

# Chapter 15

## Norway

### 15.1 INTRODUCTION

In 2003, 3 MW of new wind energy capacity were installed in Norway. Interest is high for wind power as a commercial source of electricity – however, financing and public acceptance remain substantial hurdles to wind turbine installation. The electricity price increase in the Nordic electricity market in fall 2002 and winter 2003 heightened interest in energy in general, as well as somewhat in wind energy. However, since estimated long-term future electricity prices are still quite low, this situation in itself is not a strong enough incentive to spur new investments in wind energy.

### 15.2 NATIONAL POLICY

#### Strategy

The key features of Norwegian energy policy are: improved energy efficiency; more flexibility in the energy supply; decreased dependence on direct electricity for heating; and an increased share of renewable energy sources, other than large hydropower, in the energy supply mix.

The Norwegian parliament adopted the following national objectives in the spring of 2000:

1. Limit energy use considerably more than if developments were allowed to continue unchecked
2. Increase annual use of water-based central heating based on new renewable energy sources, heat pumps, and waste heat of 4 TWh by the year 2010
3. Install wind power capacity of 3 TWh by the year 2010
4. Increase environmentally friendly land-based use of natural gas

#### Progress Towards National Targets

The ambition of the Norwegian government is to have an annual electricity production based on wind energy of 3 TWh/yr by the year 2010, which represents approximately 1,000 MW installed capacity, at the average availability at the most favorable sites. The total installed capacity in Norway is 100 MW, which normally represents a production of 300 GWh/yr.

Two projects, totaling 500 GWh, have received national grants and are under construction. The government has given grants to three other projects, with a total production capacity of 800 GWh. If all projects are carried out, Norway will reach approximately 50% of its national target of 3 TWh wind power production.

The Norwegian Water Resources and Energy Directorate (NVE) has done research work with regard to a green certificate market for Norway, and the report has been sent to the Ministry of Petroleum and Energy. The ministry will consider the conclusions from the report and decide whether or not Norway will implement a green certificate market.

Additionally, the governmental enterprise, Enova, has finished a report study on several transition schemes to a green certificate market for Norway.

## 15.3 COMMERCIAL IMPLEMENTATION

### Installed Capacity

The total installed capacity for Norway is 100 MW, with approximately 300 GWh of wind energy production per year. Two wind farms were commissioned during September and October 2002, which increased the total installed capacity from 17 MW to 97 MW in 2002.

The first wind farm consists of 20 turbines, each rated 2 MW. It is located at the western coast of Norway, on the island Smøla, and has an estimated energy production of 118 GWh/yr. The second wind farm consists of 16 turbines, each rated 2.5 MW. It is located close to the North Cape, near the town Havøysund, and has an estimated energy production of 120 GWh/yr.

An overview of the Norwegian wind turbines and the energy production in 2003 is shown in Table 15.1.

## 15.4 MARKET DEVELOPMENT AND STIMULATION

### Main Support Initiatives and Market Stimulation Incentives

Enova, a governmental enterprise established in 2002, is empowered to be in charge of the Norwegian investment program for wind power, and a technology implementation program including wind technology.

Enova offers a maximum of 10% investment grants for new wind farms based on a maximum investment cost of 6,000.00 Norway Krone (NOK)/kW installed (694,000.00 euro/MW). Wind farm owners also received a production subsidy of 0.0475 NOK/kWh (5.49 euro/MWh) in

2003. The Norwegian parliament decides this premium price annually. The production subsidy has been discontinued for 2004. (See <http://www.enova.no> for more information.)

## 15.5 ECONOMICS

### Trends in Investment

The unit cost of the Norwegian wind turbines erected in 2002 was approximately 8,300.00 NOK/kW, including infrastructure and grid connection. No commercial wind farms were established in 2003 so the unit costs for 2003 were not calculated.

Estimations on production costs from sites with favorable wind conditions suggest a production cost of as low as 220.00 NOK/MWh to 260.00 NOK/MWh, including capital and operation and maintenance (O&M) costs. Therefore, compared with the spot market electricity price, wind energy, on average, cannot yet compete on current commercial terms. However, compared with the price of new hydropower projects, some wind energy projects are almost competitive.

During 2001, 2002, and 2003, several interesting commercial agreements were made, based on export of wind energy produced in Norway for the Netherlands. The market for Norwegian wind energy in the Netherlands is now closed.

## 15.7 INDUSTRY

### Manufacturing

The Norwegian/Swedish Company, Scanwind Group AS (SWG), has developed two different wind turbine designs: a 3-MW, direct-driven generator and a 3-MW geared generator. The first direct-driven generator was erected at Hundhammerfjellet in mid-

Wind Turbine Projects	Year	No. Units	Total Power	Production 2003
			KW	GWh
Frøya	1986	1	55*	0.15*
Frøya	1989	1	400	0.7
Vallersund	1987	2	75	0.15
Kleppe	1988	1	55	0.05
Smøla	1989	1	300	0.56
Andøya	1991	1	400*	1.2*
Vesterålen	1991	1	400*	1.2*
Vikna I & II	91/93	5	2200*	5.5
Hundhammarfjellet	1998/2003	1	1,650+3,000**	3.9
Lindesnes	1998	5	3,750	8.7
Sandøy	1999	5	3,750	9.2
Kvalheim	2001	5	4,000	12.4
Smøla	2002	20	40,000	95.8
Havøygavlen	2002	16	40,000	80.3
<b>TOTAL</b>		<b>65</b>	<b>100,035</b>	<b>219.8</b>

\*Estimated production. Data not received from utility company

\*\* 3MW Scanwind turbine erected summer 2003

**Table 15.1 Overview production data from Norwegian wind farms**

Norway (Figure 15.1). The first geared version will be erected in summer 2004. The testing period for the direct-driven generator showed very good results.

ScanWind is now in the decision phase for establishing production lines for blades, towers, generators, and invertors. ScanWind has established the first assembly line in Norway at Verdal in mid-Norway.

UMOE Ryving, a Norwegian-based investment company, is now in series production of high performance, 1,500-kW wind turbine blades. After the company delivered the first set in February 2003,

positive operational experience and test results are now present from the first turbine in operation with Umoe blades.

In 2001, in order to assist the development of wind energy in Norway, SINTEF Energy Research, Institute for Energy Technology (IFE) and the University in Trondheim (NTNU) took a joint initiative to develop a test station for wind turbines at the western coast of mid-Norway. The test site is under construction and will be in operation in 2004 or 2005.

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**Figure 15.1** Erection phase for the direct-driven ScanWind 3000 DL turbine at Hundhammerfjellet