Feed-in Tariff load factor analysis: 2021/22

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Key headlines

Median load factors for wind, solar and hydro installations decreased in 2021/22. Unfavourable weather conditions were the main driver, with this financial year being drier and less windy than previous years.

The median load factor for solar photovoltaics (PV) was 10.2 per cent in 2021/22, a small 0.2 percentage points fall with respect to 2020/21. The load factor is closely associated with average daily hours of sunlight, which decreased slightly in the latest financial year.

Wind load factors fell by 2 percentage points to a median of 17.4 per cent, the lowest load factor since 2016/17. Windspeeds in 2021/22 were the lowest across all the years considered in this analysis, although weather does not always perfectly align with wind load factors.

North East and South West England had the highest median load factor for solar PV, while Scotland had the highest wind load factor this year. Wind load factors continue to exhibit greater regional variability than that seen for solar PV.

Introduction

This article analyses load factors of small-scale renewable installations accredited under the Feed-in Tariff (FiT) scheme[1]. For each financial year since 2011/12 (the second year of the FiT scheme), we provide an update on national load factors for all technologies, as well as regional load factors for solar PV and wind installations, and quarterly national load factors for solar PV schemes. Detailed tables are available as an Excel workbook, at the following link (opens in a new window): www.gov.uk/government/publications/quarterly-and-annual-load-factors.

This year, we have made several changes to the methodology to make the analysis more robust. A summary of these changes is available in an annex at the end of this publication, but note that the changes have not resulted in materially different load factors.

Background

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

The Feed-in Tariff scheme was launched in April 2010[2]. It is managed by Ofgem. It is a financial support scheme for eligible low-carbon electricity technologies, aimed at small-scale installations. The following technologies are supported:

- Solar photovoltaic (up to 5 MW capacity)
- Anaerobic digestion (up to 5 MW capacity)
- Hydro (up to 5 MW capacity)
- Wind (up to 5 MW capacity)
- Micro Combined Heat & Power (Micro CHP, up to 2 kW capacity)

Some generators receive financial support for generating electricity and some for exporting electricity, depending on the tariff which they are on. The generation tariff is based on the number of kilowatt hours (kWh)

[1] The article published in December 2021 can be found at the following link (opens in a new window)

[2] More details here: www.ofgem.gov.uk/environmental-and-social-schemes/feed-tariffs-fit

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, though a grace period has been allowed to a small number of installations since then. Accredited generators continue to receive support for 20 years from the date they were commissioned (10 years for micro CHP, 25 years for solar PV commissioned prior to August 2012).

Data cleansing

Table 1 shows how many installations were registered on the Central Feed-in Tariff Register at the start of FIT year twelve and how many installations had valid meter readings. To be included in the analysis, each installation was required to have meter reading taken sufficiently close to April 1st 2021, and a corresponding reading approximately one year later. See the annex below for more information on how readings were chosen.

Of the 869,971 schemes registered for FiTs at the start of the financial year[3], 26 per cent were found to have sufficient meter readings for the annual analysis. Extreme load factor values were further excluded (as in previous years' analysis), accounting for around 4,700 (0.5 per cent) of installations. The column 'Valid load factor' in Table 1 indicates how many installations were included in the final annual analysis for each technology. Micro CHP data is included in the main results, but this data must be treated with caution as the number of valid data points remains very low.

Table 1: Installations included in analysis by technology – FIT Year 12

Technology	Commissioned by 31st March 2021	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	427	231	199	47%
Hydro	1,206	419	359	30%
Micro CHP	525	19	7	1%
Photovoltaic	860,252	223,396	219,102	25%
Wind	7,561	2,700	2,445	32%
All Technologies	**869,971**	**226,765**	**222,112**	**26%**

