West Midlands (14 per cent), the North West jointly with the South East (12 per cent).

Eighty-four per cent of the UK generation from biomass and waste (including that used for co-firing) took place in England, with Yorkshire and the Humber having the largest share (63 per cent) mostly from Drax, followed by Scotland (5 per cent) and the East of England jointly with the South East (4 per cent). Excluding bioenergy sources used for standard co-firing (see note 4 to Table 2), Yorkshire and the Humber has the largest capacity to generate from biomass and waste (50 per cent of the UK total), mostly from the three 645 MW converted units at Drax. This is followed by the South East (7 per cent) and Scotland (5 per cent).

⁷ JRC Solar radiation and photovoltaic electricity potential http://re.jrc.ec.europa.eu/pvgis/cmmaps/eu_cmsaf_opt/G_opt_UK.png.

More detailed analysis also available from Met Office www.metoffice.gov.uk/renewables/solar

⁸ This will be 259 MW on completion in 2017.

Chart 3: Renewable capacity by country

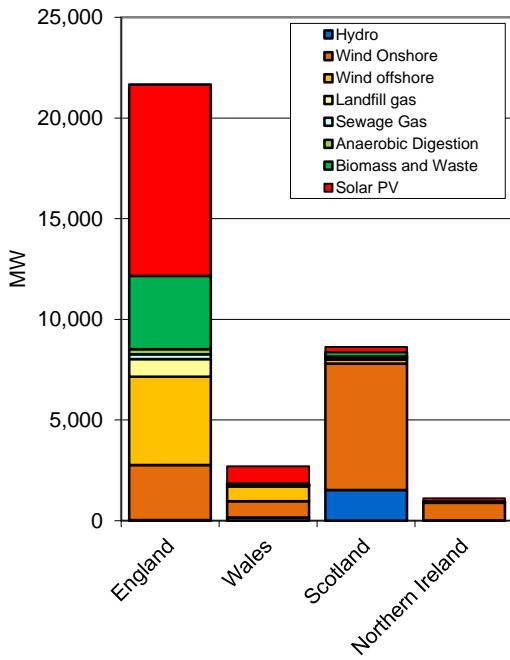


Chart 4: Renewable capacity by English region

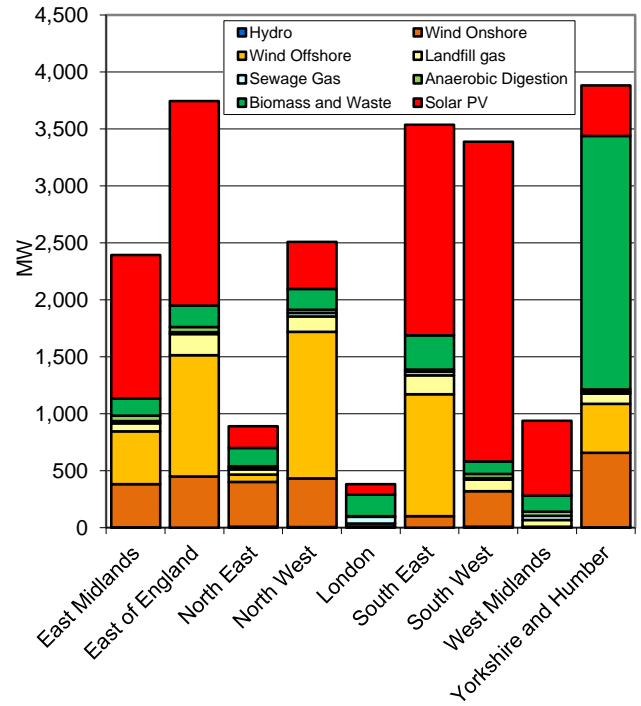


Chart 5a: Onshore wind capacity by country

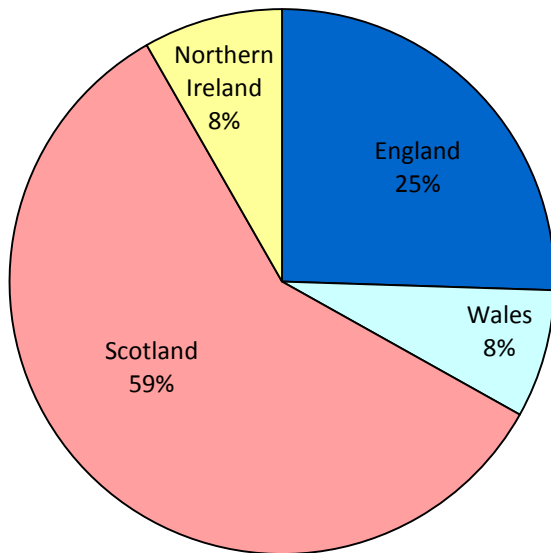


