KRIEGERS FLAK
WIND FARM

We are studying the possibility of building an offshore wind farm with around 130 wind turbines in a stretch of the Baltic Sea known as Kriegers flak. The area is located in the Southern part of the Baltic Sea between Sweden and Germany, 30 kilometres south of the Swedish city of Trelleborg.

Electricity for 400 000 homes

If the plans for the wind farm at Kriegers flak materialize, this would provide an annual energy boost of around 2.1 terawatt hours. This corresponds to the domestic electrical energy demand of around 400 000 homes. Assuming four persons per household, around 1.6 million persons will be supplied with their electricity from Kriegers flak.

Thirty kilometres out to sea

A wind farm always affects the landscape to a greater or lesser extent. The impression of size and dominance a wind farm makes is dependent on the individual's attitude to wind power, his or her relationship to the site, the nature of the landscape, and how far offshore the plant is located.

Viewed from the shore, some of the wind turbine towers at Kriegers flak would be below the horizon, since the wind turbines are located around 30 km from the shore. When viewed from the shore, a 160-metre high wind turbine is

If the wind farm at Kriegers flak is built, it will be located around 30 kilometres from the shore and will produce the domestic electricity demand for around 400 000 homes.

equivalent in size to a drawing-pin held at arm's length. Depending on the weather conditions, the farm will seldom be clearly visible from the coast. The authorities place strict conditions on the sound emitted by wind turbines. However, the sound from the Kriegers flak wind farm will never be heard ashore.

Why just Kreigers flak?

To achieve maximum possible output, a wind turbine must be sited in the right place, where the winds are strong and uniform and can generate a large amount of electrical energy. Such places are usually out at sea. Kreigers flak in the Baltic Sea is one of the areas that is considered to have the very best conditions for wind power generation.

A moderate depth of water is also important, so that it will not be unreasonably expensive to build the wind farm. The deeper the water, the more expensive the construction work. At Kreigers flak, the depth is between 17 and 40 metres.

How will the environment be affected?
All energy generation makes an impact on the environment in one way or another. The impact of a wind farm is greatest during the construction stage. Once in place, it is admittedly a new element in the environment, but is virtually free from environmentally harmful emissions.

Extensive studies of the influence of a wind power plant on the environment have been made for Kriegers flak. As an example, the effect of the plant on fish, birds, marine mammals and seabed flora has been studied.

The risk of changes to the sedimentation and flow conditions are also being explored. We are also examining the effect of sound and shadows that occur when the plant is in place.

Environmental studies before, during and after construction
All interests must be carefully weighed when a wind farm is being planned. Serious consideration must be given to the flora and fauna, leisure activities, the cultural environment, shipping and fisheries, and also to the residents.

We benefit from the experience gained from other offshore wind farms and the research studies carried out on site. In order to minimize the impact on the environment, we carry out environmental studies before, during and after the construction of the wind farm.

Birds
Studies have shown that birds normally evade offshore wind turbines, and extremely few sea birds collide with the wind turbines.

Birds have good vision, relatively good hearing and good navigation capabilities. When birds approach a wind farm, they usually change course and fly to one side of the farm. Overhead power lines and road traffic represent a greater threat to birds.

Marine flora and fauna
The work of excavating the sea bed for cable trenches and foundations temporarily makes the water turbid. This may lead to impaired growth of plants and animals. Research has shown that turbidity of the water usually has little effect and is of a short-lived nature. The water recovers quickly.

The sound and vibrations from working vessels and foundation work may frighten fish and mammals. But since the construction work is of limited duration, the consequences are considered to be modest. Part of the sea bed area

will be taken up by the foundations, which will deprive the animals there of their living environment. But the foundations of wind turbines have proved to become an artificial reef in which algae and invertebrates appear to do well.

The foundations are quickly colonized and create entire communities of marine life. Mussels on or in the vicinity of the wind turbine foundations may even do better from the nutrient viewpoint than mussels far from the wind turbines.

Shipping
Extensive studies have been made on the possible effect of the wind farm on the safety of shipping. Few ships ply the area at the present time. So the probability of a collision is very low. In order to reduce the risk further, the wind farm will be clearly marked out and will be provided with technical monitoring equipment.

Fisheries
The wind turbines and cables will cause difficulties to fishing by making it impossible to trawl, for instance. Net fishing may also be much more difficult.

In return, the area may become a protected reproduction area for fish. The fish population could increase in the longer term, which would benefit the fishing industry in the Baltic Sea.

Recycling
A wind turbine installation is expected to have a service life of 20 – 25 years. At the end of its useful life or when it is to be replaced, virtually all parts can be recovered. When the site is no longer used for wind power, it can be completely restored.

The environmental impact of decommissioning a wind farm is roughly the same as the impact caused when the farm is being built.

