Utsira – demonstrating the hydrogen society on renewable terms

Senior Vice President Knut Harg

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Utsira

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Oil & Energy

- 2 nd largest offshore operator on Norwegian Continental Shelf
- Strong production growth through 2007
- Strengthening our international oil and gas position
- Operating the Ormen Lange field development – the world's most challenging gas field at 850 –1100 m below sea
- Energy provider to the European market: oil, gas and power

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Aluminium

- One of three leading integrated global aluminium companies
- Strong market position – broad product range: Automotive, Packaging, Building and Litho
- Production of 1.47 million tonnes primary metal and developing next-generation primary capacity
- Supplied market with 3.3 million tonnes of aluminium, including 1.2 million tonnes remelted and recycled metal
- 27 000 employees and turnover of NOK 69 billion

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Hydro's involvement in new energy

Tradition

Present

Future

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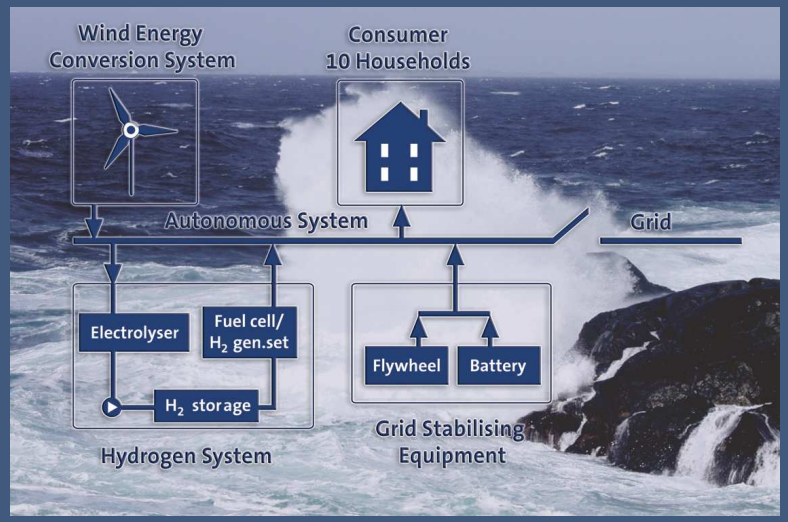
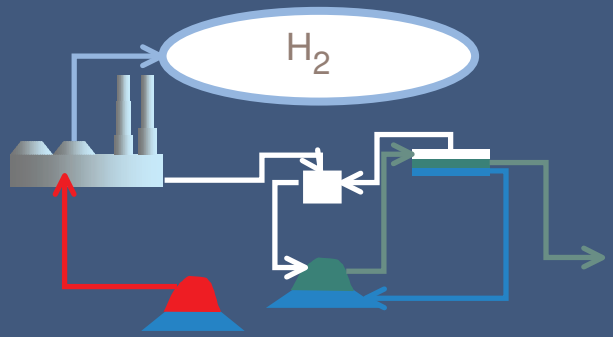
Hydrogen as energy carrier – Hydro priorities

Complete hydrogen solutions with local H_2 production for the transport sector



Hydrogen in renewable energy systems



Future large scale hydrogen production from natural gas with CO_2 handling

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Hydrogen solutions for Europe

Complete hydrogen fuelling stations from Hydro

- The ECTOS-project in Reykjavik

- CUTE – a pan-European demonstration project of hydrogen for transportation in 10 cities

- CEP Berlin – Clean Energy Partnership comprises 10 international companies Hydro delivers gaseous hydrogen to 13 of 16 vehicles at a public station

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The demonstration project at Utsira

Full scale energy supply with renewable energy in remote areas

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The world's first full scale wind – hydrogen plant

- **Purpose:** Demonstrate how renewable energy can provide safe and efficient energy supply to isolated areas
- **Goals:** Full scale demonstration and testing of a wind - hydrogen energy system
- **Partners:** Hydro and Enercon, Norwegian Authorities
- **Perspective**: Test of system for two years

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Main focus in demonstration project

- Ensure that the installed components in the system work together
- Deliver power to the customers at the expected quality
- Cost reductions and optimization of technical solutions
- Commercialization and marketing

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The wind – hydrogen plant at Utsira

A vision becoming reality

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Main components

Wind turbines	2 * 600 kW
Hydrogen engine	55 kW
Fuel cell	10 kW
Electrolyser	10 Nm^3/h, 48 kW
Compressor	5,5 kW
Hydrogen storage capacity	2400 Nm^3, 200 bar
Flywheel	5 kWh
Battery	50 kWh
Master Synchronous Machine	100 kVA