Chart 5b: Offshore wind capacity by country

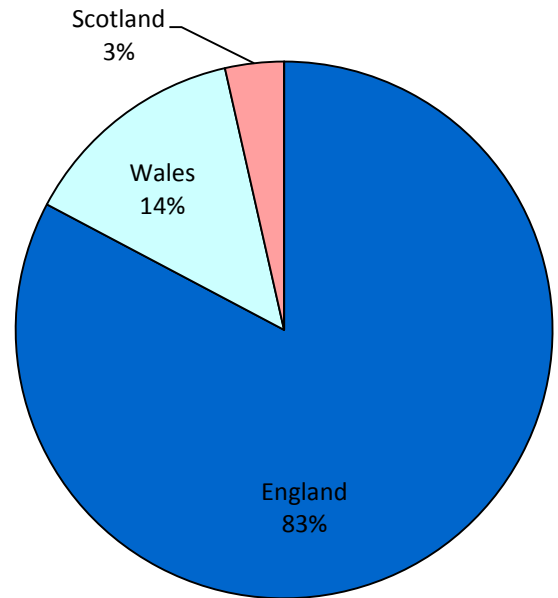


Chart 6a: Onshore wind capacity by English region

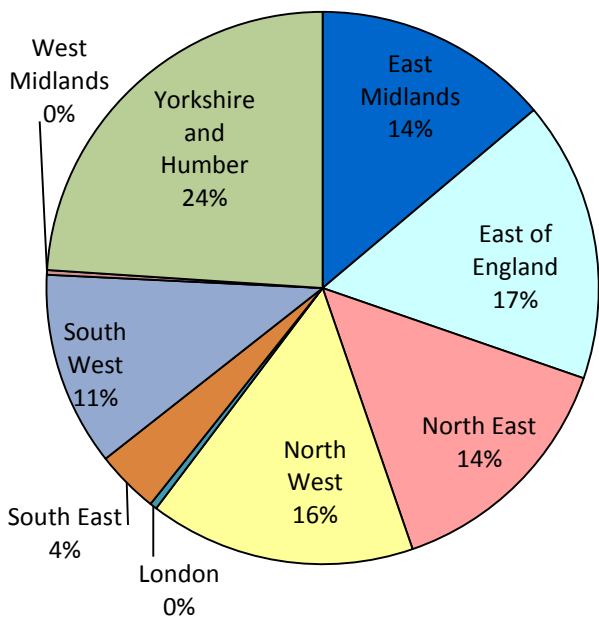


Chart 6b: Offshore wind capacity by English region

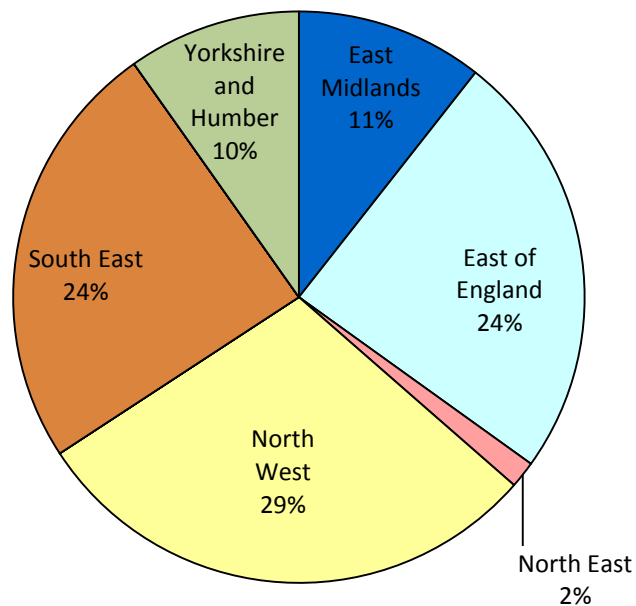


Chart 7: Renewable generation by country

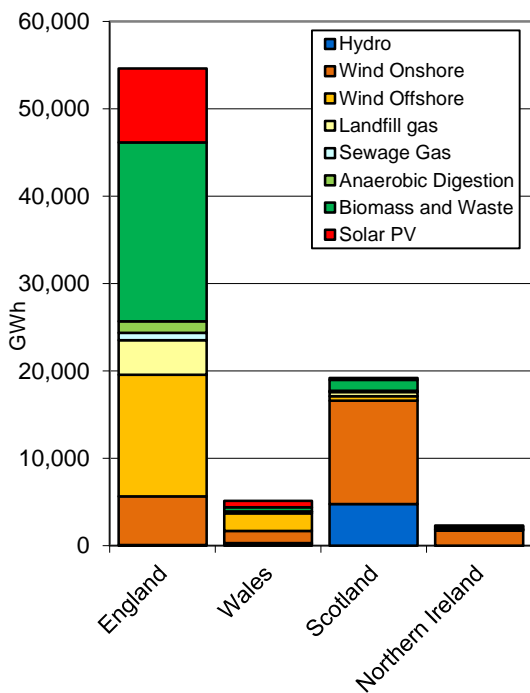


Chart 8: Renewable generation by English region

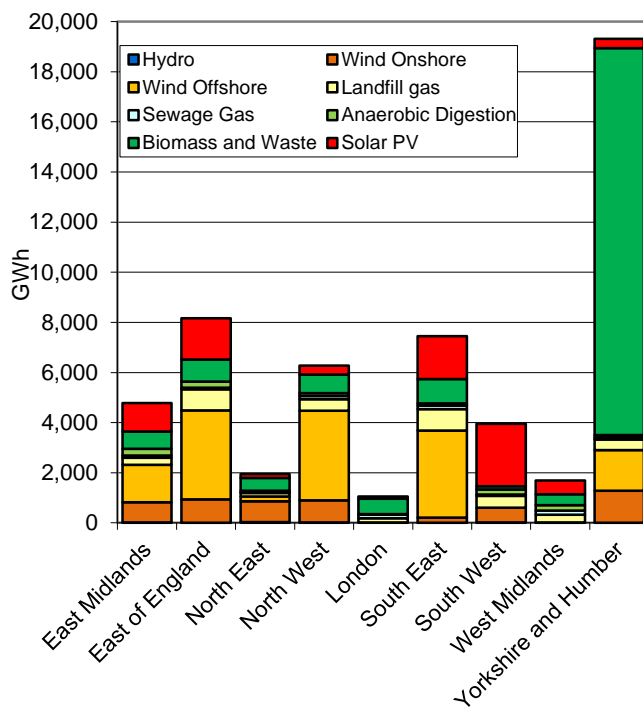


Chart 9a: Onshore wind generation by country

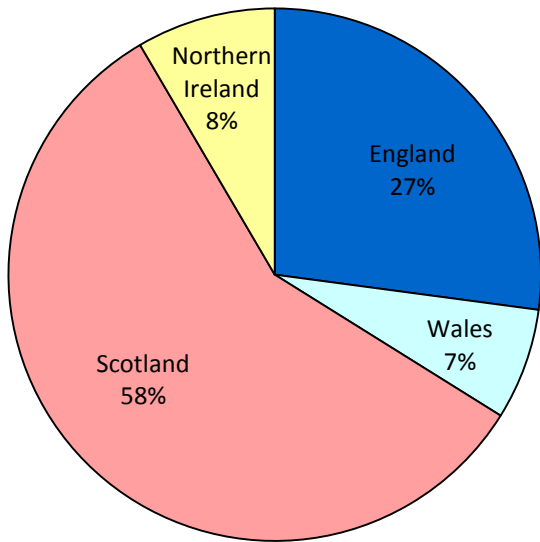


Chart 9b: Offshore wind generation by country

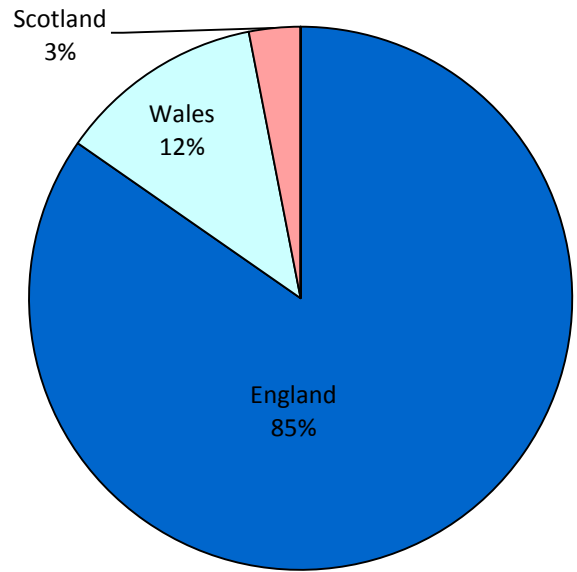


Chart 10a: Onshore wind generation by English region

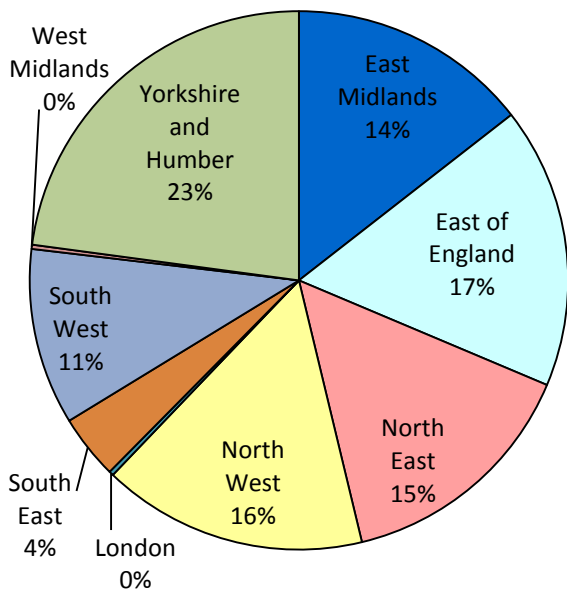
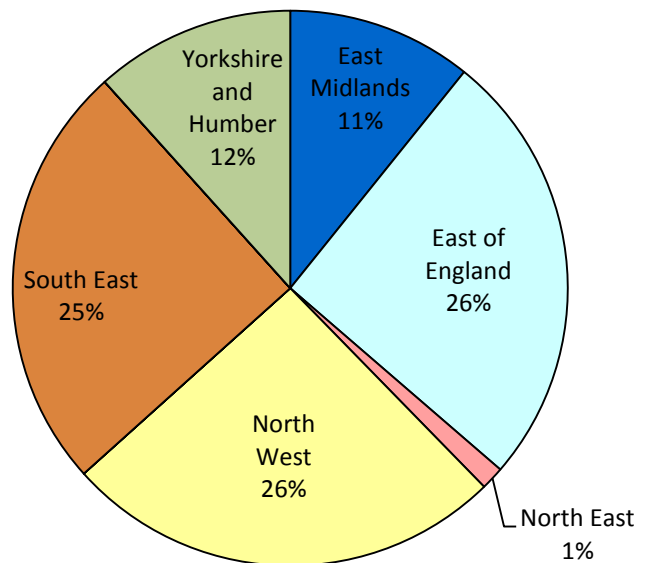


Chart 10b: Offshore wind generation by English region



UK Wind Turbine Installations (>1 MW), end-December 2016

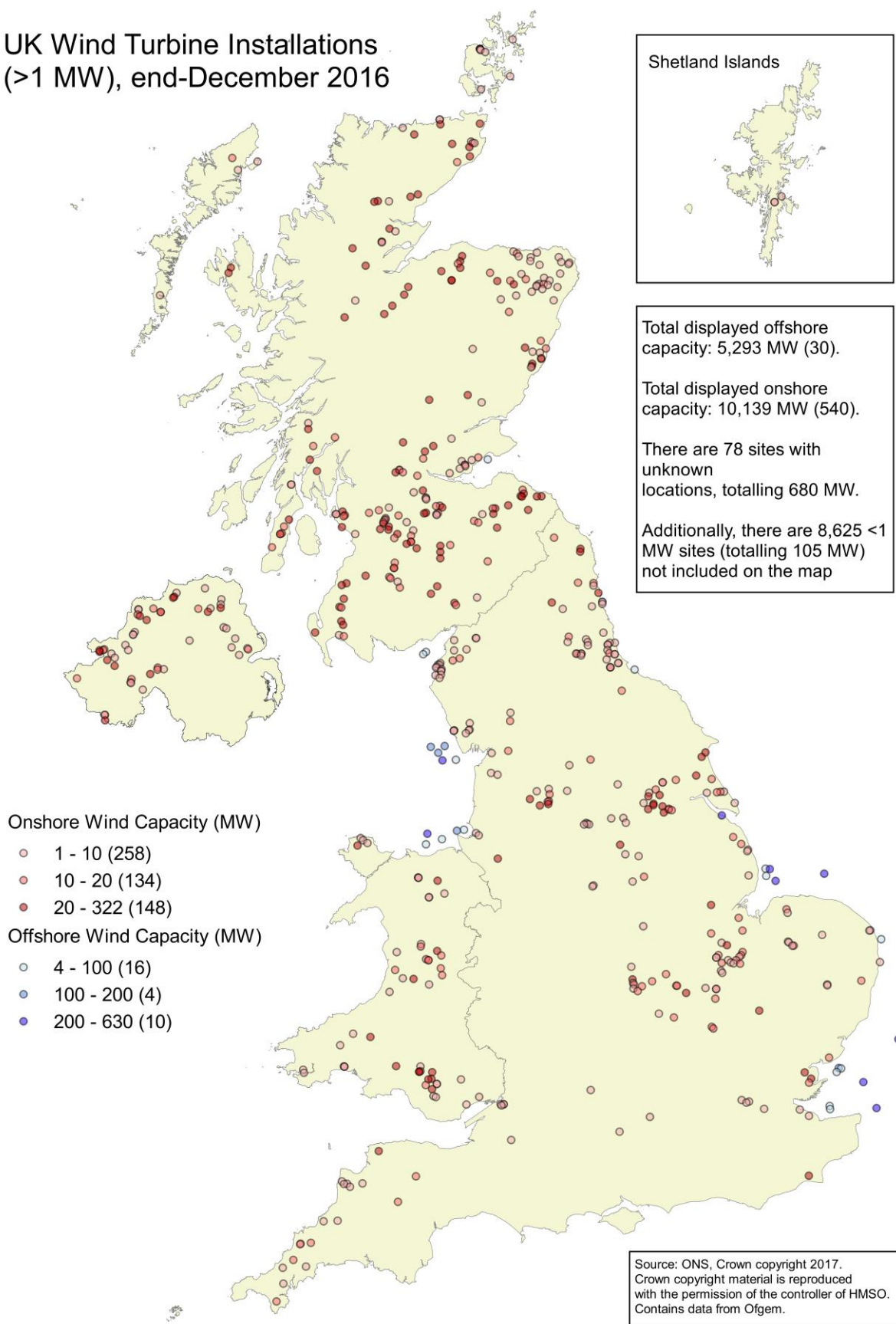


Figure 1: UK wind turbine installations (> 1 MW), by capacity band, December 2016

Regional trends: 2016

Across the year, Scotland (+979 MW), South West (+562 MW), Wales (+413 MW), East of England (+399 MW), South East (+381 MW), East Midlands (+357 MW) and the North West (+351 MW) have all shown considerable growth in generating capacity.

