Feed-in Tariff load factor analysis

Load factors are a measure of the efficiency of electricity generation and this article updates the load factors for Feed in Tariffs, the bulk of which are Solar PV.

Summary

- Load factors for both solar and wind were down marginally on last year, largely as a result of prevailing weather conditions. Solar PV decreased from 10.5 to 10.3 and wind from 20.4 to 19.1. These are within the usual variation shown in the data.

- As in previous years, regional variations in load factors exist, reflecting again different weather conditions in the UK. For Solar we see values ranging from Scotland at 9.1 per cent and South West England at 10.7 per cent. In contrast, Scotland had the highest load factor for wind at 26 per cent, more than double the load factor in the East of England at 12 per cent.

Introduction

This article updates the Feed-in Tariff (FIT) load factor analysis presented in the December 2020 edition of Energy Trends[1] with data for FIT year ten (financial year 2019/20). We also present regional analysis of solar PV for the nine years that data has been published (FIT years two to ten) and wind for years five to ten. All the data in this article is also available in Excel format at the following link, including quarterly load factors for solar PV: http://www.gov.uk/government/statistics/quarterly-and-annual-load-factors

Background

Load factors are a measure of the efficiency of electricity generation. A load factor is defined as the ratio of how much electricity was generated over a certain time period as a proportion of the total generating capacity.

The Feed-in Tariff scheme was launched in April 2010. It is a financial support scheme for eligible low-carbon electricity technologies, aimed at small-scale installations. The following technologies are supported:

- Solar photovoltaic (PV; Up to 5 MW capacity)
- Anaerobic digestion (AD; Up to 5 MW capacity)
- Hydro (Up to 5 MW capacity)
- Wind (Up to 5 MW capacity)
- Micro combined heat and power (MicroCHP; Up to 2 kW capacity).

[1] The article published in December 2019 can be found at the following link: https://www.gov.uk/government/publications/energy-trends-december-2019-special-feature-article-feed-in-tariff-load-factor-analysis

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Installers receive support through generation and export tariffs, paid directly from electricity suppliers. The generation tariff is based on the number of kilowatt hours (kWh) generated whereas the export tariff is based on electricity that is generated on site, not used and exported back to the grid. The FIT scheme closed to new entrants at the end of March 2019.

Data cleansing

Table 1 shows how many installations were registered on the Central Feed-in Tariff Register at the start of FIT year ten and how many installations had meter readings in both March 2019 and 2020. In order to be included in the analysis a meter reading is required in both of these months to cover the whole financial year and remove seasonal effects which would bias the results.

Of the 867,762 schemes registered for FiTs when the scheme closed to new entrants on 31st March 2019[2], 16 per cent were found to have meter readings in both March 2019 and March 2020. Extreme load factor values were further excluded (as in previous years' analysis), accounting for around 1,796 (0.2%) of installations. The column 'Valid load factor' in Table 1 indicates how many installations were included in the final analysis for each technology for the annual generation data. Micro CHP data is included in the main results, but this data must be treated with caution as the number of installations is relatively low.

Table 1: Installations included in analysis by technology – FIT Year 10

Technology	Commissioned by 31st March 2019	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	421	123	116	28%
Hydro	1,191	211	207	17%
Micro CHP	596	32	27	5%
Solar PV	857,857	140,069	138,312	16%
Wind	7,697	1,813	1,790	23%
All Technologies	**867,762**	**142,248**	**140,452**	**16%**

* Meter reading in March 2019 and March 2020.