Results

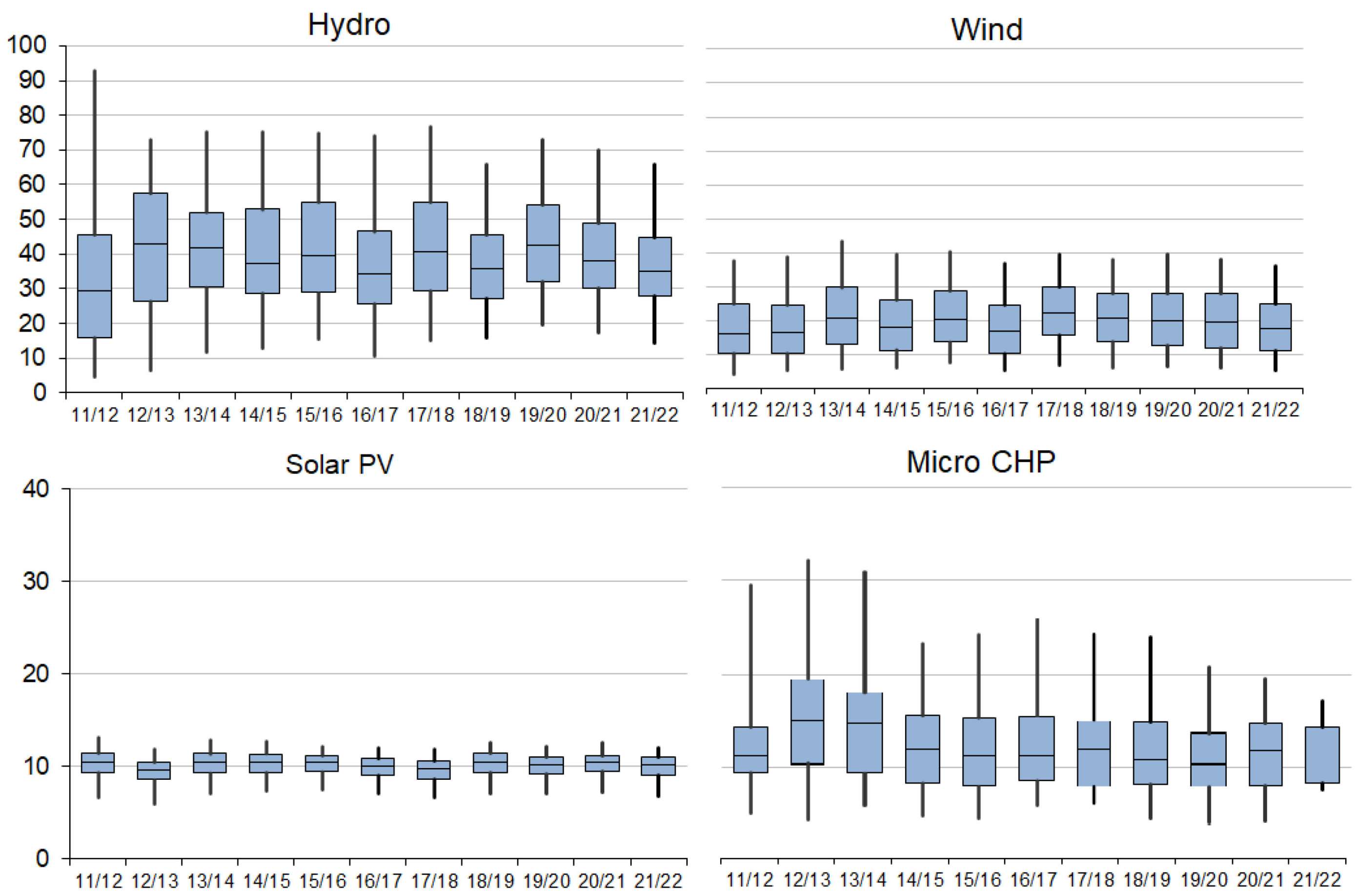
Chart 1 below illustrates the annual load factors for each technology reported in the accompanying Excel workbook. Load factors are presented on box-and-whiskers plot for each technology and across all the FiT years, displaying their median value and the range spread across it.

The plots reveal the differences between the technologies: although primary electricity technologies (solar PV, wind, and hydro) are all dependent on weather conditions, hydro and wind exhibit a wider spread around the median, implying that their load factors are more volatile when subject to a change in weather. Whereas load factors for solar PV are more closely distributed and less likely to drift away from the median.

The variation of the percentiles from year to year are partly due to different weather patterns, although the size of the sample used is likely to have some influence. In particular, the sample size for Micro CHP is very small in the latest year, with only 1 per cent of all accredited stations covered in the analysis this year. Figures for this technology should therefore be treated with caution. Solar has the largest sample each year which is likely to be why the percentiles are less volatile than the other technologies.

[3] Subject to further revision.

Chart 1: Load factor range by technology and year



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

The median load factor for solar PV in 2021/22 was 10.2 per cent, 0.2 percentage points lower than in 2020/21; this can be explained by the slightly lower average sunlight hours reported for this year. The load factors for solar PV shows a close relationship with average sunlight hours, with patterns repeating in the two series. The relatively small variation measured across the sample and the small difference between weighted mean and median also indicates that the efficiency of solar PV installations is less dependent on factors such as location and size of the installation than other technologies, although some regional differences exist which are discussed further below.

