



Oil & Energy



HYDRO

Utsira wind power and hydrogen plant

Inauguration

July 1, 2004





The electrolyser

An electrolyser is a device that produces hydrogen and oxygen by splitting water molecules by means of electricity. The gases are produced when an electric current flows from an anode to a cathode through water mixed with lye (electrolyte). The electrolyte is used to optimize electrical conductivity.

Hydrogen power production

Power is produced from hydrogen by a 10 kW fuel cell and a 55 kW hydrogen combustion generator. The fuel cell produces power through a chemical reaction: energy is released from the hydrogen when it reacts with the oxygen in the air.

Hydrogen storage

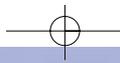
The hydrogen produced by the electrolyser is compressed and stored in a container that can hold up to 2400 Nm³ (normal cubic meters) of hydrogen gas. This is sufficient for two full days of energy supply to the households in the autonomous system.

Grid stabilization

This unit contains a flywheel with a storage capacity of 5 kWh. It helps to maintain a stable power supply from the plant to the grid, in combination with the additional grid stabilizing equipment.

Wind turbines

The wind turbines from Enercon each provide a maximum of 600 kW. At optimum performance, this is more than enough energy to supply the entire Utsira community. The turbine tower rises 46 metres above the ground, and the blades on the rotor have a diameter of 40 metres. The wind turbines operate at wind speeds in the range of 2.5-25 metres/second. From 25 m/s, the output power declines to 34 m/s, when the windmills shut down automatically.



Utsira is a small island community with some 220 inhabitants, located approximately 18 kilometres off the west coast of Norway.

Facts about Hydro and the project at Utsira

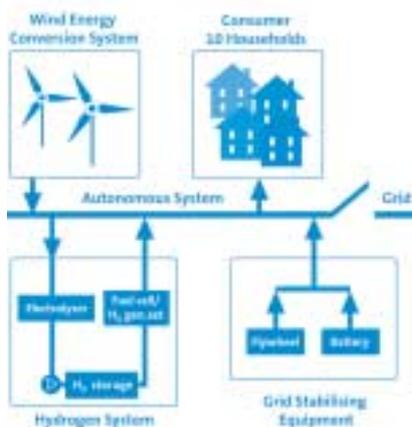
Hydro is the second largest power producer in Norway, with an annual normal production of 9 TWh. All our energy is renewable and most is produced at around 20 hydroelectric power plants.

Project partner is the German Wind turbine producer Enercon and we have received valuable support from Norwegian public funding.

The project

Hydro's project at Utsira is the world's first full-scale autonomous, renewable energy supply system based on wind power and hydrogen. The purpose of the project is to demonstrate how renewable energy can provide a safe and efficient energy supply to remote areas where there is a plentiful source of renewable energy and/or insufficient infrastructure.

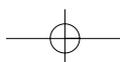
The autonomous system includes 10 households, whose entire energy demand will be exclusively provided by renewable sources. In combination, wind power and hydrogen will be able to provide a continuous and viable supply of energy to the community.



Basic principles

At Utsira, wind power alone would not be sufficient. The island can be ravaged by violent storms, but at other times there may be no wind at all. Wind turbines cannot run in either of these circumstances. Besides, demand varies. Hydrogen, however, provides excellent chemical energy storage, and can be used to store the energy produced by the wind turbines, thus ensuring a sustainable energy system:

1. When the wind turbines at Utsira are running at optimum level, they will produce more energy than the community needs. The surplus energy can be used to produce hydrogen through water electrolysis. Additional surplus energy will be sold in the market. One wind turbine will produce solely for the market.
2. The hydrogen produced will be compressed and stored in a gas storage vessel and will be available when needed.
3. Under circumstances when the wind turbines are not in operation – i.e. when there is too little or too much wind - the hydrogen can be used in a fuel cell and a hydrogen generator to produce power.





Hydro creates a more viable society by developing natural resources and products in innovative and efficient ways.

Healthy societies depend upon source businesses to provide products like energy and aluminium that fuel progress and drive solutions for fundamental needs such as power, fuel and transportation.

Hydro is a Fortune 500 energy and aluminium supplier operating in more than 40 countries. We are a leading offshore producer of oil and gas and the world's third-largest aluminium supplier. Our 36,000 employees create value by strengthening the viability of the customers and communities we serve. To learn more our business and our commitment to creating a viable society, visit www.hydro.com.

Utsira project facts

MAIN COMPONENTS

Wind turbines
Flywheel
Master Synchronous Machine
Hydrogen engine
Fuel cell
Electrolyser
Hydrogen storage capacity
Project management

Milestones

TECHNICAL PARAMETERS

2x600 kW
5 kW
100 kVA
55 kW (top load)
10 kW
10 Nm³/h, 48 kW
2400 Nm³

Supplier

Enercon
Enercon
Enercon
Continental
IRD
Hydro
Hydro
Hydro

Start of pre-project
License to operate energy plant
Signing of main contracts
Site construction start-up
Wind turbines commissioned
Implementation - H2 generation set
Stand alone system ready for demo phase
Implementation of fuel cell
Inauguration

January 2002
April 2003
April 2003
June 2003
September 2003
Winter 2004
Spring 2004
Summer 2004
Summer 2004

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