Andel and Stiesdal join forces on large-scale energy storage

The energy and fibre-optic group Andel invests DKK 75m (EUR 10m) in Stiesdal Storage Technologies. The ambition is to take pumped thermal electricity storage to a new level.

April 20, 2021. The green transition is well under way, and increasingly larger energy volumes are produced from renewable energy sources such as wind and solar. Many expect that in just 10 years our electricity will be fully based on renewable energy sources. But when the sun does not shine, the wind does not blow and the traditional power plants are no longer in operation, what do we do, then? That is one of the great challenges in the green transition and to this end, pumped thermal electricity storage is a strong option.

Electricity from hot stones

The potential of storing energy in stones has been documented in two Danish innovation projects performed at DTU Risø by Andel and Stiesdal Storage Technologies, respectively. In both projects, electricity is stored as heat in stones – and the heat can then be used to produce electricity when needed.

Through the projects at Risø the level of knowledge on large-scale storage was elevated from an idea into something that is realistic and technically feasible. Andel has been looking for a strong industrial partner for the further development, and its CEO Jesper Hjulmand is very pleased with the partnership with Stiesdal Storage Technologies:

“I am very much looking forward to starting a close collaboration with Henrik Stiesdal and his colleagues. Henrik is a pioneer who has taken part in the green transition since 1976, and his company represents a very special technological competence. We must now jointly complete a prototype, which can subsequently be tested and displayed. It is a strategic match for Andel that we strengthen our focus on energy storage. That is the way forward if we want to achieve full integration of renewable energy and the electrification of society”, says Jesper Hjulmand.

Commercial solution on the way

Henrik Stiesdal has worked on energy storage since 2010 and is also looking forward to the partnership:

”The only really big challenge to an electricity supply that is 100% green is that we cannot store the electricity from the time when the wind blows and the sun shines until its subsequent use. Production and consumption are simply not in balance. So far, there are no commercial solutions to this problem; but we hope to be able to provide that with our ”GridScale” energy storage system, and we are extremely pleased to have included Andel as a strategic partner in the project. Technological development and sophisticated equipment are not enough, we also need collaboration with an experienced operator that has extensive knowledge about the electricity grid and can make production, storage and consumption interact in practice. On this, Andel is a strong and ambitious partner, which can test the technology and perform large-scale rollout”, says Henrik Stiesdal.

The energy storage reservoir that the partners are working on comprises crushed stones the size of peas stored in insulated steel tanks. When there is excess supply of electricity in the electricity grid, the storage is charged using a specially designed heat pump system which moves heat energy from one set of tanks to another. The stones get colder in the tanks from which the energy is taken, while they get a lot hotter in the tanks that receive the heat, up to a temperature of approx. 600 degrees C. The heat can be stored in the stones for many days, and when electricity is needed in the grid the

heat energy is returned from the hot tanks to the cold tanks using a kind of gas turbine which produces the electricity. This is a highly efficient solution due to a low loss of energy. The size of the storage facility can be scaled up simply by adding more tanks containing stones.

Inexpensive and efficient
Ole Alm, Head of Development at Andel and responsible for the company's work on energy storage has big expectations for the new storage facility:

"Stone is an inexpensive and sustainable material, which can store large volumes of energy taking up only a little space, and it can withstand innumerable rounds of charging and discharging of the storage. We know this from our tests at the Risø facility. We must now create units that are flexible and relatively easy to handle. They can be placed at solar farms and offshore wind farms, at substations and industrial facilities, and perhaps on the future wind energy islands. For this, we need an industrial partner like Stiesdal Storage Technologies so that together we can create functional large-scale solutions".

Peder Riis Nickelsen, CEO of Stiesdal Storage Technologies is looking forward to the next step in the project:

"Commercially sustainable storage of large volumes of energy requires a very inexpensive storage medium and that the supplementary equipment can be mass produced. Our "GridScale" technology fulfils both of these criteria. The cost of crushed stone is at a totally different level per unit of energy than practically any other material for energy storage. Besides, our charging and discharging system can utilise well-known technologies that have been applied for a century within other industries and are is well-suited for mass production. Thus, we see great opportunities in the concept, both in Denmark and particularly in the export markets".

