

# Global Wind Atlas calibration to Elexon power

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# Table of contents I

1 Calibration to power

2 Global Wind Atlas

3 Elexon data

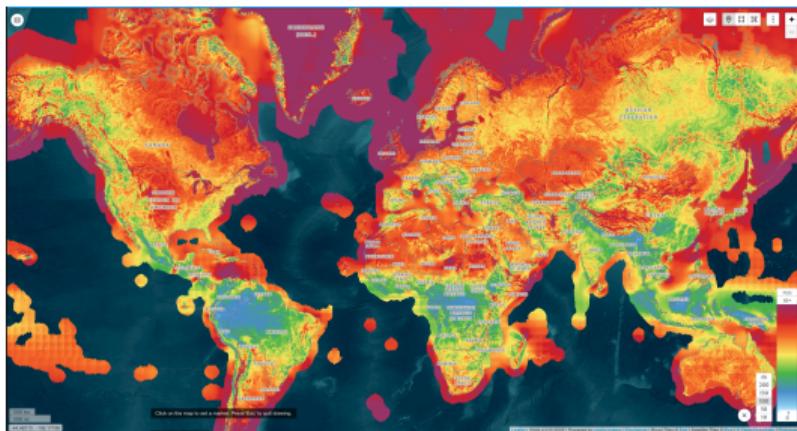
4 Power conversion

Calibration to power

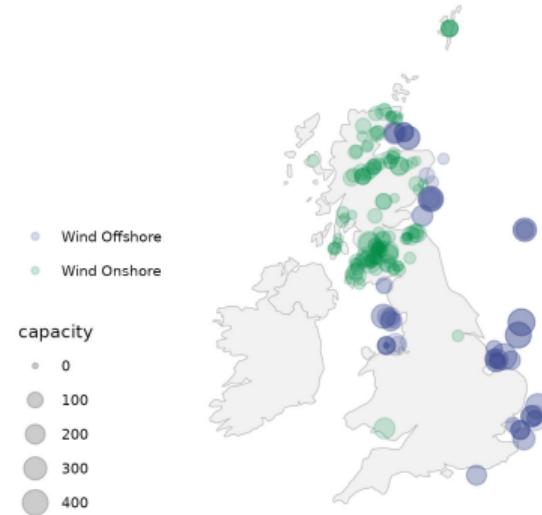
# Global Wind Atlas (GWA) vs Elexon generation

