Chapter 7
Finland

7.1 INTRODUCTION

In 2002, deployment of wind energy in Finland showed a new start after low growth years of 2000 and 2001. The production of wind energy was lower than in 2001 due to a very low wind year, according to wind indices. Series manufacturing of 1-megawatt (MW) wind turbines was started in Finland.

7.2 NATIONAL POLICY

Strategy

The Action Plan for Renewable Energy Sources was updated. The plan recognizes the Kyoto Protocol on the reduction of emissions of greenhouse gases of 1997 and the European Union (EU) White Paper endorsed by the Commission in 1997 and the Council in 1998, into targets for renewable energy deployment.

The target is to increase the use of renewable energy sources at least by 50% (3 Mtoe/a) by 2010 from the level in 1995. Ninety percent of this increase is expected to originate from bio-energy, 3% from wind power, 3% from hydro-power, 4% from heat pumps, and less than 0.5% from solar power.

The share of renewable energy sources in power production would increase by 8.3 terawatt-hours (TWh) (2,010 megawatts [MW]) from the level in 1995. The major part, 75%, would be generated from bio-fuels. Achieving the targets would reduce greenhouse gas emissions by about 7.7 million tons of carbon dioxide equivalent. The vision for 2025 is an addition of 100% (6 Mtoe) of renewable energy from the level in 1995, with biomass still dominating but several percent of the total electricity generated by wind.

The target for wind energy deployment is set to 500 MW in 2010 and is envisioned to be 2,000 MW in 2025. Thus wind energy production would reach 5 TWh/a in 2025, which is about 5% of projected gross power consumption.

Progress Towards National Targets

During the review of the Action Plan for Renewable Energy, progress towards the goals was assessed. It was recognized that the progress has been slow compared to the goals, especially for wind and solar energy. Also, the funds available for an investment subsidy type of funding are not adequate to achieve the goals set by 2010.

The factors behind the slow progress in wind energy have been the low cost of electric energy in the market together with the on-average lower than earlier investment subsidy, the long lead time for planning of wind projects, and differing practices in grid connection policies for distributed generation.

In the updated Action Plan for Renewable Energy, it is proposed that alternative subsidy systems for wind energy be looked for. A working group established by the Ministry of Environment has set up a framework for planning and building permission procedures. The Åland islands between Finland and Sweden constitutes an autonomous region with its own legislation, budget, and energy policy. Wind energy deployment is steady and, related to the population, the targets are ambitious. Wind energy is expected to cover

10% of energy consumption in the region by 2006.

7.3 COMMERCIAL IMPLEMENTATION

Two 2-MW wind turbines were put into operation in 2002, bringing the total wind capacity to 41 MW by the end of the year. A further 7 MW, originally also due to be on line by the end of the year, were under construction. The gross wind energy production amounted to about 63 gigawatt-hours (GWh). This is about 10% less than production in 2001 and is due to a poorer-than-normal wind year. The development in capacity and gross production is presented in Figure 7.1.

Gross power consumption in 2002 is estimated to be about 81 terawatt-hours (TWh). Domestic production covered 90% of the electricity need. Wind stands thus for about 0.1% of the national consumption.

7.4 MARKET DEVELOPMENT AND STIMULATION

Support Initiatives and Market Stimulation Incentives

The Action Plan for Renewable Energy Sources states that the investment subsidy will remain the primary support mechanism, although new support mechanisms are to be investigated. For wind energy installation, an investment subsidy of up to 40% can be awarded, depending on the rate of novelty in the project. Projects that have applied for subsidy in 2002 and are to be realized in 2002 have received an investment subsidy of about 30%. In addition to the investment subsidy, a price premium of 7 €/MWh is awarded. This corresponds to the tax on electricity that is paid by household consumers.

