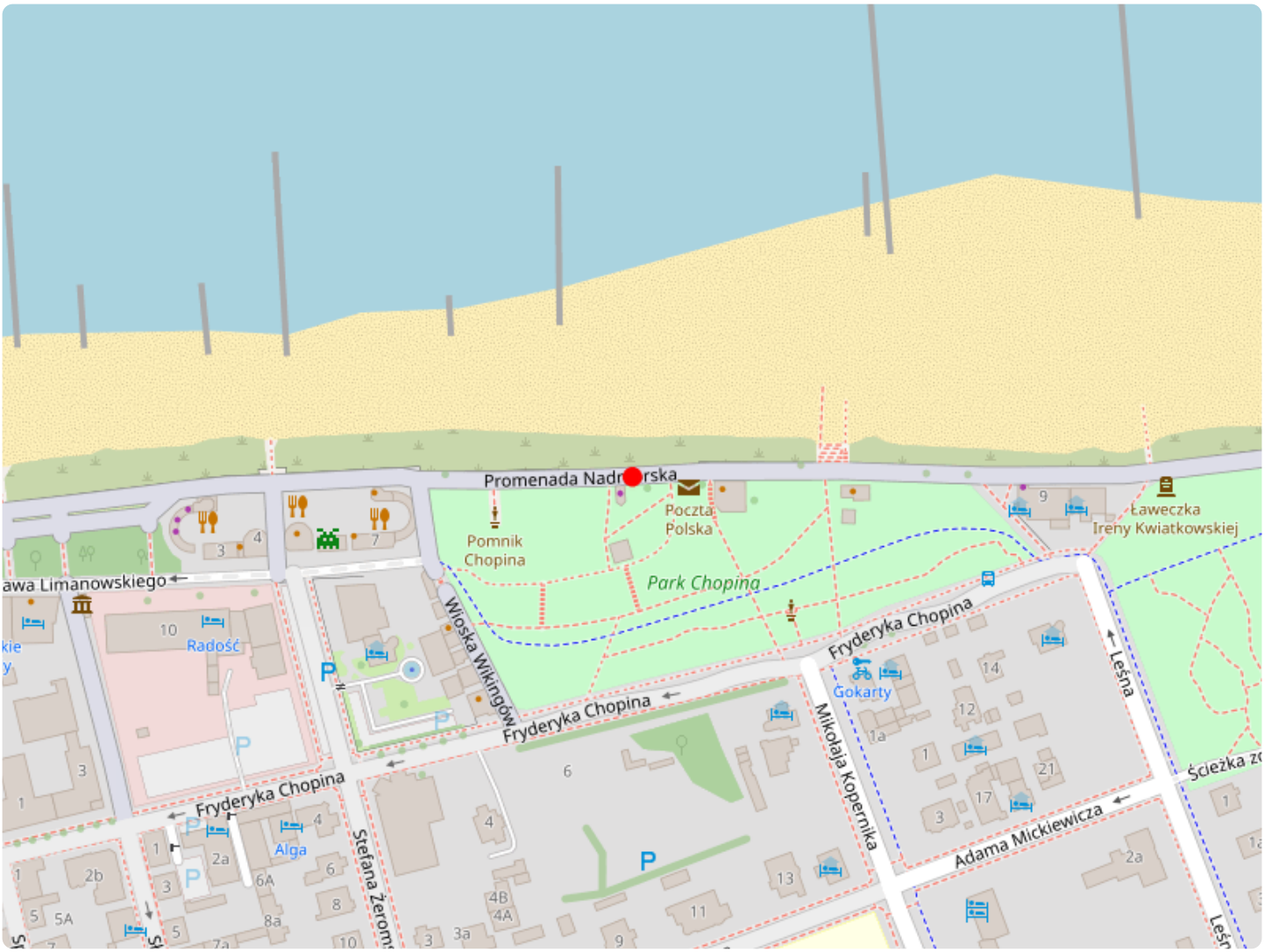
VIARTEM ANALYTICS

Wind Report

Seafront Promenade, Port of Ustka, Ustka, Poland

LATITUDE
54.588572
LONGITUDE
16.862032



Map source
Map data © OpenStreetMap contributors, available under the Open Database License. https://www.openstreetmap.org/copyright

Important: This analysis is for informational purposes and may contain errors. It is not a guarantee of the actual turbine performance.

VIARTEM

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How to read this report

The report looks at your site from several angles: turbine performance, typical climate-based wind potential and a separate comparison using weather station data.

