

RENEWABLE ENERGY AND ENERGY EFFICIENCY

- Recent developments and activities in Norway

October 2008



The new opera with PV façade. Photo: S.Sundsbø

- *Policies and priorities* -
- *Production and consumption of energy* -
- *Industry capacity and technology development* -

For the Research Council of Norway
by
KanEnergi AS

About the report

This report is an update of new developments in the field of renewable energy and energy efficiency in Norway in the period 2007 – October 2008. Greenhouse gas emission issues are also included as they are often closely connected to the energy sector.

The report is focusing on new developments only; it is beyond its scope to give a full description of legislation, markets and projects in Norway.

Fairly static information, like the Soria Moria declaration of the Government and an overview of administration of policy instruments have been included in the attachments.

The report was prepared by KanEnergi AS (www.kanenergi.no) on behalf of the Research council of Norway (www.forskningradet.no). The report will be submitted to the International Energy Agency, IEA (www.iea.org).

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Further information

The Norwegian energy sector:

FACTS 2006, Energy water and resources in Norway

www.regjeringen.no/en/dep/oed.html?id=750

Renewable energy - www.renewableenergy.no/

Production, consumption and imports:

Statistics Norway, Energy theme page - www.ssb.no/energi_en/

Energy 2008 – www.nve.no/energistatus

Policy developments:

The Ministry of Petroleum and Energy - www.regjeringen.no/en/dep/oed.html?id=750

The Ministry of the Environment - www.regjeringen.no/en/dep/md.html?id=668

The Ministry of Transport and Communication - www.regjeringen.no/en/dep/sd.html?id=791

The Government - www.regjeringen.no/en.html?id=4

Additional links to further information can be found under the relevant chapters in this report.

Summary of developments 2007 – September 2008

Policies and priorities

In January 2008, the Government and the opposition parties launched a broad agreement to boost national climate efforts. The agreement on climate policy secures a long-term climate policy that is not affected by changes of government. The agreement on climate policy states that the target year for becoming carbon-neutral is moved forward, from 2050 to 2030. Considerable funds have been, and will be, allocated for efforts to promote renewable energy sources, strengthen public transport and implement measures aimed at reducing emissions from the transport sector.

From 2008, the Norwegian emission trading system (ETS) is linked with that of the EU. The EU ETS directive applies for Norway with a few adaptations.

Negotiations with Sweden on a common market for green certificate failed in 2006, and the Government instead suggested a system of feed-in tariffs for renewable electricity. The system is being revised by the EFTA Surveillance Authority (ESA) and has not been implemented as planned. The Government will resume the negotiations with Sweden as soon as the consequences of the new EU directive on renewable energy have been clarified, the principals for a joint system could be ready by October 2009. In the meantime, the preliminary support schemes are continued.

A committee established by the Ministry of Petroleum and Energy launched a comprehensive strategy for the energy sector in February 2008 (Energi21). The report calls for a national focus on five critical areas; energy efficiency, climate friendly power, CO₂ neutral heating, flexible energy systems and a supportive energy and business climate. The strategy included the establishment of specialized RD&D centers, which will reflect the priorities set by Energi21 and will have strong connections to industry. Applications are being revised by the Research Council; in January 2009 the 5-6 new centers will be appointed. The Energi21 committee will continue as a link between the industry, ministries and the Research Council.

In April, the Government presented a strategy for increased use of bioenergy, aiming at additional 14 TWh bioenergy by 2020. The use of bioenergy in Norway today is about 14 TWh.

Production and consumption of energy

The total production of electricity in 2007 was 137,3 TWh, an increase of 12,9 percent compared to 2006 and the third highest production level ever, due to abundant amounts of water in the hydro power plants. In 2007, Norway reached a net export of more than 10 TWh, in 2006 Norway had a net import of almost 1 TWh. During the first half of 2008, the production was 8 percent higher than the first half of 2007. During the summer 2008, the power transfer capacity between Norway and Europe was tripled and additional cables are being planned.

Uncertainties concerning future support schemes for renewable power production have caused wind energy companies to postpone new projects. A temporary wind power support scheme was launched in April 2008 and the Government is positive that this will secure the goal of 3 TWh wind power by 2010.