The Information Centre for Energy Efficiency (Motiva) is also promoting wind energy

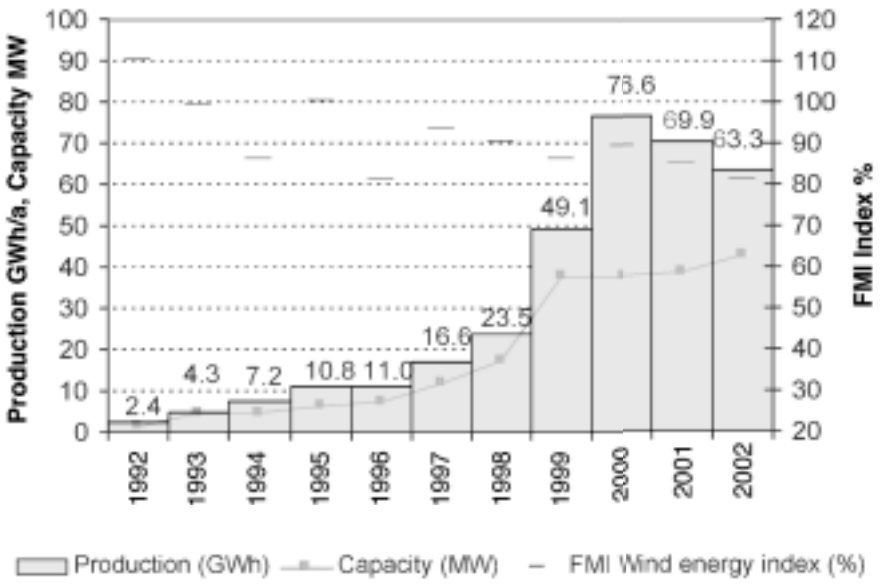

Figure 7.1 Development of wind energy production and installed capacity in Finland, 1992 to 2002

by publishing best-practice guides and handbooks. The Finnish Wind Energy Association is also actively promoting wind energy through seminars and political lobbying.

In the CLIMTECH-program, financed by the National Technology Agency (TEKES), the possibilities of various technologies for greenhouse gas emission reduction as well as new business opportunities were investigated in order to have guidelines for further support for the different technologies. Export prospects for the Finnish wind industry seem to be promising and can be supported by active support of both R&D and the domestic market. The contribution of wind energy to the reduction of greenhouse gas emissions depends on the rate deployment of wind energy, which is expected to take off in the latter part of this decade.

Unit Cost Reduction

Cost development trends in wind investments have been analyzed as part of the production and failure statistics in 2002. From 1991 to 2001, average investment costs have been reduced from about 1.2 million €/MW to 0.9 million €/MW (in 2001 Euros). There is a wide spread in the costs of individual projects.

An attempt was also made to analyze the development of operation and maintenance costs over the years. Trend lines could not be drawn because of the scarcity and large spread of the available data.

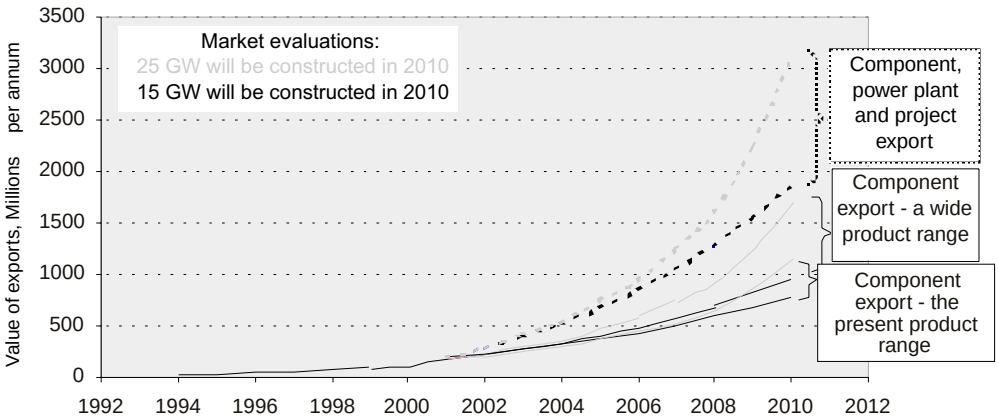

Figure 7.2 Export prospects of wind technology until 2010 for present product range and for a wider product range

