

EMD International A/S

Niels Jernesvej 10

9220 Aalborg Ø, DENMARK

tel.: +45 9635 4444 fax: +45 9635 4446

e-mail: emd@emd.dk web: www.emd.dk

Wind atlas for Midnorth POLAND.

EMD/Per Nielsen 2001-10-31

Poland is one of the new countries, which seems to have the potential of being a large market for wind energy projects in the near future.

EMD has been working on different projects and analysed a large part of the measured wind data of proper quality in the northern part, which is the most promising region.

Some of the best wind data have been bought, containing 5 years of measurements in 10 + 30 m height close to the village Bartowice in the northern region. Based on these data and our expectations regarding wind conditions from other studies, a wind atlas (wind statistic) has been developed. The Wind atlas can be used for energy calculations on WTGs with the wind atlas method within approximately a 20 km distance from the northern coastline, as well onshore as offshore.

The wind atlas can also be used for feasibility studies for larger projects and for calculating smaller projects within a reasonable accuracy (assumed within +/- 15% when the local terrain is adequately evaluated). For large projects, where the feasibility is very sensitive, it is recommended to supplement with local measurements to accurate production estimations. But in this case as well, the 5-year measurements can be valuable to long-term correction of the local measurements.

2 "packages" are offered:

1) A wind statistic, which can only be used from WindPRO, with a special licence key. A Meteo data report, with all key data and graphic presentations of the measurements, is also included in this package. **Price: 1 000 Euro excl. V.A.T.**

2) The wind statistic (offer 1)) + a complete set of scanned maps (including local Polish coordinates + UTM/Geographic coordinates for use together with GPS loggings, but excl. copy rights!) + wind data time series, 10 min. values from sep. 1996 – august 2001 (5 years) + digital height contour lines for a large part of northern Poland + photos of the measurement mast. All prepared in a WindPRO 2 project ready to work with. **Price: 3 000 Euro excl. V.A.T.**

If you buy Package 1 you can later upgrade to package 2 for the price difference 2.000 €. On the following pages the content of the 2 packages are described.

Order slip – send or fax to: EMD, Niels Jernesvej 10, DK-9220 Aalborg Ø – fax: +45 9635 4446

I hereby order:

Package 1), Mid-north Poland wind atlas, 1 000€ excl. V.A.T.

Package 2), Mid-north Poland wind atlas + WindPRO project with scanned maps (NO copyright), height contour lines, wind data as time series etc. 3 000€ excl. V.A.T.

Name and company address:

Liabilities.