Electricity consumption in Norway was 126,9 TWh in 2007, an increase of 3,6 percent compared to 2006 and an all-time peak for a calendar year. Lower electricity prices, high economic growth and colder temperatures are main reasons for the high consumption. However, increased exports and high domestic consumption have led to increasing electricity prices in 2008; the September prices have only been higher in the peak year 2006.

Industry capacity and technology development

Example offshore wind power:

A study conducted in 2007 estimated a physical potential of 14.000 TWh for offshore wind power in Norway. This has been a hot topic through the last year, and new concepts under development have benefited from increased interest and funding.

The world's first full scale floating wind turbine, Hywind, will be built and tested over a two-year period offshore Karmøy. Planned start-up is autumn 2009. There are plans to expand the Karmøy-cable and establish a permanent test centre for immature ocean energy technologies; the realization is depending on public funding.

Other companies like Sway, Lyse and Statkraft are working on different concepts for offshore wind power.

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1 Policies and priorities

1.1 Aims and visions

In January 2008, the Government and the opposition parties launched a broad agreement to boost national climate efforts. The agreement on climate policy secures a long-term climate policy that is not affected by changes of government. The agreement on climate policy states that the target year for becoming carbon-neutral is moved forward, from 2050 to 2030. The parties believe that it is realistic to assume that Norway's annual greenhouse gas emissions can be reduced by 15–17 million tons of CO₂ equivalents by 2020 when forest carbon uptake is included. This means that about two thirds of Norway's total emissions reductions will need to be made nationally.

In 2007, the Government stated that Norway's commitment under the Kyoto Protocol will be improved by 10 %, and plan to cut global emissions of greenhouse gases by the equivalent of 30 % of our 1990 emissions by 2020.

From 2008, the Norwegian emission trading system (ETS) is linked with that of the EU. The EU ETS directive applies for Norway with a few adoptions. The Government intends to ensure that when Norway joins the emissions trading scheme, the total quantity of allowances in the system will increase by far less than the emissions generated by the Norwegian installations included in the scheme. Participation in the ETS will not otherwise affect how Norway seeks to implement its Kyoto commitment.

1.2 Policies, Legislation and Strategies

Energy policy, in the short and medium term, focuses on new renewable energy sources such as wind and bio, reduced energy consumption, a more flexible energy system, distributed power production and gas-fired power plants with reduced or no emissions.

1.2.1 Energy supply

Revision of the Energy Act

The Norwegian electricity sector was deregulated and liberalized through the Energy Act of 1991. Following-up the Soria Moria-declaration, the Ministry of Petroleum and Energy will evaluate the legislation to see if the experiences and results are coherent with the aims of the energy policy. The proposed changes to the energy act are being evaluated.

Certificates of origin

A directive on certificates of origin for production of electricity was implemented January 1st 2008. The directive is based on the EU directives on production of electricity from renewable energy sources and on combined heat and power. The Norwegian Water Resources and Energy Directorate (NVE) approves the certificates.

www.nve.no

Proposal for EU directive on the promotion of the use of energy from renewable sources

In January 2008, the European Commission released a proposal for a Directive on the promotion of the use of renewable energy. The Directive is designed to address all sectors of the renewable energy industry with the goal of helping them move toward the Commission's target for 20 percent of Europe's energy being produced from renewable sources by 2020. The directive is expected to be implemented in Norway. Norway has about 60 percent renewable energy production because of the hydro power, but could be allocated a further 11 percent.

www.enova.no

A new R&D strategy: Energi21

A committee established by the Ministry of Petroleum and Energy launched a comprehensive strategy for the energy sector in February 2008 (Energi21). The report calls for a national focus on five critical areas; energy efficiency, climate friendly power, CO2 neutral heating, flexible energy systems and a supportive energy and business climate. The Energi21 committee will continue as a link between the industry, ministries and the Research Council.

www.energi21.no

Bioenergy strategy

In April 2008, the Government presented a strategy for increased use of bioenergy, aiming at additional 14 TWh bioenergy by 2020. The use of bioenergy in Norway today is about 14 TWh.

www.dep.no/oed

1.2.2 Energy efficiency

Energy efficiency in buildings

The implementation of the *EU Energy Performance of Buildings Directive* requires changes to the Norwegian Energy Act. A proposal from the Norwegian Water Resources and Energy Directorate (NVE), which has been responsible for the preparatory work, was distributed in June 2007. A revised version based on remarks NVE received is being evaluated. A final proposal is expected to be ready autumn 2008.