It has not yet been finally decided where the first prototype storage facility should be placed and tested. However, it is certain that it will be on South or West Zealand or on Lolland-Falster, where in particular the production from new large solar power facilities is increasing without being matched by consumption. Thus, the energy produced must be able to be stored or transported to avoid bottlenecks in the electricity grid, which lead to production stops from renewable energy sources.

Additional support from the Danish Energy Agency
To further accelerate the development, a consortium of eight Danish project partners has been granted a subsidy from the Energy Technology Development and Demonstration Program (EUDP) under the Danish Energy Agency.

The innovation project, *GridScale – a Cost-effective Large-scale Power to Power Storage*, spans three years and has a budget of DKK 35 million. In addition to Stiesdal and Andel, the partnership includes Aarhus University (AU), the Technical University of Denmark (DTU), Welcon, BWSC, Energi Danmark and Energy Cluster Denmark. The partners are to produce an energy system analysis and a design optimisation of the hot stone storage facility.

Among other things, the partners will combine the model for the European energy system developed by Aarhus University with DTU's model for optimisation of gas turbines to gain insight into the potential role of hot stone energy storage in a European context and also to optimise an ideal design:

"The objective is to establish how hot stone energy storage can best help Denmark's and Europe's green transition. The ambition is to have an alternative ready for implementation on wind energy islands and

many other locations with the need for storage of renewable energy", says CEO Glenda Napier, Energy Cluster Denmark.

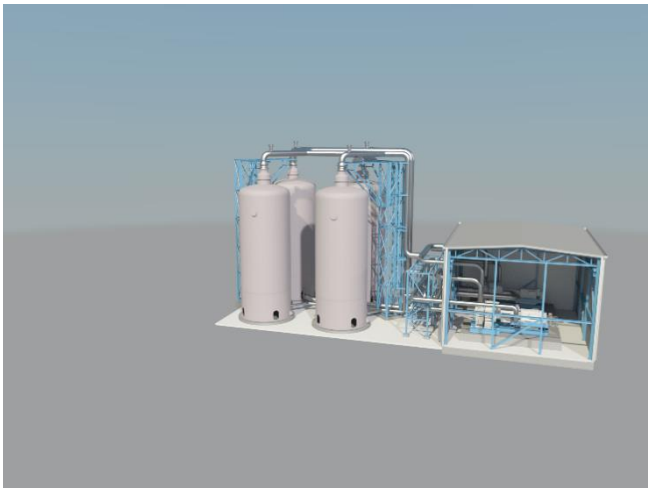
FACTS ABOUT ANDEL'S RISØ PROJECT

During a period from 2016 through 2019, Andel, in a collaboration with DTU, AU, Energinet, Rockwool, Dansk Energi and the EUDP, completed a hot stone storage project. The objective of the project was to study whether it would be possible, using known technology, to build a high-temperature energy storage facility filled with stones, which could store electricity inexpensively from days with excess energy and use this energy in days with a shortage of energy. Furthermore, the project was to illustrate the role of a storage facility in the energy system and the commercial spin-off potential.