1. TURBINE CHARACTERISTICS

Power curves

Show the instantaneous power of a particular turbine at a given wind speed.

The curves alone do not give annual energy production. That also requires the wind speed distribution for the site.

2. REFERENCE SCENARIO

Climate data

Describe typical long-term wind potential at a point on the map.

Suitable for comparing turbines and hub heights because they represent the climate-based potential of the site.

3. STATION-BASED COMPARISON

Weather stations

A comparison based on hourly observations from surrounding weather stations, usually referring to about 10 m above ground.

Includes adjustments for variability and gustiness. It is not a guaranteed minimum yield or a measurement at your site.

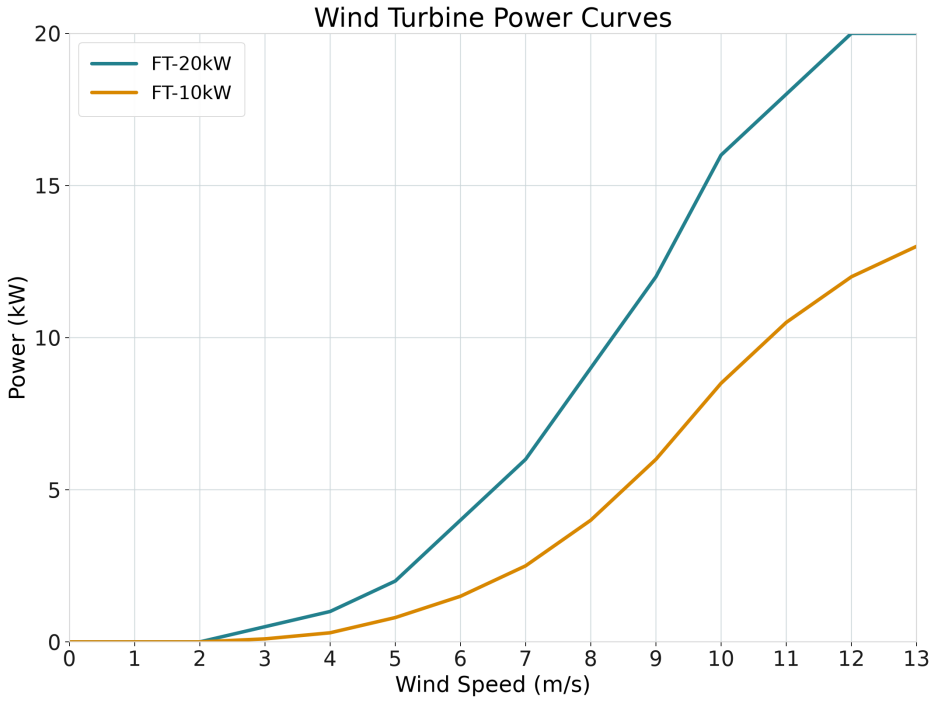
Why use two data sources? Climate data provide a stable reference for site potential. Station data offer a comparison with observations from the wider area, allowing for factors that can reduce production. The two approaches use different data and assumptions, so their results can differ. Stations may be far from the site; neither approach replaces on-site measurements or assessment of local obstacles.

