

Plausible 2050 offshore wind locations in the North Sea

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This **version 3** released November 2024.

Version 3 is a major revision which will break backwards compatibility. Many wind farm zones and most turbines have moved. Column names have changed.

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This release includes two datasets:

1. A set of zones representing plausible wind farm locations to have been built in the North Sea by the years 2030, 2040, and 2050, based on the national ambitions announced up to summer 2024. This dataset is provided as a zipped shapefile, “OSW zones.zip”.
2. A set of points representing plausible locations for offshore wind turbines to have been built in the North Sea by the years 2030, 2040, and 2050, based on the same national ambitions. This dataset is provided both as a zipped shapefile (“turbine_locations.zip” and a CSV file (“turbine_locations.csv”). Both contain the same points. Coordinates are lat/lon to WGS84 (EPSG 4326).

We emphasize that these are not *predictions*: it is impossible for us to know what will be built and exactly where it will go in the future. Rather, they are *projections*, based on nationally stated ambitions, that we believe are plausible and defensible, and thus may be used for further modelling or analysis.

If you find this dataset useful, please cite and/or acknowledge it as appropriate, using the DOI above. A suggested citation is shown later in this readme. The authors would also appreciate hearing from you on simon.waldman@hw.ac.uk – partly to show impact from our work, and partly for our own satisfaction. If you tell us that you are using it, we can also notify you of new revisions.

Details of wind farm zones file columns

Description:	OWF name if known, otherwise a name is assigned.
Area (sqkm):	OWF area in km ²
WTF Capacity:	Nameplate capacity of the individual turbines in this wind farm, in MW. If multiple turbine types are in use, the dominant turbine is used.
Platform:	“Fixed”, “Floating”, or “Mixed”. For future projected wind farms this is an estimate based on water depth.
Project Phase:	State of the OWF development, one of: Operational, Under Construction, Planned, or Projected. The first three apply where a wind farm already exists or is already in the development process. “Projected” is used when a new zone has been designated by the authors.
OWF Capacity:	Nameplate capacity of the wind farm as a whole, in MW.
Year:	Whether this wind farm contributes towards 2030, 2040, or 2050 targets. For wind farms in development this is based on their forecast completion dates; some judgement has been applied where these have not been announced. Germany has targets for 2035 and 2045; these have been incorporated into 2040 and 2050 respectively for this work.
Rotor Diameter:	Rotor diameter of the WTGs in metres. If multiple turbine types are in use, the dominant turbine is used.
Turbine model:	Model(s) of WTG used in this farm. Where this is not known this will read “Projected future turbine”.
Notes:	Additional information about this wind farm. This field is mostly used to indicate where a wind farm will not contribute to electricity grids, eg INTOG farms.
Country:	Country in whose EEZ the OWF lies.
WTG Spacing:	Distance in km between turbines in a wind farm, assuming a square grid layout. Given as 0 for existing wind farms.
Spacing All:	As above, but with existing wind farms included. This number may be misleading for existing farms that do not have regular layouts.
IHO Area:	Does this farm lie fully or partially within the IHO-defined North Sea? (http://marineregions.org/mrgid/2350)
ICES Area:	Does this farm lie fully or partially within the ICES-defined North Sea? (ICES Area IV, larger than the IHO area)

Details of turbine location file

For existing wind farms, or those under development whose layouts are known, the turbine locations are drawn from the dataset by Martins et al dataset, March 2024 revision (found at [1], described by [2]). We are grateful to the authors for their assistance. One wind farm (Hywind Tampen) has its turbine locations drawn from an unreleased work-in-progress version of the Martins dataset. For other wind farms (either projected farms, or in-development farms without known turbine locations), a speculative grid is generated using predicted turbine sizes from for the year of construction, and spacings based on the density adopted by recent wind farms in that EEZ.

Columns:

Latitude / Longitude:

As expected. WGS84 (EPSG 4326).

Source: "Martins" indicates coordinates for existing wind turbines sourced from the Martins et al dataset.

"Future" indicates newly-generated, speculative, coordinates.

Year: For existing wind farms, gives the year of first production (from Martins et al)
For future wind farms, gives the year by which we expect it to be built and for which we have included it as contributing towards targets: 2030, 2040, or 2050.

Capacity: Nameplate capacity of this turbine in MW.

Rotor Diameter:

Rotor diameter of this turbine in metres.

Platform: "Fixed" or "Floating".

Known issues

- The existing Nordwind OWF in Belgium has the wrong shape and a lower capacity than in reality.
- There is an error in the geometry of the Dogger Bank D wind farm which does not affect its visual display but may require fixing for further geospatial analysis.
- Future zones which consist of multiple polygons, or polygons with cut-outs in them, may not have optimal gridding of future turbine locations and may thus hold slightly fewer turbines than they could.

Citation

A description of how these zones and coordinates were arrived at is currently under development as a journal article, and once it is available this readme will be updated to link to it. To see if this has happened, or otherwise to see the latest version of this dataset, use DOI [10.5281/zenodo.7109882](https://doi.org/10.5281/zenodo.7109882).

If using this version, please cite the data set directly. Example citation:

Waldman S, Gilmour C, Munro P, Forster R, Russell D, “Plausible 2050 offshore wind locations in the North Sea” (version 3), dataset, 2024. DOI: 10.5281/zenodo.14222865

Version History

VERSION NUMBER	DATE	CHANGES
1	Sept 2022	Initial version, without existing or planned wind farms included.
2	Dec 2023	Now includes already-built wind farms (from DeepOWT [3]) and planned ones. Changed coordinate system to lat/lon. Readme updated. Included a new shapefile giving the predicted zones. Author SW has moved institution
3	Nov 2024	Major revision; many zones and most turbines have moved. Column names have changed. National ambitions, and existing / planned wind farms, updated to summer 2024. Estimates for future wind farms now take account of the density (in MW/km ²) of recent wind farms in that country's EEZ. This has resulted in less area being needed in some countries, especially Germany. No longer using DeepOWT data [3] for existing wind farms. Replaced with Martins et al data [1], described in [2]. Authors CG & DR were added.

References

- [1] M. C. I. Martins, ‘Offshore Energy Structures in the North Sea: Past, Present and Future-June 2024 version’. University of St Andrews, University of St Andrews, Jun. 2024. doi: 10.17630/1639540b-600e-42aa-8920-ac1890b78b5a.

- [2] M. C. I. Martins, M. I. Carter, S. Rouse, and D. J. Russell, 'Offshore energy structures in the North Sea: Past, present and future', *Mar. Policy*, vol. 152, p. 105629, Jun. 2023, doi: 10.1016/j.marpol.2023.105629.
- [3] T. Hoeser, S. Feuerstein, and C. Kuenzer, 'DeepOWT: a global offshore wind turbine data set derived with deep learning from Sentinel-1 data', *Earth Syst. Sci. Data*, vol. 14, no. 9, pp. 4251–4270, Sep. 2022, doi: 10.5194/essd-14-4251-2022.

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