Calibrate a GWA driven estimate to actual observed output

**Global Wind Atlas**



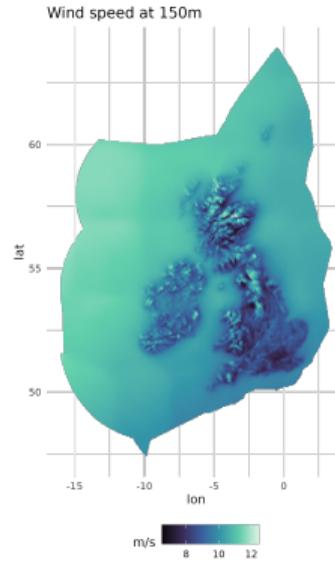
**Elexon wind farms map (2025)**



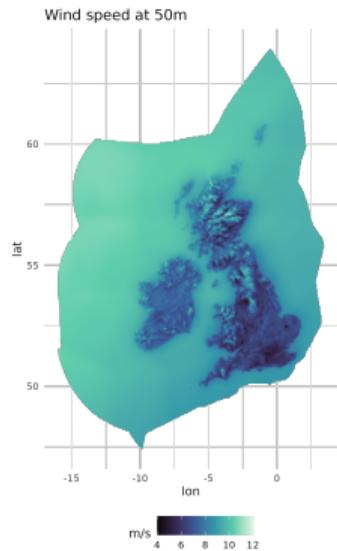
# Global Wind Atlas

# Characteristics

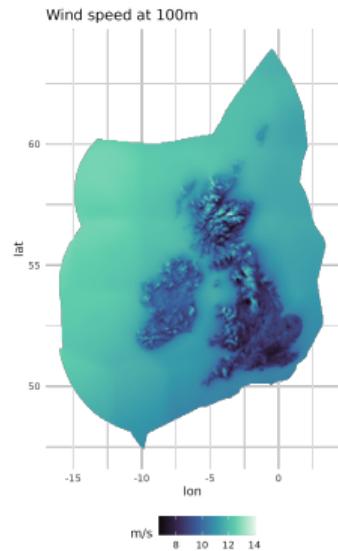
- Using DTU's Wind WAsP methodology
- Downscaled from ERA 5 to a 250m grid
- Models land and 200km from shorelines
- Long term average wind speed
- Heights: 10m, 50m, 100m, 150m, 200m
- Scale and shape parameters Weibull