The growth in overall renewables capacity in these regions has primarily come from solar (46 per cent) and onshore wind (28 per cent). Table 4 summarises the key contributors to capacity growth in 2016 for each region.

The rapid uptake of solar in 2016 was again primarily driven by the pending closure of RO to certain schemes (in March 2016, this was grace period large-scale schemes, as well as non-grace period small-scale schemes), as well as the reform to the FiT financial support mechanisms in February 2016, and decreasing technology costs. Several large solar farms were built in 2016, including Shotwick (72 MW) and Swindon (61 MW).

Onshore wind and offshore wind capacity has increased by 35 per cent and 4.2 per cent, respectively, due to new schemes, such as the first 156 MW of Pen y Cymoedd⁹ in Wales, Dunmaglass (94 MW) in Scotland, and the Burbo Bank Extension (200 MW).

Biomass and waste capacity has grown by 7.4 per cent. This year has seen the addition of two new straw-fired power stations in Yorkshire and the Humber (Brigg 55 MW) and Eastern (Snetterton 45 MW). All four UK operational straw-fired stations are in the eastern part of England coinciding where the most straw arises because of the high levels of arable farming in this area.

Regional trends: 2003-2016

Between 2003 and 2016, there was a 932 per cent increase in overall **capacity** from renewables in the UK. Faster rates of growth were recorded in individual regions. These include Yorkshire and the Humber (3,083 per cent), primarily due to Drax, the East Midlands (2,927 per cent) due to PV and wind, the South West (2,773 per cent) from primarily PV, Northern Ireland (2,193 per cent) from mainly onshore wind, the South East (2,104 per cent) and the East of England (1,349 per cent) both mainly from PV and offshore wind, the North West (1,181 per cent) from offshore wind, and the North East (1,001 per cent) from onshore wind (see charts 11 and 12).

Between 2003 and 2016, there was a 685 per cent increase in overall **generation** from renewables in the UK, but faster rates of growth were recorded in Yorkshire and the Humber (2,866 per cent), Northern Ireland (2,129 per cent), the East Midlands (1,005 per cent), the South East (840 per cent) and the South West (772 per cent) (see charts 13 and 14).

The reason for these differences in growth rates for both capacity and generation is not only dependent on the local resource (such as wind and solar), but also (notably in the case of Drax), the availability of existing fossil fuel capacity suitable for conversion to biomass. Furthermore, there was very little use of some technologies in some regions driven primarily by the resource availability (e.g., wind in London and hydro in the East of England).

⁹ 228 MW when complete in 2017

Table 4: Regional capacity growth, 2016

Region	Key Technology	Growth (MW)	Key Schemes
East Midlands	Solar PV	240	Copley Farm, Lincoln (Skegness), Danes Farm - extension
	Biomass and Waste	63	Balderton, Spalding
	Onshore Wind	54	Mainly medium and small-scale projects
East of England	Solar PV	293	SPD2 Hall Farm, South Creake, Rose and Crown, Royston, Vine Farm
	Biomass and Waste	54	Snetterton
	Onshore Wind	52	Wryde Croft
North East	Solar PV	45.5	Mainly medium and small-scale projects
	Onshore Wind	26.4	North Steads, Wingates
North West	Offshore Wind	200	Burbo Bank Extension (Burbo Bank 2)
	Onshore Wind	62	Frodsham Wind Farm
London	Solar PV	5.3	Primarily FiT
	Sewage gas	5.2	Riverside STW one scheme closed)
South East	Solar PV	326	Eveley
	Biomass and Waste	44	Ridham Dock
South West	Solar PV	462	Newton Ferrers, Swindon, SunE Troughton Farm, Sandridge
	Municipal Solid Waste Combustion	62	Cornwall Energy Recovery Centre, Severnside Energy Recovery Centre
West Midlands	Solar PV	157	PV Mount Farm, Charity Farm plus medium and small-scale proj
	Municipal Solid Waste Combustion	17	Birmingham Bio Power
Yorkshire and Humber	Onshore Wind	119	Goole Fields 2, Fraisthorpe, Twin Rivers
	Biomass and Waste	94	Brigg REP, Cross Green ERF
	Solar PV	60	Laceyby
Northern Ireland	Onshore Wind	155	Long Mountain, Tievenameenta
	Solar PV	30	Mainly medium and small-scale projects
	AD	17	Small-scale projects
Scotland	Onshore Wind	916	Moy, A'Cruch, Black Law II, Dersalloch, Galawhistle, Dunmaglass, Harburnhead, Corriegarh
	Solar PV	36	Errol
	Biomass and Waste	21	Speyside CHP
Wales	Solar PV	216	Shotwick, plus mainly medium and small-scale projects
	Onshore Wind	183	Pen y Cymoedd