Table 2: Solar PV load factors and average sun index

Year	Median load factor	Average daily sun hours
2011/12	10.5	3.7
2012/13	9.6	4.5
2013/14	10.5	4.5
2014/15	10.4	4.4
2015/16	10.4	4.3
2016/17	10.1	4.2
2017/18	9.7	4.1
2018/19	10.5	4.9
2019/20	10.2	4.4
2020/21	10.4	4.5
2021/22	10.2	4.4

In 2021/22, the median load factor for wind was 17.4 per cent, decreasing by 2 percentage points since 2020/21. This is the lowest value reported since 2016/17 and reflects a low average windspeed for 2021/22 compared to previous years. Although windspeeds were similar to those seen in 2011/12, load factors were higher this year, likely reflecting the introduction of newer, more efficient turbines during the past decade.

As in previous years, the weighted mean of the load factor for wind is higher than the median, though it tends to grow in the same direction. The difference between the median and weighted mean generally reflects that larger wind farms are more efficient, and therefore skew the mean load factor towards the upper band.

As can be seen from Table 3 (below), there is a relationship between wind speed and wind load factors, but it is weaker than the relationship between solar PV and sun hours. As shown in Chart 1, load factors for wind vary more than those for solar PV, with percentiles spreading further away from the median. It is also worth noting that windspeeds can vary considerably by location and by height above the ground, making an accurate nationwide analysis more difficult to achieve.

Table 3: 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	22.2	27.3	8.8
2018/19	20.6	26.0	8.5
2019/20	19.8	26.9	8.8
2020/21	19.4	26.6	8.4
2021/22	17.4	25.1	8.0

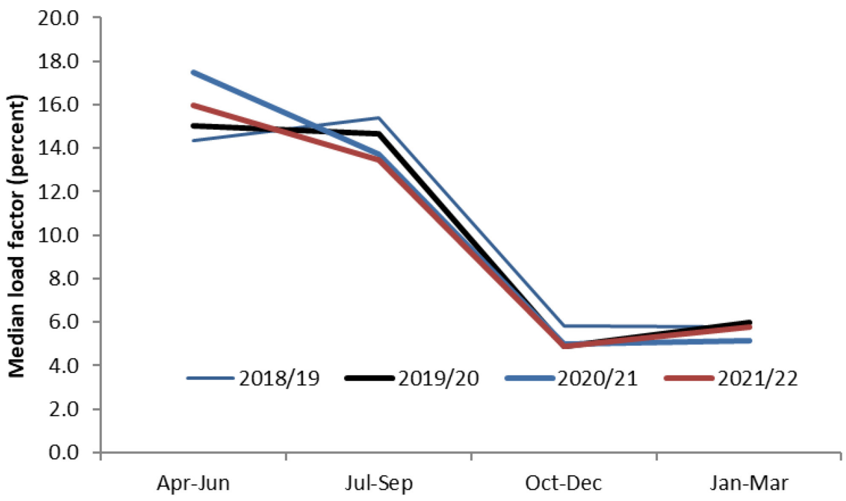
The median load factor for hydro in 2021/22 was 35.2 per cent, down from 38.1 per cent the previous year. Load factors for hydro installations tend to vary a lot within the sample, although the median value has remained fairly stable over the years, following the trend of average rainfall quite closely. The average load factor is particularly low compared with the 2019/20 value of 42.4 per cent, this can be attributed to the latest financial year being the driest in the last decade.

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, while the winter and autumn quarters have the lowest load factors.

In 2021/22, the spring quarter (Apr-Jun) had the highest load factor of the year (16.0 per cent) and this has often been the case over the previous ten years. The median load factors were lower in the first two quarters than in 2020/21, reflecting lower average sun hours.