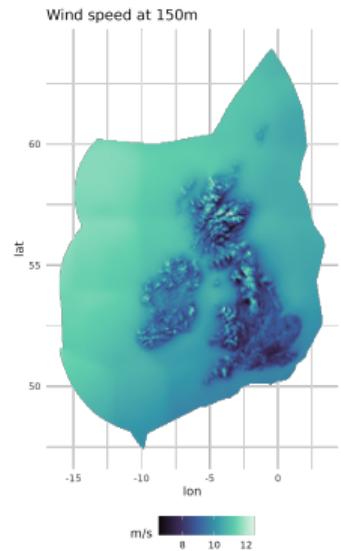
# Mean wind speed



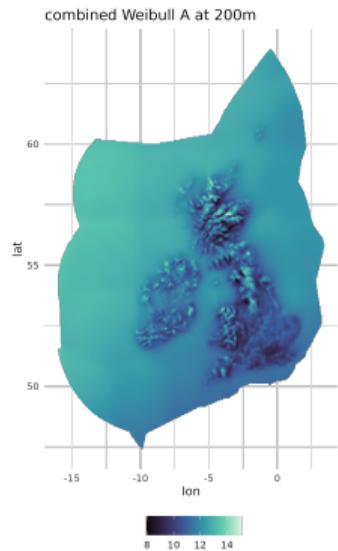
50m



100m

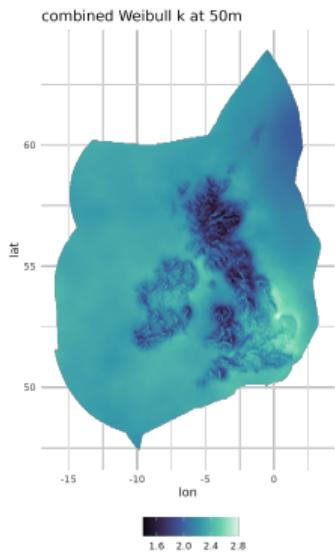


150m

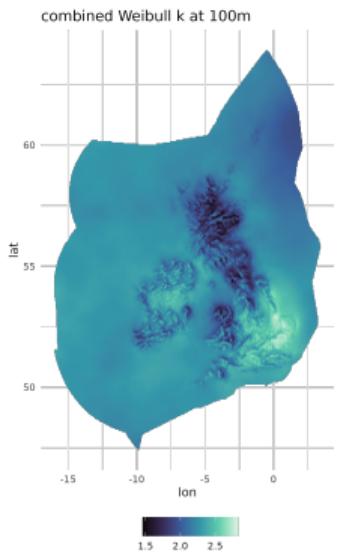


200m

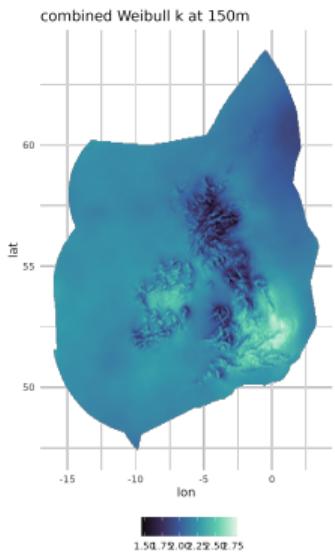
# Weibull shape parameter $k$



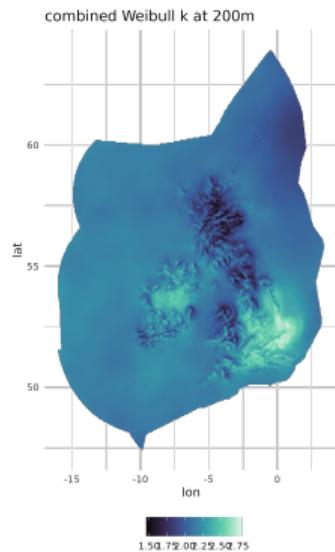
50m



100m

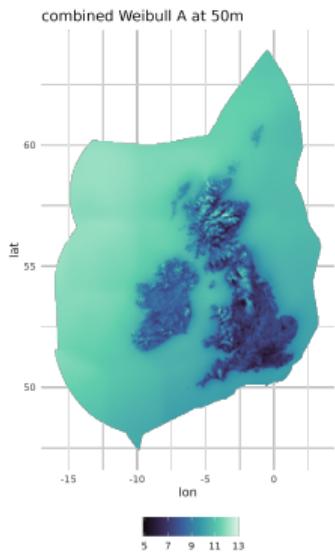


150m

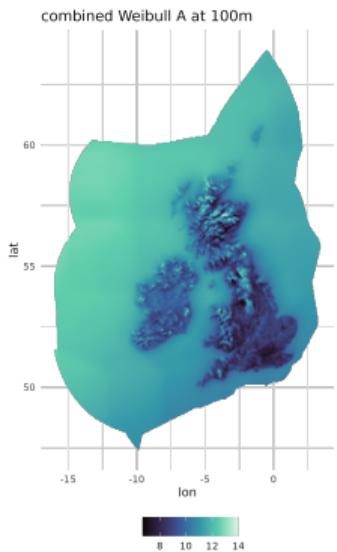


200m

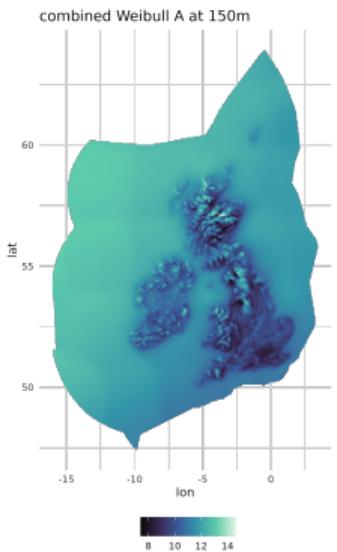
# Weibull shape parameter $A$



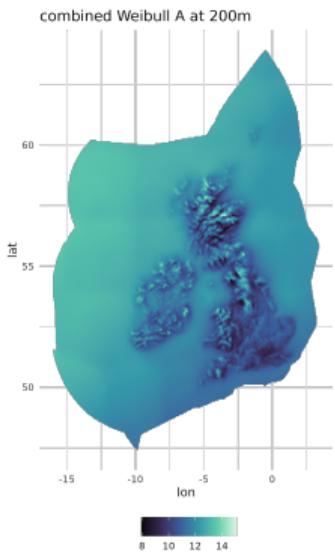
50m



100m



150m



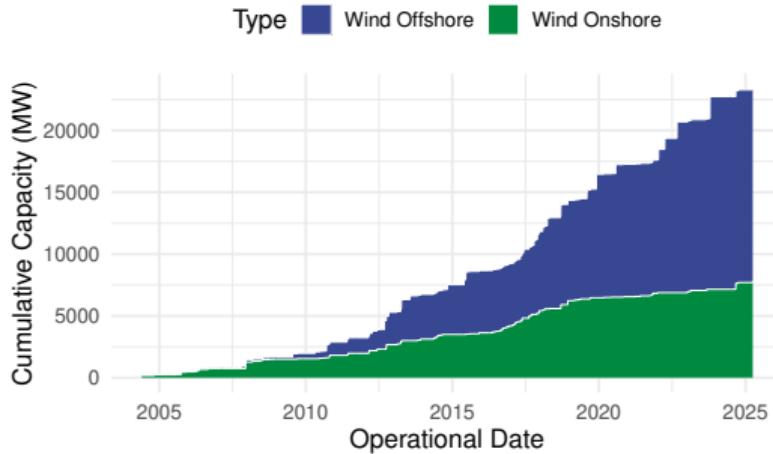
200m

Elexon data

# BMU data

- 150 wind farms split in over 216 units
- Total capacity: 27 GW
