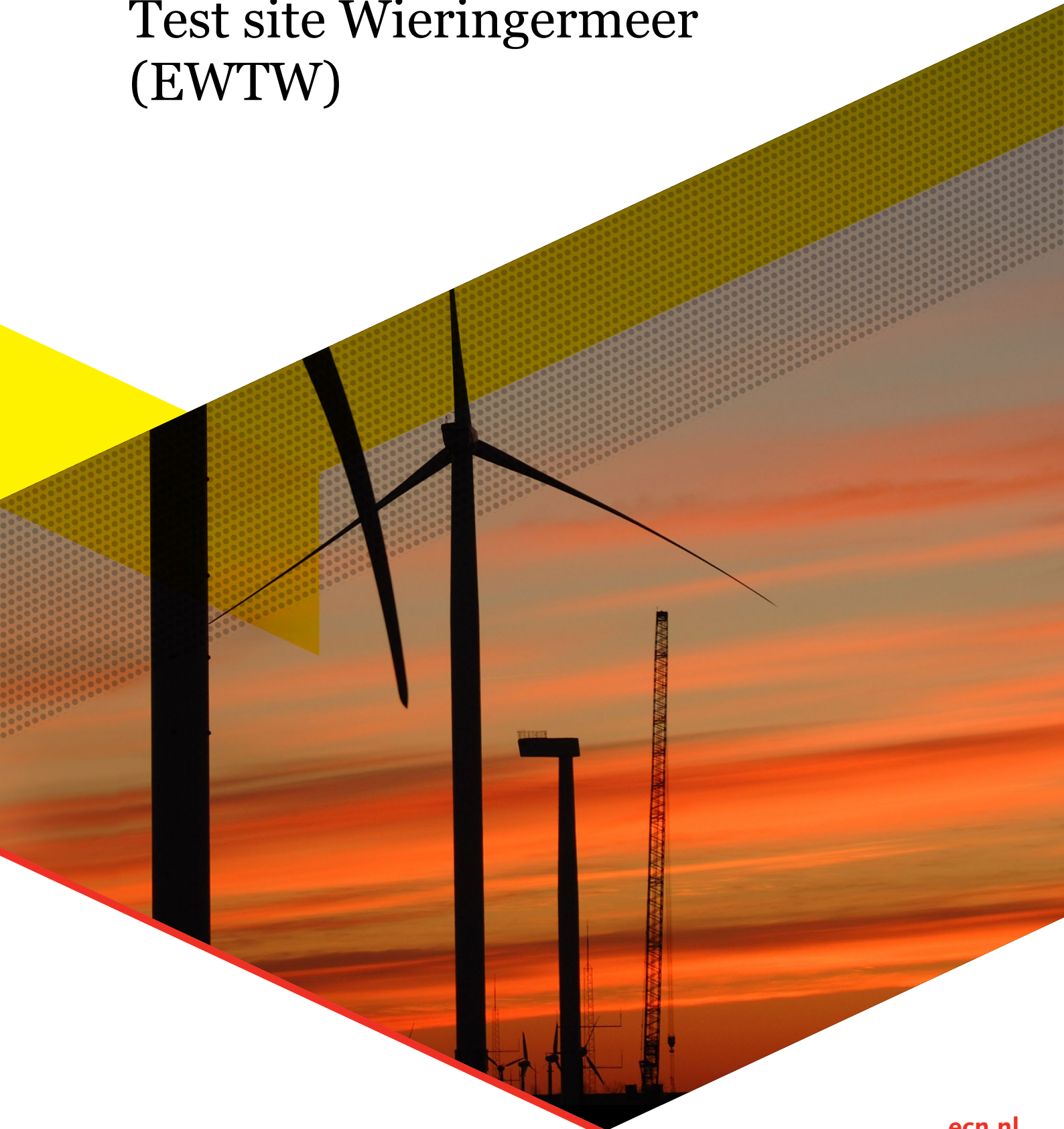


# ECN Wind turbine Test site Wieringermeer (EWTW)





## ECN's test site is a unique facility and comprises the combination of an R&D wind farm with commercially available turbines and six prototype test locations.

Supporting facilities are five meteo towers, a 36 MVA grid connection, the measurement infrastructure, data collection equipment, and a test site control center. The site has a favourable wind climate: the average wind speed at 100 m height is 8,3 m/s.

