Feed-in Tariff load factor analysis

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Key headlines

Median load factors for solar photovoltaic (PV) decreased to 9.4 per cent in 2023/24. This is the lowest recorded median in the time series. Average sun hours in 2023/24 were down on the previous year and were at their lowest since 2017/18.

The median load factor for wind was 20.2 per cent in 2023/24, a 2.9 percentage points increase with respect to 2022/23 despite a very small rise in average wind speed. However, the weighted mean load factor saw a more modest increase.

Like last year, **South West and East of England had the highest median load factor for solar PV,** while **Scotland had the highest wind load factor**. Wind load factors exhibit greater regional variability than solar load factors.

This article analyses load factors from a sample 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, Wind and Hydro schemes. Detailed tables are available as an Excel workbook, at: https://www.gov.uk/government/publications/quarterly-and-annual-load-factors

Background

Load factors are a measure of the efficiency of electricity generation. A load factor is the amount of electricity generated by a system over a certain period expressed as a proportion of its maximum possible output.

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 (AD, 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) 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). At the end of 2023/24, there was more than 5,100 MW of solar PV capacity supported by FiTs (around 30 per cent of total solar PV capacity). In addition, there was around 770

[1] The article published in December 2022 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

MW of wind (5 per cent of total onshore wind capacity), nearly 200 MW of hydro (10 per cent of total hydro capacity) and nearly 300 MW of AD capacity (around 46 per cent of total AD capacity) accredited on FITs.

Data cleansing

Table 1 shows how many installations were registered on the Central Feed-in Tariff Register at the start of FIT Year 14 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, 2023, and a corresponding reading approximately one year later.

Of the 869,446 schemes registered for FiTs at the start of the financial year[3], 23 per cent were found to have sufficient meter readings for the annual analysis. Extreme load factor values were then excluded (as in previous years' analysis), accounting for around 2,300 (0.3 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 statistics are no longer included in this release as there are few installations remaining which are still in support of FIT support (see Introduction).

The headline coverage is always lower in the most recent survey wave, due to the absence of a final meter reading for many installations. In the 2022 publication, we introduced a new method whereby closing readings for the previous year's analysis are added to the data set which increases the sample size for that year, making the results more robust. See the methodology annex in the December 2022 edition of this article[1] (link in note 1). Therefore, we have revised the results for 2022/23 by supplementing the data with this year's data. This has added nearly 130,000 more installations with valid readings to the analysis. This means that the load factors published for the latest FiTs year (2023/24) are subject to revision next year when more data will be available but typically, this method does not have a substantive effect on the reported load factors.

Table 1: Installations included in analysis by technology – FIT Year 14

Technology	Commissioned by 31st March 2021	Generation Data Reported*	Valid load factor	% remaining in analysis
Anaerobic digestion	427	237	209	49%
Hydro	1,206	395	352	29%
Photovoltaic	860,252	199,365	197,395	23%
Wind	7,561	2,614	2,358	31%
All Technologies	**869,446**	**202,611**	**200,314**	**23%**

For this year's edition, we have revised the data for FiT year 13 (2022/23). This is because more data is available by using meter readings from the latest survey which were taken on or around March 31st 2023. As with all sample data, there is a degree of uncertainty surrounding the results and any generalisation to the population should be treated with caution not least because these sites are not randomly selected but are an artefact of those sites who have provided data at the start and end of the financial year.