- Half hourly resolution
- Records starting in 2019
- Curtailment (pending)
- Location / turbine data unavailable

Wind installed capacity



# Renewable energy planning database (REPD)

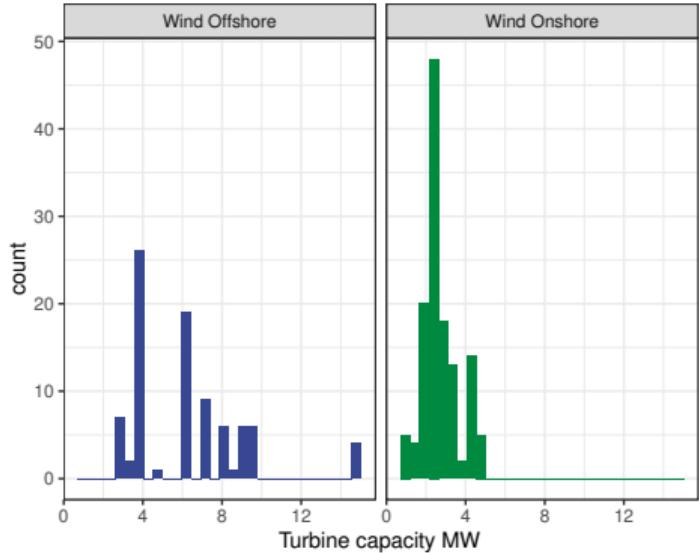
- Official UK government renewable data
- Over 800 wind farms listed as operational
- Coordinates available
- Also available:
  - Development status
  - Number of turbines
  - Turbine capacity
  - Turbine height (for some only)

REPD wind farms

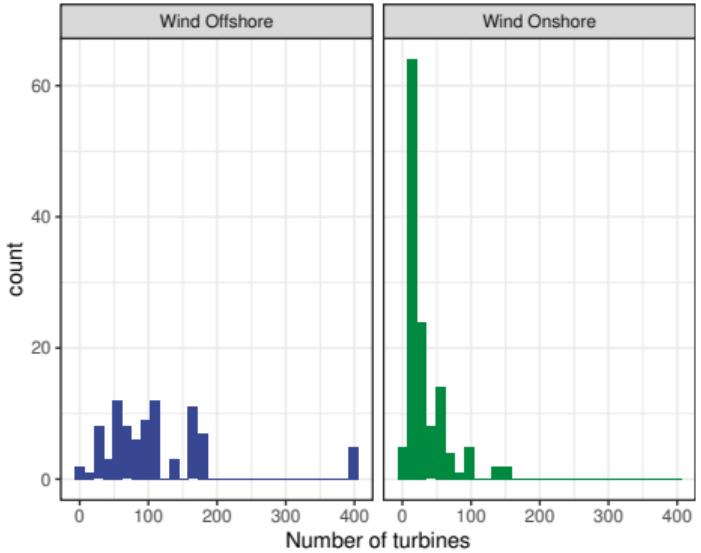
Type	Development Status	Count	Capacity MW
Wind Offshore	Operational	47	14,679
Wind Offshore	Under Construction	7	7,742
Wind Onshore	Operational	770	14,738
Wind Onshore	Under Construction	37	1,779
Total	-	861	38,938