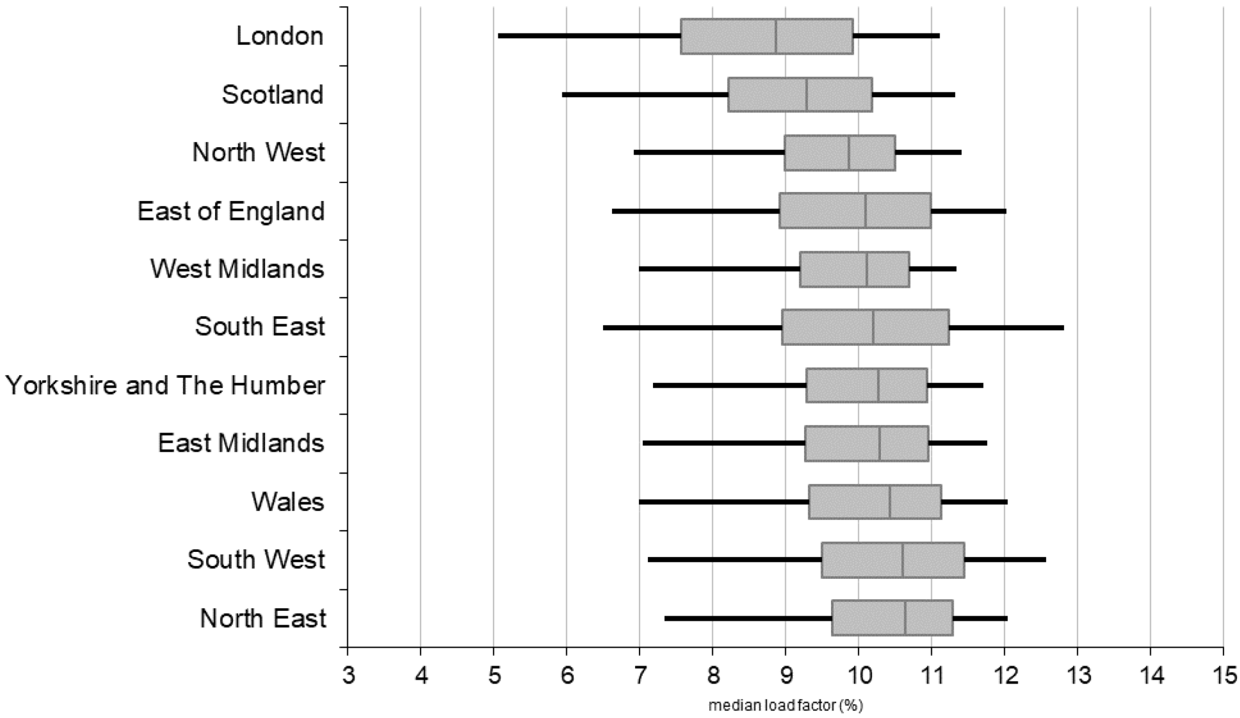
Chart 2: Quarterly Solar PV load factors by FIT year



Regional Solar PV load factors

Chart 3 below displays the solar PV load factor for Scotland, Wales, and each region of England in Year 12. The median load factor varies across regions, but the load factors' distributions are similar from region to region.

Chart 3: Solar PV regional load factor for FiT Year 12.



In 2021/22, North East and the South West had the highest load factor of 10.6 per cent. London had the lowest median load factor in 2021/22, being lower than Scotland for the first time. This may be due to pollution, particles settling on the panels or because panels are shaded by tall buildings nearby. London typically has one of the lowest regional load factors. When compared to 2020/21, median load factors decreased in all regions except in the north, where the North East saw the highest absolute increase (0.4 percentage points) and the other regions were broadly unchanged. The increases in the north were offset by decreases in the south. London, the South West and the South East saw the largest absolute decreases compared to last year.

