

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

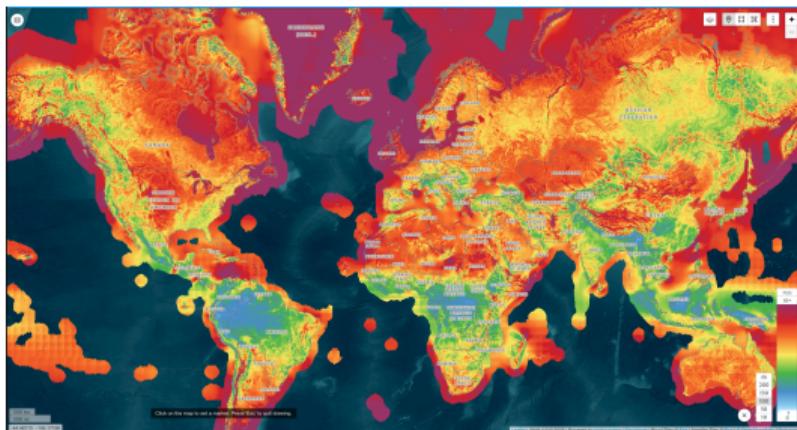
4 Power conversion

Calibration to power

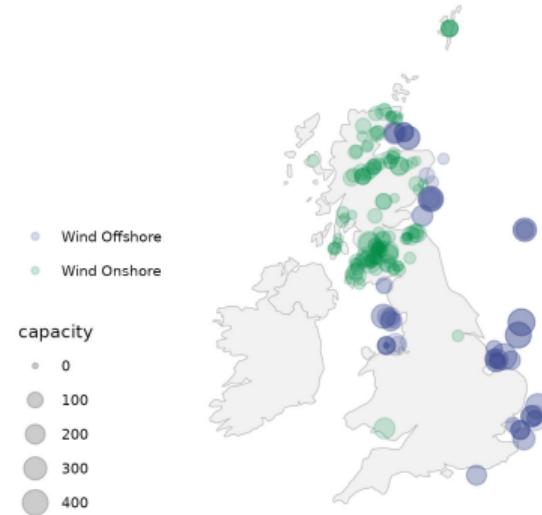
Global Wind Atlas (GWA) vs Elexon generation

Calibrate a GWA driven estimate to actual observed output

Global Wind Atlas



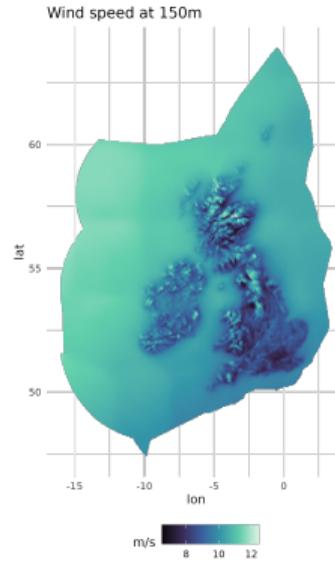
Elexon wind farms map (2025)



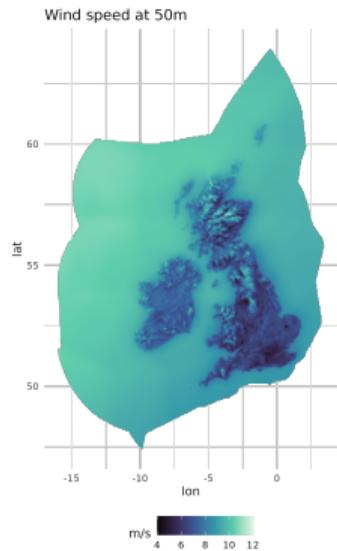
Global Wind Atlas

Characteristics

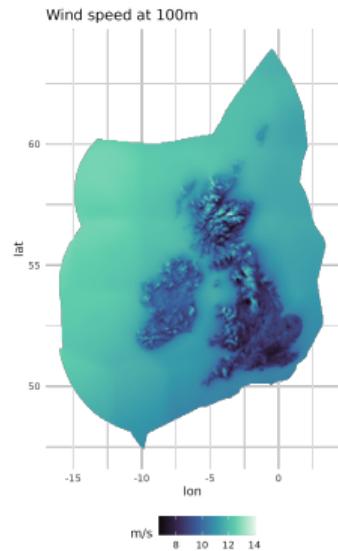
- Using DTU's Wind WAsP methodology
- Downscaled from ERA 5 to a 250m grid
- Models land and 200km from shorelines
- Long term average wind speed
- Heights: 10m, 50m, 100m, 150m, 200m
- Scale and shape parameters Weibull