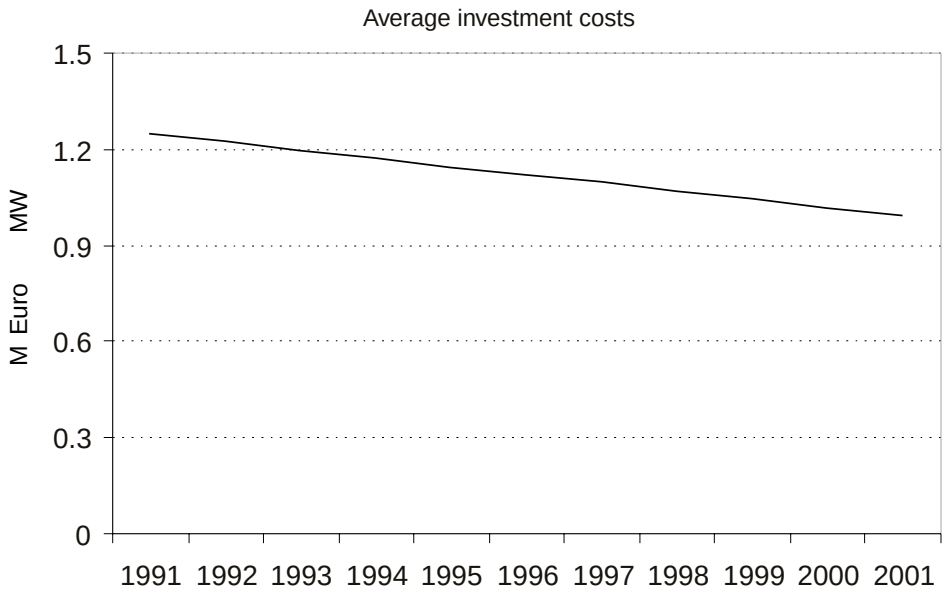

Figure 7.3 The development of average total installation costs of wind power plants in Finland, 1991 to 2001 (in 2001 Euros)

7.5 DEPLOYMENT AND CONSTRAINTS

Wind Turbines Deployed

Out of the 65 turbines now in operation in Finland one is from Finland, the rest are from Denmark and Germany. The most recent and largest wind turbines have for a long time been preferred, mainly due to difficult siting in the complex coastal landscape. The projects to be constructed in 2003 and 2003 use turbines with rated power from 1 MW to 2.5 MW.

Turbines installed in the harsh climate of northern Finland are protected with ice-preventive equipment. The same solution is tested at certain sites in southern Finland as a public safety concern due to occasional icing. Experience shows that the higher and the closer to sea the turbines are, the more prone they are to icing.

Operational Experience

In general the turbines operate satisfactorily. There are incidents of breakage in seals and bearings, but overall availability among the reporting turbines reaches about 95%. Gearbox failures accounted for about 50% of the down time during the past year. Turbines operating in extreme climates report higher down times.

Main Constraints on Market Development

The electricity market has been fully liberalized, down to the household consumers, since 1997. Thus all wind energy installations are “merchant“ producers that have to find their customers on a competitive market. Current market prices are that low and, despite the quite substantial support, wind

