

Ballen Marina tests intelligent power grid

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The largest marina on the Danish island Samsø has been selected as test marina in a pioneer European project aimed at helping island communities with limited power grids to increase the use of sustainable energy. The project is named SMILE (SMart Islands Energy Systems), and the aim is to test, over the course of 2019, how Ballen Marina may be energy-optimized by storing and managing energy from solar power cells.

In 1997, Samsø was singled out by the Danish government as a role model for communities based on sustainable energy. Today, the island is CO2 neutral due to solar power cells, wind turbines and biomass. The island produces so much power that they export part of their power production to the mainland. The vision is to be fossil-fuel free by 2030.

Power consumption off the charts in July

Samsø is also a popular holiday island, and the power

demand fluctuates according to peak or low seasons. The town of Ballen is the major holiday town on Samsø and offers a wealth of restaurants, clothes stores, shopping opportunities and cosy local places. During peak season, many venture from all over the island to Ballen Marina, the island's largest marina with 10,000 visiting yachtsmen a year. Peak season thus means large demands on the marina's power grid, culminating in week 29 in mid-July during the music festival Samsø Festivalen.

"We have a critical period of around six weeks during peak season where we may experience bottlenecks in the marina's power supply. It is a very positive thing for us to have been selected for the SMILE project, because this is a prime opportunity for us to test how we may energy-optimize the marina and hopefully be an inspiration to others who also consider using green energy," says Frederik Bilsted Pedersen, head of department of Samsø Marinas and ferry service.



The steel cubicle housing the large battery arrives.



"It is a very good opportunity for us to test how we may energy-optimize the marina"

Frederik Bilsted Pedersen, harbour master at Samsø Marinas

Power source of choice: Solar energy

Among the project partners is Samsø Energy Academy, located around 300 meters north of the marina.

"In the current setup, there is a single power line supplying the marina," explains Jan Jantzen, project manager at Samsø Energy Academy. He adds:

"In order to meet the power demand during busy periods, one possible choice was to invest in a larger electrical line and increase the power supply that way.

We also considered placing a wind turbine on the marina, but we figured that would be unpopular at a marina. Instead, we decided to install solar power cells at the marina. Today, we have solar power cells on the roof of the harbour office, on the south railing along the pier, on the toilet building and on the small red storage house at the end of the pier."

Gigantic battery with 240 kWh

The small red storage house is in fact the steel cubicle that houses the battery. The walls have been reinforced to optimize fire resistance, and an inverter transforms the solar power into alternating current. A ventilation system and a heat pump ensure a room temperature suitable for the battery.

Over time, Ballen Marina intends to fit out the storage house as an interpretive centre with an exciting story on sustainable energy for both children and adults. However, this is beyond the current budget, and the marina is in the process of applying for further funding.



Facts on the battery

- The aim of the battery system at Ballen Marina is to ensure stable power supply based on sustainable energy.
- The battery stores energy for later use – in this way, yachtsmen can make use of solar power even after sunset.
- The battery has a capacity of 240 kWh, the inverter 50 kW.
- The marina uses a solar power cell facility at 60 kW as the battery's power supply.
- The battery takes up as much space as three large refrigerators. They are placed in a steel cubicle on the marina, and its steel frame structure enables transportation of the cubicle.
- The cubicle is placed inside a red storage house built in a maritime style.
- The cubicle takes up an area of 8 m² and measures 2.3 m from floor to ceiling.
- The battery arrived in December 2018 and was supplied by the project partner Lithium Balance.
- The EU project SMILE has donated the battery and 200 power sockets, total value DKK 1,5 mio. Samsø Municipality has invested the same amount.



Harbour master Frederik Bilsted Pedersen and the big batteries in the cabin. Altogether 240 Kwh. From the outside they look like tree big refrigerators.



Hands well placed in the pockets, this is how the battery looks like from the inside.

"The marina's Smart Grid enables monitoring load on the grid, which in turn enables the harbour to manage current distribution.

Jan Jantzen, project manager, Samsø Energy Academy.

Smart Grid = intelligent power grid

Increased phase-in of sustainable energy places great demands on power grid flexibility and power management. As such, the project involves Ballen Marina installing an intelligent power grid.

This intelligent power grid is known as a Smart Grid system. This system is capable of balancing power production and consumption management.

"We have installed a grid in which the energy source (solar power cells) is connected to the storage facilities (batteries).

The harbour master can control the circuit through software (an app). In this way, the marina is much less vulnerable to power shortage, and we will be able to utilize the fluctuations in power production that are a natural consequence of using solar power," says Jan Jantzen.

The marina's Smart Grid enables monitoring load on the grid, which in turn enables the harbour to manage current distribution. This is done by turning on and off for instance the sauna, the sanitary pump, the circulating pump in the service building etc.

"We expect that the battery is fully charged around 4-5 PM. This allows us to postpone tasks that require a lot of power until the end of the day. We could for instance turn

on our sanitary pump during the night. This way, the battery will be empty of power in the morning and ready for another day's charging. This benefits the environment, but it also benefits marina operations," says Jan Jantzen.