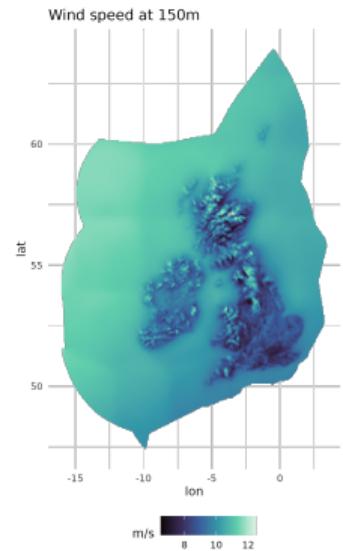
Mean wind speed



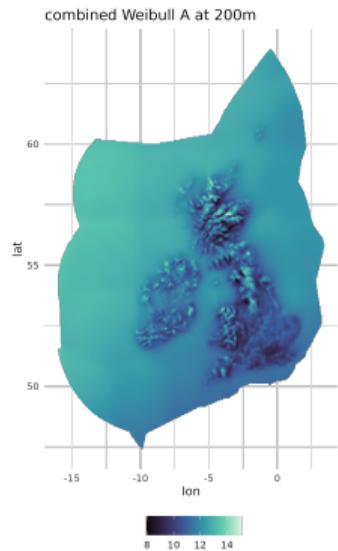
50m



100m

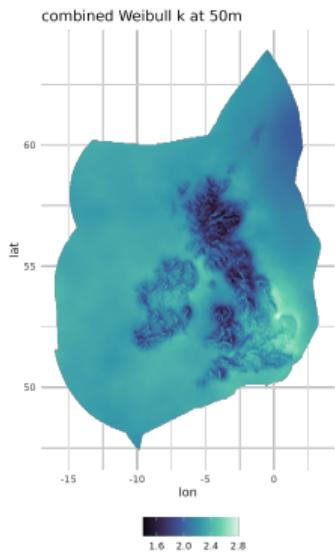


150m

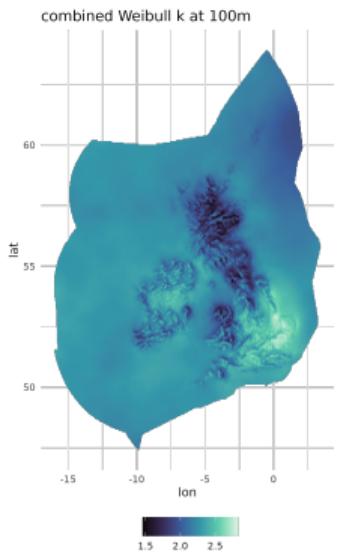


200m

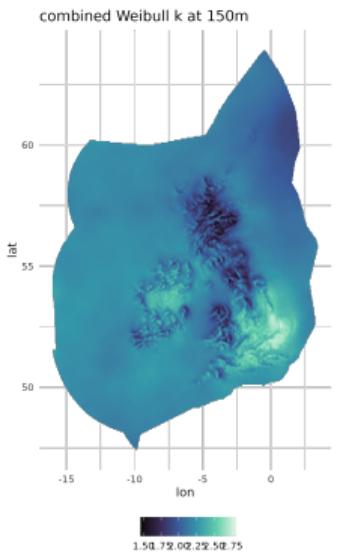
Weibull shape parameter k



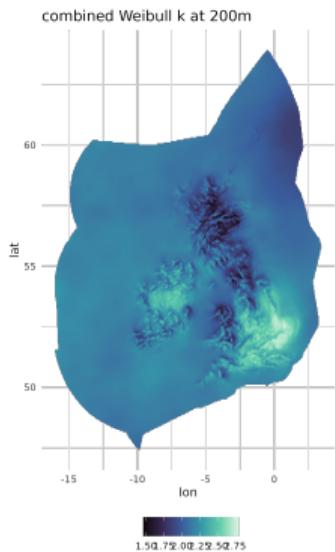
50m



100m