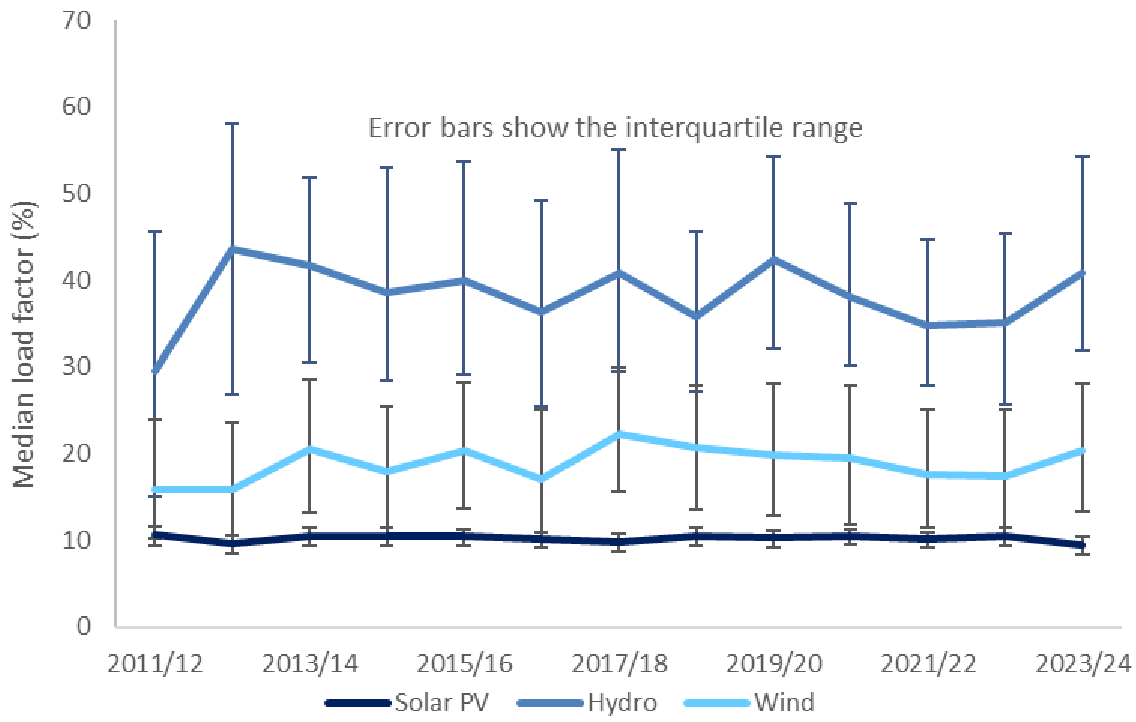
Results

Chart 1 below shows the annual load factors for the leading technologies (hydro, wind, and solar PV) over the FiT years. We present load factors on a line plot for each technology and year, displaying their median value and the interquartile ranges as a measure of dispersion around it. The plot highlights the differences between the technologies: although primary renewables are all dependent on weather conditions, the distribution of load factors around their median repeats across the years and has a different spread for each technology.

[3] Excluding Micro CHP and subject to further revision.

While load factors for solar PV are more concentrated, hydro and wind load factors exhibit a wider spread and a wider range of values can be observed. Fluctuating sample sizes may also influence the distribution year on year; solar PV has the largest sample size each year.

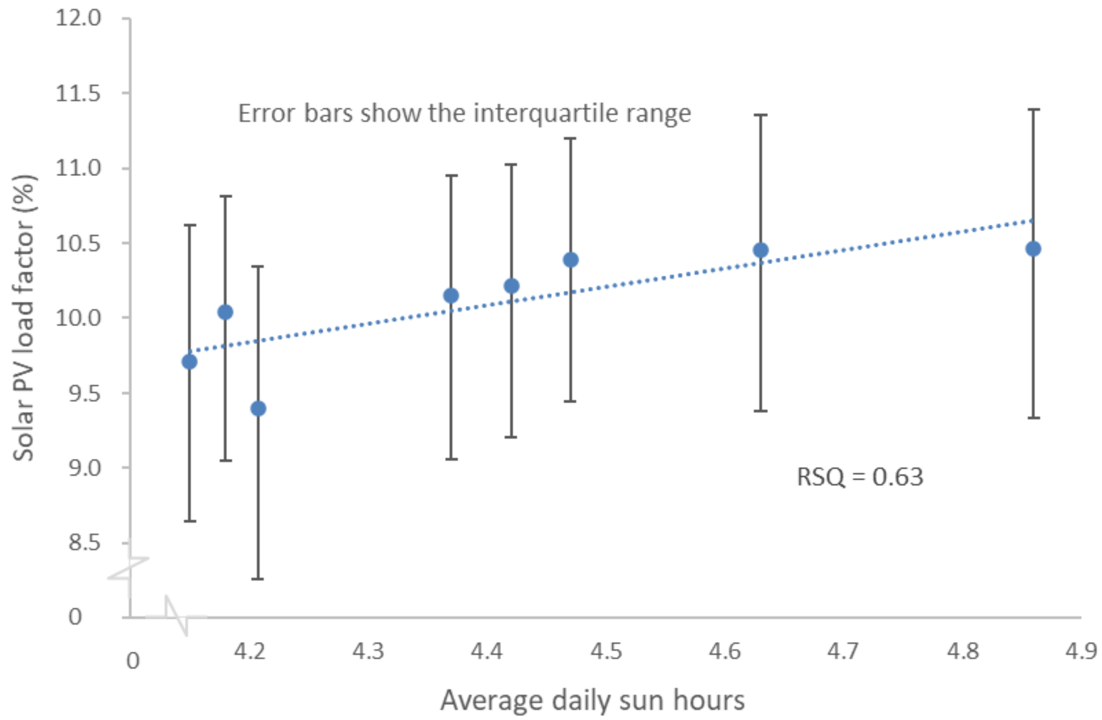
Chart 1: Hydro, Wind and Solar PV load factors, 2011/12-2023/24