<http://www.buildingsplatform.org/cms/index.php?id=8>

<http://www.bygningsenergidirektivet.no/>

1.2.3 Climate

Emission trading

From 2008, the Norwegian emission trading system (ETS) is linked with that of the EU. The EU ETS directive applies for Norway with a few adaptations.

www.dep.no/md

1.3 Administration of policy instruments

A brief presentation can be found in attachment 4.3.

New developments:

Transnova – environmentally friendly transportation

From 1990 to 2005 the CO₂-emissions from road transport increased by more than 25 percent, and the emissions from this sector now represents a quarter of the national emissions. In order to reduce these emissions, the Government has decided to establish a new state owned enterprise that will be responsible for enhancing solutions for environmentally friendly transportation, Transnova. The planned budget is NOK 50 million annually throughout the first period (2009-2012).

www.dep.no/sd

1.4 R&D and innovation programmes

Increased public funding

The largest renewable energy related support schemes in Norway are administered by Enova, which in 2008 had a budget of NOK 1277 million. As of January 2008, the Energy Fund totaled NOK 2,2 billion, of which 93 percent was tied to a portfolio of 1023 active projects.

According to the agreement to boost national climate efforts launched by the Government and the opposition parties in January 2008, considerable funds will be allocated for efforts to promote renewable energy sources, strengthen public transport and implement measures aimed at reducing emissions from the transport sector in the years to come. Enova expects an annual budget of more than NOK 1,5 billion as of 2010. The R&D budget will increase with NOK 300 million in 2009 and will total at least NOK 600 million in 2010. This is equal to the public R&D budget for the petroleum sector.

Research and Development

In 2007, the main focus of the R&D program Renergi was renewable energy sources, including hydro power. The budget was NOK 202,5 million. The industry is well

represented in the project portfolio. The participation of industry is low in the bioenergy sector, and measures are being taken to improve the situation.

www.renergi.com

Other relevant programs of the Research Council support projects on forestry (upstream), materials (nano and processes for silicon metals) and carbon capture and storage. The forestry related programs are soon to be merged into a new program called “nature og næring” (Nature and industry).

BIA www.forskningsradet.no/bia

AREAL/TRE www.forskningsradet.no/areal and www.forskningsradet.no/tre

NANOMAT www.forskningsradet.no/nanomat

CLIMIT www.climit.no

The Energi21 strategy, launched in February 2008, included the establishment of specialized RD&D centers, which will reflect the priorities set by Energi21 and will have strong connections to industry. Applications are now being revised by the Research Council; in January 2009 the 5-6 new centers will be appointed.

www.energi21.no

New support schemes for heating

Enova launched new programs for heating systems in 2008. The aim of the new programs is to secure the Government target of 4 TWh environmentally friendly hydronic heating by 2010. Enova only supports technologies where the market is in a start-up phase, and has ceased the support for air-air heat pumps, as the market has now become sufficiently large to ensure affordable prices. In 2008, Enova has a budget of NOK 100 million for support of environmentally friendly heating solutions in households. In 2006, the budget for this program was NOK 71 million. The new program includes support for solar collectors and district heating:

- Solar collectors

The support is limited to 20 % of the costs, maximum NOK 10.000,-.

- District heating

The program has three focus areas: heat production, infrastructure and local heating plants.

www.enova.no

Supporting SMEs

Through the program “Energy and Environment”, Innovation Norway assist and advise small and medium sized enterprises (SME) planning to establish their business operation within the energy and the environmental sector, in Norway and abroad.

In 2008 the focus areas are:

- Wind, Wave and Tidal Technologies
- Energy Efficiency and Energy Systems
- Clean Water

- Carbon Capture and Storage

The program includes consulting, networking, marketing and profiling, plus possible financing of cluster projects.