Results

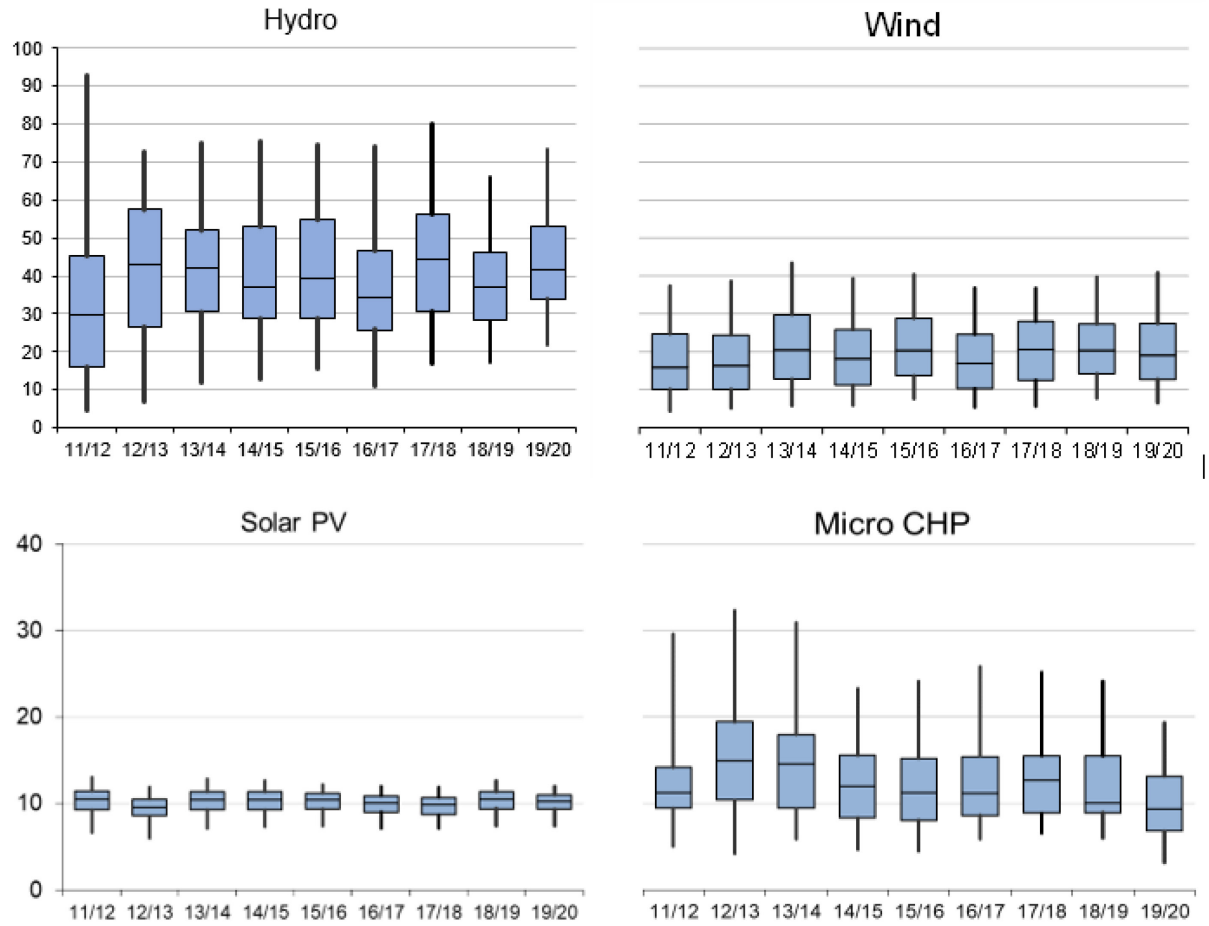
Table 2 gives the weighted mean and median load factors as well as associated percentiles for each technology. Chart 1 presents this data across all available years (FITs years two to ten), highlighting the large range present for Hydro compared to other technologies, whilst solar installations have the smallest range of load factors.

Table 2: FIT Year 9 (2019/2020) load factors by technology

Technology	Count	Weighted mean	Percentile				
			5th	25th	50th (median)	75th	95th
Anaerobic digestion	116	75.3	20.0	61.3	84.0	94.6	97.5
Hydro	207	40.9	22.0	34.0	41.8	53.2	73.2
Micro CHP	27	10.1	3.2	6.8	9.3	13.1	19.2
Photovoltaic	138,312	10.2	7.5	9.4	10.3	11.0	12.0
Wind	1,790	29.7	6.5	12.7	19.1	27.5	40.8

[2] Subject to further revision

Chart 1: Load factor range by technology and year



Lines indicate range from 5th to 95th percentile. Boxes indicate range from lower to upper quartile (25th to 75th percentile) with median indicated.