The median load factor for solar PV in 2022/23 was 9.4 per cent, 1.4 percentage points lower than in 2022/23; this was due to shorter average sun hours which were down by around 9 per cent over the course of the year. The weighted mean was 8.6 per cent, also down on last year. The weighted mean is typically lower than the median, but the difference is small in relative terms; this suggests that the efficiency of solar PV installations is less dependent on their size than other technologies, although small scale installations (less than 50 kW) account for around two thirds of accredited capacity and may skew mean load factors towards the lower end.

The load factors for solar PV show a close relationship with average sunlight hours, with patterns repeating in the two series (see Chart 2 below). The load factor for the latest year is lower than expected given the average sun hours but the expected value is well within the interquartile range.

Chart 2: Solar PV load factors and average sun hours, 2016/17-2023/24



In 2023/24, the median load factor for Wind was 20.2 per cent, increasing by 2.9 percentage points since 2022/23, even though average wind speeds over the financial year only saw a marginal increase. However, the median load factor had been especially low last year, the lowest since 2016/17 and one of the lowest on record. As in previous years, the weighted mean of the load factor for wind is notably higher than the median and tends to be more closely related to the average wind speeds. In 2023/34 the weighted mean was 25.3, a small increase on 25.2 in 2022/23. 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 higher values.

There is a relationship between annual wind speed and wind load factors, but it is weaker than the relationship between solar PV and sun hours. Load factors for wind vary more than those for solar PV throughout the year, with percentiles spreading further away from the median. It is also worth noting that wind speeds can vary considerably by location and by height above the ground, making an accurate nationwide analysis more difficult to achieve.

The median load factor for hydro in 2023/24 was 40.8 per cent, an increase of 5.7 percentage points on the previous year, despite a small increase in average rainfall. Load factors for hydro tend to vary a lot within the sample. As reported last year, the load factor for 2022/23 was particularly low, the latest load factor is more in line with previous years, for example, average rainfall in 2023/24 was around 18 per cent up on 2021/22, in line with the increase in the median load factor.

The median load factor for anaerobic digestion was 82.3 per cent in 2023/24, which is consistent with the values observed in recent years.