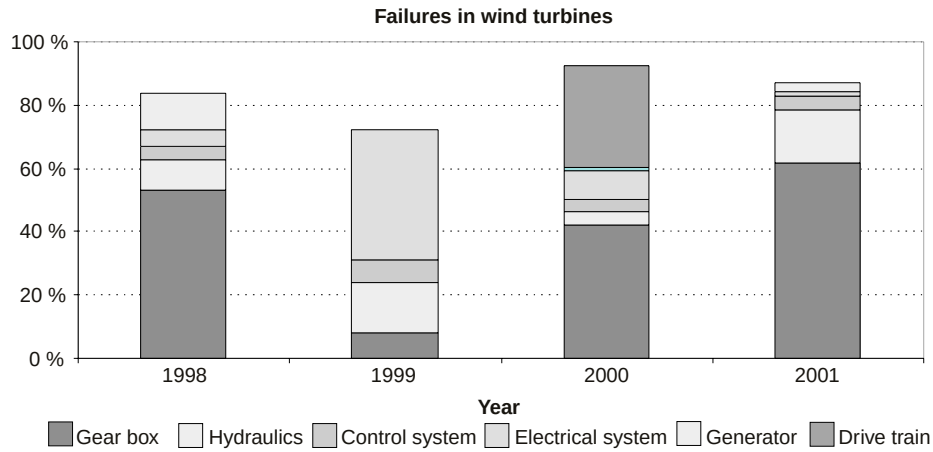

Figure 7.4 Development of down time due to failures in Finland, 1998 to 2001

energy can not yet compete with spot prices for electricity. Most turbines are owned by or operate in co-operation with a local utility to facilitate energy market access.

The transmission and distribution charges for distributed generation vary greatly across the country and are so high in some areas that they totally prevent local generation.

Wind energy deployment is slow, but there is still a continuous discussion on the environmental impact of wind turbines. Land-use restrictions and visible pollution, especially in relation to summer residents and vacation activities, might yet prove a significant obstacle to development.

7.6 ECONOMICS

At a good site on coastal Finland, the cost of wind energy production could be about 240.00 FIM/MWh to 250 FIM/MWh, including an investment subsidy.

As stated previously, all wind energy installations are commercial power plants and have to find their customers in a free power market. In most cases an agreement with a local utility is made, giving market access and financial stability. Some utilities have offered to buy wind energy production at a price higher than avoided costs in general.

There are several companies offering green, or specifically wind, electricity, certified by the association for nature conservation and at a price higher than the average household price. Market success for these initiatives has, however, been modest. Only a few percent of household consumers have changed electricity supplier at all since the liberalization.

7.7 INDUSTRY

A new Finnish manufacturer, WinWinD, presented its first prototype in spring 2001, which is now in operation in Oulu. The turbine has a rated power of 1 MW and will operate at variable speed. It has a one-stage planetary gearbox and a permanent magnet generator. The aim is to develop the concept further into a 3.5-MW turbine for offshore applications. The next units of the 1-MW turbine are under construction and will be on line in spring 2003.

For some time, the Finnish industry has been able to produce main components, such as gearboxes and induction generators, as well

as materials like cast-iron products, tower materials, and glass-fiber products for the main wind turbine manufacturers. The total turnover of this "sale of components" is estimated to be about 200 million € in 2002. The industry has been successful in supplying components for medium-sized wind turbines up to 2 MW. This has required some investments in new production facilities.

A blade-heating system for wind turbines operating under icing conditions was released as a commercial product in 1998. It has been developed mainly for the domestic market but also for export. The first delivery, to Sweden, was made in 1998.

The manufacturing industry has formed a branch group under the Association of Metal Industries to promote technology development and export in wind technology.

7.8 GOVERNMENT-SPONSORED R,D&D

Since 1999 there has been no national research program for wind energy. Individual projects can receive funding from the National Technology Development Agency (TEKES) according to the general priorities and requirements for technical R&D. Benefit to industry is stressed as is the industry's direct financial contribution to individual research projects. Priority is given to product development and the introduction of new products.

New development mainly comprises the new domestic turbine mentioned previously. The actual performance of the turbines installed has been followed both in terms of annual production and failure statistics and, in two cases, in more thorough measurement and follow-up projects.

Offshore Siting

There is a drive towards offshore locations of turbines. The foundation and installation of turbines in the icing waters require careful design of the support structure. Projects to develop foundation and installation technologies suitable for Finnish offshore conditions have been initiated in a cooperative venture of research bodies and industry.

Some semi-offshore installations at "artificial" islands out of gravel in low waters are already built. The new projects planned will be located either just on the shoreline or on small rock cliffs and islands, which are barely above sea level. There are no plans for new investments in fjell areas at the moment.

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