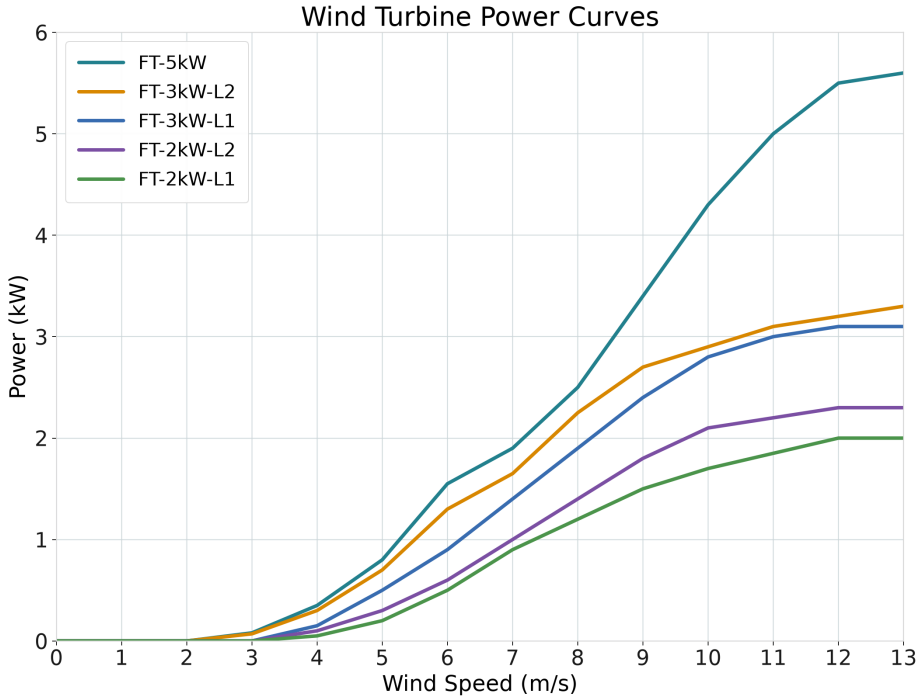
Power Curves

Turbine power characteristics used in the calculations.

How to read this chart The horizontal axis shows wind speed in m/s; the vertical axis shows instantaneous turbine power in kW.

- A curve that rises at lower wind speeds indicates earlier power production in lighter winds.
- A flat section usually indicates rated power: output no longer increases as wind speed rises.
- This is not an annual production forecast. It shows device performance, which is then combined with wind data.





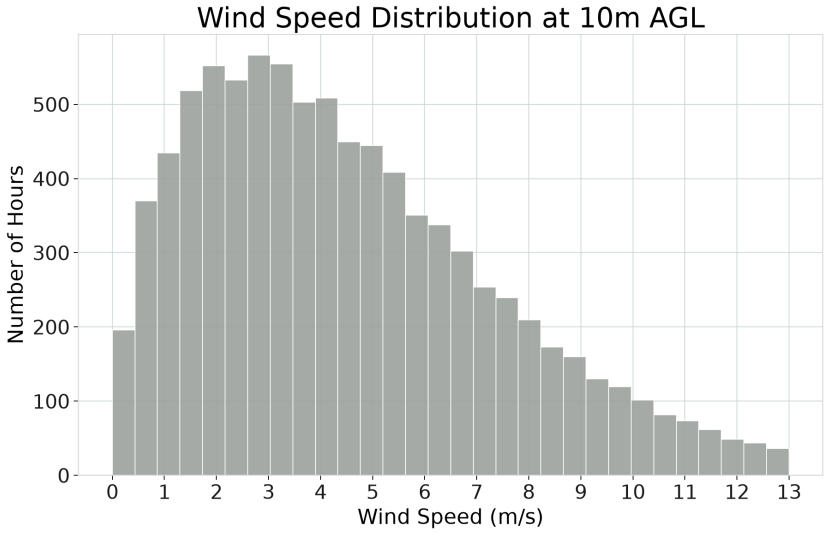
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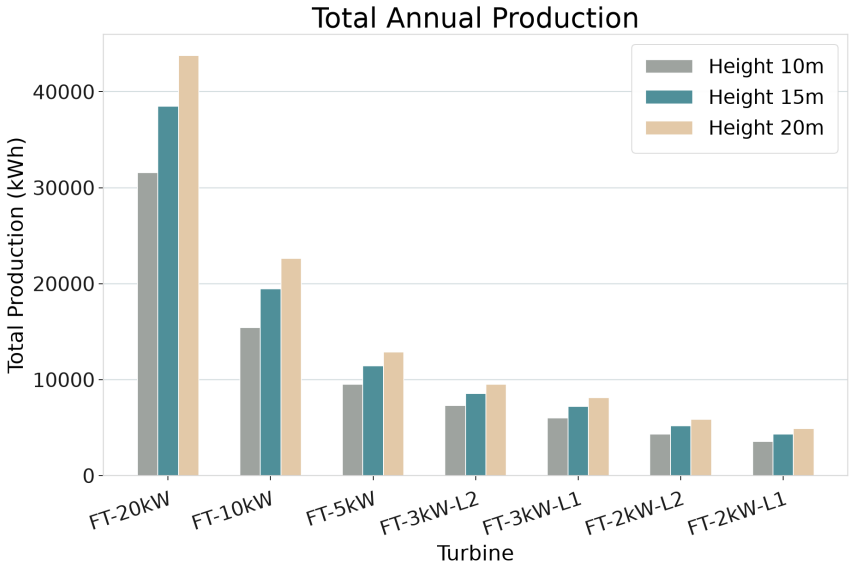
Analysis Based on Climate Data

Based on climate data, including Global Wind Atlas 3 and ERA5 from ECMWF.

