Wave Power

Vattenfall supports research and demonstration activities relating to new wave power concepts. The main reasons for this commitment are that wave power is renewable and is expected to become commercially viable in the foreseeable future.

However, thorough investigations of different concepts have to be undertaken in order to find the most promising alternatives. Further research is needed in areas such as base load properties, grid and system compatibility, legal matters, environmental impact and competitiveness. Despite the many challenges ahead, wave power has major potential around the world to become a cost-effective alternative with limited environmental impact.

Potential

Globally, the potential for wave energy is enormous and ranges from 6 000 to 15 000 TWh per year. In the EU countries alone, the annual potential along the European west coast is estimated to 2000 TWh. An important task is to estimate a realistic potential within the Vattenfall market. The gross wave energy potential in the Swedish part of the Baltic Sea is approximately 23 TWh, but 80% is found far offshore and outside Swedish territorial waters. The best conditions for wave energy extraction in Swedish waters are found off the west coast, where the area is open to the more energetic North Sea wave climate. The annual wave energy potential is estimated to be 30 TWh around the coasts of Sweden. Taking a wider perspective, the potential along the Scandinavian west coast is more than 500 TWh, where 90% originate from Norweigan waters. The practically extractable level might however be less than 10%.

From the Vattenfall market perspective, the localization of wave energy converters off the western coasts of Scandinavia provides the most interesting alternative, due to the presence of Atlantic and North Sea waves. These waves are highly energetic and the production pattern is assumed to be more predictable than, for example, wind power. This is due to the fact that waves/swell continue to reach the coast long after the wind has dropped, which is favourable from a system perspective.

Many different technologies

Many different wave energy devices are currently under development by companies and academic research groups around the world. So far, only a minor part of these concepts have been tested in full-scale sea trials, and only a few are likely to reach commercialization. Most of these concepts include structures that are placed on the surface, which also make them vulnerable to waves and they thus have to be over-dimensioned for the most extreme weather conditions.

Vattenfall is assessing the most interesting wave power generation devices in order to identify opportunities for demonstration activities and future business. One promising design concept, where buoys on the surface transmit the wave motion and energy to generators placed on the seabed, is currently being tested off the west coast of Sweden.

Point absorbers with linear generators

The combination of point absorbers (buoys) with linear generators is an innovative wave energy concept developed at Uppsala University. In contrast to the most mature concepts, this technique is designed to work also in more moderate wave climates such as along the Swedish coasts.

The concept involves surface following buoys and point absorbers connected to three-phase permanent magnetized linear generators placed on the seabed. The motions of the buoys drive pistons in the generators, converting the energy of the waves into electric energy.

The pilot project - Islandsberg

A pilot project, partly funded by Vattenfall, has been initiated by Uppsala University and tests have started on the west coast of Sweden. The test site is situated in Skagerrak, slightly more than 1 nautical mile or 2 km west of the light-house Islandsberg, in the municipality of Lysekil.

The project is expected to be fully equipped by 2009 and to remain in operation until 2014, when all the equipment must be removed. The permit enables the project to install a maximum of 10 units where the rated power of each generator is 10 kW. The generators will be placed on a sandy seabed, connected to each other by standard cables. The generated alternating current is rectified and transmitted on-shore, where it is again inverted and connected to the power network.

In order to evaluate a number of environmental and marine ecological aspects there will be up to 40 additional buoys within the project, but not connected to generators. This will make it possible to study the effects of single units as well as of larger arrays of buoys, and the micro fauna, fish and marine mammals in the area will also be studied. Special attention will be paid to biofouling, as the growth of mussels and barnacles, for example, might influence technical performance and maintenance but may enhance biodiversity.

In cooperation with Seabased AB, an innovation company connected to Uppsala University, Vattenfall is also performing a localization study aiming at constructing a minor wave power demonstration plant of approximately 100 kW.

Buoys and point absorbers connected to linear generators. *© O. Danielsson*

- Research and development forms an integral part of Vattenfall's efforts to achieve its vision of being a leading European energy company.
- We ensure that the systems we use today to generate and distribute electricity and heat are as efficient and safe as possible.
- We contribute to the development of the energy solutions of the future and ensure that they meet prevailing environmental, financial and acceptance demands.

Vattenfall AB, December 2007

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