Chart 11: Trends in capacity from renewables by country

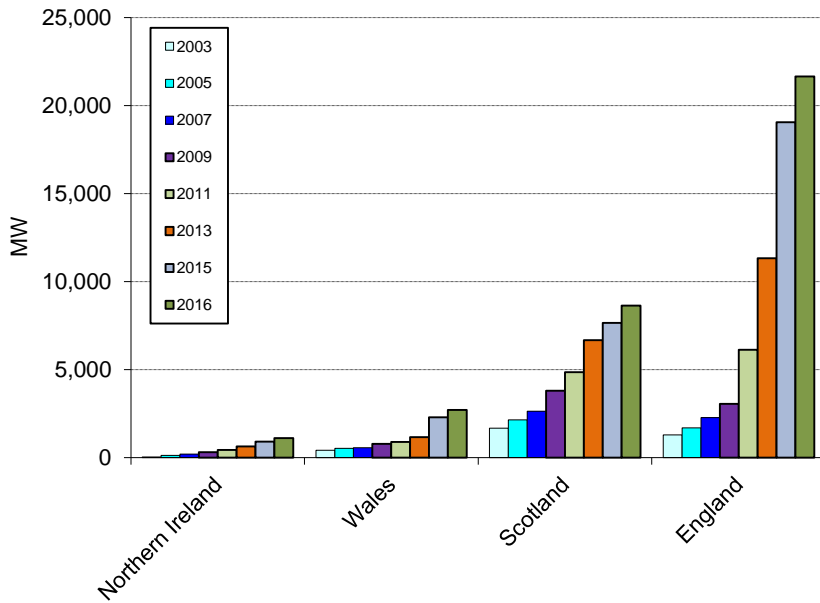


Chart 12: Trends in capacity from renewables by English region

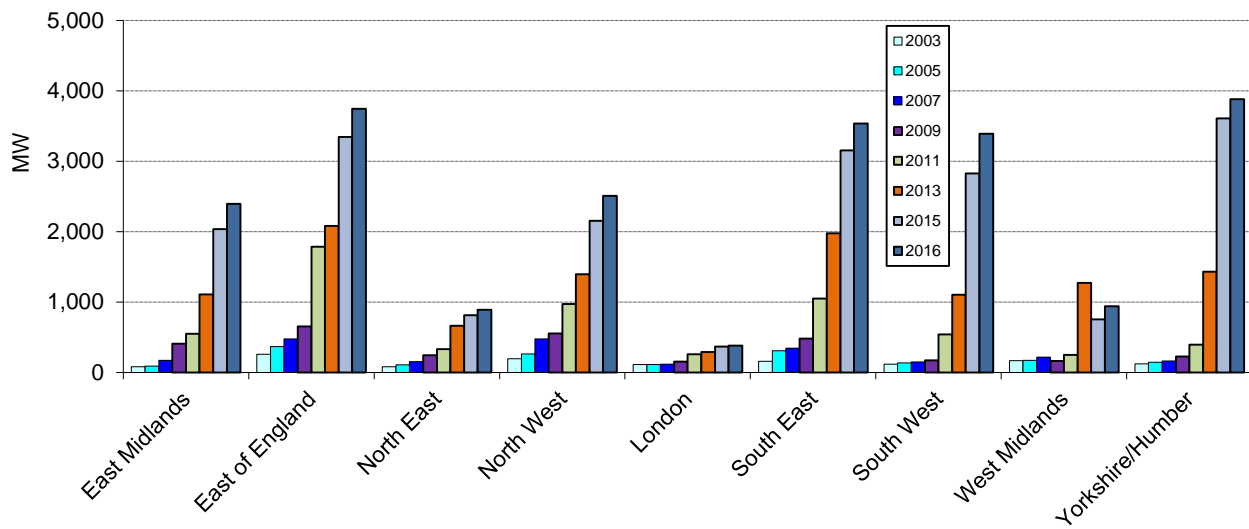


Chart 13: Trends in generation from renewables by country

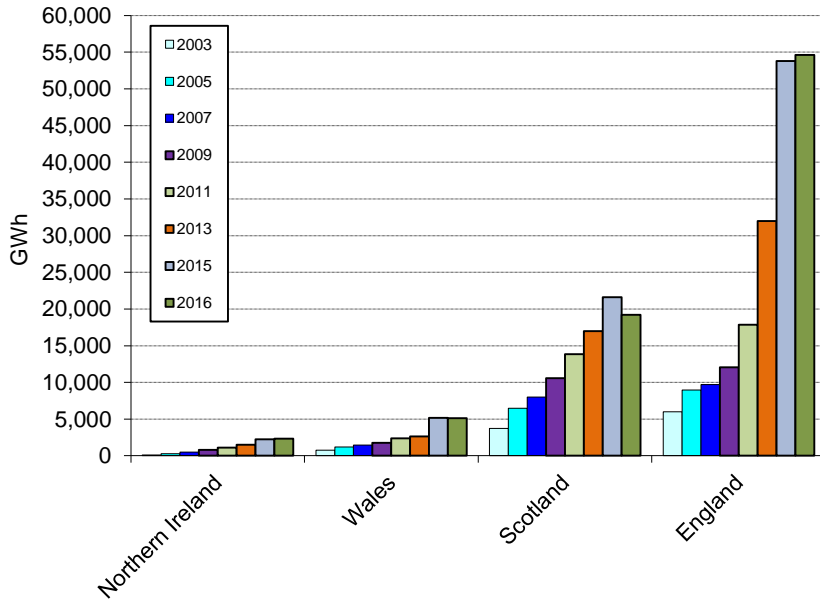
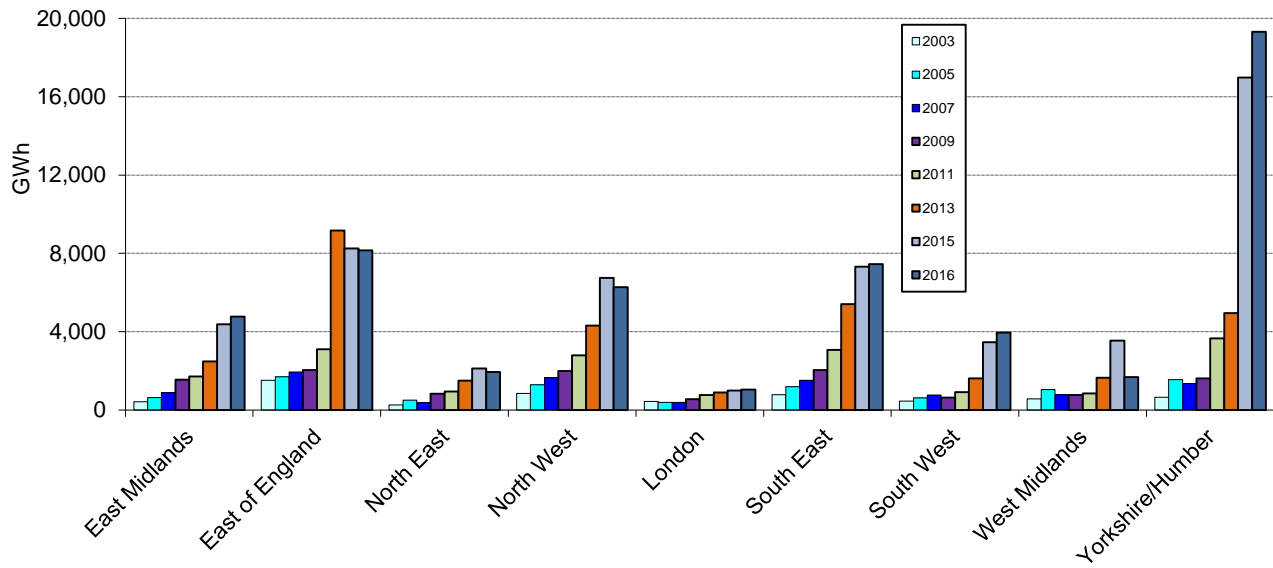


Chart 14: Trends in generation from renewables by English region

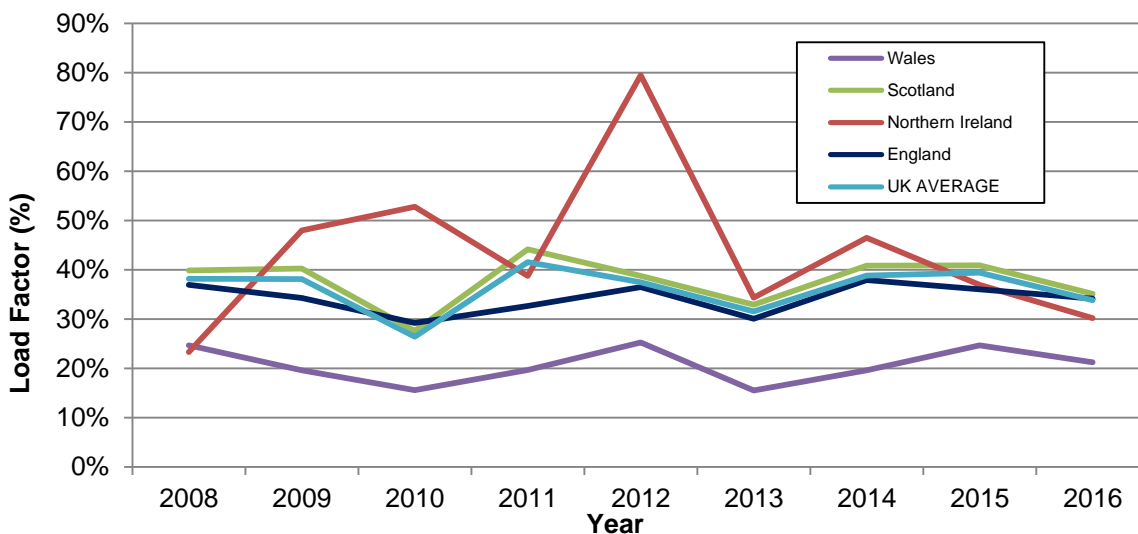


Load factor analysis

Load factors for the various technologies, presented on an unchanged configuration (UC) basis¹⁰, are shown in Table 5 from data provided in Tables 2 and 3 of this article¹², together with time-series data in several charts¹³.

The load factors for hydro range from 42.5 per cent in the East Midlands to 13.0 per cent in the South East, with the UK average (mean) and median values for the UK overall of 33.8 and 31.6 per cent respectively. Rainfall for 2016 was much lower than for 2015 and the third lowest recorded over a 10-year period; again, this is reflected in the low LFs for hydro. Chart 15 shows the time series variation in load factors and whilst Scotland generally follow variations in annual rainfall, Wales, England and particularly Northern Ireland exhibit more unusual behaviour with a time lag following the record high rainfall in 2011.

Chart 15: Hydro load factor on an unchanged configuration basis, by UK country



Load factors for solar PV range from 9.3 per cent in Northern Ireland to 11.3 per cent in the South East, reflecting solar irradiance levels in the UK. The UK average is 10.8 per cent, with Wales occupying the median of 10.4 per cent. Average daily hours of sunshine in 2016 were less than that for 2015 with a correspondingly lower LF (Chart 16). There were insufficient reliable data with which to report on the performance of PV in Scotland.

¹⁰ Previously, load factors were presented in terms of installed capacity and expressed the average hourly quantity of electricity generated as a percentage of the average capacity at the beginning and end of the year. These can still be found in the load factor time-series spreadsheets, available at: www.gov.uk/government/collections/renewables-statistics. However, this method does not consider the impact of new schemes being constructed but not operating fully in the year. This can result in a distorted picture, depending on the timing and magnitude of new capacity coming on stream, and can even result in values >100%. The *unchanged configuration* basis for load factor calculations has therefore been used in this article.

The term “load factor on an unchanged configuration basis” describes the amount of electricity generated from schemes that have been operating throughout the whole of the calendar year with the same installed capacity configuration. The formula for calculating this is:

$$\frac{\text{Electricity generated during the year (MWh)}}{\text{Installed capacity of schemes operating throughout the year with an unchanged capacity configuration (MW) x hours in year}}$$

In view of the interest shown nationally in this measure, this is now calculated for several renewable technologies. These data are only reported where the region contains three or more operational schemes. The England figure includes data from all English schemes regardless of how many were operational within each region of England.

¹¹ A limitation of this analysis is the availability of Renewables Obligation Certificates (ROCs) data, which is often incomplete for the latest calendar year, when DUKES is compiled (April 2017 this year). This can have an impact on the schemes included in the unchanged configuration definition as new data could include or remove schemes.