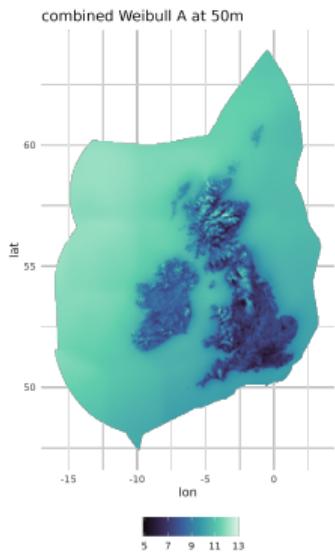


150m

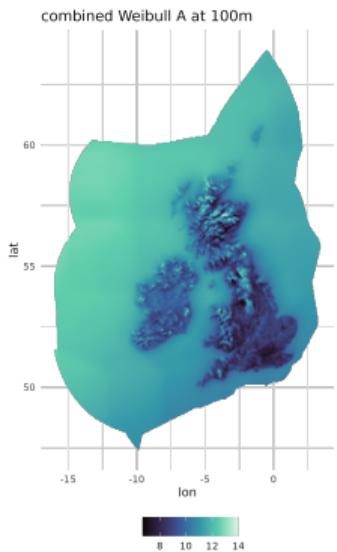


200m

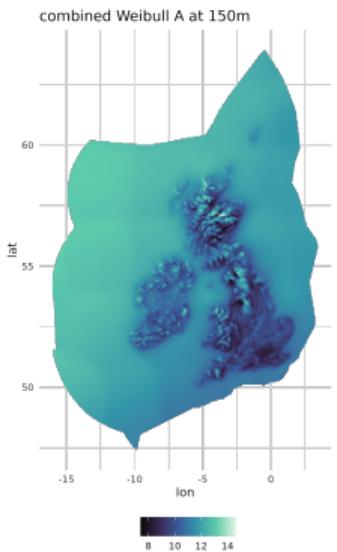
Weibull shape parameter A



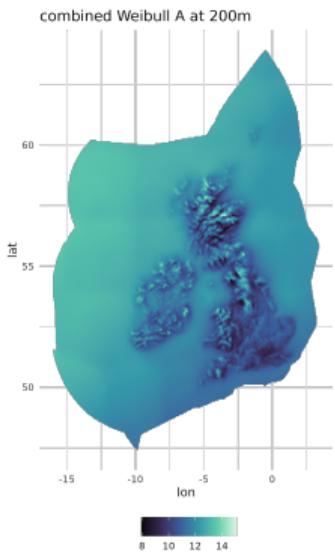
50m



100m



150m



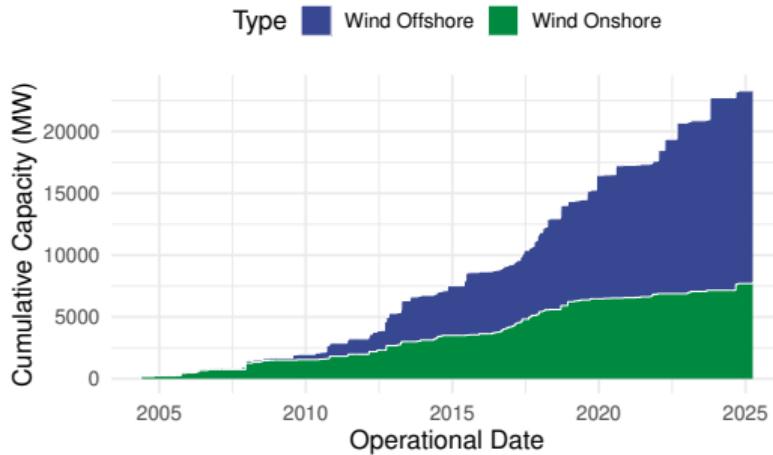
200m

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)