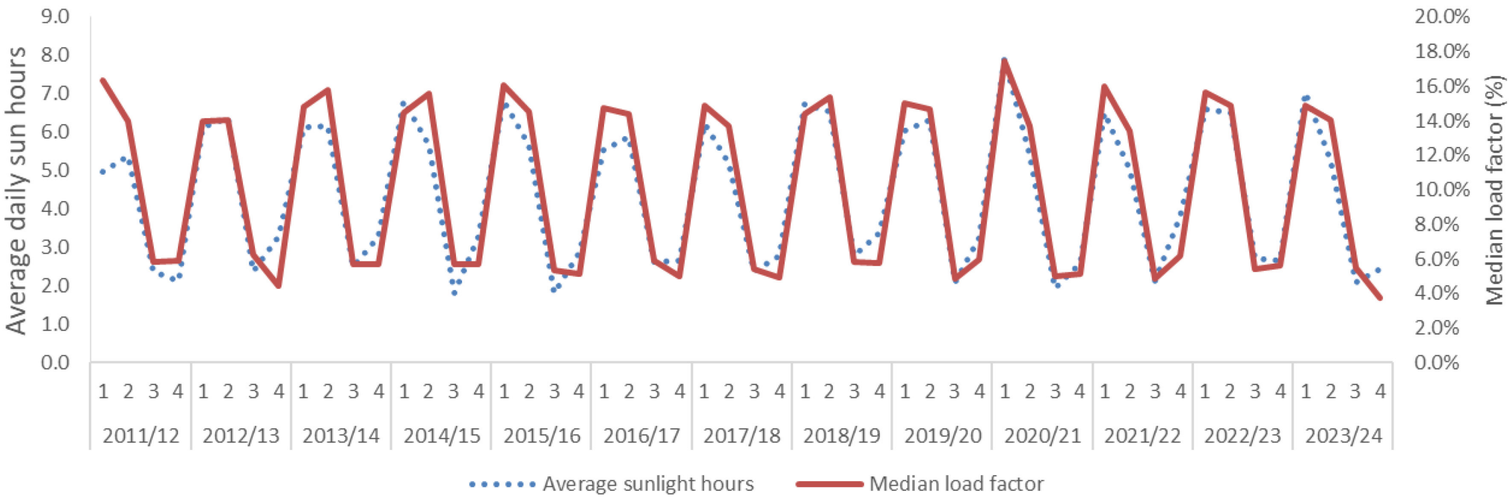
Quarterly load factors

The load factors for solar PV, wind and hydro follow a seasonal pattern due to weather conditions, with high load factors for hydro and wind being associated with wetter, windier autumn and winter months, and solar PV load factors being higher in spring and summer months.

Chart 3 below shows quarterly load factors for Solar PV compared to average sunlight hours. As expected, there is a strong association between sunnier seasons and higher load factors. Solar PV generation is boosted when the sun shines for longer and is weaker in winter months.

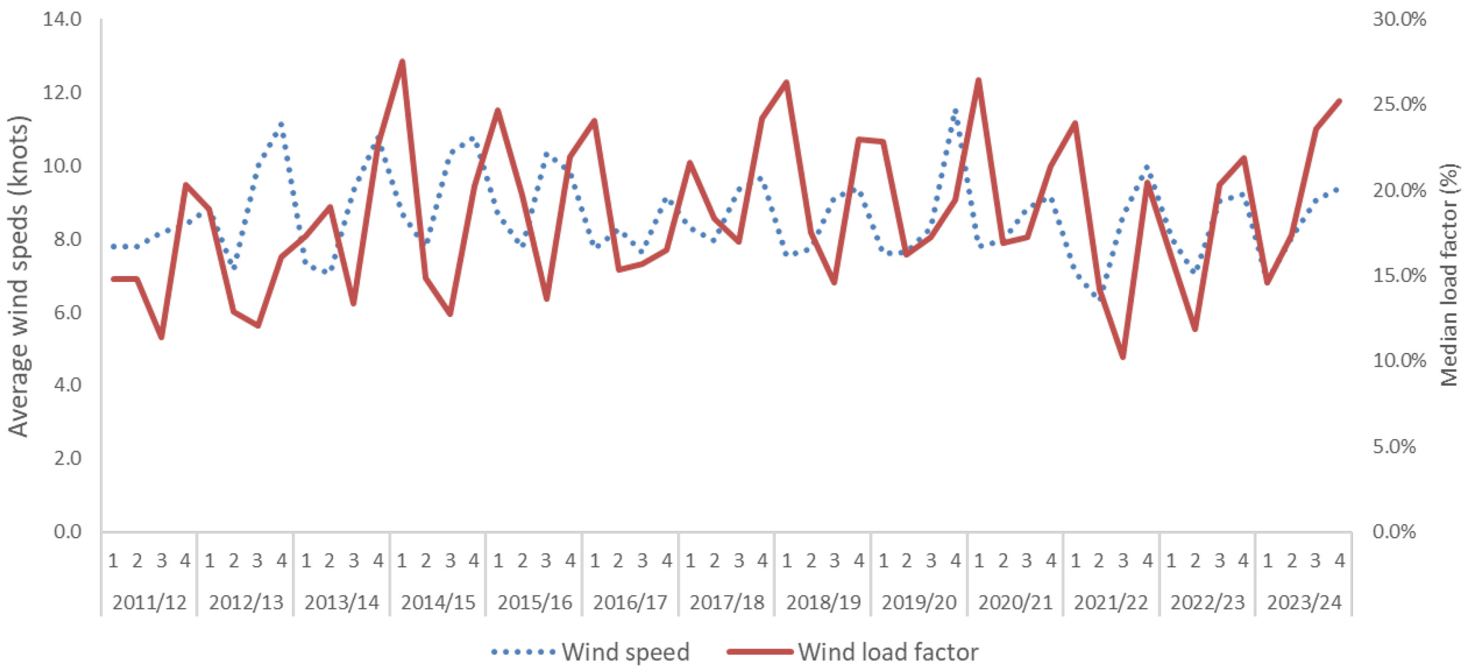
In 2023/24, the spring quarter (April-June) had the highest load factor of the year (14.9 per cent), which has often been the case over the previous ten years. The sun's irradiance is at its highest in June. The lowest load factor of 3.8 per cent was observed between October and December; this is the lowest quarterly load factor recorded in our time series. However, the sample size is relatively small in this quarter so this figure is subject to revision next year when more data will be available.