The median load factor for Solar PV in 2019/20 was lower than 2018/19 by 0.2 percentage points. However, in 2019/20 average sunlight hours were 4.4, down from 4.9 in 2018/19 which had been the sunniest year in this time series. The median load factor was at a similar level to that seen in the years 2013/14 – 2015/16 when average daily sun hours were at a similar level. See Table 3:

Table 3: Solar PV load factors and average sun index

Year	Median load factor	Average daily sun hours
2011/12	10.5	4.5
2012/13	9.6	3.7
2013/14	10.4	4.5
2014/15	10.4	4.5
2015/16	10.4	4.3
2016/17	10.1	4.2
2017/18	9.8	4.1
2018/19	10.5	4.9
2019/20	10.3	4.4

As in previous years, the weighted mean load factor for wind installations is higher than the mean (see Table 2), and this difference has generally increased over the time-series, possibly reflecting the increase in the number of higher performing larger wind schemes in the analysis. The relationship between average daily wind speed[3] and load factor for wind installations is weaker than that observed between sun hours and solar load factors (see Table 4). In 2019/20 the median load factor decreased from 20.4% to 19.1%, despite an increase in average wind speeds. However, the weighted mean of the load factors increased from 26.0% to 29.7%, the highest in this series. The mean and median load factors are broadly similar to those seen in 2017/18 when the average wind speed across the year was also 8.8 knots.

There is a relationship between wind speed and wind load factors but load factors for wind vary much more than those for solar PV. Chart 1 (above) shows the wider spread between the lower and upper quartiles for wind but these ranges overlap from year to year. This may be because the wind farms that are on FITs are on average much smaller than major power producers and they may not be located in the optimum position for wind generation. Furthermore, wind speeds are measured at ground level which may differ from the wind speed at the level of the wind turbine. The average wind speed quoted here is for the whole of the UK but wind speed can vary significantly by location.

Table 4: Wind load factors and average wind speed

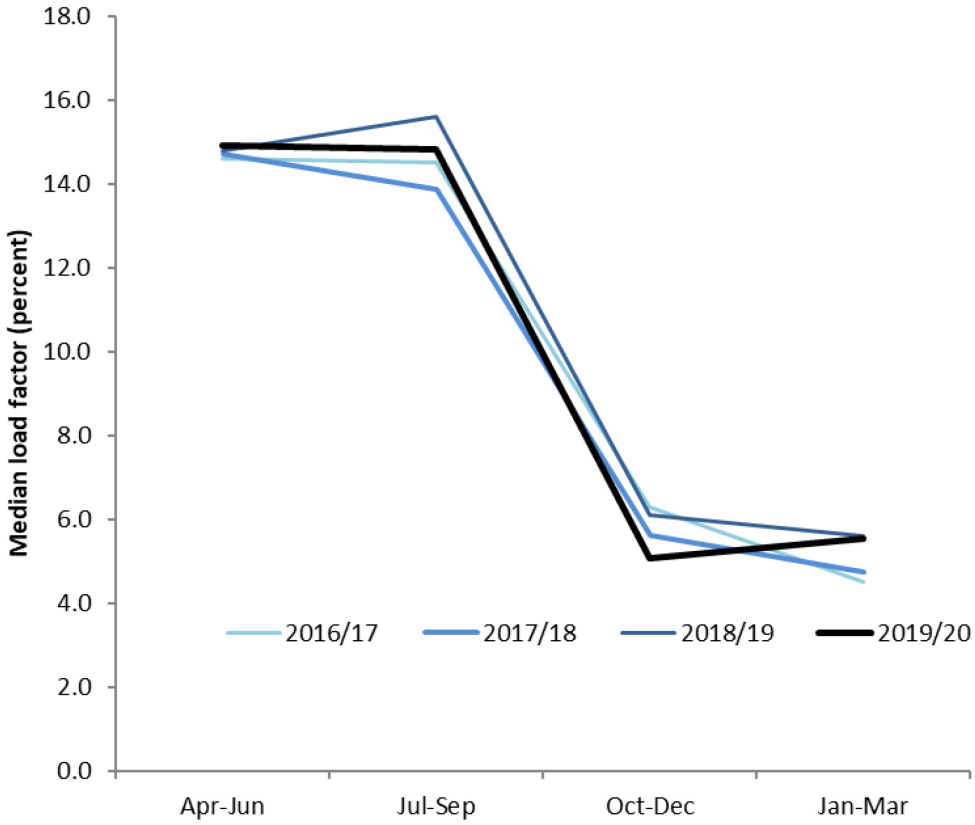
Year	Median load factor	Weighted mean load factor	Average wind speed (knots)
2011/12	15.9	18.3	9.2
2012/13	16.3	22.3	8.0
2013/14	20.5	27.2	9.3
2014/15	18.1	25.3	8.6
2015/16	20.3	28.7	9.2
2016/17	17.0	24.6	8.2
2017/18	20.5	28.4	8.8
2018/19	20.4	26.0	8.5
2019/20	19.1	29.7	8.8

