

NORWAY

Trygve U. Riis

The Research Council of Norway

INTRODUCTION AND BACKGROUND

Norway is in a unique energy situation compared to most other countries. Being a highly developed industrial country, we produce 10 times as much energy products as we consume. Almost 95% of the produced energy is oil and gas, for the world, and particularly the European market. In addition to the fossil energy, Norway has a production capacity for electricity from hydropower comparable to the domestic consumption. In addition to hydro power, around 1 TWh wind energy, and 3-4 TWh gas fired power is produced in Norway. Due to the high share of hydro power, the actual production varies from year to year, and the variations can be as high as 30-35TWh. With a number of cables to Sweden, Denmark, and the Netherlands, Norway is exporting surplus energy in wet years and import in dry years. Due to the high number of water dams in the Norwegian system, we also have an important role as swing producers in balance with the mainly thermal-based power system in Europe and the increasing production of intermittent wind energy in Germany, Denmark, etc. In total, the Norwegian energy consumption is about 60% based on renewable energy. Due to EU regulations, and as a consequence of the renewable energy certificate system with Sweden, the rate of renewable is expected to increase in the coming years, and Norway is expected to become to a larger extent a net exporter of electricity as well.

UPDATE ON MEMBER'S ENERGY FRAMEWORK

UPDATE ON RELEVANT POLICIES

A political agreement on the climate policy was decided on in 2008, and a white paper from the government will be issued in the near future. The climate agreement included a substantial increase in R&D spending for renewable energy and clean energy technologies.

UPDATE OVERVIEW ON RELEVANT PROGRAMS AND PROJECTS

There is no specific hydrogen and fuel cells program in Norway. The R&D activities are mainly supported under the large RENERGI program, covering renewable energy, energy efficiency, and other clean energy topics, all topics except carbon capture and storage (CCS), where there is a dedicated R&D&D program in Norway. The RENERGI program period is soon coming to an end, and a new program is under development. The structure and content will be the same, but a new program plan with a revised strategy is under development. Hydrogen and fuel cells will still be part of the program.

Transnova was established in 2009 and is a Norwegian government organization dedicated to promotion of climate friendly transport. Transnova supports demonstration activities in Norway that contribute to reduced greenhouse gas emissions by replacing fossil fuels with clean or renewable fuels, by reducing transport volumes and by moving goods and passengers from lorries and private cars to more efficient modes of transport. In 2012, Transnova has a budget of 70 million Norwegian kroner, (US\$12 million) and has the first three years of its existence spent around US\$8 million on hydrogen related projects – representing around 25 percent of our budgets.

VITAL STATISTICS

Non-EU Member state

Population

4 985 900 (01.01.2012)

Territory

323 802 km²

Capital

Oslo

GDP/capita

547 268 NOK

Average Annual GDP Growth
(10.7% (2010))

Primary Energy Structure (2010)

Production

Total production	2 437 TWh
Coal:	15
Fuel wood	12
Crude oil	1 049
Gasoline, liquid gas	138
Natural Gas	1099
Waterfall	125
Wind	1

Renewable energy share of total
energy consumption: 60% (2010)

Consumption

Total consumption: 247 TWh

Coal:	7
Petroleum products	80
Natural gas	7
Electricity	132
Wood	12
District heating	4



HYDROGEN R,D&D SPECIFICS

PROGRAMS, PROJECTS, INITIATIVES IN BRIEF

HyNor Project



The HyNor project, a joint public-private partnership initiated to demonstrate a real-life implementation of a hydrogen refuelling infrastructure, continued in 2011, but with a focus on a denser network in the Oslo-region, rather than a “hydrogen highway,” which was the motivation at the start of the project. In 2011, one hydrogen refueling station was added to the network, and one was closed down, leaving the number of operating stations by the end of the year at four. The station which closed its operation is the station in Stavanger, and the new station is part of the H2-Moves Scandinavia project, which is a European lighthouse project under the FCH JU (Fuel Cells and Hydrogen Joint Undertaking). The project involves a state of the art filling station in Oslo, which will provide the 19 FCEVs (fuel cell