Chart 3: Quarterly Solar PV load factors by FIT year



Wind load factors also follow a regular quarterly pattern. Chart 4 displays a line plot of wind load factors across the quarters since 2011 against average wind speed. Except for some discrepancies in the early years, load factors have mirrored wind speed quite closely, reaching their maximum during the winter months in most years. The load factor for the final quarter in this series is high compared to average wind speed but again, the sample size is relatively small and this figure is subject to revision next year.

Chart 4: Average wind load factors and wind speeds by quarter

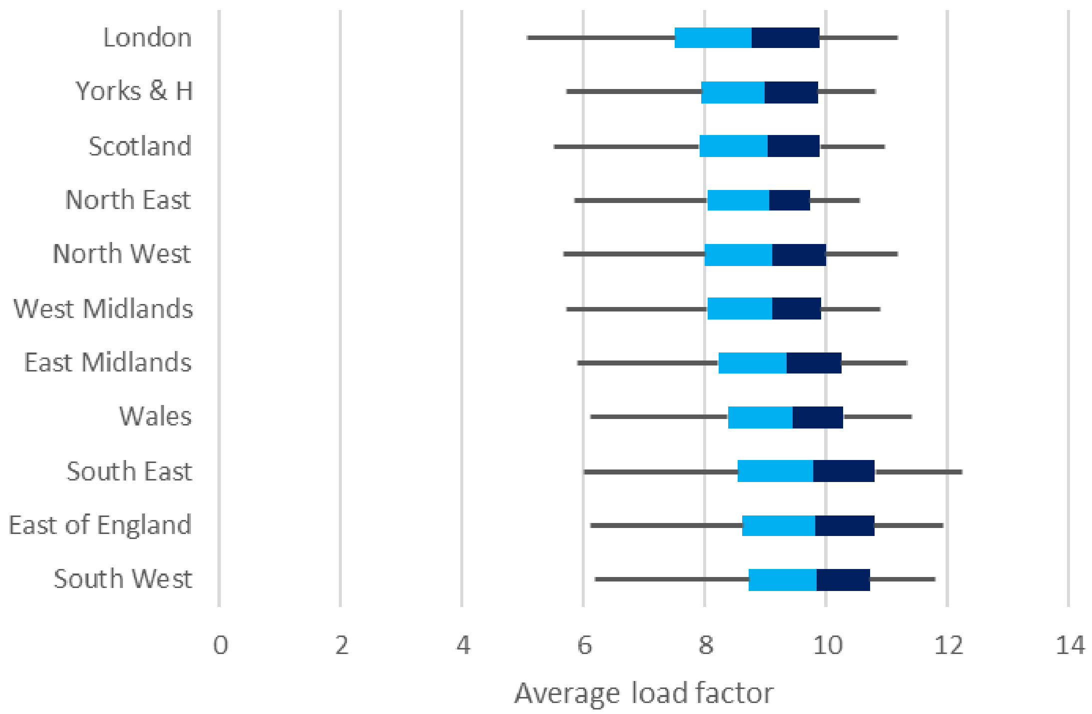


For hydro, wetter seasons are associated with higher load factors, though the relationship between weather and load factors is less strong than it is for wind or solar PV.