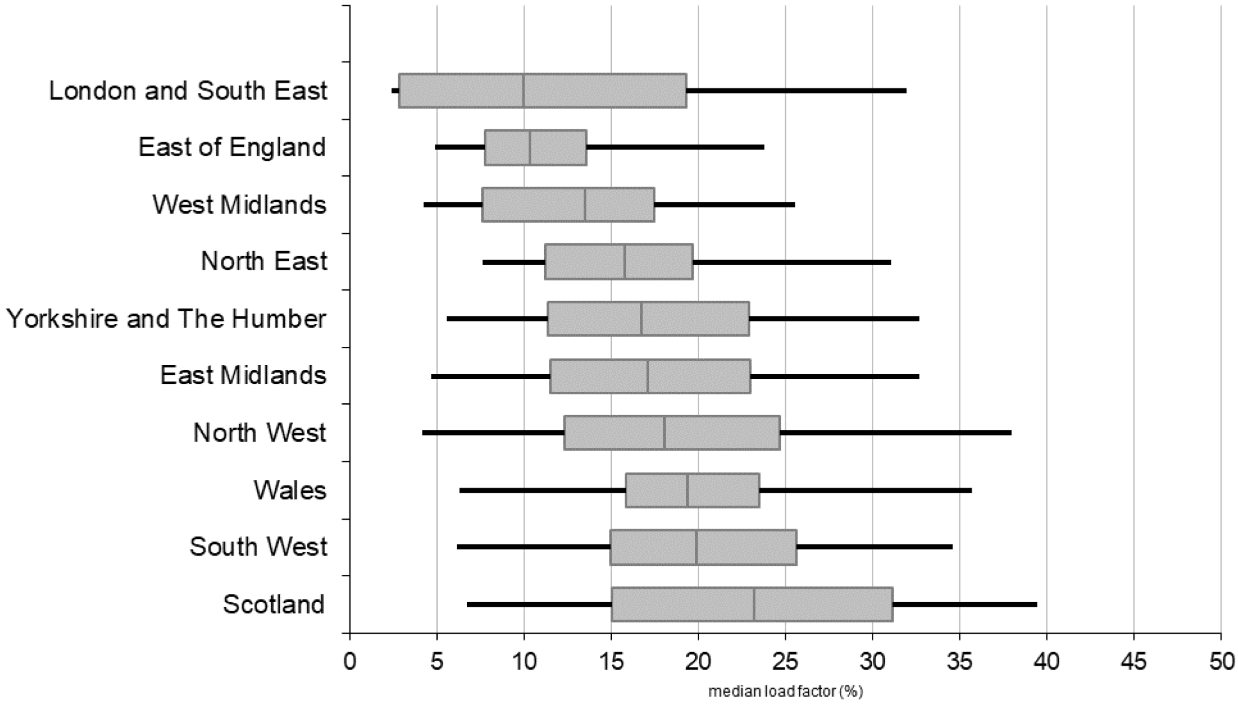
Regional Wind load factors

Chart 4 below shows wind load factors in a box-and-whiskers plot for each region. Data from London and the South East are aggregated due to low number of installations with a valid load factor within these regions.

In the latest year, **Scotland had the highest Wind median load factor at 23.2 per cent**, followed by the South West then Wales. Load factors have decreased in all regions except London and the South East when compared to last year, with the largest fall being seen in the North West (down 3.6 percentage points).

Unlike solar PV, load factors for wind appear to follow different distributions across different regions, although the overall spreads are comparable. West-facing coastal regions tend to report higher load factors more frequently than inner and east-facing regions. Moreover, with the exception of London and South East, regions with a lower median load factor are less likely to report extreme load factors. This suggests that wind load factors have a stronger geographic dependence than solar PV load factors.

Chart 4: Wind regional load factors for FITs year 12



Annex: Summary of methodology changes

This year we have made several changes to the methodology for producing load factors which have led to an increase in the sample size used and therefore more robust statistics. We have used the updated methodology to produce the 2021/22 (FiT year twelve) statistics and have revised the published load factors for FIT years 8 to 11. These changes are detailed below.

It is worth noting that the changes to the methodology have not had a material impact on the published load factors, implying that the previous methodology was sound. Table A quantifies the impact of the new methodology on the median load factors. Across all technologies there has been little change in median load factors, with solar PV factors remaining particularly stable despite the notably broader coverage.

Table A. Comparison of the newly calculated median load factors against former publications, by technology.

	FiT year 8 (2017/18)		FiT year 9 (2018/19)		FiT year 10 (2019/20)		FiT year 11 (2020/21)	
Technology	Previous	Revised	Previous	Revised	Previous	Revised	Previous	Revised
Anaerobic digestion	86.9	85.6	87.2	84.2	84.0	82.4	85.3	83.1
Hydro	44.2	40.7	37.1	35.8	41.8	42.4	38.7	38.1
Solar photovoltaic	9.8	9.7	10.5	10.5	10.3	10.2	10.4	10.4
Wind	20.5	22.2	20.4	20.6	19.1	19.8	19.1	19.4

Existing methodology

Since 2013, we have obtained meter readings for registered installations from energy suppliers and used this to produce quarterly and annual load factors for financial years back to 2011/12 (FiT year two). Data from FiT year one is not available as the number of installations running for the full year was very small.

The methodology originally used for the load factor analysis was described in detail in an Energy Trends article published in September 2014[4]. In 2015, an additional step was included, whereby metering data corresponding to multiple installations were removed from the analysis. This introduces a break in the series from FiT year 5 onwards.