Climate data represent the typical long-term wind potential of the site.

- The distribution shows the estimated hours per year at each wind speed in the climate model.
- Production bars compare turbines and hub heights, helping identify suitable options for the site.
- This reference scenario is useful for comparison but cannot fully account for local obstacles, trees or buildings.





	FT-20kW	FT-10kW	FT-5kW	FT-3kW-L2	FT-3kW-L1	FT-2kW-L2	FT-2kW-L1
Height 10m	31.6	15.4	9.5	7.3	6.0	4.3	3.6
Height 15m	38.5	19.4	11.4	8.6	7.2	5.2	4.3
Height 20m	43.8	22.6	12.9	9.5	8.1	5.9	4.9

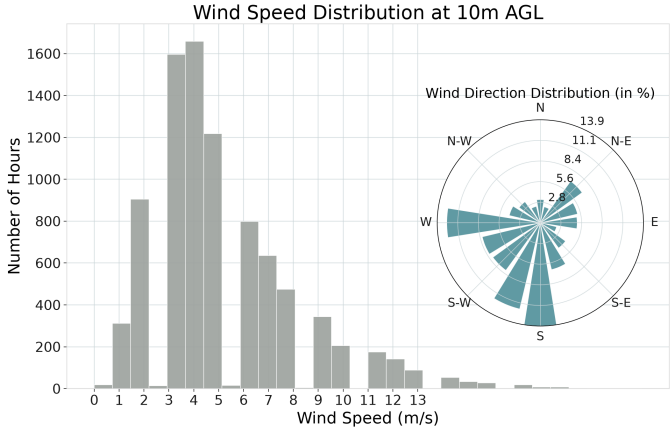
Annual energy production at selected hub heights (MWh)

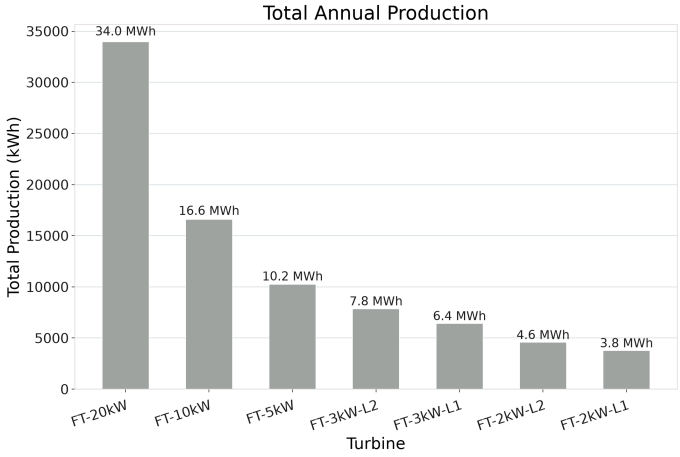
Analysis Based on Nearby Weather Stations

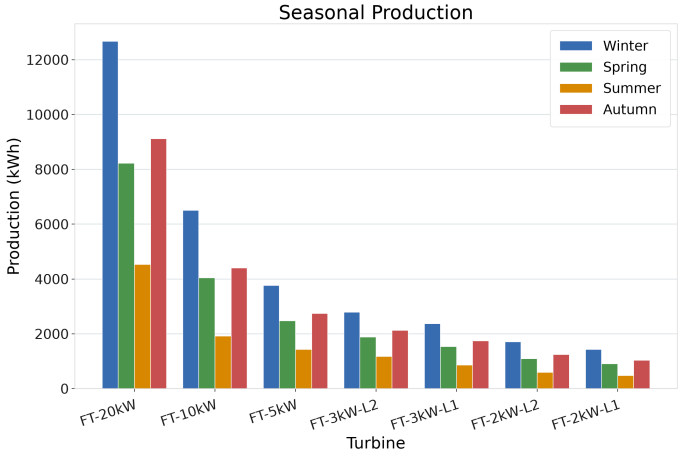
10 m height. Some weather stations may have data recording gaps, which could affect the quality of estimates.

Weather station data provide a separate comparison based on hourly observations from the wider area.

- These data generally refer to about 10 m above ground, so they do not automatically capture the benefits of a taller mast.
- This scenario includes allowances for direction variability and gustiness, which may reduce production.
- It is not a guaranteed minimum or a formal P90 assessment. Stations may be far from the site; use it as a comparison, not a local measurement.