Quarterly Solar PV load factors

Quarterly load factors for Solar PV installations are available in the accompanying excel workbook and the last four years are presented graphically in Chart 2. These show an expected association between load factor and daily hours of sunshine, where the quarters mainly covering Autumn and Winter have the lowest load factors. This chart shows that the load factors seen in FIT year ten (2019/20) for Solar PV were relatively low in October to December and high in January to March. This is in line with typical seasonal trends.

[3] Average wind speed taken from Energy Trends section 7: weather, table 7.2 " Average wind speed and deviations from the long-term mean (ET 7.2)" www.gov.uk/government/statistics/energy-trends-section-7-weather. Note that data for 2019/20 are provisional and subject to revision.

Chart 2: Quarterly Solar PV load factors by FIT year



Regional Solar PV load factors

Solar PV Factors for each region have been published for FIT years two to ten in the accompanying excel file and are presented for years five to ten in Table 5. Chart 3 highlights that the lowest load factors are seen in Scotland, while the highest are seen in the South West. In year ten (2019/20), the median load factor was down in every region except North East England, although they were at a very similar level in Wales and the other regions in the North of England. This reflects average sunlight hours being down on FIT year nine but there are regional variations in sunlight hours. In every year London has had a lower load factor than the South East and this year it had the lowest outside of Scotland. This may be due to pollution or particles settling on the panels or because more panels are shaded by tall buildings nearby.