Changes this year

Up to 2021, the data processing was carried out through a series of SAS scripts that were manually adjusted every year. For this edition we have made the additional step of consolidating the entire process into a self-contained, reproducible, and documented pipeline. This has resulted in a more robust and consistent process that makes the best use of all the available data.

The increase in coverage is mainly a result of relaxing the criteria for readings to be included in the analysis. Prior to 2021, readings were included in the analysis if, and only if, they fell within the month of the cut-off period (e.g., March and June for the quarter 1 analysis). This year, we have implemented some flexibility in this mechanism, allowing readings to fall within a larger window that spans over different months. To cover the full financial year and to prevent bias induced by seasonal effects, the number of days between readings must also fall within a prescribed range. See the Assumptions and Methodology sheet in the accompanying Excel workbook for more details: www.gov.uk/government/publications/quarterly-and-annual-load-factors.

[4] The article published in September 2014 can be found at the following link (opens in a new window)

The methodology review focussed on three different areas:

Improving process efficiency.

- Processed data weren't previously held in a single dataset, but raw returns were processed straight into the final analysis. This required a long, manual process to make returns machine-readable, with many data points being removed unnecessarily or lost due to human error. As data are now stored in a SQL table only when they pass through a strict pipeline, more data points have been successfully reformatted. Thanks to these improvements, we were able to retain more data in the final sample; for example, we have recoded the FiT installation number in several returns which were not consistent with Ofgem's numbering system for extensions (a 1-indexed progressive integer), but only where a different numbering system occurred (e.g., 0-indexed). The previous method recoded all FiT extension numbers regardless of any anomalies in the numbering of extensions, which is likely to have led to some errors. However, the number of installations with extensions is small so this has a small bearing on the load factors.

Greater flexibility on dates.

- It became apparent that several cleaning procedures in the previous method were over-simplistic. Readings were previously chosen using a strict criterion (only readings recorded in the opening and closing months of the financial year / quarter were kept). However, a reading date may have been available in the following month which may have been more suitable. For example, in the old method, an installation with a reading on 1st April 2020 and 1st April 2021 would not be included in the analysis for 2020/21 as there was no corresponding reading in March 2021.

- It should be noted that in all cases the exact number of days between meter readings is calculated to produce an accurate load factor. This was also the case in the previous methodology.

- We have developed a method to select the best reading if more than one were available: in the scenario that there are two valid readings in the same month for a single installation, the pipeline would automatically choose the one with the closest date to the nearest cut-off point – e.g. if the month is at the end of a quarter (March, June, September, December), this would be the latest reading in that month, if the month is at the start of the quarter (April, July, October, January) this would be the earliest reading. This has resulted in a sample which more closely represents the quarter or year that we are analysing.

- As we have revised previous years, we have taken the opportunity to match data from one financial year to data for the following financial year. This had not been done in previous versions of this publication and has also added to the amount of valid data. For instance, if an installation had a meter reading in April 2020 but not in March 2021 it would have been discarded in the old method, now it may be included if there is a valid meter reading in April 2021. In this publication we have matched data to the following financial year back to 2017/18.

Quality assurance.

- Given the piecemeal nature of the previous process, errors and spurious changes were extremely hard to track down. The new process is more transparent as assumptions can be specified explicitly in the code, and results are guaranteed to be consistent between years. It is also possible to keep track of excluded data points, allowing the analyst to gauge whether some assumptions might be too strict or too lenient.

Tables B and C below report the coverage for the 2021 survey (FiT year 11), calculated using the two different methods. With the exception of Micro CHP, whose sample size continues to be very small, for all other technologies there has been a 10 percentage point increase in the coverage. As a result, the overall coverage jumped to 31 per cent.

Table B. Installations included in the analysis (FiT year 11, previous method)

Technology	Commissioned by 31st March 2019	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	425	165	155	36%
Hydro	1,177	260	245	21%
Micro CHP	525	21	14	3%
Photovoltaic	859938	181,867	177,826	21%
Wind	7,552	1,981	1,876	25%
All Technologies	**869,617**	**184,294**	**180,116**	**21%**

Table C. Installations included in the analysis (FiT year 11, new method)

Technology	Commissioned by 31st March 2021	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	427	251	202	47%
Hydro	1,206	436	363	30%
Micro CHP	525	34	20	4%
Photovoltaic	860252	271,183	267,702	31%
Wind	7,561	2,971	2,658	35%
All Technologies	**869,971**	**274,875**	**270,945**	**31%**

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

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