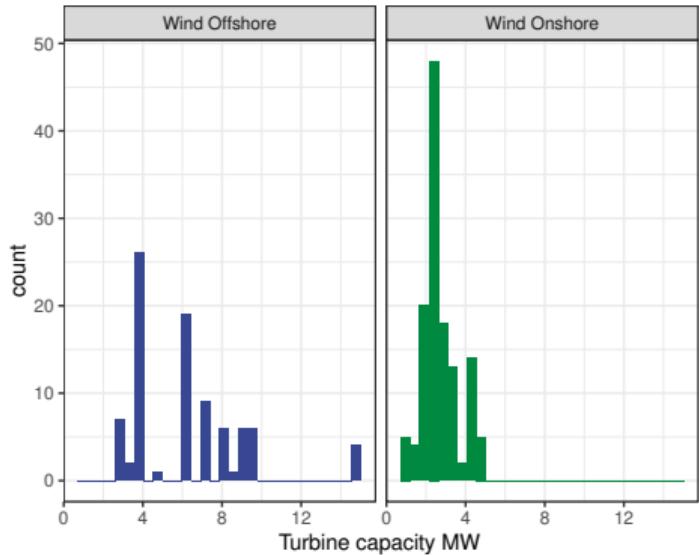
- Official UK government renewable data
- Over 800 wind farms listed as operational
- Coordinates available
- Also available:
 - Development status
 - Number of turbines
 - Turbine capacity
 - Turbine height (for some only)

REPD wind farms

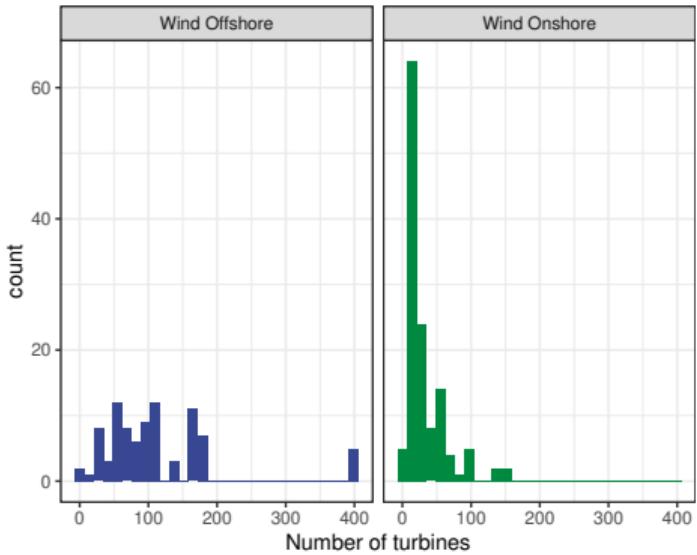
Type	Development Status	Count	Capacity MW
Wind Offshore	Operational	47	14,679
Wind Offshore	Under Construction	7	7,742
Wind Onshore	Operational	770	14,738
Wind Onshore	Under Construction	37	1,779
Total	-	861	38,938