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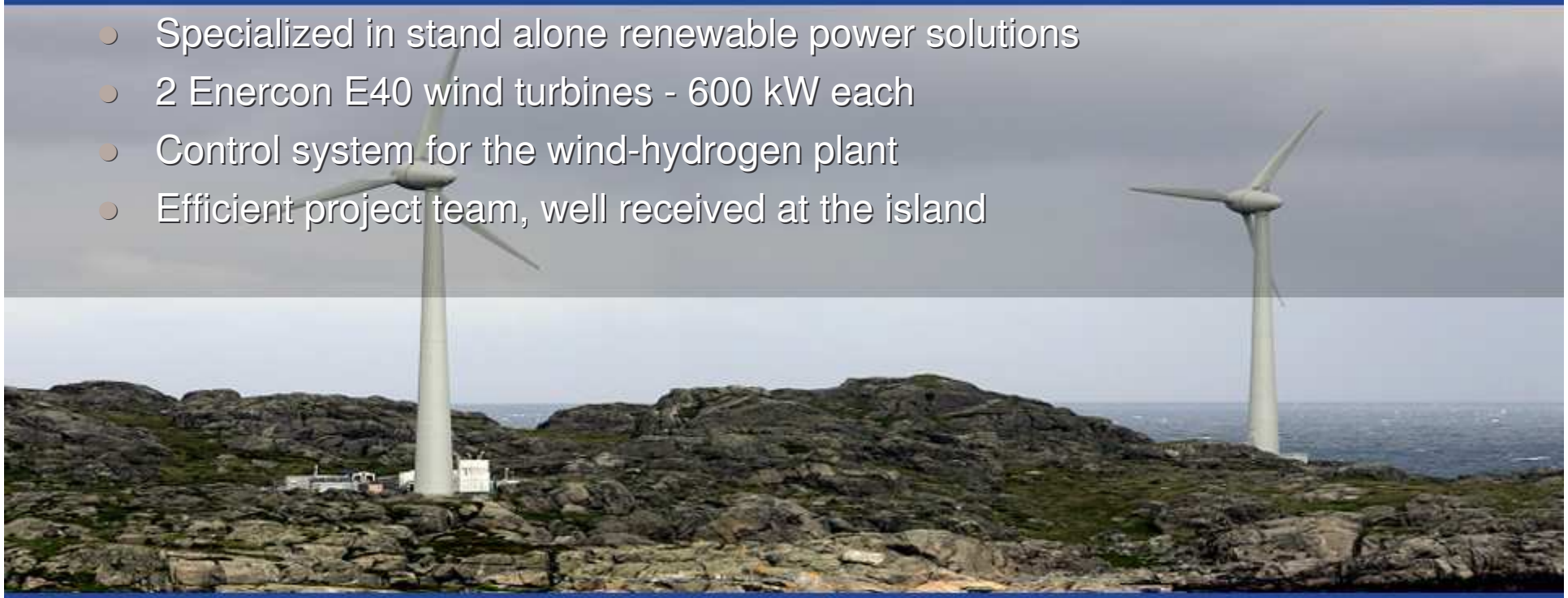
Project partner: Enercon

- Specialized in stand alone renewable power solutions
- 2 Enercon E40 wind turbines - 600 kW each
- Control system for the wind-hydrogen plant
- Efficient project team, well received at the island



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Electrolyser with remote control features

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Remote control of entire plant from Power Plant Operations Centre

Continuous control (24 hours x 365 days)

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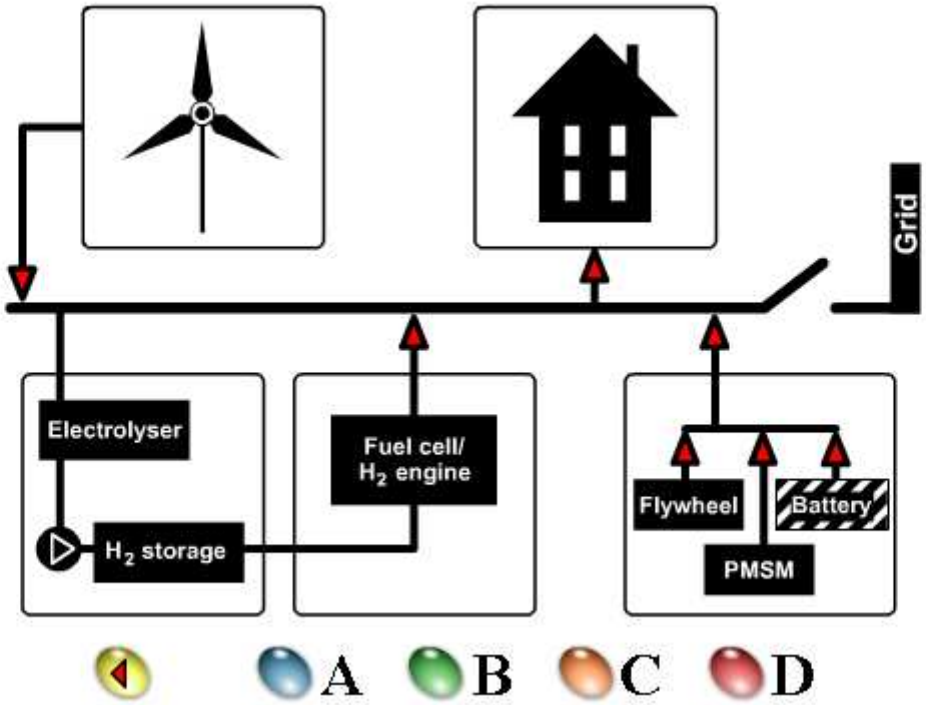
Utsira – How it works