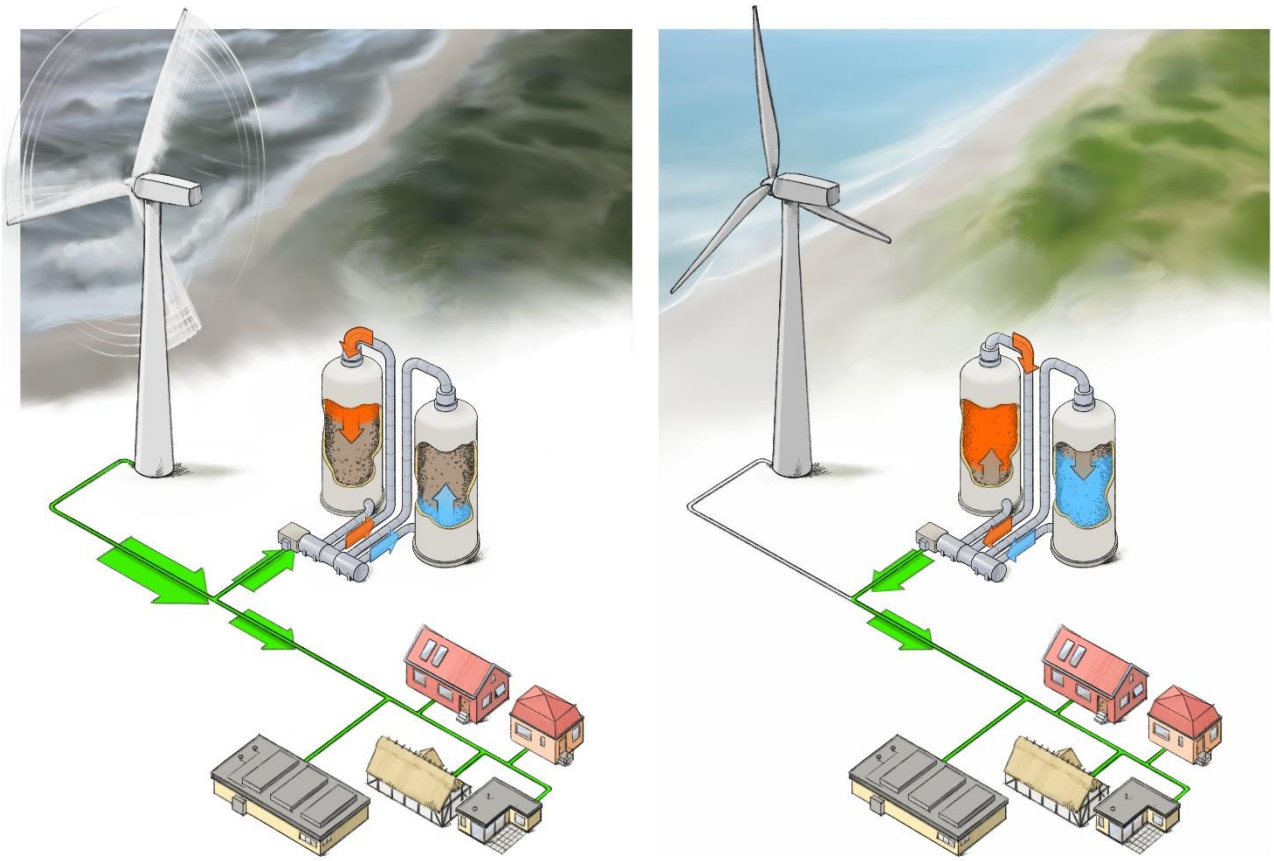
The project confirmed that stones can withstand repeated heating, that it is possible to re-extract the energy from the storage at a constant temperature, and that a large-scale storage facility can contribute to the solution of challenges in the electricity system.

FACTS ABOUT STIESDAL STORAGE TECHNOLOGIES' RISØ PROJECT

During a period from 2018 through 2020 Stiesdal Storage Technologies in a collaboration with DTU, AAU, Welcon, Frecon, Blue Power Partners and Energy Cluster Denmark completed a project supported by the European Regional Development Fund. The objective of the project was to verify the models for storage of hot stones in a test facility with a 1:10 scale steel tank. The project demonstrated that the heat can be transferred from air to stones as theoretically calculated, even having a smaller drop of pressure than expected.



The GridScale energy storage consists of one or more sets of steel tanks filled with crushed stone. Charging and discharging is done with a system of compressors and turbines. The number of tank sets with stone filling can be varied, depending on the desired storage duration.



When there is a surplus of electricity from wind or solar, the energy storage is charged. This is done by a system of compressors and turbines pumping heat energy from one or more storage tanks filled with cool stones to a corresponding number of storage tanks filled with hot stones. This makes the stones in the cold tanks very cold, while it gets very hot in the hot tanks, up to 600 degrees. The heat can be stored in the stones for many days. When the power is needed again, the process runs the opposite way, so that the stones in the hot tanks get colder, while they get hotter in the cold tanks. Illustration: Stiesdal Storage Technologies.