Turbine data available

Turbine capacity histogram



Number of turbines histogram

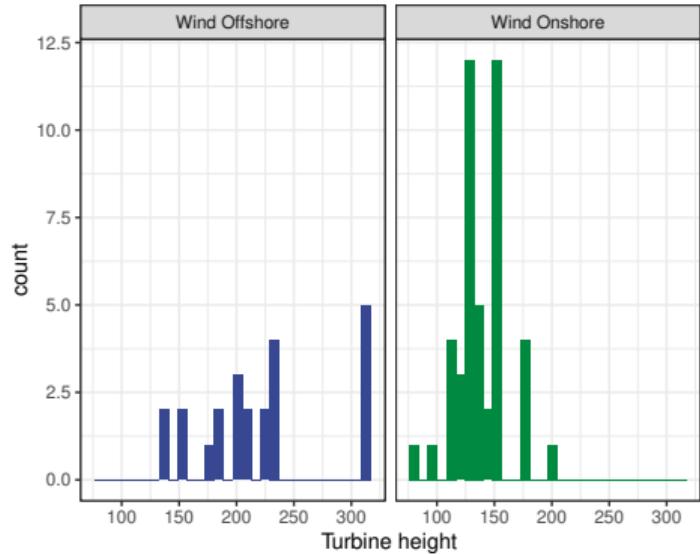


Turbine data available

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

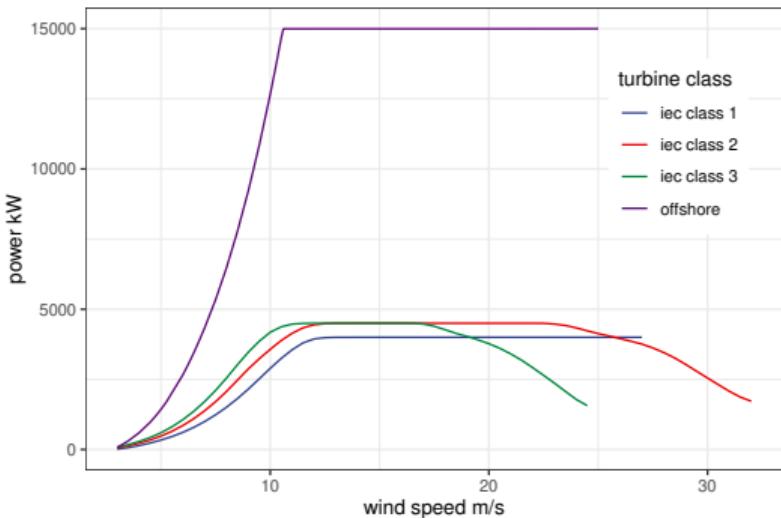


Power conversion

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

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 μ_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).

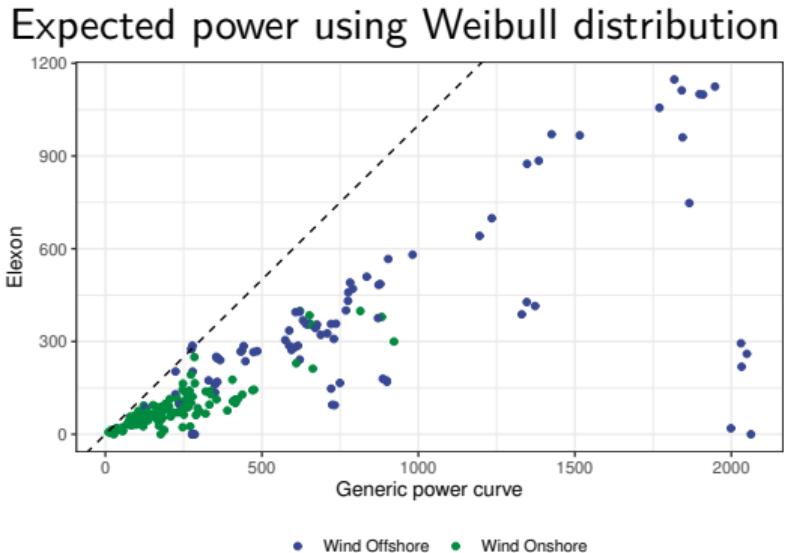
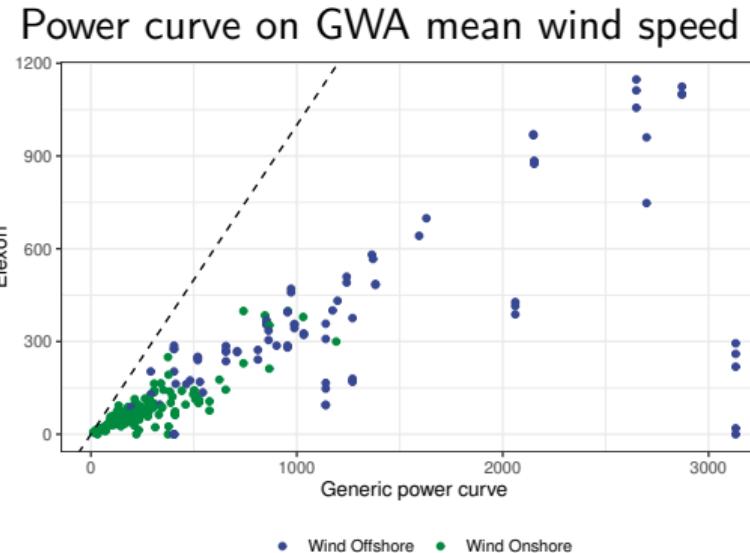
Power estimate based on generic power curves

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