<http://www.innovasjon Norge.no/Satsinger/Sektorsatsinger/Energi-og-miljo/Energy-and-Environment/>

Future support schemes for renewable electricity production unresolved

Negotiations with Sweden on a common market for green certificate failed in 2006, and the Government instead suggested a system of feed-in tariffs for renewable electricity. The system is being revised by the EFTA Surveillance Authority (ESA) and has not been implemented as planned. The Government will resume the negotiations with Sweden as soon as the consequences of the new EU directive on renewable energy are clarified, the principals for a joint system could be ready by October 2009. In the meantime, the preliminary support schemes are continued. A temporary support scheme for wind power was launched in April 2008.

1.5 International R&D Cooperation

In the energy area, Norway collaborates primarily in the EU system, with the International Energy Agency (IEA) and at Nordic level. For a list of other international cooperation initiatives, see

<http://www.regjeringen.no/upload/kilde/oed/bro/2006/0004/ddd/pdfv/287581-kap.08.pdf>

Norwegian energy R&D organizations were represented in 72 applications in the EU 7th framework program in 2007. The success rate has been about 20 %, which is significantly lower than in 2006. However, the number of applications increased, from 27 in 2006.

2 Production and Consumption of Energy

Nature has provided Norway with abundant reserves of crude oil, natural gas, water and wind. The annual production of energy is approximately ten times the domestic use, and more than 99 % of the Norwegian electricity production is hydropower.

2.1 Renewable Energy Production

Hydropower

Installed capacity in Norwegian hydropower plants is around 28 300 MW, and approximately 620 power plants have an installed capacity over 1 MW.

The total production of electricity in 2007 was 137,3 TWh, an increase of 12,9 percent compared to 2006 and the third highest production level ever, due to abundant amounts of water in the reservoirs. In 2007, Norway reached a net export of more than 10 TWh, in 2006 Norway had a net import of almost 1 TWh. During the first half of 2008, the production was 8 percent higher than the first half of 2007. During the summer 2008, the transfer capacity between Norway and Europe was tripled and additional cables are being planned.

In 2007, licenses were issued for 55 small scale hydropower stations, with a total production of around 640 GWh per year. This is more than in any previous year.

Wind Power

In 2007, a total of 899 GWh wind power was produced in Norway. This is an increase of 34 percent compared to 2006, but lower than expected. The total installed capacity was 385 MW at the end of 2007. At the beginning of 2006, 280 MW of wind power was installed in Norway.

