

BEST-KEPT DUTCH SECRET

Seizing Energy from Water



At least 10% of the Dutch electricity demand can be met from water, according to the Inspiration Atlas 'Water as a source of renewable energy'. This is not widely known. In fact, this form of energy generation is one of the best-kept secrets in The Netherlands. The Directorate-General for Public Works and Water Management (Rijkswaterstaat) and Deltares are trying within the Rijkswaterstaat Water Innovation programme to show both government and industry the different options and offer them the opportunities to put their innovative solutions into practice.

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The Dutch Directorate-General for Public Works and Water Management (Rijkswaterstaat; acronym RWS) and Deltares, an institute for applied research and specialist advice, are the driving forces behind innovations in renewable energy generation from water in the Netherlands. They are collaborating on reconnaissance projects into the different options. Exploratory studies into innovative solutions and experiments are being carried out under the 'Energy from water' banner. They are, however, also going a step further. As keeper of the North Sea, Wadden Sea, south-western Delta, rivers and IJsselmeer (see Figure 2), RWS is perfectly placed to facilitate innovations with hydro power. New techniques that have proven successful as scale models in the laboratory are tested in practice with support from the Rijkswaterstaat Water Innovation programme (WINN).

Governmental Task

The Netherlands is now facing the task of actually starting to realise all the opportunities. Energy from water must be given a stimulus in the same way as was done for solar and wind energy. In the Netherlands, RWS has the social responsibility to help increase the proportion of green energy in total energy consumption. It has been set down in a governmental coalition agreement that 20% of energy must come from renewable sources by 2020. Through WINN, RWS is making its contribution for achieving this target. Another aim of WINN is to use energy from water for the operation of sluices, bridges and similar objects, and in this way enhance the robustness of these objects. What could be better than sluices being able to open and close, using energy they generate themselves by the water that flows through them?

Renewable Energy Serious Matter

The days of simply experimenting with scale models in laboratories and setting up demonstration projects are over. Energy from water is going to play an increasing role in Dutch renewable energy; as evidenced from the different pilots and business cases that are currently being set up. RWS can figuratively but, above all, also literally provide the scope for innovation, and can stimulate and facilitate it. Parties with renewable energy technologies are increasingly making grateful use of the different management areas of RWS. Deltares is currently taking location-specific looks at the impact pilot plants have on the surrounding area and where precisely what potential is available and how it can best be generated. From a national survey it emerged that no less than 10% of Dutch electrical energy can be generated from water.

Wave and Tidal Turbines in Practice

In the Western Scheldt, a pilot has been set up with Ecofys (Eneco Energy) Wave Rotor. These rotors generate energy from tidal flows and wash. In broad terms, this design corresponds to the principle of the Darrieus wind turbine, which has vertical blades that are vertically adjustable. The rotors have also had horizontal blades fitted; to exploit the vertical component of wave motion. In this way, the Wave Rotor generates energy from both the horizontal (tidal motion) and the vertical (wash) components of the energy present in the water.

Another pilot has been set up in the drainage sluice on the Afsluitdijk (Closure Dike), where a Tocardo turbine has been installed (Figure 3). A Tocardo is a wind turbine, connected by an arm, suspended in flowing water with its blades under water. The turning blades are connected directly to the generator that they drive. The blades turn in a free environment, which means that the design gives slightly lower performance. The Tocardos do have the advantage that they are easy to install without causing damage. With its central axis and bearings, the construction is simple and the system insensitive to bedload transport. The design of the Tocardo makes the best possible use of existing knowledge of ship's screws, propellers and wind turbine blades. The Tocardos can generate electricity during both ebb and flood tides.

At the same time, a business case is being prepared with Tocardos and Wave Rotors on the Eastern Scheldt Barrier. Here, we are trying to generate the energy that the barrier needs to function locally with the innovative techniques available. The aim is to implement the techniques that have been tested in the Western Scheldt and the Afsluitdijk on a semi-commercial scale.

Yet another innovation in the pilot phase is the WPI, a Norwegian technology, also designed along the same principle as the Darrieus turbine. The WPI has a rotating vertical axis, fixed to which are a number of (aircraft) wings placed vertically (see Figure 4). The turning motion of the WPI drives a generator. With some of the energy generated, the wings are set to an optimum position in relation to the water flow, while the turbine is rotating. Constantly seeking the perfect wing position increases performance significantly. With the WPI, the tip speed is 3.6 times the current speed. As a result, slow-running water can also provide substantial energy generation. The WINN programme is aiming for a pilot in 2010.

Osmotic Energy

Another way of generating energy from water is osmotic power. Using membrane technology, energy can be generated from salt and fresh water on the basis of reverse electrodialysis, or osmosis. Since the Netherlands as a river delta has many places at its disposal where sea and river water meet, this has huge potential. The WINN programme is searching out these opportunities. WINN supports the setting up of a test installation at Deltares and is discussing a pilot project with Wetsus in a salt factory. Besides this, WINN has set aside a pilot site for osmotic energy on the Afsluitdijk (see Figure 5).

Apart from osmotic energy, the Wave Rotor, WPI and Tocardo, there are other innovations and techniques that to a greater or lesser degree can meet the demand for renewable energy. However, they are still largely in their infancy. In the Netherlands, but also elsewhere, different parties are working hard on new techniques. Deltares recently carried out a technology scan to see what technologies and developments are available in this market, so not to waste any opportunity.

Combining Techniques

Deltares and the WINN programme are especially interested in innovations that 'kill two birds with one stone'. Energy from breaker waves, for example. The question here is: how can energy be generated from breaker waves and at the same time ensuring that dikes, beaches or dunes are not damaged or are damaged less? If there is a method that works, they will gladly give it support. Likewise, the technique for generating energy from waves beating against canal banks after vessels have passed by. When this wash is carefully intercepted or absorbed, it makes for better navigability of the canal or for a more stable trim of vessels in port. This method of energy generation may not be profitable, but the combination of goals may make it interesting. Innovation is also about combining cleverly.

Big Step

The RWS is happy to help entrepreneurs with innovative concepts that are not yet fully developed. The authors have experienced that the step from making experimental ideas actual pilot projects seems a very large one and that many factors come into play in this regard, such as water management and landscape integration, as well as the impact on nature and environment, and the nuisance that may be caused to other parties. Realising innovations is a complex process in which communication and support are essential. However, it is clear that we simply cannot allow ourselves to waste opportunities to generate energy from water?

Acknowledgement

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Further Reading

Deltares, 2008. The Inspiration Atlas 'Water as a source of renewable energy'. 52 pp.

<https://www.hydro-international.com/content/article/seizing-energy-from-water>
