

The Swedish programme to promote wind energy

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Current status of electricity production from wind in Sweden

The total Swedish electricity production 2003 was 143 TWh. The main part comes from hydropower and nuclear power, which contributes with ≈ 65 Twh each. 11 TWh comes from combustion generated heat. The total demand was 149 TWh 2003 and the difference was covered with import.

The total installed wind power electricity generation was 404 MW at the end of 2003. During 2003 wind power contributed with 0.68 TWh, 0.47 % of the total electricity production.

Current installed offshore wind power.

There are currently three offshore wind farms in Sweden. *Bockstigen*, outside the coast of the island Gotland, with five 500 kW has been in operation since 1998. At *Utgrunden*, in the straight between the island Öland and the Swedish mainland, seven Enron 1.5 MW turbines was taken in operation 2000. *Yttre Stengrund* was built a little south of Utgrunden. Yttre stengrund with five NEG-Micon 2 MW units were taken in operation in 2001.

Planned off shore wind farms

The Lillgrund offshore wind farm (www.eurowind.se), in Öresund between Sweden and Denmark, just recently received its permits for building. The wind farm is planned for 48 units with a unit size of 2-3 MW. Further wind farms are in the process of carrying out environmental impact assessment studies. Airicole (www.airicole.se) is planning a second phase of the Utgrunden wind farm. Vattenfall is planning a wind farm not far from Yttre Stengrund. At the Swedish part of Kriegers Flak, two different companies, Eurowind and Sweden Offshore Wind (www.swedenoffshore.se) are planning for a large wind farm. Final permit can only be given to one company since they are planning on the same location. The plans at the Swedish part of Kriegers Flak are ranging from 640-1000 MW.

	Bockstigen	Utgrunden I	Yttre stengrund	Lillgrund	Utgrunden II	Vattenfall Karlskrona Vind	Kriegers flak
MW per unit	0.5	1.42	2	2-3 MW	ca 3.6	3-3.5	ca 5
No. Units	5	7	5	48	24	5	128-220
Total MW	2.5	9.9	10	ca 120	Max 90	15-17.5	600-1000
Hub height	46	65	60	ca 60	up to 90 m	ca 70	85-120
Water depth	5.5-6.5 m	ca 7 m	8-12 m	4-9 m	7-23 m	ca 15 m	16-39 m
Distance to shore	4.5 km	ca 7 km	4 km	ca 7 km	ca 7 km	ca 9 km	ca 30 km
Status	In operation	In operation	In operation	Permits ready Planned 2005	EIA going on. Planned to be built 2005-2006	EIA going on. Planned to be built 2005-2006	EIA going on

Table 1. Current offshore wind farms and some planned.

National Swedish goals and the spatial planning process.

In June 2002, the Swedish parliament decided on a planning goal to plan for 10 TWh/year electricity production from wind power before year 2015. There is no set goal for an actual production for electricity from the wind. The goal is rather set to create prerequisites in the planning such that it can be possible to build wind power to produce 10 TWh/year by year 2015.

In order to get the process going in different geographical regions, the Swedish Energy Agency has made a suggestion on the geographical distribution within Sweden. It is assumed that a production capacity of 6 TWh/year can be built in the Swedish Exclusive Economic Zone, EEZ. 4 TWh/year of production then has been distributed on the 21 different Swedish counties.

On land and within the Swedish territorial waters, the municipalities have a planning monopoly. This means that the municipalities decide on the use of land and the territorial sea within their respective geographical areas. However, according to planning laws the municipalities have to make comprehensive plans for the use of land and sea. The Swedish Energy Agency is now responsible to verify that the municipalities, in collaboration with county authorities, assign enough areas for electricity production in their comprehensive plans for land and sea use.

The planning process in the EEZ is different. The National Board of Housing, Building and Planning has a directive to account for the general prerequisites for building wind power at the sea. As part of this process a GIS system "VindGis" has been developed. In VindGis different conflicting interests can be overlaid each other.

The Swedish Environmental Protection Agency has directives to look at the ground areas (banks) in the sea and to investigate their different environmental values. The Swedish environmental protection agency has so far made priorities on the protection values for some banks. Further investigations on the environmental value will, however, be carried out during 2004 and 2005.

Work to plan for wind energy in the EEZ has thus started, but no national coordinated appointment made on sea areas in the EEZ has been made.