### R&D wind farm

The R&D wind farm consists of five Nordex N80 wind turbines with a rated capacity of 2.5 MW. The turbines have been used extensively by ECN and its international partners to perform wind farm specific R&D programs and verify design tools. The focus has been on medium and long term R&D in the field of turbine and wind farm aerodynamics, load and condition monitoring, optimisation of O&M strategies, and turbine and farm control. ECN's innovations like the FleetLeader and Active Wake Control could not have been developed without the R&D wind farm. The R&D wind farm with its well instrumented meteo masts is also being used to develop and test new measurement systems like Lidars and Sodars and ECN's FOBM sensor (Fibre Optic Blade Monitoring).

The five Nordex N80 turbines produce about 28.000.000 kWh per year. The income of this green electricity gives a solid base for the financial exploitation of the site.

## Prototype test locations

The six prototype locations enable manufacturers to test and optimise prototypes and execute measurement campaigns for certification purposes. Due to the favourable wind climate, tests can be executed at all desired wind speeds within a short period of time. The site is designed and well equipped to perform power performance measurements, mechanical load measurements, noise measurements and electrical measurements in accordance with the relevant IEC 61400 standards. ECN's measurement team can do these measurements for you or assist you. The team is accredited (ISO17025 and MEASNET) which ensures that the measurement results can be used for certification purposes.

The test site can accommodate prototypes with installed electrical power up to 12 MW. The environmental permit allows wind turbines with a hub height up to 150 m and a rotor diameter up to 175 m. The route to obtain a building permit is relatively short. Usually the civil activities at the site can start within three months after the lease contract is concluded. The 10 kV grid connection cables and the data communication infrastructure are already available at the prototype locations.

As a manufacturer, you can lease the location for a period of typically four to five years. You pay a yearly lease fee and in return receive the benefits of the produced electricity.

## Test site

Since 2003 ECN is exploiting its wind turbine test facility EWTW (ECN Wind turbine Test site Wieringermeer) in the municipality of Hollands Kroon.

The site is located just south of the village Kreileroord at about 30 km distance from ECN's main offices in Petten. The harbour "De Oude Zeug" is at 8 km distance and can be used for the transport of large turbine components. At this harbour, also the ECN blade test facility WMC (Wind Turbine Materials and Construction) is located. For visitors it's an easy 1 hour drive from the Amsterdam airport "Schiphol". The highway A7 has an exit that runs 8 km from the site.



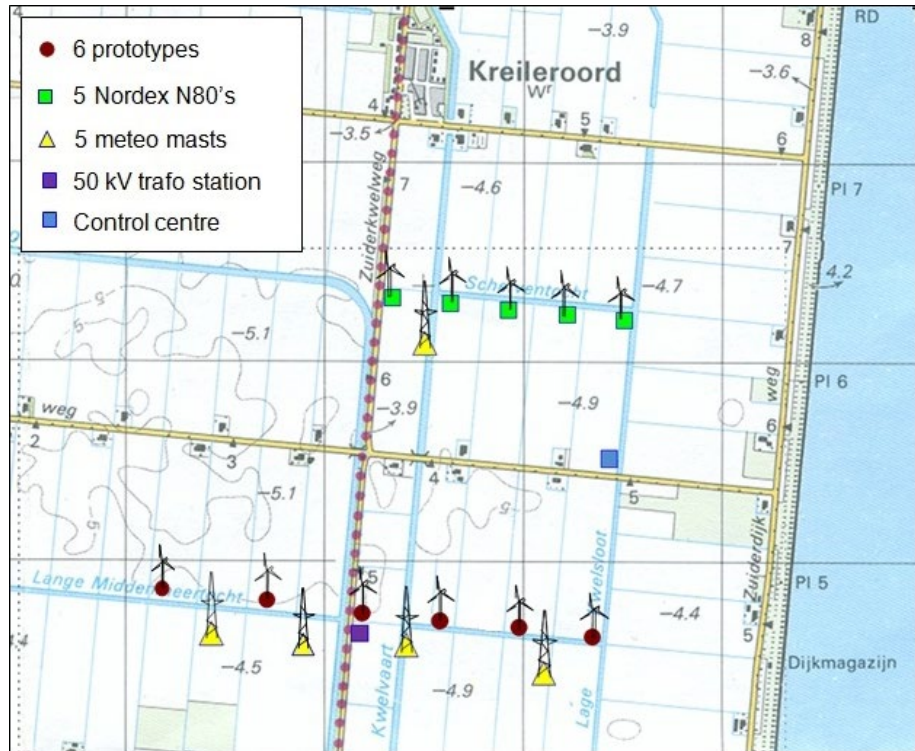


## Extension of the test site

Thanks to the success of the EWTW, ECN is expanding its test site. Upscaling is foreseen for the R&D wind farm by replacing the five N80 turbines by eight larger ones. The number of prototype locations will increase from six to nine. The expanded site will become available early 2018 ([www.windparkwieringermeer.nl](http://www.windparkwieringermeer.nl)).