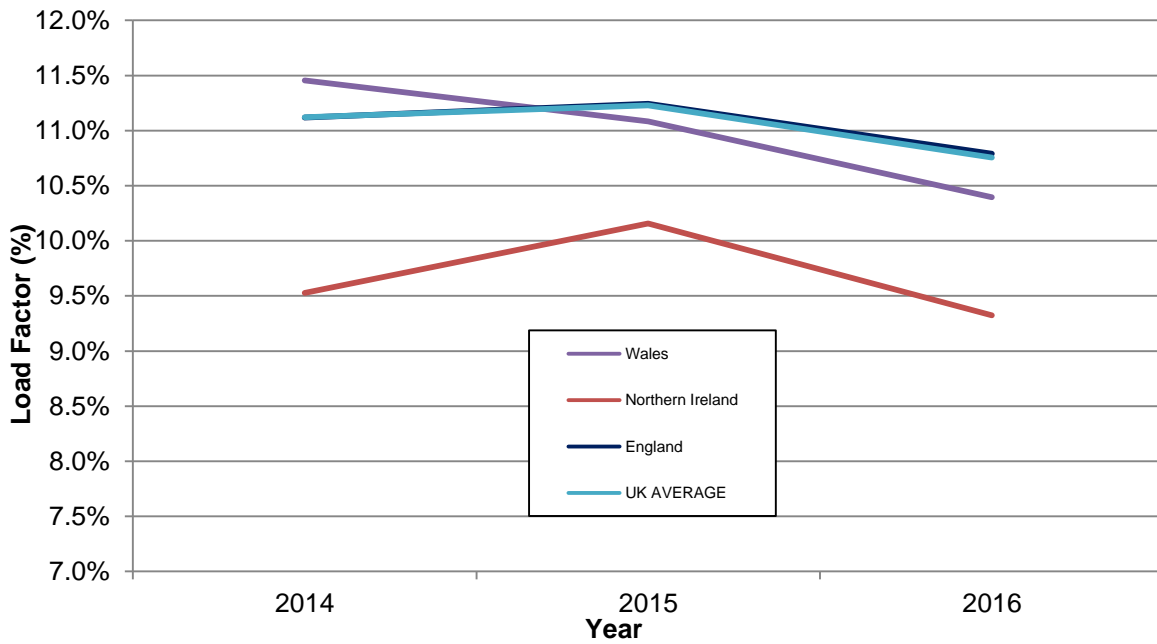
¹² The AD UCLF time series statistics have been separated out this year

¹³ Gaps in the time-series were due to insufficient data with which to accurately report AD UCLF time series statistics

Table 5: Regional load factors on an unchanged configuration basis, 2016

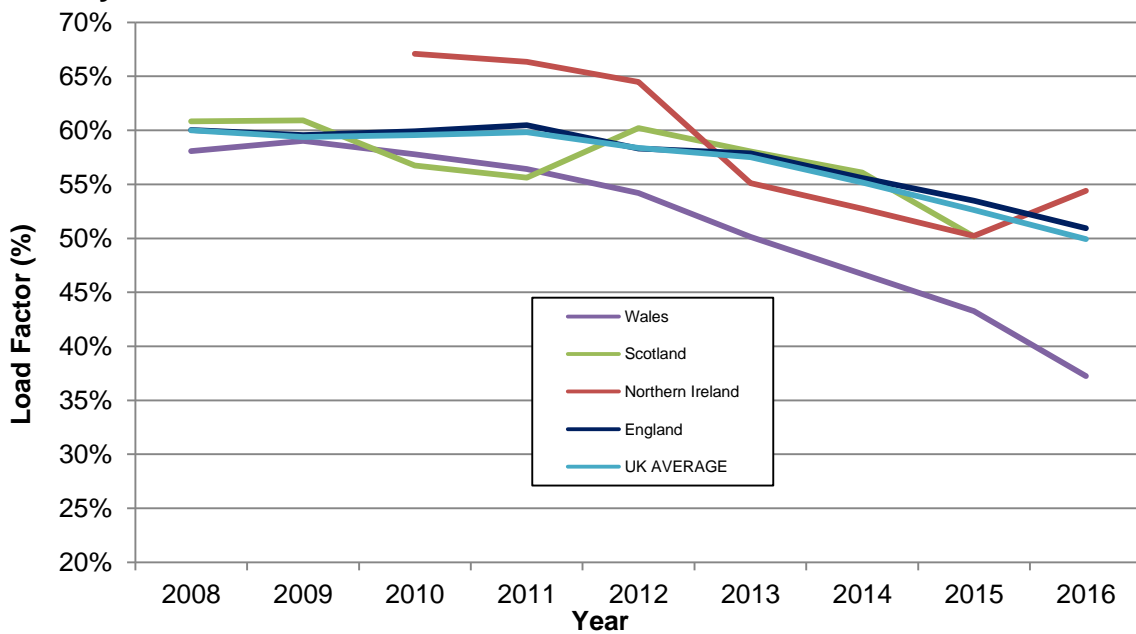
	Onshore Wind	Offshore Wind	Solar PV	Hydro	Hydro (small scale)	Hydro (large scale)	Landfill gas	Sewage gas	AD	Biomass and Waste
England	25.4%	37.9%	10.8%	34.2%	32.5%	37.9%	50.9%	42.9%	58.0%	76.5%
East Midlands	25.3%	36.7%	11.0%	42.5%	42.5%		46.4%	52.0%	75.9%	55.5%
East of England	25.3%	38.0%	10.9%				51.3%	43.9%	66.3%	78.2%
North East	25.0%	34.5%		42.2%	67.6%	37.9%	37.7%	26.7%	53.5%	68.6%
North West	27.5%	37.4%	10.5%	33.6%	33.6%		38.9%	44.1%	41.1%	65.7%
London			8.4%				76.1%	22.5%	34.3%	76.3%
South East	24.6%	37.0%	11.3%	13.0%	13.0%		58.3%	49.1%	48.4%	62.6%
South West	24.0%		10.5%	23.2%	23.2%		52.6%	43.9%	56.1%	27.1%
West Midlands			10.3%	26.0%	26.0%		58.7%	50.7%	77.7%	69.4%
Yorkshire and the Humber	25.0%	43.0%	9.6%	33.1%	33.1%		52.3%	53.9%	44.4%	81.0%
Northern Ireland	25.3%		9.3%	30.2%	30.2%		54.4%		81.5%	68.3%
Scotland	23.5%	30.5%		35.2%	35.4%	35.1%	46.8%	50.3%	39.4%	70.8%
Wales	24.3%	31.5%	10.4%	21.2%	32.6%	19.5%	37.2%	42.0%	34.0%	67.0%
UK AVERAGE	24.2%	36.7%	10.8%	33.8%	34.6%	33.8%	49.9%	43.1%	59.4%	75.9%
MEDIAN	25.0%	36.8%	10.4%	31.6%	32.8%	35.1%	51.8%	44.1%	51.0%	68.4%

Chart 16: PV load factor on an unchanged configuration basis, by UK country



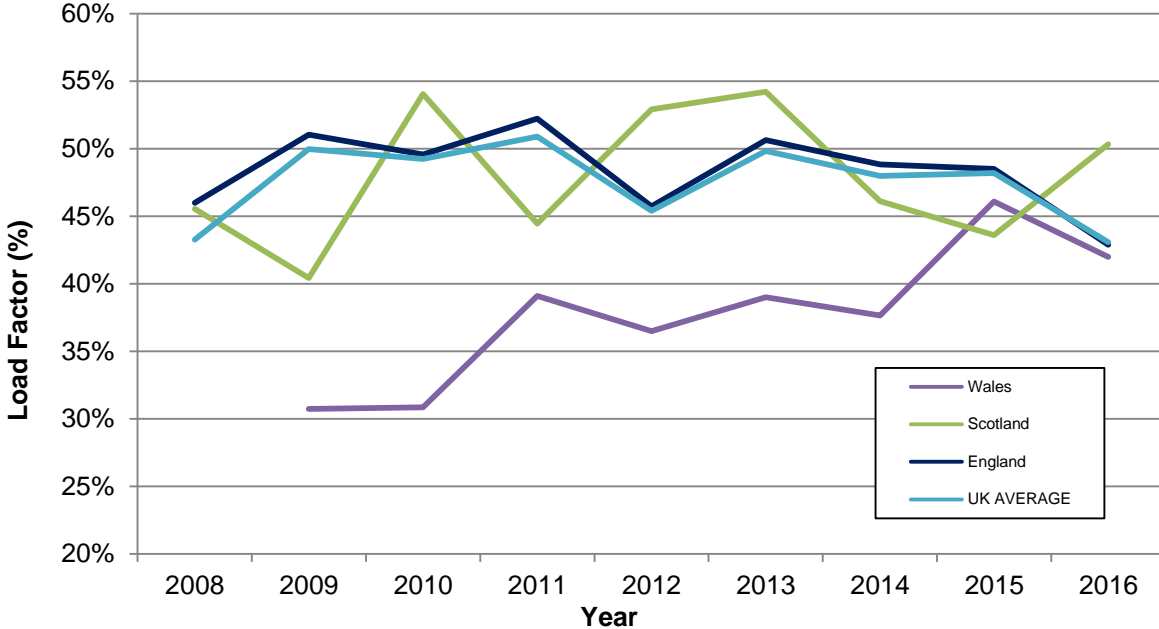
For landfill gas, the load factors vary from 76.1 per cent for London to 37.2 per cent in the Wales, with UK mean and median values of 49.9 and 51.8 per cent respectively. Chart 17 shows that for England, Wales and Scotland, the landfill gas load factor has been steadily decreasing each year and this could be attributed to reductions in the quantity of waste landfilled since the early 2000s leading to less efficient gas abstraction. In the case of Northern Ireland, there has been a growth in capacity and load factors as new sites have been exploited but this has now settled down to similar values to the rest of the UK.