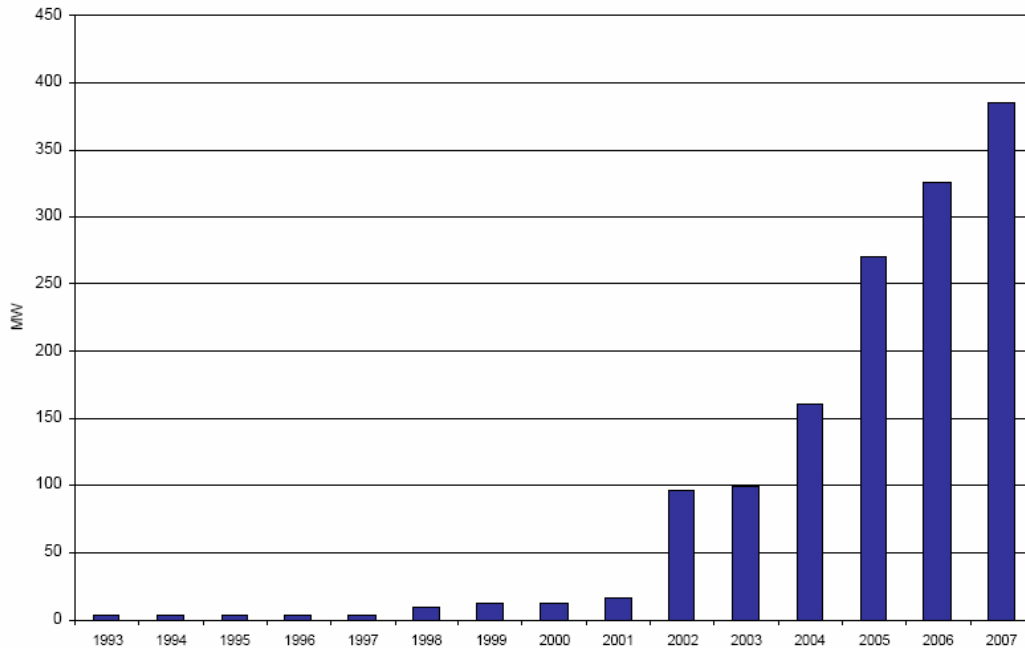


Figure 1 Installed wind power capacity in Norway. Source: NVE

Uncertainties concerning future support schemes for renewable power production have caused wind energy companies to postpone new projects during the last year. A temporary support scheme was launched in April 2008 and the Government is positive that this will secure the goal of 3 TWh wind power (if not produced, at least under construction) by 2010.

www.nve.no

Solar Energy

By the end of 2006, installed solar heating systems in Norway totaled 9 MW_{th}. The market is increasing, but compared to the neighboring countries (Sweden 209 MW_{th} installed and Denmark 287 MW_{th} installed), it is still immature.

There are approximately 140 000 PV-installations in Norway, mainly in cabins not connected to the grid. In 2005, the total installed capacity was estimated to 7 MW. The corresponding annual energy production capacity would be in the order of 5 GWh. Suppliers report continued sales of PV panels, but the increase in production is unknown and most likely very small.

In April 2008, the new opera in Oslo was opened. The building has Norway's largest PV-façade; the 300 m² solar panels are expected to deliver 20.000 kWh/year.

Bioenergy

The use of bioenergy is estimated to 14 TWh. Norwegian households used about 6,7 TWh bioenergy in 2007, corrected for efficiency factors this corresponds to about 3,5 TWh net energy consumption.

Higher electricity and oil prices have led to increased use of biomass in industry. The consumption of wood residues was 2 699 GWh in 2007, an increase of 531 GWh since 2006.

District Heating

In 2007, the consumption of district heating was 2 758 GWh, 10,5 % higher than in 2006. The number of district heating plants increased significantly; in 2007 there were about 50 plants, more than twice as many as in 2006.

Use of district heating has increased with an average of 9,3 % annually over the last five years. Even though the consumption is increasing, district heating only constitutes 1,2 percent of net domestic end use of energy.

2.2 Energy Consumption

Electricity consumption in Norway was 126,9 TWh in 2007, an increase of 3,6 percent compared to 2006 and an all-time peak for a calendar year. Lower energy prices, high economic growth and colder temperatures are main reasons for the high consumption. However, increased exports and high domestic consumption have led to increasing energy prices in 2008; the September prices have only been higher in the peak year 2006.

Energy consumption in industry

Since the energy-intensive industries have had to purchase energy on a commercialized basis, their expenditures have risen. For all other sectors, the prices were lower in 2007 than in 2006. The use of district heating was 2 758 GWh in 2007, continuing the steady increase over the last years.

Results of public energy efficiency programmes

The state owned company Enova SF administers the public energy efficiency programmes. Companies that receive support for energy efficiency measures have to sign a contract stating how much energy their project will save.

In 2007, the Enova signed energy savings contracts of about 1.2 TWh, of which 814 GWh in industry and 365 GWh in the building sector.

www.enova.no

3 Industry capacity and technology development

3.1 Wind power

A study conducted in 2007 estimated a physical potential of 14.000 TWh for offshore wind power in Norway. This has been a hot topic through the last year, and several new concepts under development have benefited from increased funding.

The world's first full scale floating wind turbine, Hywind, will be built and tested over a two-year period offshore Karmøy. Planned startup is autumn 2009. There are plans to expand the Karmøy-cable and establish a permanent test centre for immature ocean energy technologies; the realization is depending on public funding.

http://www.statoilhydro.com/en/NewsAndMedia/News/2008/Pages/hywind_fullscale.aspx

Other companies like Sway, Lyse and Statkraft are working on different concepts for offshore wind power.

www.sway.no www.lyse.no www.statkraft.no

Scatec and Grieg Group have established a joint venture to develop full scale offshore wind farms, NorWind. A basic element of the NorWind strategy is to invest in complementary technologies and participate in the development of these companies. As part of this strategy, NorWind has taken a 33.4 % ownership position in OWEC Tower, so far the only technology installed on more than 30 meters water depth. Last year, OWEC Tower provided two foundations to the Beatrice projects, now installed at 45 meters depth of the coast of Scotland.