Chart 3: Regional Solar PV load factors for FITs years 2-10

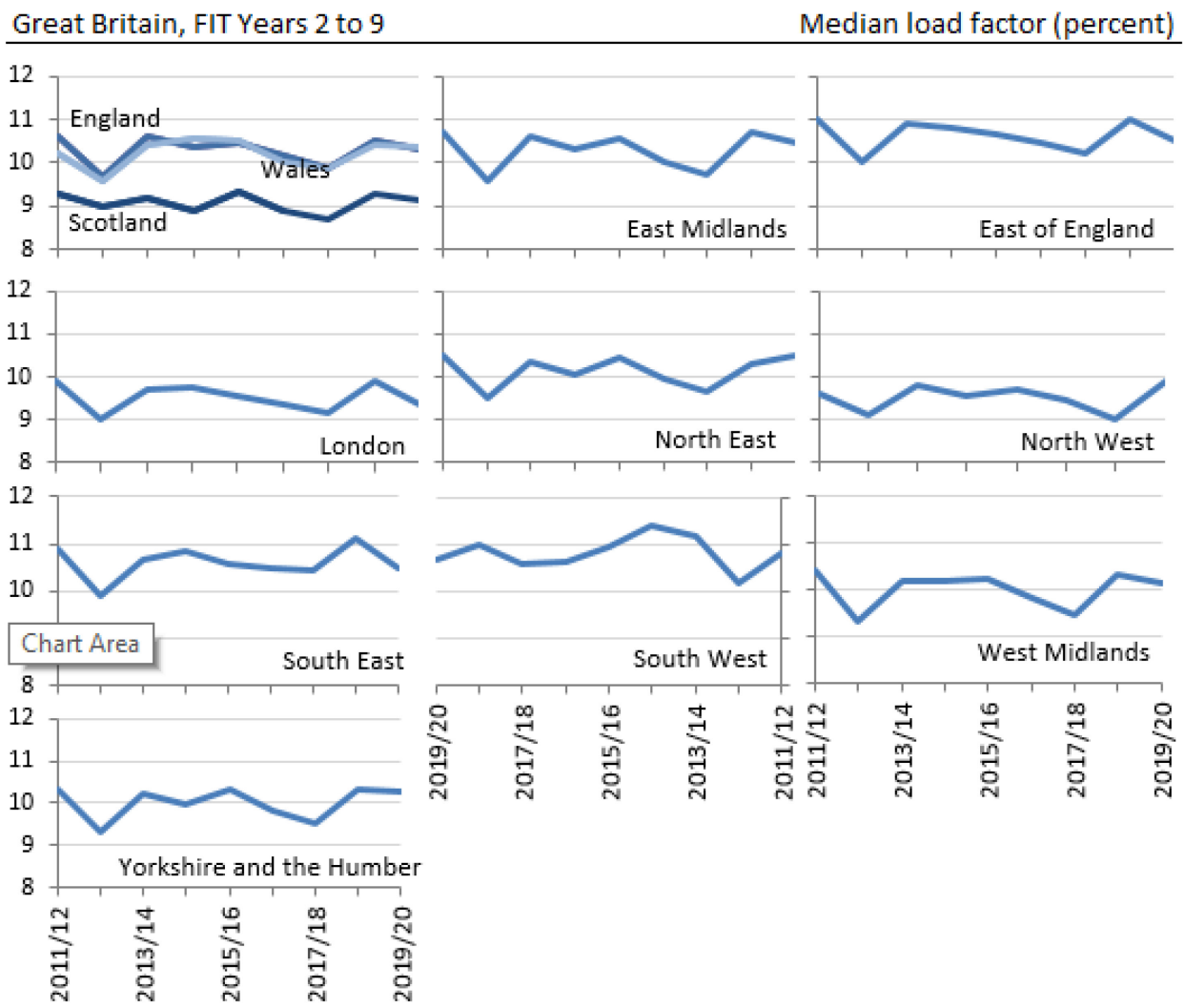


Table 5: Regional Solar PV load factors for FITs years 5-10

Region	FIT Year 5 (2014/15)		FIT Year 6 (2015/16)		FIT Year 7 (2016/17)		FIT Year 8 (2017/18)		FIT Year 9 (2018/19)		FIT Year 10 (2019/20)	
	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
North East	8,023	10.1	6,444	10.4	5,595	9.9	9,625	9.7	8,086	10.3	9,337	10.5
North West	17,360	9.5	13,689	9.7	11,546	9.5	19,736	9	21,398	9.9	14,117	9.9
Yorkshire and the Humber	18,507	9.9	15,058	10.3	12,826	9.8	19,339	9.5	15,866	10.3	21,813	10.3
East Midlands	18,735	10.3	13,489	10.5	11,548	10	19,023	9.7	16,041	10.7	18,880	10.5
West Midlands	15,312	10.2	12,013	10.2	10,219	9.8	13,946	9.5	11,843	10.3	16,080	10.1
East of England	21,247	10.8	16,917	10.6	14,308	10.5	22,240	10.2	26,783	11	14,211	10.5
London	4,996	9.8	3,813	9.6	3,240	9.4	4,852	9.2	4,027	9.9	2,456	9.4
South East	25,994	10.9	18,955	10.6	15,632	10.5	24,933	10.4	21,379	11.1	12,817	10.5
South West	36,938	11.4	29,331	11	25,715	10.6	36,357	10.6	32,044	11	17,412	10.7
England	**167,112**	**10.4**	**129,709**	**10.5**	**110,629**	**10.2**	**170,137**	**9.9**	**157,467**	**10.5**	**127,123**	**10.3**
Scotland	**11,363**	**8.9**	**6,802**	**9.3**	**5,731**	**8.9**	**11,036**	**8.7**	**11,681**	**9.5**	**4,861**	**9.1**
Wales	**15,100**	**10.5**	**11,614**	**10.5**	**9,946**	**10.0**	**14,598**	**9.9**	**12,545**	**10.4**	**6,328**	**10.4**