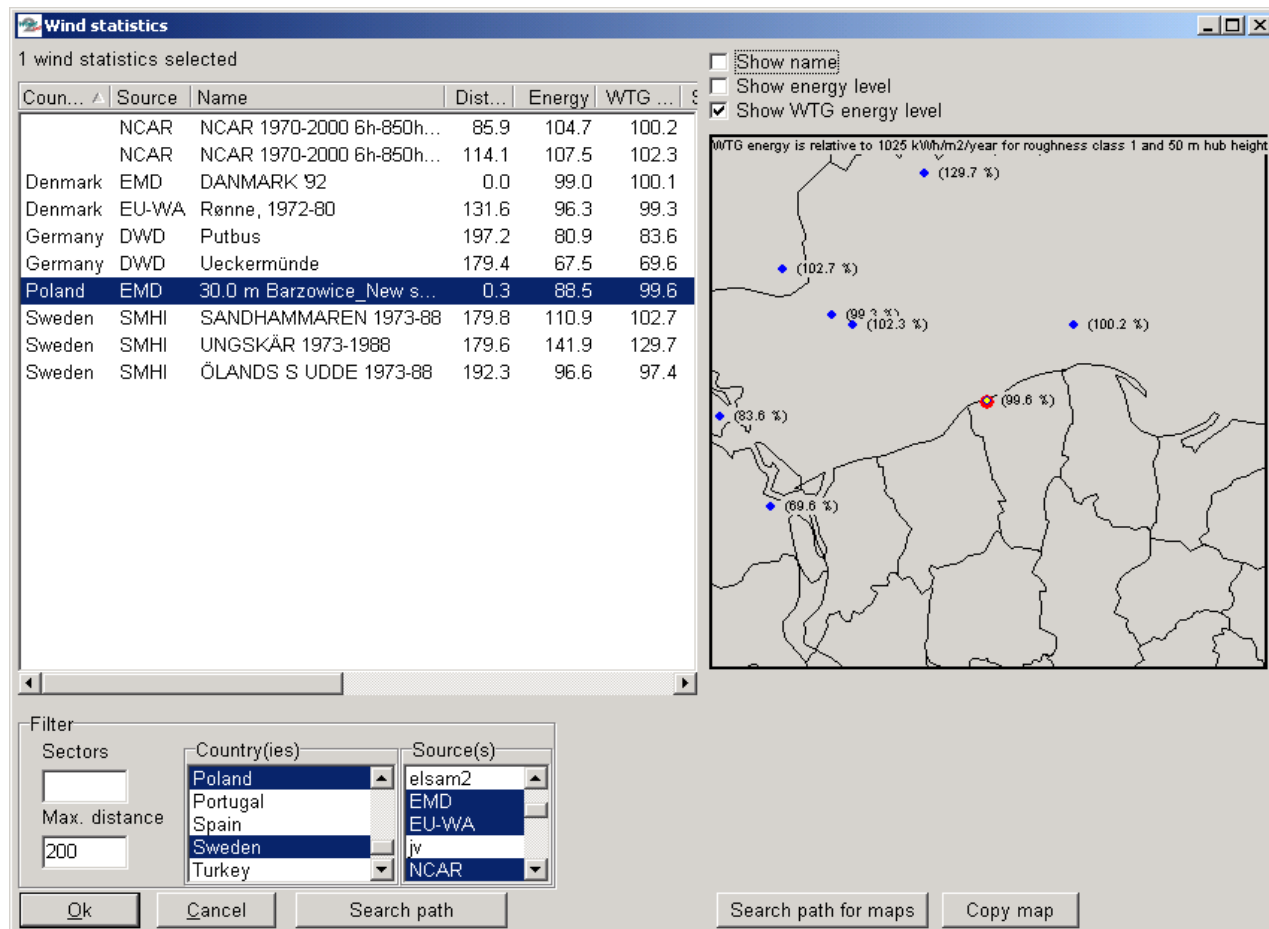
Energi og Miljø Data (EMD) cannot be held financially liable for any financial losses, which direct or indirect may be caused by errors or omissions in the delivered data and disclaim any consultancy responsibility in this respect.

Content of "Package 1"

The wind statistic

The wind statistic is generated on basis of 5 years measurements in 30m heights from the Bartowice measure mast placed 67 m.a.s.l.

The local terrain is described partly on basis of a site inspection, partly on basis of 1:50.000 and 1:10.000 maps. The height contour lines are digitised and the roughness evaluated. Thereafter, the wind data are "cleaned" by WASP and the data file is stored as a .wvs file in WindPRO. This file requires a licence key to use it, which will be delivered in an updated WindPRO 2 registration file.