# Turbine data available

Turbine capacity histogram



Number of turbines histogram

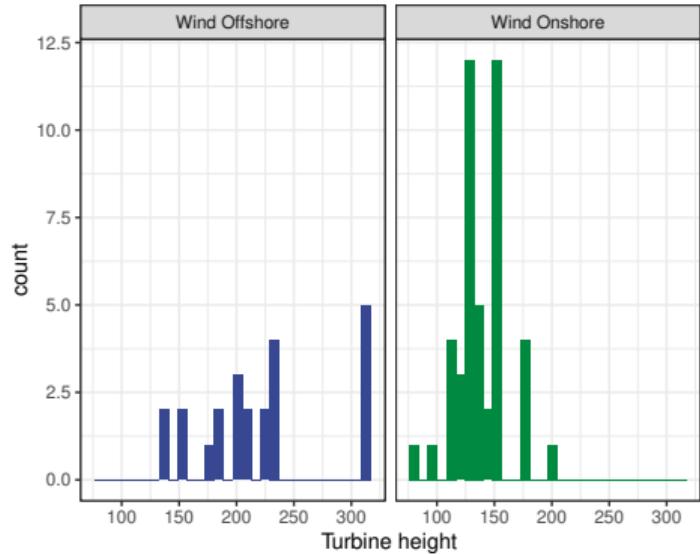


# Turbine data available

## Turbine Height availability

Type	Height available	Average height (m)	count
Wind Offshore	FALSE	222.0	23
Wind Offshore	TRUE	NaN	64
Wind Onshore	FALSE	137.7	45
Wind Onshore	TRUE	NaN	84

## Turbine height histogram



Power conversion

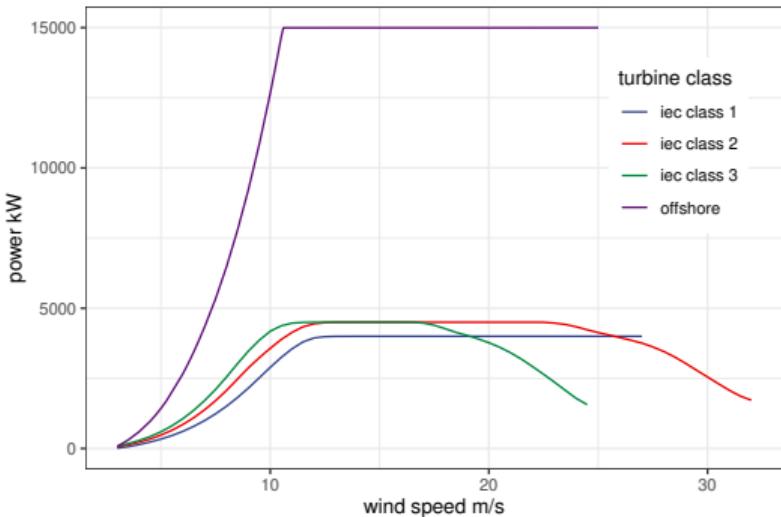
# Generic power curves

- Using 3 generic power curves
- Offshore plus the IEC 3 classes
- Assigning class based on GWA mean wind speed at location
- Rescaling rated power to turbine capacity

## IEC classification

Class	Mean wind speed at hub height (m/s)	Extreme 10-min gust (m/s)	Typical sites
I	10	70	Very windy / exposed sites
II	8.5	59.5	Moderate wind sites
III	7.5	52.5	Low-wind / inland sites

Generic power curves ( $PC_k$ )



## Power estimate based on generic power curves

For each location  $i$  we have: observed power  $p_i$ , number of turbines  $n_i$ , turbine capacity  $c_i$ , turbine height  $h_i$ , and mean wind speed  $\mu_i$ .