Regional Solar PV load factors

Chart 5 below displays the solar PV load factor for Scotland, Wales, and each region of England in Year 14. The median load factor varies across regions, but the distributions are similar from region to region.

Chart 5: Solar PV regional load factors for FiT Year 14 (2023/24).



In 2023/24, South West England **had the highest load factor**, closely followed by the East of England and South East England, all at around 9.8 per cent. The same regions typically have the highest average load factors. London had the lowest median load factor in 2023/24, followed by Yorkshire and the Humber and Scotland. London typically has one of the lowest regional load factors; this may be due to pollution particles settling on the panels, or because panels are shaded by tall buildings nearby. Every region showed a decrease in median load factors when compared to the previous year.

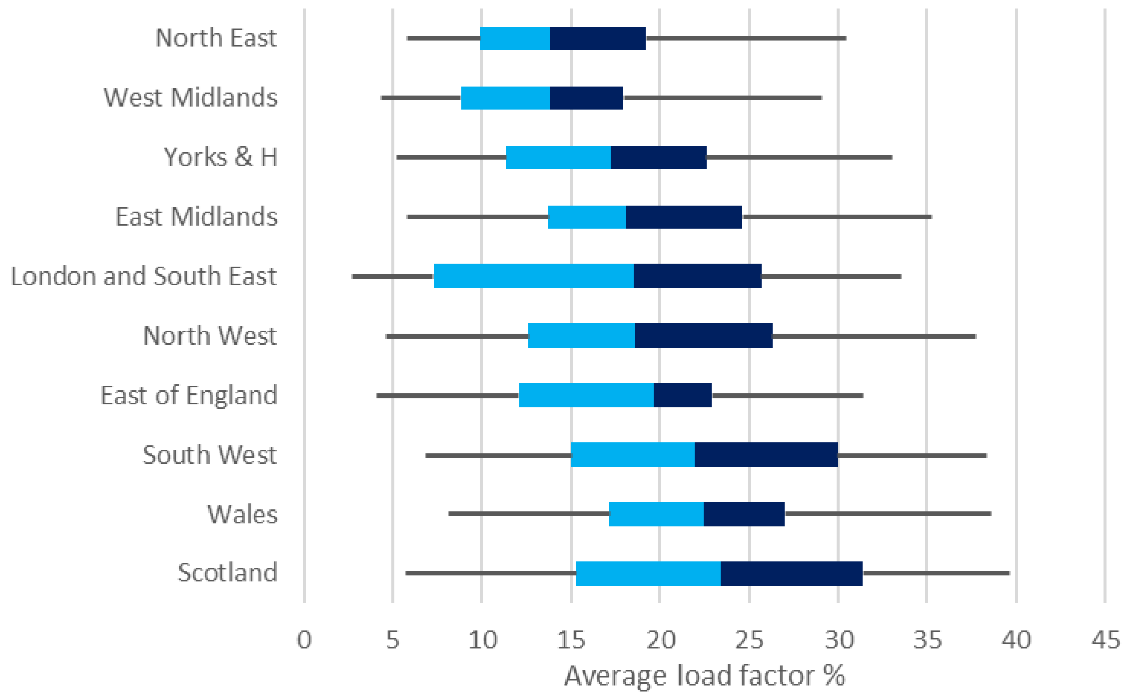
Regional Wind load factors

Chart 6 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 the low number of installations with a valid load factor in these regions.

In the latest year, **Scotland had the highest Wind median load factor at 23.4 per cent**, followed by Wales and South West. Scotland remained the highest median load factor despite a small decrease compared to last year. Every other region showed an increase in median load factor with the exception of North East England.

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 central and easterly regions. Moreover, 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 6: Wind regional load factors for FITs year 14 (2023/24)



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