www.norwind.no

www.owectower.no

Chapdrive AS has worked cooperatively with the Centre for Renewable Energy and Viva AS on a project to reduce the weight of turbines that would be needed in large offshore wind tower structures. By using hydraulic pumps and motors, the groups have succeeded in cutting back weight at the top of the tower where it is commonly located, near the blades.

www.chapdrive.com

Developing wind turbines that can withstand the strong stresses in the open ocean requires considerable technological expertise. In partnership with the IFE, Marintek, NTNU, Statkraft, Hydro, Statnett and Lyse, SINTEF Energy Research is coordinating a project called "Deep sea offshore wind turbine technology."

www.sintef.no

3.2 Solar energy

Increasing: solar heating

There is an increasing number of Norwegian solar heating companies, some import already existing solutions, others are developing new systems. The market for solar heating technologies for households is expected to grow due to the new support scheme launched by Enova in 2008.

Renewable Energy Corporation (REC)

REC is the world's largest producer of silicon materials for photovoltaic (PV) applications and multi- and monocrystalline wafers, as well as a significant producer of cells and modules. REC is planning production of solar solutions that can deliver electricity below 10 eurocent per kWh by 2010.

<http://www.recgroup.com/>

NorSun

NorSun started the production of monocrystalline silicon wafers in Årdal in June 2008. The company also has production in Finland and a third plant is being planned in Singapore.

<http://www.norsuncorp.no/>

Elkem Solar

Elkem Solar is developing an efficient metallurgical process for producing silicon metal which meets the solar cell industry's requirements. By the end of 2008, Elkem Solar is opening a production plant in Kristiansand, in one year's time the annual production capacity will be 5.000 tonnes. Contracts for deliveries until 2018 have already been signed.

www.elkem.com/solar

3.3 Bioenergy

Biofuels

Due to higher feedstock prices and subsidized American biofuel, the only Norwegian producer of biodiesel based on rapeseed/soy oil ceased the production spring 2008. Another company is planning a new multi-feedstock plant, start-up 2009.

www.uniol.no

2nd generation biofuels

Norske Skog has established Xynergo, a company that will develop a process for, and later produce, 2nd generation biodiesel (based on wood). A full-scale plant is planned to open in 2015.

www.norskeskog.com

The research institution PFI coordinates another R&D projects on biofuels, "Cost effective production of renewable liquid biofuel and biochemical from Scandinavian wood materials", which is looking into alternative methods to Biomass-to-liquid (BTL) for production of bio oils. The researchers claim that production of biofuels from wood could be profitable in 5-10 years.

www.pfi.no/

The company Weyland AS is developing a method for production of bio ethanol from cellulose based waste. The process is based on concentrated acid technology and the first production plant is to be located in Bardu, Troms.

www.veyland.no

3.4 Ocean Energy Technologies

Norway's long coastline represents an excellent opportunity for exploiting ocean energy and several new technologies are under development. As other European countries have been able to offer better funding opportunities, some development projects like the tidal turbine of Hammerfest Strøm and the wave power installation "Buldra" have been exported and are further developed abroad.

Tidal Power

Statkraft and Hydra Tidal Energy Technology are in the process of developing and testing a tidal power plant based on a floating, anchored steel structure which will generate electricity via four large turbines driven by marine currents. The companies are applying for concession for a demonstration plant in Moskenesstraumen in Lofoten. The first 1,2 MW platform is expected to start producing electricity in 2009/10, the output will be about 5-6 GWh. If the test phase is successful, the owners intend to have the first plant consisting of ten platforms ready in 3-4 years.

http://www.statkraft.no/Images/Tidal%20power%2C%20versatile_tcm3-6030.pdf

Salt gradients

Statkraft has started to build a pilot plant for osmotic power; the plan is expected to produce electricity by the end of 2008. If the pilot is successful, Statkraft intend to have a full-scale plant ready by 2015.

http://www.statkraft.no/Images/Osmotic%20power%2C%20a%20huge_tcm3-6032.pdf

3.5 Hydrogen

An extensive number of hydrogen development projects are being conducted in Norway and the hydrogen strategy of 2007 was meant to enhance and structure the further work. In spite of the positive attention the strategy plan received, it has not been follow-up by relevant organisations so far.