electric vehicles) in the project with hydrogen, and a mobile refueller which will be used for a European road tour. The vehicles are 10 Mercedes Benz B-class F-CELL, 5 Think city electric vehicles with a hydrogen fuel cell system as range extender, and 4 Hyundai ix35 fuel cell vehicles. The filling stations in operation use hydrogen from different resources and demonstrate various technologies for production and supply of hydrogen. Two additional stations will be opened in 2012: one in Lillestrøm, 25 kilometers north of Oslo; and one hydrogen bus station in the city of Oslo.

The bus station is part of the HyNor Oslo bus project, which is also part of the FCH JU project CHIC (Clean Hydrogen In European Cities). The HyNor Oslo bus project is managed by Ruter AS, the public transport executive of Akershus county and Oslo municipality. VanHool will supply the buses, and Air Liquide Norway AS will deliver hydrogen from a filling station at Rosenholm bus facilities in Oslo. The buses will be in daily operation at a regular route for a minimum of five years.

Akershus County, together with Oslo will throughout 2012 develop a hydrogen strategy for the Oslo region.

ZEG POWER

ZEG technology provides the power concept with the highest energy efficiency from hydrocarbon fuels, more than 80% for large scale plants, and ZEG technology is the only concept with the potential to produce electricity and hydrogen with integrated CO₂-capture less expensive than today. In addition, there are no emissions from a ZEG Power plant, neither NO_x, particles nor aerosols. The technology also shows great flexibility with respect to fuel, since all types of hydrocarbons can be used; natural gas, biogas, gasified coal, tar, or oil. In addition, the relative amount of electricity and hydrogen (and heat) can be adjusted according to market demand.

The technology is developed as a joint cooperation between Institute for Energy Technology (IFE) and Christian Michelsen Research AS (CMR Prototech) through the development company ZEG Power AS.





In 2012 ZEG Power will realize a 20kW_e + 30kWh₂ ZEG plant (BioZEG) based on biomass. The pilot will be built in connection with the Hynor Lillestrøm hydrogen filling station. In the project cost effective conversion of biomass to hydrogen and electricity for transportation purposes will be demonstrated. A prestudy of the plant (50kW) has shown a potential of more than 70% in total efficiency. The plant will primarily be fuelled by upgraded landfill gas. However, in order to increase the fuel flexibility integration of a gasification unit will also be evaluated.



BioZEG makes production of green electricity and hydrogen possible in standalone distributed plants based on local biomass or waste resources. The hydrogen and electricity produced can be used directly for transportation purposes; for electricity powered, hydrogen powered or plug-in hydrogen/batteries hybrid vehicles. On site production of hydrogen will in addition reduce the need for energy consuming trucking of hydrogen. CO₂ from biomass is considered climate neutral. However, in BioZEG CO₂ is captured as an integrated part of the process. This will give a negative climate contribution if the CO₂ is sequestered, and used locally or stored.

R&D PROJECTS

Norwegian R&D are leading or participating in several projects under the “Fuel Cells and Hydrogen Joint Undertaking” in EU (FCH JU).

The JU was established in 2007/8, based on a strong priority for this field in EU, and particularly with interest from large industrial companies to increase and focus R&D and demonstration of hydrogen and fuel cell projects.

In the figure below, a list of the projects that Norwegian R&D institutions are involved in is listed.





REFERENCES

MEMBER WEBSITE:

www.rcn.no

OTHER IMPORTANT WEBSITES

www.hydrogen.no

www.transnova.no

www.hynor.no

CONTACT INFORMATION

Mr. Trygve Utheim Riis,
The Research Council of Norway,
Department of Energy,
P.O.Box 2700 St.Hanshaugen,
0131 Oslo,
Norway
e-mail: tur@rcn.no