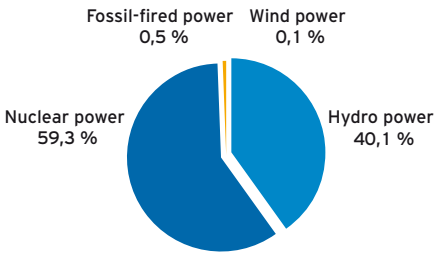
Beginning of construction in 2009?
If the wind farm meets the demands that Vattenfall makes on its projects and if the Vattenfall Board decides to build the wind farm at Kriegers flak, it will be completed in stages during the period between 2009 and 2013.

Wind has been used as a source of energy for thousands of years. Around 700 wind turbines are now in operation in Sweden, principally in the southern parts of the country, along the coasts and on the island of Gotland. Vattenfall owns 39 of these (in 2005), but intends to increase this proportion substantially in years to come. Development will progress from smaller groups of wind turbines ashore to large wind farms out at sea, since offshore wind turbines usually deliver much more power than their counterparts ashore.

Long term research into wind power
The construction of wind power plants in Sweden has so far been modest. This is largely due to our excellent availability of hydro power and nuclear power. Vattenfall has devoted almost 30 years to research and development of wind power. We now account for 7 percent of the total wind power generated in Sweden, and our turbines jointly produce 0.05 TWh annually. This corresponds to the electrical energy demand of roughly 10 000 homes during one year. But this proportion will increase substantially when the Lillgrund wind farm, which will be supplying domestic electric power to 60 000 homes, is taken into operation at the end of 2007. We are confident that wind power will be a good supplement to other power generation sources. So we are studying the possibilities of expanding this energy source further in years to come.

Renewable electricity should increase
To meet the electric power demand while also conserving the environment, power

generation from renewable sources should increase substantially in the immediate future. Swedish Parliament has therefore set a target based on an EU directive: By 2016, power generation from renewable energy sources should have increased by 17 TWh from the level in 2002. The increase corresponds to around 12 percent of the electrical energy consumption in Sweden. Vattenfall will play a leading role in this increase.



Power generation by Vattenfall in Sweden in 2005. Power generation from renewable energy sources will increase substantially in the immediate future. Vattenfall will play a leading role in this increase.

Wind power – the world´s most rapidly growing energy source

Wind power is the electricity generation source that worldwide is increasing at the highest percentage rate. In 2005 alone, production increased by more than 40 percent. Sweden is now in seventeenth place in the world in terms of wind power generation capacity. But this position will change in the near future.

Even though the proportion of wind power is increasing robustly, it will account for less than 2 percent of the world's total power generation in 2030.

FACTS:

- In Sweden, wind power accounts for 0.6% of the total electricity consumption
- In Denmark, wind power accounts for 18.5% of the total electricity consumption
- In Germany, wind power accounts for 6% of the total electricity consumption

National sites of interest for wind power

The Swedish Energy Agency has identified a number of areas that are particularly well suited for the construction of wind power plants, which are known as national sites of interest. These amount to a total of 49 areas in 13 counties. It would however be difficult to estimate how much wind power will actually be built in these areas. That depends among other things on factors such as the acceptance afforded to the project by the authorities and residents of the area.

Everyone will be paying
Vattenfall wind farms will be built on a commercial basis, with the same return on capital requirements as for other power generation plants. But it is expensive to build new power generation capacity, regardless of whether or not it is renewable. The Swedish Government has introduced a system of electricity certificates that are intended to favour expanded use of renewable energy sources. This means that all electricity consumers are paying a small surcharge per kilowatt hour, which is known as the electricity certificate charge. Since wind power is renewable, it is also entitled to financial support through the electricity certificate system. This enables wind power and other renewable electric power generation to compete with other power generation sources.

Sweden is well suited for wind power
The conditions for wind power in Sweden are good. Our country is in the "west wind belt", where the average wind velocities are higher than in many other countries. Wind power also fits well into our Swedish system in which nuclear power and hydro power account for base load generation. Hydro power serves very well as regulating power for taking up the shortfall whenever wind energy is insufficient.

More electricity from offshore wind power
Wind power outside our coasts – out at sea – has good opportunities for delivering more electricity and being competitive. The winds are often stronger and more uniform than they are ashore.

A wind farm out at sea is less disturbing to the residents and their leisure pursuits than it would be ashore. But an offshore wind power plant is costly to build today. The further out to sea it is located, the more expensive it is to build and connect to the grid ashore.

The offshore wind power technology is relatively new and is still in the course of development. But offshore wind farms are expected to be less expensive to build in the long term, in pace with growing knowledge and further development of the technology.

Free from emissions
Wind power will not replace nuclear power. The generation methods are totally different and are based on different conditions. On the other hand, wind power is a good supplement to hydro power and nuclear power. It offers a vital addition to our power generation system. Moreover, its operation is virtually free from environmentally harmful emissions.

www.vattenfall.se/kriegersflak

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