- Map location to a rescaled power curve  $\widetilde{PC}_k$
- Estimate wind farm power in GWh

$$\tilde{p}_i = \widetilde{PC}_k(\mu_i) \times n_i \times h_i$$

where  $h_i$  are the number of hours in the year (8,760 full year, 6,527 in 2025).

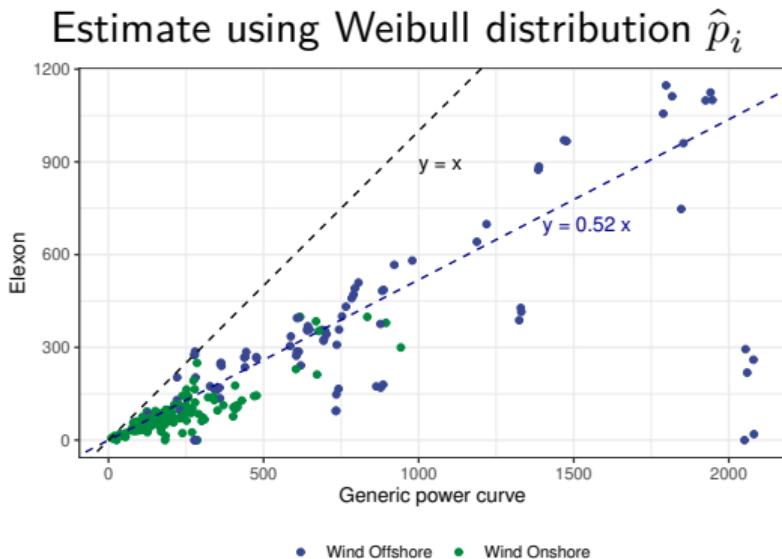
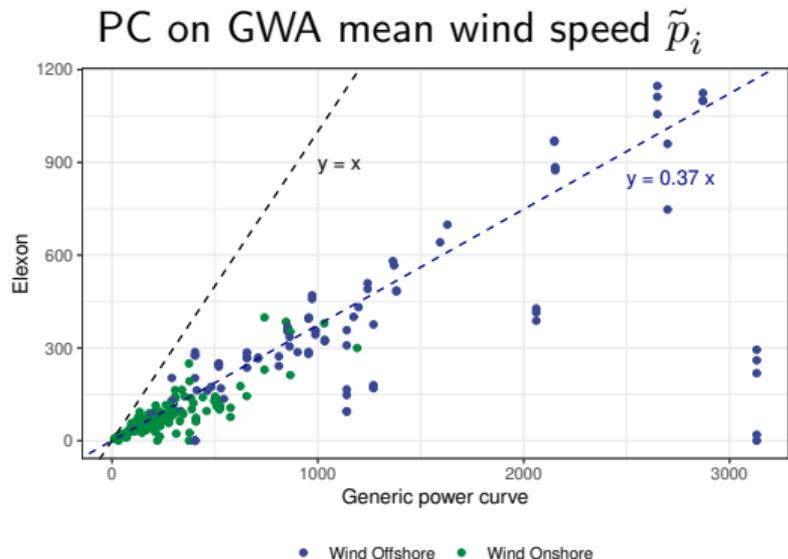
## Power estimate based on generic power curves

GWA also offers access to the Weibull parameters at each grid point. Due to the heavy tail of the Weibull distribution applying  $\widetilde{PC}_k(\mu_i)$  overestimates power.

$$\hat{p}_i = n_i \times h_i \times E\left(\widetilde{PC}_k(w_i)\right)$$

where  $w_i$  are random replicates of  $W_i \sim \text{Weibull}(A_i, k_i)$ , and  $A_i, k_i$  are the scale and shape parameters, respectively.

# GWA based estimates vs Elexon 2025



# Next Steps

- Compare other years
- Apply loss factors based on history
- Refine power curve conversion
- Quantile mapping calibration