

WIND ENERGY

Wind farm

PORI

Finland

Wind energy is not the first form of renewable energy for cities to come to mind. Only few towns and cities have enough space to construct major 'wind farms' on their territories. Small-scale wind power facilities are more common in towns and cities that initially conducted feasibility studies. This is not so in the Finnish city of Pori, where the city has been a pioneer in Finland by constructing an 8 MW wind farm, thus doubling overall wind energy production in the country.

THE CITY

With approximately 76,000 inhabitants and with an area measuring 1,053.2 km², Pori is the tenth largest city in Finland and the capital of the Satakunta region. Located on the Gulf of Bothnia, Pori's economy is closely linked with the sea. Around 60% of the population work in trading and transportation. Copper and steel production and titanium pigment technology are the predominant industries.

The annual jazz festival forms the cultural highlight, which is popular with an international audience.

Climatic data:

Average wind speed on the coast: 7,2 m/s



CONTEXT

The city of Pori, which has been a member of Energie-Cités since 1997, also participates in the Cities for Climate Protection (CCP) campaign initiated by the International Council for Local Environmental Initiatives (ICLEI). Like all cities involved in the campaign, Pori has committed itself to introduce climate protection measures as a way of improving the quality of life in the city. To implement this undertaking, the city council drew up a programme until 2008 to establish the actions and strategies needed. Pori will thus continue to be committed to sustainable development in all areas. In the area of renewable energy sources, Pori aims to step up the use of biofuels and wind energy.

Pori already gained first experience with wind energy in 1993, when a 330 kW wind facility was erected as, so to speak, an environmentally sound counterpart to the two state-built coal-fired heat plants. Later the Local Agenda 21 programme included the intensified use of renewables as one of its declared aims for the Pori region. The first project implemented by the city of Pori and eight other municipal energy supply companies in Finland in 1999 was the construction of the largest wind farm in Finland and the first information centre on wind energy and renewables in the country.

EXPERIENCE OF PORI

The aim of this project is not only to develop Finland's wind energy production extensively, but also to influence public opinion concerning wind power plants in a positive way and encourage other communities to undertake similar projects.

As Pori did not have adequate financial resources for this expensive project, Pori Energia (the municipal energy supplier) negotiated with eight other cities in Finland to participate in the project. In 1998 the energy supply or district heating companies of Pori, Espoo, Helsinki, Jyväskylä, Lahti, Lappeenranta, Tampere, Turku and Vantaa set up the company Suomen Hyötytuuli Oy, which owns and operates the wind farm. Power from the wind farm is marketed under the name Hyötytuuli (efficient wind) at a price of € 0.04811/kWh, which translates into a figure of approximately € 25 per annum more in comparison with conventional power forms for the average Finnish household.

The wind farm was planned by several parties right from the start. The town's environmental and municipal planning departments and also Pori Energia carried out initial planning of the wind power facility. The wind potential in the region was therefore assessed for the purpose of determining the best locations and earmarking them for wind power generation as part of regional planning. In parallel to the planning work and the approval procedures of the official bodies, the public received extensive information concerning the project. Both local residents and associations made considerable use of opportunities to voice their opinions and several of their proposals were incorporated in the planning process. This improved public opinion concerning the project.

The seafront and the breakwater on Reposaari and Tahkoluoto islands offshore from the city of Pori were considered to be the most suitable location. Certain key elements (such as the foundations, extension of the power grid) were designed and constructed on site using local know-how. As several cities were involved in the project, it progressed rapidly, and in July 1999 the eight wind turbines were commissioned.

Pori Energia set up the information centre near to the wind farm. This information centre is also large enough to accommodate groups, such as school classes, and to provide information on wind energy specifically and renewable energy in general. Tourists and visitors also have an opportunity to gain a practical insight into wind power generation both in situ and by means of computer animation. They can further explore the coastal area of the Gulf of Bothnia more closely by an educational nature trail. The information centre also organizes special theme days and exhibitions.

Technical data:

Commissioned:	July 1999
Hub height:	50 to 60 m
Rotor diameter:	26 m
Rated capacity:	8 × 1 MW
Theoretical annual output:	20,000 MWh

The eight turbines, which were manufactured by Bonus Energy A/S of Denmark, are designed for the conditions prevailing in cold regions. Iced blades not only reduce



generation by up to 10%, but are also dangerous, as they can hurl ice. The blades of the four wind turbines near the road were therefore equipped with an ice protection system. Installation of a system of this type increases investment costs by approximately 5%.



The total costs for planning and constructing the wind farm were approximately €8.5 million and those for the information centre were around € 255,000. The Finnish government provided subsidies to the order of 33% of the total costs of the wind farm within the scope of its renewables promotion programme, and Suomen Hyötytuuli Oy provided the remaining capital.

Theoretical and actual output:

When planning the wind farm it was assumed that the annual output would be 20 GWh. However, in 2000 power generation only amounted to 17.8 GWh, as the wind farm was out of action for one month due to unexpected maintenance and repair work. Since the manufacturer Bonus Energy A/S resolved the initial technical difficulties, the turbines have been working to the operator's full satisfaction.

Pori wind farm	1999	2000
power generated (MWh)	930	17,800
of which sold as green power (MWh)	290	610
customer base	43	119

EVALUATION AND OUTLOOK

The wind farm in Pori is a pioneer project in two ways. First of all, these are the first 1 MW wind turbines in Finland and, secondly, they are the first in the world of this size with an ice protection system incorporated in the blades. Hyötytuuli Ltd. and VTT Energy (Finnish Technical Research Centre) use the wind park to carry out research on icing and wind conditions in the Gulf of Bothnia. For this purpose, near by the information centre there is a research mast, height of 87 m, which is equipped with different research devices. Technical data is measured at 37, 62 and 87 m heights. Two have time jobs is the direct permanent impact of the wind park, one person is working at the information centre and a second in the maintenance.

The wind farm in Pori has, in the meantime, developed into one of the most popular tourist attractions in the region. In the first two years since it opened the information centre has had more than 10,000 visitors. As a result of the good public relations work, there are also no complaints from neighbours; the people of Pori are proud of their wind farm.

Wind power generation in Finland has doubled through the wind farm. Other municipalities have now also started constructing wind turbines. Pori itself is already in the process of drawing up specific plans to expand the wind farm by a 2 MW facility.

An annual electricity production of 17 000 MWh from the Pori wind farm avoids 12,700 t CO₂, 50 t SO₂ and 40 t NO_x.

FURTHER INFORMATION

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This case study was prepared by Energie-Cités in cooperation with the City of Pori. It received funding from the European Commission DG TREN within the scope of the ALTENER Programme.