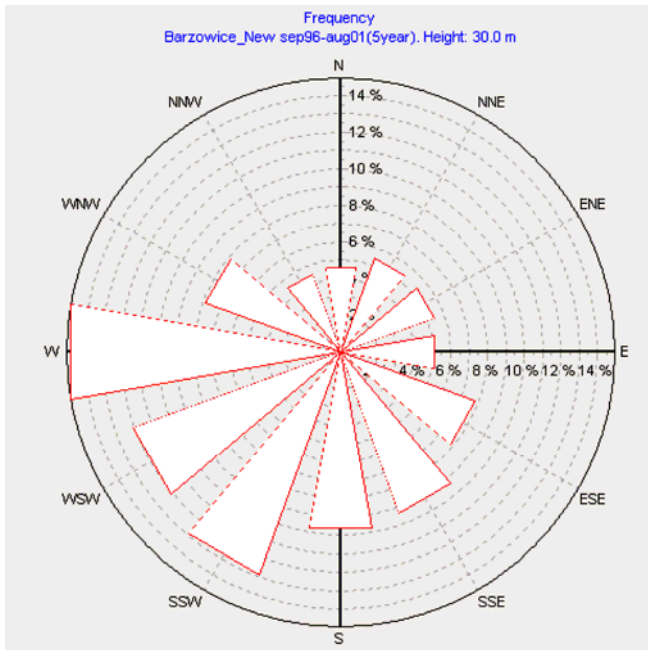


This window from WindPRO shows how the wind statistic will appear, shown together with the nearest other wind statistics from EU-Wind Atlas, SMHI (Sweden), DWD (Germany) and finally NCAR. The different wind statistics in the region around the measure site show very similar WTG-energy levels, which means that a calculation of a WTG production with similar terrain conditions using one of the other neighbouring wind statistics will give approximately the same calculated energy production. Of course another wind direction distribution can give some quite different figures at a specific site and a specific park layout.

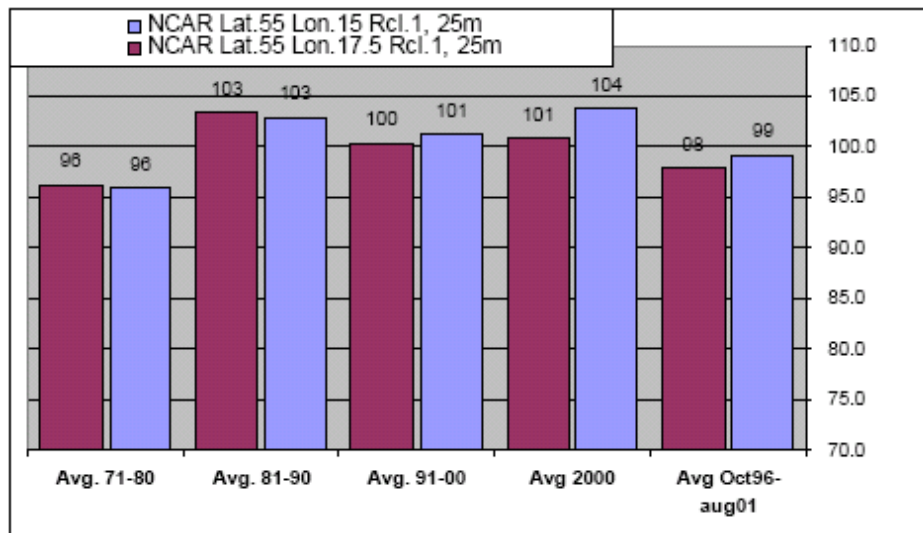
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The most deviating is the German "Uekermünde", close to the Polish border, but this is almost 200 km from the measure site and more south. This is a signal saying that towards southwest, the wind energy level is decreasing. But the decrease is probably not as high as the Uekermünde data shows (30% less). Based on treatment of other measure data in northern Poland there are no indications of a decreasing level within the first 50 km in southwest direction from the Bartowice measure site – but going directly towards south, a certain decrease must be expected.



The wind direction frequency at Bartowice measured over a 5-year period, Sept. 1996 – August 2001.



The graph shows how a wind index based on the two nearest NCAR data points indicates that the measure period has been 1-2% lower than the 30-year period 1971-2000. So in this sense the wind statistic should be slightly conservative.

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Content of "Package 2" (includes also "Package 1")

Package 2 is a good starting point when working with calculations and documentation of WTG projects in central-northern Poland. The content of the package can save you lots of work due to the complicated coordinate setting of Polish maps. Partly the maps are not "straight", partly the Polish coordinate system seem to be "unknown". We have tried several places, but have not yet succeeded in getting a description in order to define it.

So the attached maps are partly in UTM-WGS84 zone 33 coordinates, which makes use of GPS logger points reasonably accurate together with the maps, partly defined with local Polish coordinates, which makes it possible to make documentations in local coordinates and to add on new maps (e.g. 1:10.000) and define these based on the local coordinate system.