Regional Wind load factors

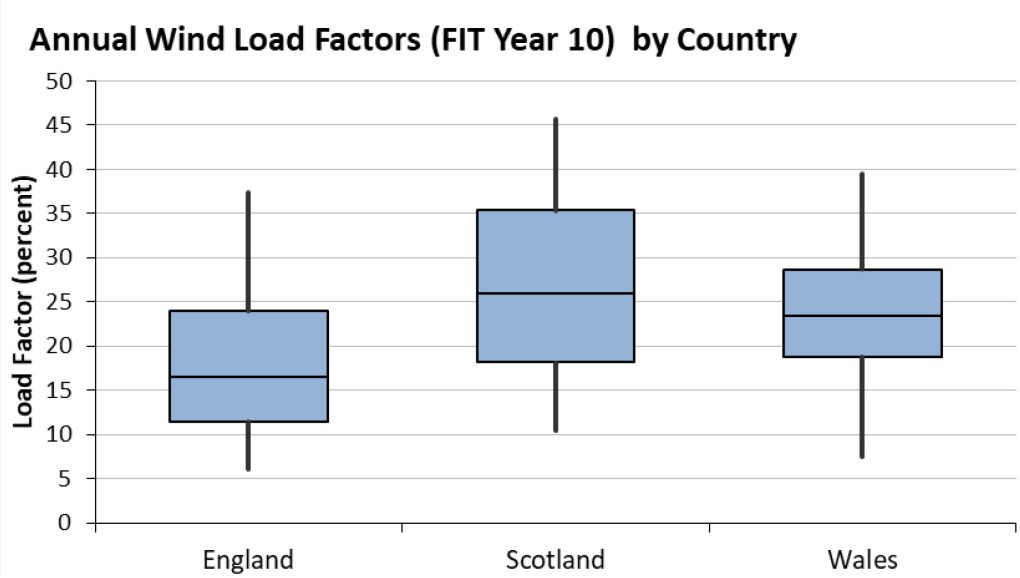
Regional load factors for Wind schemes for FIT years five to ten are available in the accompanying excel file. The median load factors for years seven to ten are presented in Table 6. Data from London and the South East have been aggregated as there are a low number of installations within these regions with a valid load factor. The table shows that in the latest year the highest Wind load factors are found in Scotland, followed by Wales then South West England. Chart 4 summarises this data for England, Scotland and Wales.

Table 6: Regional Wind load factors for FITs years 7 to 10

Region	FIT Year 7 (2016/17)		FIT Year 8 (2017/18)		FIT Year 9 (2018/19)		FIT Year 10 (2019/20)	
	Count	Median	Count	Median	Count	Median	Count	Median
North East	67	14.2	63	18.5	60	17.8	53	17.2
North West	129	18.9	90	18.8	133	20.6	119	20.4
Yorkshire & the Humber	321	17	161	19.7	313	17.9	277	18.5
East Midlands	134	13.6	60	18.9	132	17	117	19.1
West Midlands	63	13.6	38	11.1	56	12.2	58	15.4
East of England	361	8.6	74	16	73	17.8	353	11.5
London & South East	18	10.2	16	8	9	14	16	13.7
South West	276	20.6	166	20.2	284	20.2	234	23.2
England	**1,369**	**14.6**	**668**	**18.3**	**1,060**	**17.2**	**1,227**	**16.5**
Scotland	**436**	**24.0**	**360**	**23.5**	**546**	**24.4**	**404**	**26.0**
Wales	**192**	**20.4**	**85**	**20.6**	**206**	**21.6**	**159**	**23.4**

Chart 4: Wind regional load factors for FITs year 9 by country

Lines indicate range from 5th to 95th percentile. Boxes indicate range from lower to upper quartile (25th to 75th percentile) with median indicated.



Methodology

From 2013, BEIS obtained meter readings for registered installations from Energy Suppliers and used this to produce quarterly and annual load factors for FIT years two to ten (data from year one is not available as the number of installations running for the full year was very small).

The methodology used for the load factor analysis was described in detail in an Energy Trends article from September 2014[4]. One additional quality assurance (QA) step has been added since 2015, to remove any installations from the analysis where more than one generation meter is attached. This step has only been applied to FIT year five to ten data; previously produced statistics have not been revised. Whilst all efforts have been made to quality assure the data in this publication, the results are based on a sample.

This publication is available from: www.gov.uk/government/collections/energy-trends

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[4] The article published in September 2014 can be found at the following link: www.gov.uk/government/statistics/energy-trends-september-2014-special-feature-article-analysis-of-feed-in-tariff-generation-data