Chart 17: Landfill gas load factor on an unchanged configuration basis, by UK country



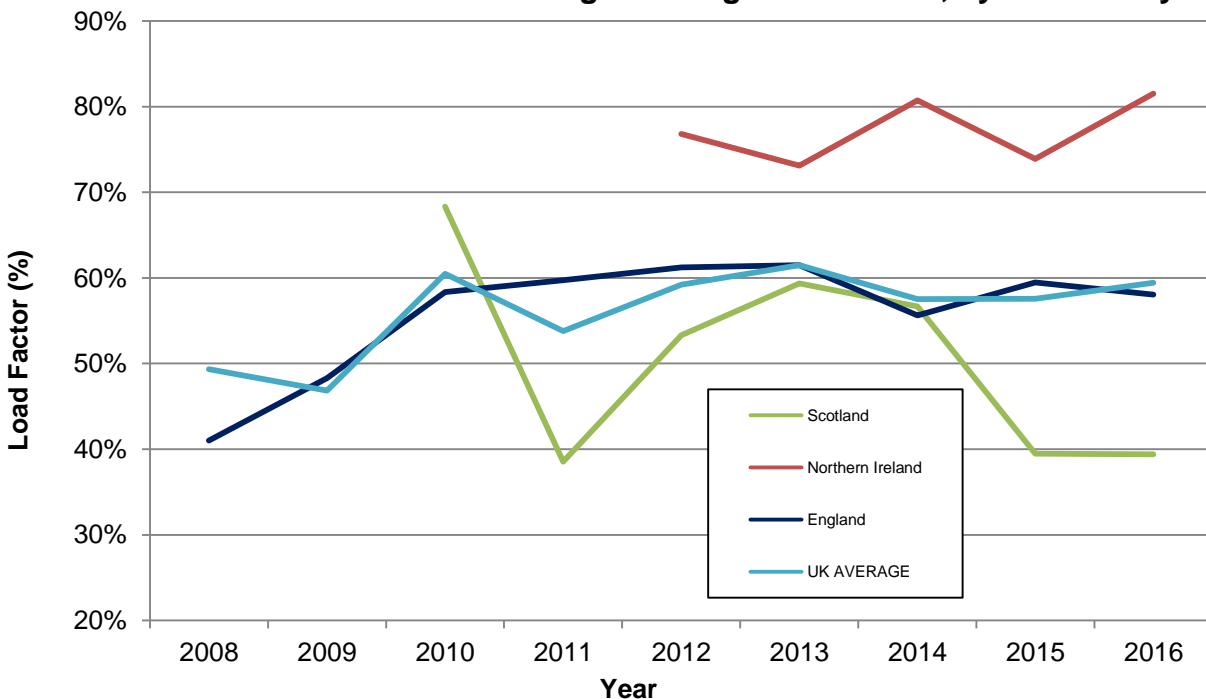
Sewage gas LFs generally fluctuate between about 40 to 50 per cent though historically there have been some unexplained low LFs for Wales, as well as extreme fluctuations in Scotland. There were insufficient reliable data with which to report on the time series performance of sewage gas in Northern Ireland.

Chart 18: Sewage gas load factor on an unchanged configuration basis, by UK country



For Anaerobic Digestion (AD), LFs can vary significantly as, depending on the feedstock, full plant output post commissioning of new schemes is not fully achieved for between 3-6 months as shown by the variations in Chart 19. This year saw a 30 per cent increase in installed capacity and a UK LF of 59.4% represents the third highest recorded to date. There were insufficient reliable data with which to report on Wales. The LFs for Northern Ireland are high compared with GB data for reasons currently unknown.

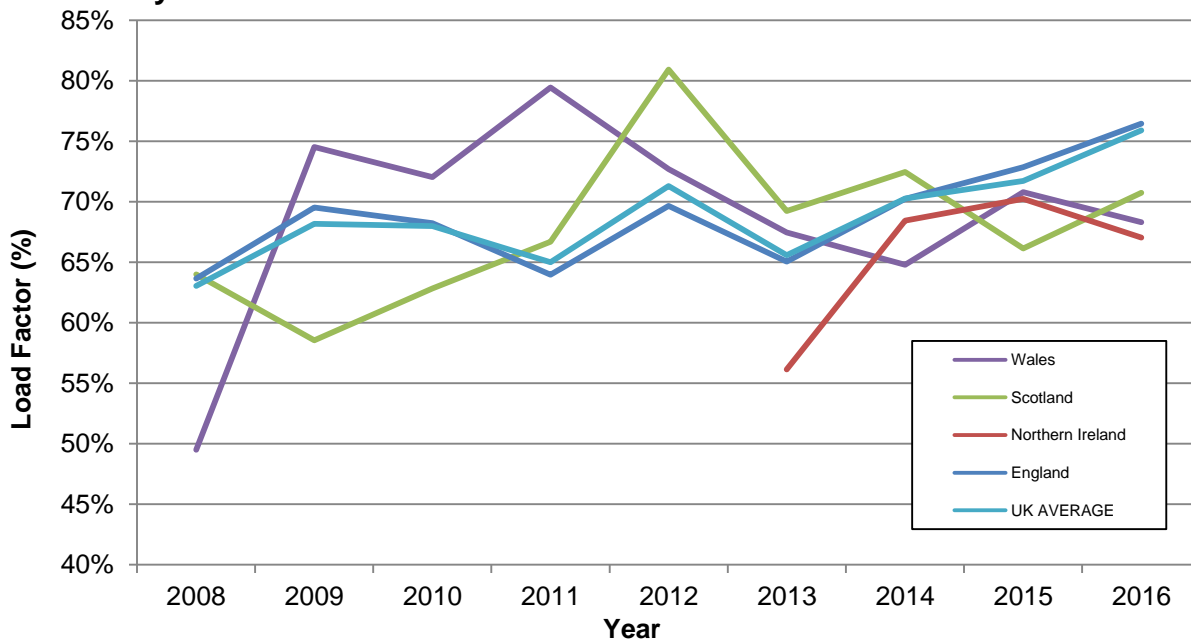
Chart 19: AD load factor on an unchanged configuration basis, by UK country



Special feature – UK renewable electricity

Regional load factors for biomass and waste ranges from 81.0 per cent in the Yorkshire and the Humber (due to the high utilisation rates of Drax), to 27.1 per cent in the South West (due to the lower rates for several Advanced Conversion Technology (ACT) schemes in the region). Drax accounts for the higher average values for England in Chart 20.

Chart 20: Biomass and waste load factor on an unchanged configuration basis, by UK country



For onshore wind, the load factors ranged from 23.5 per cent in Scotland to 27.5 per cent in the North West, with the North East and Yorkshire and the Humber both occupying the median position at 25 per cent.

Chart 21 shows the annual variation in onshore wind load factors compared to the UK's average wind speed.¹⁴ Since 2001, 2015 was the windiest year, slightly exceeding 2008; the least windy year was 2010. Thus, 2015's load factors for both onshore and offshore wind were the highest in the sixteen-year time-period. The average wind speed for 2016 (8.3 knots) was 1.0 knot less than that than for 2015 (9.3 knots), and the third lowest in the last sixteen years. This is reflected in correspondingly low load factors for onshore wind.

¹⁴ Source: Energy Trends table ET 7.2, available at: www.gov.uk/government/statistics/energy-trends-section-7-weather. Further information on the methodology used is given in Energy Trends Special feature article, Dagnall, S.P., Janes, M. and Tipping, A, March 2006, 'UK Onshore Wind capacity factors 1998-2004', Energy Trends, p28

Chart 21: Annual variation in UK onshore wind load factor on an unchanged configuration basis and wind speed