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Project Plan – Milestones

Decision	April – 2003
Site construction start up	June – 2003
Wind turbines in operation	September – 2003
Electrolyser and H_2 gen.set commissioned	winter – 2004
Inauguration	July – 2004
Stand alone system in operation	November – 2004

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Lessons learned

- Remote location complicates project execution and challenges project costs
- Early and well defined operational philosophy prior to design basis
- Early and well defined design basis on equipment and systems
- Continuous dialogue with local community necessary

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Market opportunities for renewable systems

- Remote areas and areas without steady power supply
- Support systems for renewable power systems
- Power generation for remote systems like weather stations and cellular phone systems

… so what is next?

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What is needed in the future?

- Improved electrolysers
  - Reliable, flexible high pressure electrolysers
  - Wide capacity range
- Improved fuel cells
  - Reliable, proven systems
- Suppliers of integrated systems
  - Remote control, stand-alone
  - Integrated systems
  - Competitive with diesel generators

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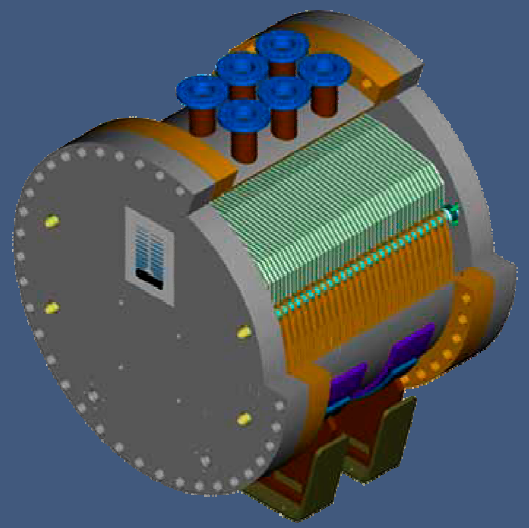
High performance electrolysers: Small footprint, higher efficiency



Gesellschaft für Hochleistungs-electrolyseure zur Wasserstofferzeugung

Norsk Hydro Electrolysers AS	50 %
MTU, Friedriechshafen	50 %

Targets for New Generation:

Current density	: 8 - 10 kA/m^2
Energy consumption	: 4,1 kWh/Nm^3 @ 8 kA/m^2
Operating pressure	: 30 bar g
Operating temperature	: 80 °C
Active area	: 2 m^2
Max. no cells in one stack	: 70
Max. prod. capacity	: 460 - 574 Nm^3/h
Operational range	: 10 - 100 %
Foot print	: 2,5 x 2,3 x 3,0 m

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Watch out for **Inergon!**

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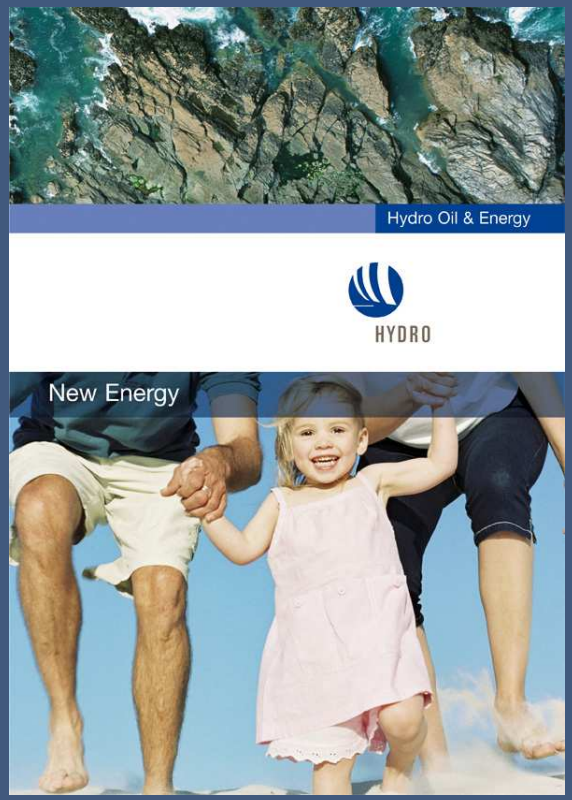

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