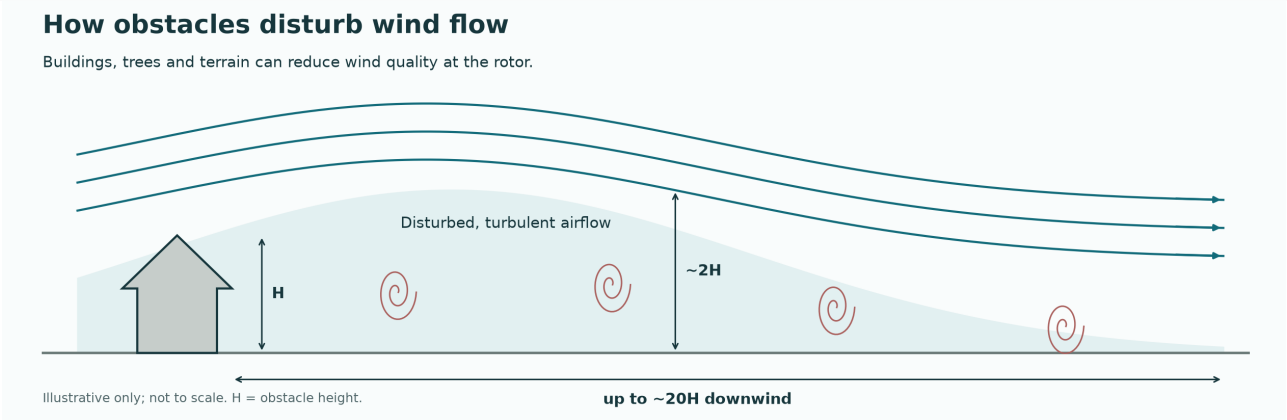
Local factors and result adjustments

Two key considerations when interpreting the results: local obstacles at the installation site, and the adjustment for wind variability and gustiness.

Effect of local obstacles

Why does turbine siting matter? A small wind turbine performs best in smooth, steady airflow. Buildings, trees, embankments and other obstacles can disrupt that flow: wind moves around the obstacle and changes direction, creating a region of lower wind speeds and increased turbulence on the downwind side.

Weather data and wind maps describe the wider area, but cannot fully account for obstacles at the installation site. A rotor operating in turbulent airflow may produce less energy than the calculator estimate.



H
Obstacle height.

2H
Indicative height of disturbed airflow.

20H
Indicative downwind extent of turbulence.

Wind direction and gustiness adjustment

Predicted production (after directional correction)

Charts in this report already include losses due to imperfect yaw alignment with the wind. In typical operation, the actual annual energy production (AEP) is lower than the baseline read from power curves. For this location, the applied correction is about 2%.

The correction is estimated with the (cos γ)^p approach used in studies by NREL and DTU Wind Energy, which describes the efficiency drop when the wind deviates from the rotor axis. The yaw misalignment γ is derived from nearby hourly station data and two indicators: directional variability (Δθ) and gustiness (TI*).

Δθ (median) ≈ 10°, TI* (median) ≈ 0.08, γ (median) ≈ 7°, applied correction ≈ 2%.

Parameter	Value
Median Δθ	10°
Median TI*	0.08
Median γ	7°
Applied adjustment	**2%**

Weather stations used

The analysis point and weather stations used to compile the hourly data.

The stations shown on the map provide the hourly observations used in this analysis. Your site may be some distance from them. The results are interpolated and should be treated as an approximation.



Map source
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ID	Name	Lat	Lon	km
12115099999	USTKA, PL	54.5830	16.8670	0.7
12124099999	DARLOWEK, PL	54.4000	16.3500	39.2
12120099999	LEBA, PL	54.7500	17.5330	46.8
12125099999	LEBORK, PL	54.5500	17.7500	57.5
12136099999	LEBUNIA, PL	54.4170	17.7670	61.5

Data sources and limitations

The information below describes the main data sources used in the report and the main interpretation limits of the results.

Climate data sources

Generated using Copernicus Climate Change Service information (2023). Neither the European Commission nor ECMWF is responsible for any use that may be made of the information or data it contains.
Global Wind Atlas 3: application and data developed by the Technical University of Denmark (DTU) in partnership with the World Bank Group, using data provided by Vortex and funding from ESMAP. GWA data is intended for preliminary site screening and does not replace on-site measurements or technical design.

Weather data source

Weather Data Provided by Visual Crossing

Map source

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Report limitations

The report is informational and analytical. It is not a technical design, bank audit, yield guarantee, or a standalone basis for an investment decision.