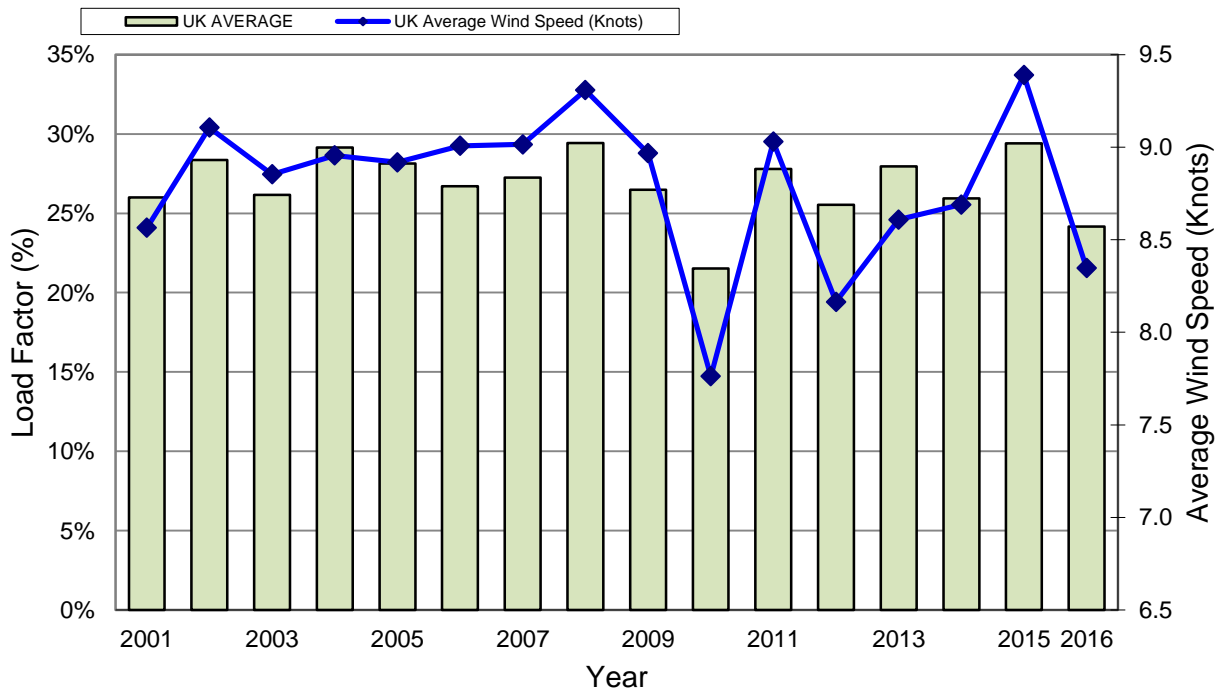
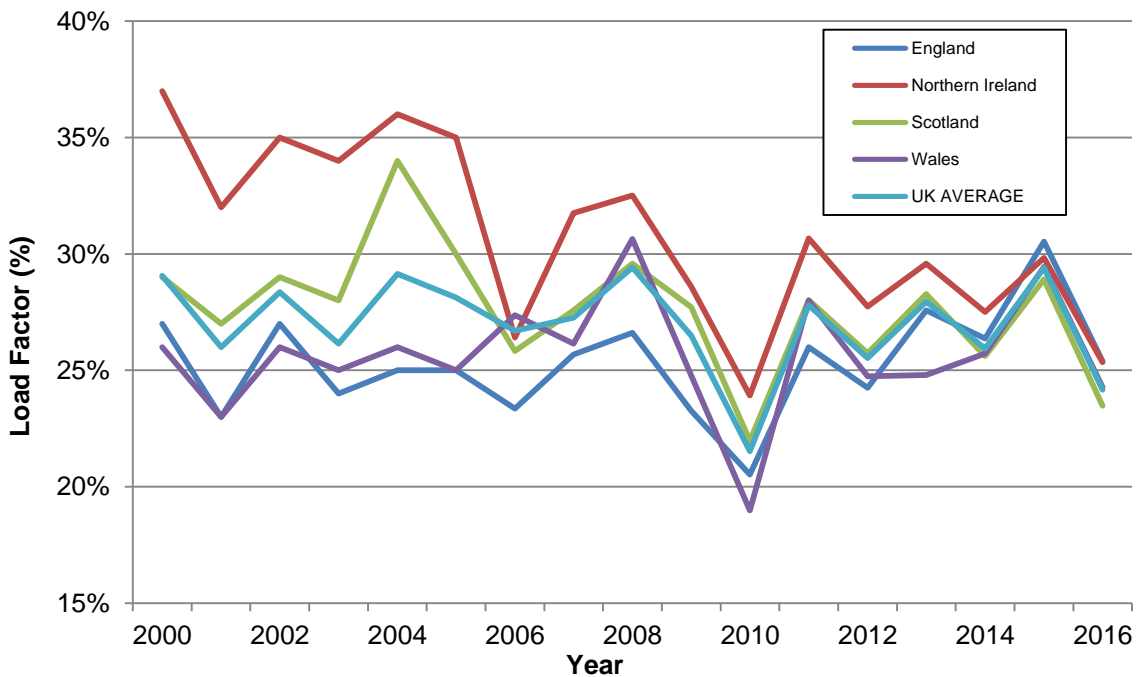


Chart 22 compares the onshore wind load factors for the four UK countries. For most of the sixteen years, the highest load factors have been experienced in the windier countries, Northern Ireland (averaging 30.8 per cent) followed by Scotland (averaging 27.6 per cent). However, in each of 2014 to 2016, Scotland's load factor fell beneath that of the other three countries, due to continued outages and curtailments at some of Scotland's largest wind farms. In 2016, English onshore wind farms continued to achieve, as per 2015, the highest load factor (25.4 per cent), with the North West the highest of the English regions, at 27.5 per cent.

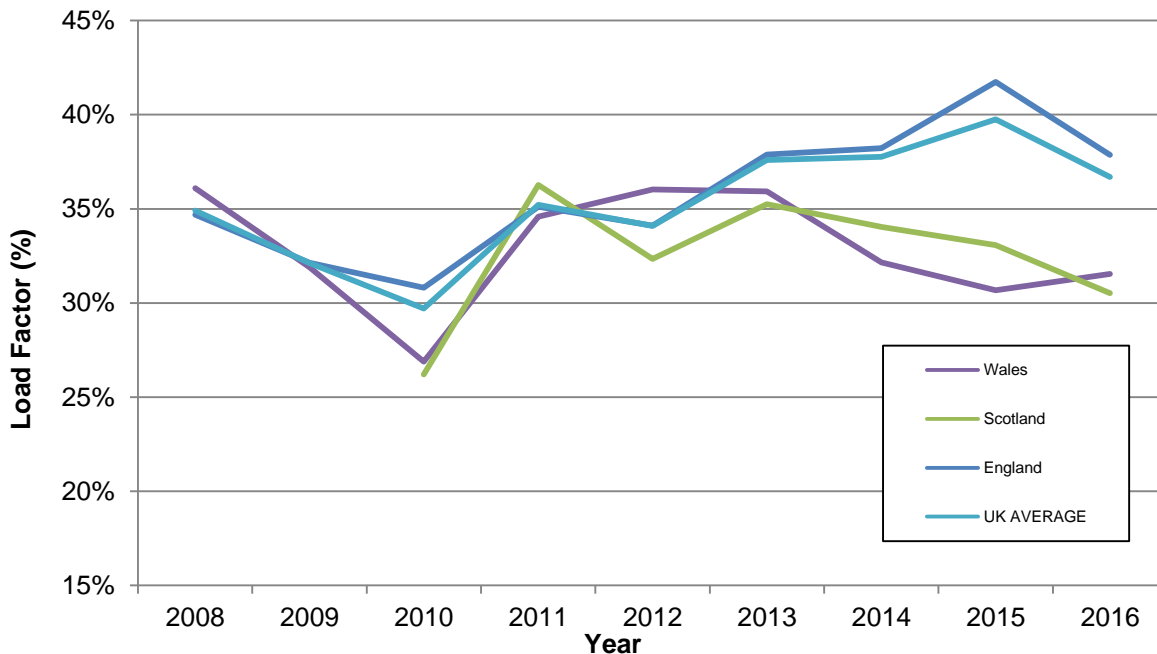
Chart 22: Onshore wind load factor on an unchanged configuration basis, by UK country



Special feature – UK renewable electricity

Offshore wind load factors ranged from 30.5 per cent in Scotland to 37.9 per cent on average in England, with Yorkshire and the Humber achieving 43.0 per cent, driven by high-performing sites including Westermost Rough and Humber Gateway. The East Midlands (which includes Lynn, Inner Dowsing and Lincs) occupied the median position at 36.8 per cent. Chart 23 shows the effect of the variation in average wind speed data described above.

Chart 23: Offshore wind load factor on an unchanged configuration basis, by UK country



Local authority analysis

Tables 6 to 8 rank the top five Local Authorities (LA), per: number of installations, installed capacity, and generation for key technologies; this is also shown graphically in Charts 24 to 26.

For overall **number of sites**, Cornwall remains the top ranked, reflecting the large number of solar PV schemes installed in the South West. In terms of individual technologies, the top ranking LAs for number of installations for onshore wind, PV, hydro, landfill gas, AD and plant biomass are, respectively: The Orkney Islands, Cornwall, Highland, Thurrock, Shropshire and Dumfries and Galloway

Selby remains the top ranked for overall **capacity**, primarily from plant biomass, since this LA contains Drax power station (including three 645 MW biomass units). In terms of installed capacity of individual technologies, the top ranking LAs for onshore wind, PV, hydro, landfill gas, AD and plant biomass are, respectively: Highland, Cornwall, Highland, Thurrock, Shropshire and Selby.

The order of top ranked LAs for capacity is also reflected in the **generation** figures

Cornwall and Wiltshire have large numbers of PV sites with correspondingly high capacity and generation and represent the installation of large solar farms. Interestingly, Sunderland and County Durham between them have an unusually large number of PV sites, especially for a region with low solar irradiance, but little capacity or generation. This large number of small schemes probably represents the promotion of domestic installations.

Highlands overall capacity and generation is driven by the construction of large-scale wind farms. Whilst the Orkneys has the most number of wind sites, almost three times that of Highlands, it has little capacity or generation; being mainly small projects meeting local needs. Although much wind capacity exists in Scotland, grid connection issues mean there are currently limitations on how much can be exported to other parts of the UK until this is resolved.

Shropshire and Herefordshire show the highest number of AD facilities as well as high capacity and generation, reflecting the high availability of AD feedstock due to the livestock farming undertaken in these Districts.