Think Hydrogen – a hydrogen/electric hybrid

In June 2008, the electric vehicle producer Think launched their Think Hydrogen, a hydrogen/electric hybrid. At the end of the year, the HyNor project will receive five

Think Hydrogen cars for testing. HyNor is a national development project which aims to establish sufficient filling stations to make it possible to drive hydrogen vehicles from Stavanger to Oslo by the end of 2009.

www.think.no

www.hynor.no

4 Attachments

4.1 Background: the energy situation in Norway

Resources, production and imports

Electricity generation in Norway in a normal year is about 119 TWh. There are large variations in production from one year to another due to variations in precipitation.

During the last years, the energy consumption has exceeded the domestic electricity production, even in a normal year. In a year with average rainfall, Norway imports about 9 TWh electricity from other Nordic countries.

The production of crude oil and natural gas amounts to approximately 90 % of the total production of primary energy carriers in Norway. The gross product from oil and gas production in 2005 amounted to around 22.5 % of the GDP in Norway. The total oil resources on the Norwegian continental shelf are calculated as 12.9 billion standard cubic meters of oil equivalent. 31 % of these resources have been used. Of the remaining 69 % almost one half is clarified for production.

4.2 The Soria Moria-declaration of 2005

After the general election in September 2005, a new majority government representing the Labour Party, the Socialist Left Party and the Centre Party was formed. The basis for the new three-party Government is communicated through the so called "Soria-Moria declaration", which describes positions on future key political issues.

Energy supply

The Government's environmental goals will determine the energy production possibilities. Since the era for development of large hydro power projects is over, increased demand must be covered through new solutions.

The Government wants:

- To secure a more favourable electric power balance by increasing production capacity and reducing growth in demand by energy saving measures. Increased energy supply will be possible by focusing on new environmentally friendly energy sources, upgrading of hydro power installations and utilize natural gas in an environmentally sound way.
- To increase Norway's contribution on international cooperation on environmentally sound technology, energy system and emphasis on renewable energy.
- To provide for an efficient and safe power grid, with reduced losses and sufficient capacity for the whole country.
- A strong public ownership in the energy sector.

Renewable energy

Norwegian energy sector know-how must be used to develop new technology and solutions that lead to reduced emissions that cause climate change. Norway has a large potential for utilizing renewable energy sources like wind, biomass, solar, wave and tidal currents. Through emphasis on efficiency measures and renewable energy sources, Norway can achieve a varied and environmentally sound energy system.

The Government wants to:

- Increase targets / goals for energy saving and renewable energy production
- Renovate / modernize existing hydro power installations and increase construction of micro-, mini- and small hydro power plants.
- Introduce a green certificate market for renewable power production. If realization of such a market fails, other measures will be considered.
- Introduce environmentally friendly technologies that are not yet mature
- Increase environmentally sound wind power development, and through the concession system secure a regional and national coordination such development.
- Increase the governmental contribution to development and commercialization of hydrogen as an energy carrier.
- See to that renewable energy does not lose in competition with power production based on natural gas with CO₂ removal.
- Introduce a braking deposit scheme on oil furnaces that are replaced with equipment utilizing renewable energy sources.

Hydronic heating systems and energy efficiency

The Government wants to reduce dependence on electrical resistance heating, and instead increase the use of other heating alternatives. The largest barrier for such change is lack of infrastructure for heat distribution. Consequently, it is of major importance to establish district heating systems in densely built-up areas and waterborne distribution systems in buildings.

The Government wants to:

- Arrange for increased use of waterborne heating, and establish favourable financing mechanisms for district heating and projects based on biomass as source of energy.
- Require energy flexible systems in all new and rehabilitated public buildings of 500 sqm or more.
- Introduce a long term contribution scheme stimulating households to select energy efficient heating solutions or systems that utilize renewable sources of energy.
- Support construction of district heating infrastructure.
- Implement the EU building energy directive in 2006, and also prepare new building codes that will turn low energy houses into a standard. New energy standards for existing buildings and renovation of buildings will be introduced accordingly.