For testing very large offshore prototypes, ECN is currently developing a new test site near the harbour of Eemshaven in the province of Groningen. The first prototypes are expected to be installed in 2016.

ECN Test Site Overview. The number of prototype locations will increase from six to nine.



Prototype wind turbines on the test site

Prototype location	T1	T2	T3	T4	T10	T11
Brand	Siemens	GE	GE	Siemens	XEMC-Darwind	Alstom
Type	NG7	2,5 xl	2,5 xl	SWT-3,6-120	DD 115	ECO-122
Rated power	2,3 / 3,0 / 3,2 MW	2,5 / 2,75 MW	2,3 / 2,5 / 2,75 / 3,2 MW	3,6 / 4,0 MW	5,0 MW	2,7 MW
Hub Height	91,5 m	85 m	100 m	80 m	100 m	89 m
Rotor diameter	113 m	88 / 100 / 110 / 103 / 120 m	94 / 100 / 103 m	107 / 120 m	115 m	122 m
Installed in	2011	2004	2005	2005	2011	2013

# Custom-made Measurement Programs

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## The test site is equipped with a state-of-the-art measurement infrastructure.

Due to the position and design of the meteo masts, the site is optimal for measurement campaigns that need to comply with the IEC 61400 standards.

ECN's measurement team offers standard measurement campaigns (power performance measurements, mechanical load measurements, and meteo measurements including Lidar and remote sensing) or assistance in noise measurements and electrical measurements. The team also offers custom-made measurement programs to support the testing, optimisation and

certification of prototype turbines. The team is accredited in accordance with the ISO 17025 standard and MEASNET.

ECN's measurement team uses high-end data acquisition systems like its in-house developed Dante measurement system. Measured wind turbine data are transferred to the central test site building by means of glass fiber connections and combined with meteo data, SCADA data, and measurement results from remote sensing techniques like Lidar and Sodar measurements.

The measurement infrastructure allows for data capturing in a central database at the ECN headquarters in Petten with automatic back-up. Automated and manual checks on quality and plausibility are standard procedure. From the database, raw and processed data can be easily exported to the turbine manufacturer.





# Organisation

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The test site is managed by ECN Wind Energy Facilities BV, a 100% ECN subsidiary. Many neighboring farmers participate in the project and receive financial benefits. The objective of this company is to facilitate manufacturers in their prototype development and to support measurement and development programs of ECN. ECN Wind Energy Facilities B.V. also maintains the financial integrity of the test site operation.

# Site Specifications

Wind turbines owned by test site	
Number	5
Type	Nordex N80
Rotor diameter	80 m
Hub height	80 m
Rated power	2,5 MW
Erected in	March 2004
Distance	300 m
Prototype locations	
Number	6
Rotor diameter 1	up to 175 m
Hub height	up to 150 m
Rated power	up to 12 MW
Distance	410 to 525 m
Electrical infrastructure	
Grid connection	at 10 kV level
Electrical grid capacity	36 MVA
Transformer station	10 kV / 50 kV
Rated power per location	6 MW / 12 MW

Meteo towers	
Number	5
Tower heights	2 times 108 m, 2 times 100 m, 1 time 92 m
Measurement heights	various, ranging from 25 to 108 m
Measured parameters	<ul style="list-style-type: none"> <li>• wind speed</li> <li>• wind direction</li> <li>• air temperature</li> <li>• air pressure</li> <li>• relative humidity</li> <li>• turbulence</li> <li>• atmospheric stability</li> <li>• Sonic anemometers</li> </ul>
Measurement infrastructure	
Number	5
Signal cables	Glass fiber multiduct system
Data acquisition	ECN DANTE systems/ Compact RIO
Evaluation	<ul style="list-style-type: none"> <li>• in Control Center at the site</li> <li>• at ECN via a direct glass fiber link</li> </ul>
Control Center	
Offices	for manufacturers
Meeting room	max. 18 persons
Miscellaneous	kitchen, workshop and dressing room



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