Power meters on 300 sockets

It takes a lot of work to prepare the marina for the new power grid. The marina has increased the number of power stations on the jetties, and new sockets have been installed in both the new and old stations.

New fuses have been installed in 300 sockets, so that they now run at 16 amperes instead of 6 amperes. With 16 amperes, the harbour tries to avoid bottlenecks and provide yachtsmen with more power. In addition, all sockets are now equipped with their own power meter.

"We measure the extend of no-load consumption, and we measure accurately how much power each boat consumes.

After the test period we will be able to see whether there is a pattern to the visiting yachtsmen's power consumption," says Frederik Bilsted Pedersen.

In cooperation with the Danish Technological Institute, who oversee safety, the test may contribute to providing a lot of best-practice experience on how the marina may plan and predict power consumption to an even higher degree in the future.





Green power – payment by consumption

When visiting yachtsmen berth at Ballen Marina, all they need to do is plug in the way they usually do. But from April 1, power will not be available until the harbour fees have been paid. Payment is done through an app.

Until now, yachtsmen have paid for electricity through a fixed additional charge of DKK 10 on top of the harbour fees. In the future, payment will follow consumption, and later, when the marina has tested the new power grid, a decision will be made on whether the price of electricity should fluctuate over the course of the day and reflect the power supply at any given time. The latter will, however, be subject to a trial, says Frederik Bilsted Pedersen: "At the moment, we think that this differentiated payment model has positive and green perspectives with regards to those yachtsmen who wish to make an extra effort to

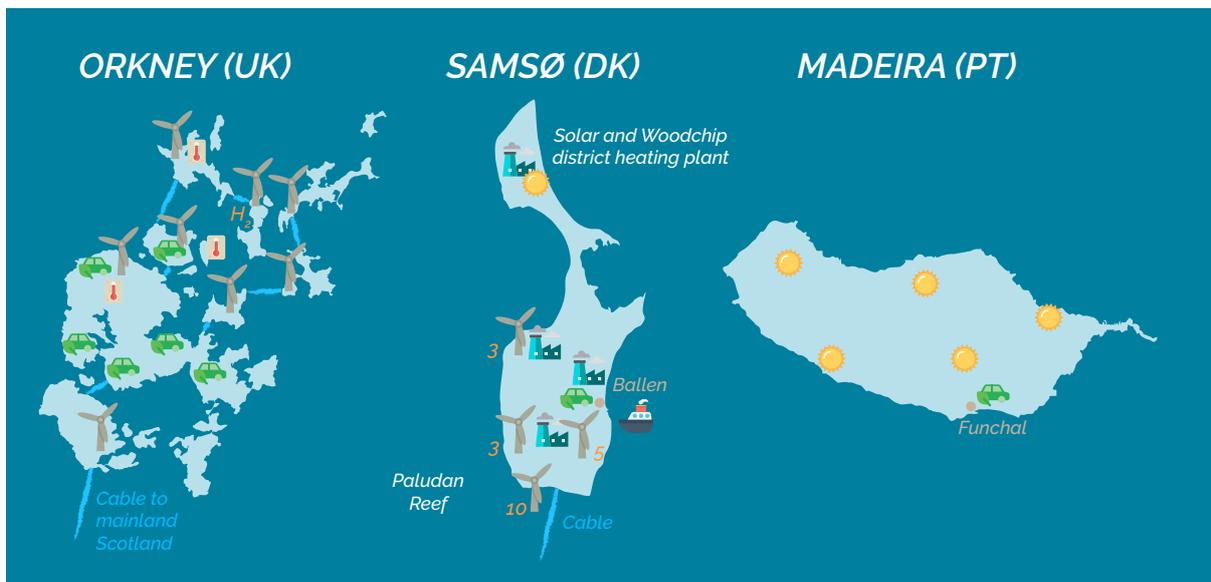
help us run a marina that takes the environment into consideration. For the yachtsmen, this requires pausing to think about when you make use of the service facilities or whether charging the battery can wait until later," says Frederik Bilsted Pedersen, who believes that this is just the beginning of working with sustainable energy in marinas.

Perspectives for Samsø

The plan is to implement Smart Grid and intelligent power grids in several places on Samsø. Ballen Marina is the first place on the island where the system is tested.

In addition, Samsø wants to reduce the island's heating demand through heat pumps and is working on a conversion of transport on the island to electricity and biomass, both in terms of inland transport and in terms of the ferry service ♦

Three islands are tested



Smart Islands Energy system

The SMILE project has received a grant of DKK 82 million and works to establish nine Smart-Grid technologies on three European islands: Samsø, Orkney and Madeira. Each island has its particular challenge and as such will get different test systems installed. Ballen Marina is the only place where an intelligent power grid is tested at a marina, and experiences from the project may be adapted by other Danish and European marinas without any restrictions.

Denmark participates in the project with a number of partners, including Ballen Marina, Samsø Municipality, Samsø Elektro, Samsø Energy Academy, Danish Technological Institute, Aalborg University and Danish manufacturer of energy storage systems, Lithium Balance.



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