The map above shows the rough "road map" included in the package and the 2 squares show the two 1:50.000 coordinate set maps, scanned in a high resolution, suitable for roughness classification, park layout etc.

The parts covered by the maps are at the same time the region, where the wind statistics are assumed to predict reasonable accurate figures.

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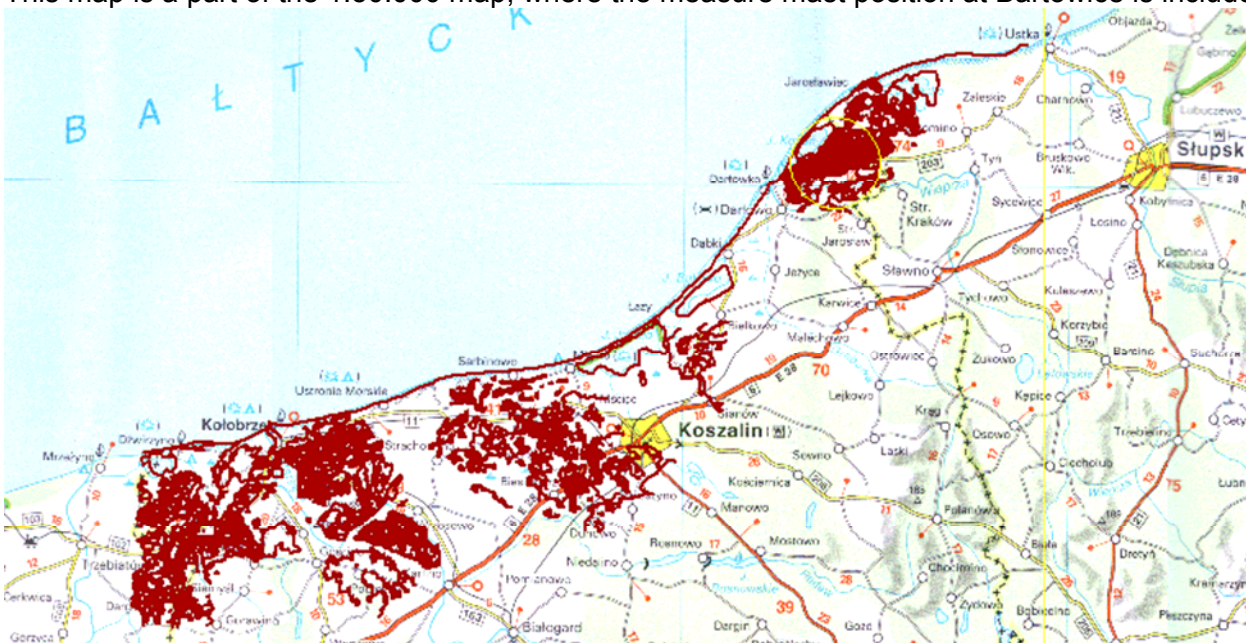
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This map is a part of the 1:50.000 map, where the measure mast position at Bartowice is included.



This map shows where digitised height contour lines are prepared.

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Finally, a part of the 1:10.000 map around the measure mast is shown. The 1:10.000 maps have very detailed height contour lines and it is recommended to digitise from these in the near area around proposed WTGs.

The wind data as time series

The complete series of 5-year data with 10 min. mean values of direction and speed in 10m and 30m-measure heights and a recovery rate of 94%, is as shown below.

Statistics for observations	
Part	Observations
09-96	109
10-96	100
11-96	100
12-96	100
01-97	100
02-97	100
03-97	100
04-97	100
05-97	100
06-97	100
07-97	100
08-97	100
09-97	100
10-97	100
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01-98	100
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12-30	100
01-31	100

The figure shows with green fields the days with 100% recovery rate, which are 144 measure values. The red marked days are completely missing. In total, there are 243.000 data points.

The time series will be included in a Meteo object in a WindPRO project, where the data can be analysed including the option to "copy – paste" them to e.g. excel spreadsheet. (Note Excel can only

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receive 65.000 data points at a time). These time series data can be valuable to perform a number of more detailed analyses regarding the wind conditions in northern Poland.