Domestic use of natural gas

The Governments target is that Norway shall become world leading in environmentally sound utilization of natural gas. Gas based power generation must not come in conflict with Norway's Kyoto commitments, but rather take part in the international trading system for climate gas quotas. Through financial support and emphasis on technology development, CO₂ from new power plants will be removed and either deposited in geological structures or used for enhanced oil and gas recovery.

The Governments wants to:

- Establish a Government owned company that contributes with financing of infrastructure for transportation of natural gas, and in cooperation with private companies, provide for CO₂ capture and transportation.
- Establish a Government owned company responsible for development of a value chain for transportation and injection of CO₂.
- Increase research and development on environmentally sound gas based power production.
- Increase capacity for small scale LNG terminals, and stimulate conversion from heavy oils to natural gas in the industry, shipping and transport sectors.
- Review the tax system on CO₂ in order to avoid situations where natural gas displaces more environmentally safer alternatives.

4.3 Administration of Policy Instruments

The most important public or Government owned institutions being responsible for the administration of policy instruments within renewable energy and energy efficiency are:

The Ministry of Petroleum and Energy

The principal responsibility of the Ministry of Petroleum and Energy is to achieve a coordinated and integrated energy policy. A primary objective is to ensure high value creation through efficient and environment-friendly management of Norway's energy resources.

www.oed.no

The Ministry of the Environment

The Ministry of the Environment has a particular responsibility for carrying out the environmental policies of the Government.

www.md.dep.no

The Norwegian Research Council

The Research Council plays a vital role in developing and implementing the country's national research strategy, acting as a government adviser, a funding agency and coordinator of research activities. The Research Council is responsible for the administration of most of the public funding available for R&D in the field of energy and water resource management.

www.forskningsradet.no

Innovation Norway

Innovation Norway promotes nationwide industrial development profitable to both the corporate economy and Norway's national economy, and helps release the potential of different districts and regions by contributing towards innovation, internationalisation and promotion. Innovation Norway has offices in all the Norwegian counties and in more than 30 countries world wide. The core group of clients are Norwegian companies, predominantly SMEs (small and medium sized enterprises). Energy projects based on biomass (fuel wood, and heat production), especially in rural areas tied to agriculture, are given priority.

www.invanor.no

The Norwegian Water Resources and Energy Directorate (NVE)

The Norwegian Water Resources and Energy Directorate (NVE) is a directorate under the Ministry of Petroleum and Energy, with responsibility for managing the country's water and non-fossil energy resources and for monitoring the energy market. NVE's mandate is to ensure integrated and environmentally sound management of the country's watercourses, to promote efficient energy markets and cost-effective energy systems and to work to achieve a more efficient use of energy. NVE also has the overall responsibility for maintaining national power supplies. NVE is involved in R&D and international development co-operation.

www.nve.no

Enova SF

Enova SF is a public enterprise owned by the Norwegian Ministry of Petroleum and Energy. The main mission is to contribute to environmentally sound and rational use and production of energy, relying on financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals. Through the suggested Basic Fund and the new support scheme for electricity production from renewable sources, Enova will broaden its responsibilities.

www.enova.no

Gassnova SF

Gassnova is the state centre for sustainable gas technologies. The purpose of the centre is to promote innovative, sustainable and cost effective gas technologies. Gassnova was put into operation on 1. January 2005. Gassnova is a public agency reporting to the Norwegian Ministry of Petroleum and Energy.

www.gassnova.no

Statnett SF

Statnett is responsible for coordinating supply and demand in the power system. Being a transmission system operator (TSO), Statnett owns and operates large sections of the main Norwegian power grid and the Norwegian section of power lines and sub-sea cables to other countries.

www.statnett.no

The Norwegian State Housing Bank

The Housing Bank is the main instrument of the Norwegian Parliament, the Norwegian government and the Ministry of Local Government and Regional Development for the implementation of national housing policy. Additional loans at a modest interest rate may be granted for installations and efforts to reduce use of energy or use of flexible heating systems.

www.husbanken.no.

Separate web-page on low energy housing: www.lavenergihus.no