Chart 24: Top five Local Authorities ranked by number of sites

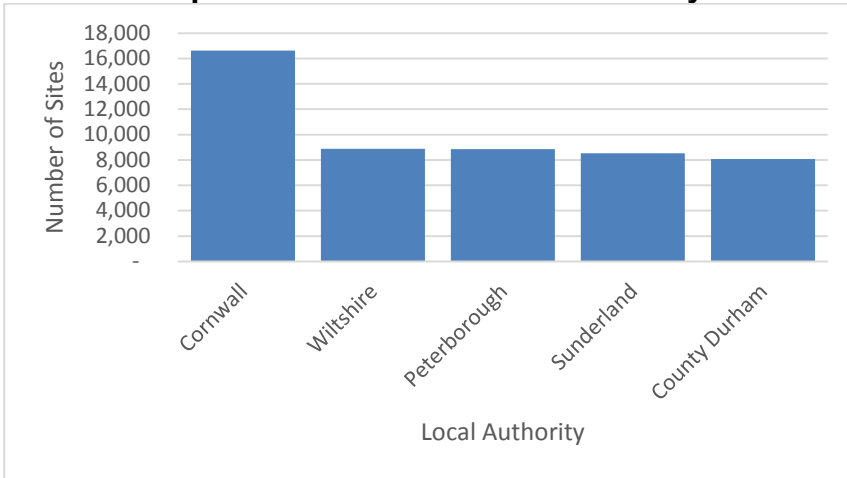


Chart 25: Top five Local Authorities ranked by capacity

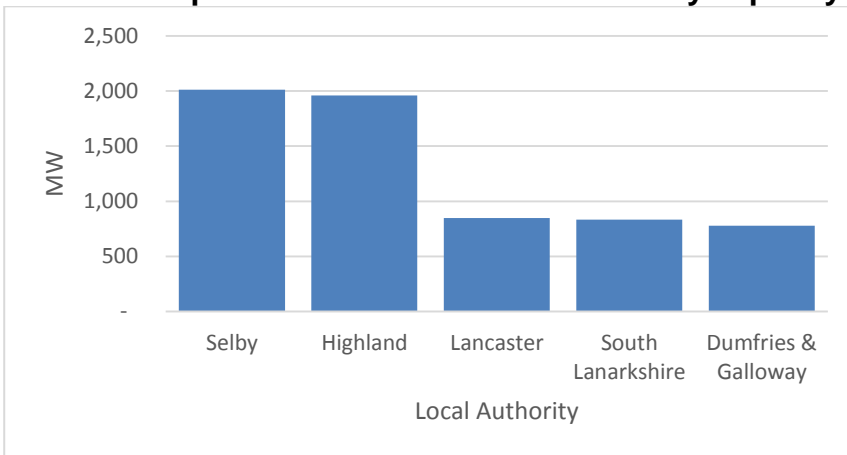


Chart 26: Top five Local Authorities ranked by generation

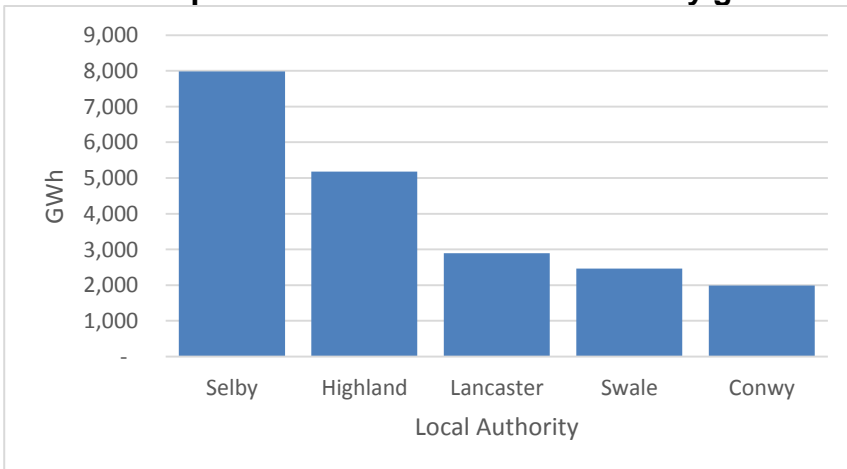


Table 6: Local Authority: Number of sites generating electricity from renewable sources, 2016¹

Onshore Wind	Solar PV	Hydro	Landfill gas	Anaerobic Digestion	Plant Biomass	Total ²	Number
Orkney Islands	760 Cornwall	16,215 Highland	162 Thurrock	10 Shropshire	29 Dumfries & Galloway	10 Cornwall	16,624
Aberdeenshire	486 Peterborough	8,848 Argyll & Bute	77 North Lanarkshire	9 Herefordshire	18 Tameside	7 Wiltshire	8,870
Cornwall	382 Wiltshire	8,846 Dumfries & Galloway	67 Doncaster	8 Strabane	12 Oldham	6 Peterborough	8,855
Dumfries & Galloway	270 Sunderland	8,525 Perth & Kinross	60 Warrington	8 East Riding of Yorkshire	8 Sheffield	6 Sunderland	8,534
Highland	235 County Durham	7,948 Gwynedd	56 Wiltshire	8 Dumfries & Galloway	7 Herefordshire	5 County Durham	8,059
				West Dorset	7		
UK Total	9,243	900,090	1,316	450	526	224	912,151

Table 7: Local Authority: Installed capacity of sites generating electricity from renewable sources, 2016¹

Onshore Wind	Solar PV	Hydro	Landfill gas	Anaerobic Digestion	Plant Biomass	Total ²	MW
Highland	1,186 Cornwall	553 Highland	734 Thurrock	44 Shropshire	14 Selby	1,957 Selby	2,010
South Lanarkshire	792 Wiltshire	533 South Lanarkshire	283 Central Bedfordshire	33 Newark and Sherwood	10 Fife	77 Highland	1,960
Scottish Borders	591 South Cambridgeshire	278 Scottish Borders	266 Warrington	32 Herefordshire	8 Slough	63 Lancaster	849
Aberdeenshire	505 Pembrokeshire	186 Aberdeenshire	152 North Lanarkshire	27 South Ayrshire	7 North Lincolnshire	55 South Lanarkshire	833
South Ayrshire	409 North Norfolk	183 South Ayrshire	70 Aylesbury Vale	21 East Lindsey	7 Allerdale	50 Dumfries & Galloway	780
UK Total	10,921	11,890	1,835	1,062	420	2,850	35,702

Table 8: Local Authority: Generation of electricity from renewable sources, 2016¹

Onshore Wind	Solar PV	Hydro	Landfill gas	Anaerobic Digestion	Plant Biomass	Total ²	GWh
Highland	2,283 Cornwall	509 Highland	2,789 Thurrock	188 Shropshire	77 Selby	7,874 Selby	7,988
South Lanarkshire	1,602 Wiltshire	418 Perth & Kinross	751 Aylesbury Vale	145 Cannock Chase	46 Fife	380 Highland	5,176
Scottish Borders	1,234 South Cambridgeshire	262 Argyll & Bute	500 Warrington	142 Herefordshire	46 Allerdale	372 Lancaster	2,896
Aberdeenshire	1,150 North Norfolk	167 Dumfries & Galloway	384 Central Bedfordshire	140 East Lindsey	38 Dumfries & Galloway	322 Swale	2,464
Moray	693 Pembrokeshire	164 Stirling	221 North Lanarkshire	128 Newark and Sherwood	38 North Kesteven	298 Conwy	1,984
UK Total	20,959	10,420	5,390	4,703	2,052	18,829	83,217

1 Top five ranked Local Authorities (LAs). Where more than five schemes are listed, this indicates that more than one LA has the same ranking.

2 Totals include offshore wind sites allocated to nearest Local Authority.

Comparison with economic activity

Economic activity in each country or region can be measured in terms of Gross Value Added (GVA). Table 9 shows that Scotland continues to show the largest generating capacity from renewables in terms of capacity per unit of GVA, followed closely by Wales and Yorkshire and the Humber. Yorkshire and the Humber shows the largest generation per unit of GVA, due to Drax, followed by Scotland and Wales. Among the English regions, the highest generating capacity per unit of GVA after Yorkshire and the Humber is the South West, followed by the East of England and the East Midlands. In terms of Generation per unit of GVA, Yorkshire and the Humber is followed by the East of England, the East Midlands and the North West.

Table 9: Density of renewables generation in different areas

	Electrical generating capacity from renewable sources kW/GVA (£million) ^{1,2}	Electricity generated from renewable sources kWh/GVA (£million) ¹
England	15.11	38,104
East Midlands	24.46	48,838
East of England	25.71	56,024
North East	17.92	39,165
North West	15.98	40,001
London	1.01	2,770
South East	14.19	29,900
South West	26.88	31,334
West Midlands	7.83	14,076
Yorkshire and the Humber	35.38	176,073
Northern Ireland	32.32	67,558
Scotland	67.92	150,949
Wales	48.60	92,122
UK average	20.48	48,780

1. GVA is Gross Value Added as published as Total GVA in Regional Gross Value Added (Income Approach), December 2015 at: www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/previousReleases

2. Excludes capacity attributable to co-firing of bioenergy which has not been allocated to regions (see footnote 4 to Table 2).

Revisions

This year saw the separation of wind statistics into onshore and offshore as well as the separation of other bioenergy into AD and biomass and waste. It has resulted to changes in the presentation of both tables and charts allowing a better understanding of the impact of these technologies.

A reconciliation exercise was also undertaken this year using finalised Ofgem ROCs data covering the period 2010 to 2014, inclusive. This has resulted in some significant changes to both capacity and generation for several regions which are summarised in Table 10, alongside further revisions to 2015 data.

Table 10: Historic capacity and generation revisions by country

Year	2010		2011		2012		2013		2014		2015	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
England												
East Midlands	-4	10	2	79	4	-2	4	27	10	-12	14	-1
East of England	0	0	0	0	0	0	0	0	0	0	0	0
North East	-7	-10	15	30	2	11	0	7	12	1	4	-344
North West	1	37	4	19	25	38	0	3	2	-6	11	0
London	-5	8	0	14	1	2	0	0	16	-2	18	7
South East	-1	51	-1	91	0	9	2	12	6	-5	-1	-6
South West	3	28	21	31	14	8	6	-26	40	-10	15	-23
West Midlands	7	15	1	1	2	-2	1	-6	28	4	12	4
Yorkshire and the Humber	0	0	0	0	0	0	0	0	0	0	0	0
Northern Ireland	18	25	3	101	3	6	-1	1	9	4	-13	1
Scotland	4	42	106	181	24	-23	70	17	8	-47	-11	-89
Wales	0	48	1	38	38	53	0	6	0	-4	2	-6
Other	20	143	7	98	20	24	60	-106	42	-9	378	63
TOTAL	36	397	159	684	133	124	144	-65	173	-85	428	-393

Further information

For further details on the sub-national renewable analysis in this article please contact:

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