



DENMARK

Mikael Näslund and Jan K. Jensen

Danish Gas Technology Centre (DGC)

INTRODUCTION AND BACKGROUND

ENERGY STRATEGY 2050

The Danish government wishes to set a clear course towards a society independent from fossil fuels.

This goal requires an energy-efficient society powered by renewable energy. In view of this goal, the Danish government wants to enhance the use of renewable energy sources, such as wind power, biomass, and biogas—the latter two of which are already in widespread use—while simultaneously allowing new sources of renewable energy to develop.

The strategy contains initiatives that will lead to a substantial expansion of wind power on land and at sea.

Furthermore, the Danish government will increase efforts to improve the energy efficiency of households and companies. This will be brought about by raising the energy savings target that energy companies have to implement amongst their consumers.

Two measures will directly reduce oil consumption. Starting in 2017 there will be an end to the installation of new oil furnaces and starting in 2020 there will be an increase to 10% of the mandated share of biofuels in the transport sector.

Biogas will be given access to new outlets through support that allows it to be used for industrial use and to be concentrated to natural gas standards.

UPDATE ON MEMBER'S ENERGY FRAMEWORK

Changes to the tax regime in early 2010 have created some advantages for hydrogen. Electricity for hydrogen production has been excluded from taxes since January 2010. The electricity tax today is 0.61 DKK/kWh, the same amount as the market price for electricity. It will make hydrogen production more attractive economically, especially when produced from surplus wind energy at low market prices.

The Danish government also announced that the tax exemption for electric vehicles and hydrogen fuelled vehicles will continue until 2015. The taxes on new cars in Denmark are very high compared to other western European countries.

The new Danish emergency radio network SINE will have a power back-up based on hydrogen fuelled PEM fuel cells from Dantherm Power instead of an engine generator or batteries. Dantherm produces 2 and 5 kW fuel cell units for back-up operation. The installations began in 2009 and a total of 450 units will be installed.

HYDROGEN R,D&D SPECIFICS

The four year test of hydrogen in plastic distribution pipes for natural gas was reported on in 2010. Samples were analyzed annually for possible material deterioration. The tests were carried out in a small grid at the Danish Gas Technology Centre. Hydrogen was

VITAL STATISTICS

EU Member since 1973 (Faroe Island and Greenland are not members of EU)

Population

5.56 million
(Source: Statistics Denmark)

Territory

43,098 km²

Capital

Copenhagen

GDP/capita

246,000 DKK (2009)

Average Annual GDP Growth

(Source: Statistics Denmark)

2006:	2.0 %
2007:	1.5 %
2008:	-1.5 %
2009:	-5.2 %

Primary Energy Structure 2009

Production

Total production: 1008 PJ	
Oil:	555 PJ (55 %)
Natural gas:	315 PJ (31 %)
Renewables:	122 PJ (12 %)
Waste:	16 PJ (2 %)

Imports

Oil:	151 PJ (49 %)
Coal:	172 PJ (51 %)

Exports

Oil:	380 PJ (72%)
Natural gas	150 PJ (28 %)



**Electricity****Production**

Total:	131 PJ (2009)
<i>Coal:</i>	<i>49 % of total</i>
<i>Natural gas:</i>	<i>19 % of total</i>
<i>Renewables:</i>	<i>28 % of total</i>
<i>Wind:</i>	<i>18 %</i>
<i>Biomass:</i>	<i>8 %</i>
<i>Biogas:</i>	<i>1 %</i>

**Total Demand/
Consumption**

Total End-user Consumption
631 PJ (2009)

By Energy Type

	PJ	%
<i>Oil:</i>	287	45 %
<i>Natural gas:</i>	66	10 %
<i>Coal:</i>	6	1 %
<i>Renewables:</i>	55	9 %
<i>Electricity:</i>	114	18 %
<i>District heating:</i>	105	17 %

By Sector

<i>Transport:</i>	33 %
<i>Industry:</i>	21 %
<i>Commercial:</i>	13 %
<i>Residential:</i>	30 %

circulated in the grid in conditions similar to real operation. A steel pipe sample was tested dynamically with pressure swings corresponding to 80 years of operation. The results have so far been implemented in two small hydrogen grids in Denmark. The report is available at DGC's web site.

The Danish microcogeneration program continued in 2010 and the hydrogen fuelled low-temperature PEM fuel cells from IRD Fuel Cells entered phase III after CE marking at the Danish Gas Technology Centre. The fuel cell units with an electric output of 1.5 kW are wall-hung like many gas boilers today. The inverter is located in a separate cabinet for easier installation. The phase III units are improved regarding design and operation strategy based on the experiences from phase II field tests.

The national network for hydrogen in the transport sector arranged a workshop on the Danish and Scandinavian future. A brief introduction is available through the presentations available at the web site www.hydrogenlink.net.

ENDNOTES

- 1] Danish Energy R&D projects (database): http://iis-03.risoe.dk/netahtml/risoe/ENS/efp_uk.htm
- 2] Denmark in figures 2011(report): <http://www.dst.dk/pukora/epub/upload/14851/dkinfigures.pdf>
- 3] Key statistics 2009 (report): http://www.ens.dk/en-US/Info/FactsAndFigures/Energy_statistics_and_indicators/Annual%20Statistics/Documents/Energi%20Statistics%202009.pdf

REFERENCES**MEMBER WEBSITE**

- Danish Gas Technology Centre (www.dgc.dk)

OTHER IMPORTANT WEBSITES

- Danish Energy Agency (www.ens.dk/en-us)
- Partnership for hydrogen and fuel cells (www.hydrogennet.dk)
- National Network for advancing hydrogen for transport in Denmark (www.hydrogenlink.net)

CONTACT INFORMATION

Mr. Jan K. Jensen (jkj@dgc.dk)

Danish Gas Technology Centre (www.dgc.dk)