Areas of national interest for wind energy production

Projects with a size > 1 MW are obliged to seek permission according to the environmental code (Miljöbalken) and environmental impact assessments must be made. Depending on whether the project size is over 10 MW or not the permits are obtained from the county authorities or the government. In each case, different positive and negative environmental impacts are assessed. To ensure a general good use of land and sea, a special designation "areas of national interest" is used in the environmental code. There are areas of national interest for different activities, e.g. fishery, general recreation, natural conservation et.c. When an area is designated an "area of national interest" for one or multiple activities, these activities have some priority in the permit procedure. In order to lift up wind energy on the same level of priority as other activities, areas of national interest for wind energy production can also be designated. It is the Swedish Energy Agency that shall make the rules for how such areas should be selected and make the final legal appointment. This process is now going on in Sweden. The main criteria set up is that the predicted wind energy content should be more than 3800 kWh/m² at 80 metre height. Areas smaller than 1.5 km² and areas too close to settlements and housings are excluded. Areas that are national parks and some other specified areas according to the environmental code are also excluded. In the current recommendations from the Swedish Energy Agency, only sea areas with water depth <30 m shall be selected.

Revenue for electricity from wind power

The revenue can be divided mainly in three parts: the market price for sold electricity, electricity certificates and an environmental bonus.

Market price

The electricity price varies with season, but also from year to year. During 2003 the price was rather high due to very little water in the rivers. During 2003, the yearly average price was 0.32 SEK/kWh (3.5 €/kWh). The current and historical prices can be found at www.nordpool.com.

Electricity certificates.

Since may 2003, Swedish electricity users has to buy a certain part of their electricity from renewable energy. Consumers are obliged to buy a certain share of electricity certificates. The purchase for normal consumers is carried out by the supplier. If you have a production unit eligible for electricity certificates, you obtain a certificate for each MWh produced electricity. These certificates can be sold to electricity suppliers and generate a revenue for the supplier of renewable energy.

The production eligible for certificates are renewable electricity production. The existing large scale hydro power units are, however, excluded.

Production eligible are:

- Wind energy
- Bio fuels
- Hydro power (new, expansions and small existing units)
- Solar energy
- Wave energy
- Geothermal energy

The user obligation is currently 8.1 % and will rise to ca 16.9 % 2010. The electrical intensive use industry is excluded from the obligation to buy certificates, so that the total amount of consumption obliged to buy certificates is around 100 TWh, meaning that 8.1 TWh has to come from (new) renewable energy 2004.

The certificates were traded at an average price of 215 SEK (0.215 SEK/KWh ≈2.4 €/kWh).

Environmental bonus

Wind energy production is also entitled a tax reduction (environmental bonus). This bonus is, however, applied only during a transition period some years after the electricity certificates were introduced. During 2004 the bonus is 0.12 SEK/Kwh for onshore wind energy and 0.17 SEK/KWh for offshore wind energy. The bonus will gradually decrease and end at 0.02 SEK/kWh 2008 for onshore wind energy and 0.12 SEK/kWh 2009 for offshore wind energy.

Subsidies in terms of investment, “Wind pilot”

To support technical development and market introduction offshore and in mountainous regions, a five year programme “wind pilot” was introduced 2004. The programme is in total 350 Msek (≈38 M€). Applications are currently (spring 2004) under evaluation. The pilot project shall increase the long term cost efficiency of offshore wind power and power in mountain terrain (cold climat). Support is paid for extra project cost due to mountain and offshore specific conditions. Support can be paid for part of the investment cost but also for targeted research and investigations, e.g. environmental issues or better foundations. The programme is managed by the Swedish Energy Agency.

Research funding through VINDFORSK

Government funded wind energy research is carried out within the research programme VINDFORSK. This programme is managed by the Swedish Energy Agency and has a total budget of around 3 M€ per year including industry funding. The programme is a continuation of the Swedish research programme that has been going on since the 1980's. 2 M€ per year is directed to basic research carried out by universities and research Institutes. The programme is divided into four main areas:

- Safer assessment of the energy production
- Cost efficient wind energy converters
- Efficient integration into the electrical system
- Well-adapted planning and environmental issues.

Research projects thus cover a broad spectrum of wind energy issues: e.g. aeroelasticity, wave loading, metrology, blade de-icing, electrical systems, noise, effects on flora and fauna.

Information on the concerning the program can be found on www.vindenergi.org. This information is, however, in Swedish.

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