

Report 2008-057

**Status and Potentials  
of Bioenergy in the  
Nordic Countries -  
Summary**

# **Status and Potentials of Bioenergy in the Nordic Countries - Summary**

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# 1 Background

This report is part of a collection of smaller reports under the Nordic Bioenergy Project "*Opportunities and Consequences of an Expanding Bioenergy Market in the Nordic Countries*", which aims to provide factual background information on the status of bioenergy in the Nordic countries. These factual reports cover the following themes:

Econ Pöyry-Report no. 2008-057: Status and Potentials of Bioenergy in the Nordic Countries - Summary

Econ Pöyry-Report no. 2008-054: Facts and Figures on the Use of Bioenergy in the Nordic Countries

Econ Pöyry-Report no. 2008-055: Facts and Figures on the Use and Potential of Biomass Resources for Bioenergy in the Nordic Countries

Econ Pöyry-Report no. 2008-052: Current Bioenergy Application and Conversion Technologies in the Nordic Countries

Econ Pöyry-Report no. 2008-0563 Current Bioenergy Policies and Measures in the Nordic Countries

Econ Pöyry-Report no. 2008-056: Global Aspects of Bioenergy Imports

The Nordic Bioenergy Project was launched in May 2007 by the Nordic Council of Ministers with the aim to help coordinate bioenergy activities in the Nordic countries and improve the visibility of existing and future Nordic solutions in the complex field of bioenergy, energy security, competing uses of resources and land, regional development and environmental impacts.

In addition to the collection of smaller background reports, the Nordic Bioenergy Project has prepared the report "*Energy, Economic and Regional Perspectives in an Expanding Bioenergy Market in the Nordic Countries*". This report provides an overview and analysis of the issues at stake for the Nordic countries in terms of the role of bioenergy in meeting various energy, industrial and regional development policy objectives. The report raises a number of questions in this regard and offers a number of perspectives to inspire future Nordic framework conditions.

During the project, two workshops were held on the themes "*Bioenergy in the Nordic Countries: Status, Opportunities and Risks*" and "*Bioenergy in the Nordic Countries: Lessons & Future Framework Conditions*". Presentations and summaries from the workshops along with the above mentioned reports are published on the following website:

<http://www.nordicenergy.net/bioenergy>

## **2 Current Biomass Use and Potential**

The bioenergy share of gross inland energy consumption varies in the Nordic countries from 4.2per cent in Norway to 12.2per cent in Denmark, 19per cent in Sweden (2006) and up to 20per cent in Finland (2004 numbers). Especially in Denmark, Sweden and Finland did the share of bioenergy increase significantly over the past 25 years.

The type of biomass resource utilized for energy purposes reflects to a large extent the natural resource availability in the country. Close to half of biomass use in Denmark (48per cent) originates from forestry comprising chips, pellets and firewood. The large remainder consists of organic waste and straw (47per cent) and only 4per cent of biogas.

Black liquor plays a prominent role in Finland and Sweden, with 50per cent and 35per cent of total biomass use respectively. Wood products and wastes represent the second large resource with 48per cent in Finland and 41per cent in Sweden.

Potential availability of domestic biomass varies from 111PJ/year in Norway to more than 500 PJ/year in Sweden. Potentials are found in biogas and straw in Denmark, in black liquor and wood industry wastes in Finland and Sweden, and in biogas, timber, and firewood in Norway.

Bioenergy has played a relatively small role in Iceland due to the availability of other renewables such as hydropower and geothermal power as well as scarcity of biomass. There is, however, increasing interest in Iceland to utilize this resource as transportation fuel.

### 3 Bioenergy Sources

In *electricity production*, Finland is a leading country in the application of bioenergy, not only among the Nordic countries but also among IEA member countries with bioenergy representing 12.6per cent (10.1 TWh) of total electricity production and peat contributing with 8.1 (6.5 TWh) in 2003. Denmark had a bioenergy share of electricity generation of 5.5per cent in 2003 while in Sweden 7.7per cent biomass contributed to electricity in 2006. The current level of bioenergy use in electricity is based on a strong positive trend over 25 years. In Denmark the use of bioenergy in electricity increased by a factor 7 and in Finland by more than 50 per cent. In Sweden the use of bioenergy in electricity production increased by almost 80 per cent since 1985.

In *heat generation*, bioenergy represents the main renewable resource in Denmark, Finland, Norway and Sweden. Sweden leads in terms of absolute application of bioenergy in heating where ca. 250 out of 290 municipalities with district heating systems use bioenergy. Bioenergy represented 65per cent of district heating in Sweden in 2006, 15per cent in Finland, 11per cent in Denmark and 7.6per cent in Norway (2002). The use of biomass for heating in Iceland is limited to municipal solid waste, with a total heat supply of 50-60 TJ/year. Comparing the development of bioenergy in the national heat production, Finland stands out with a steep increase since 1995 in the use of heat bioenergy up to 9 times the level in 1992.

In *transportation*, Sweden is leading in the efforts to develop a commercial market for clean vehicles and biofuels, with currently a 3per cent share of biofuels of total transportation fuel, primarily based on bioethanol. Biofuel production is also in Finland and Norway experiencing a strong growth, mainly based on biodiesel. Denmark currently exports the large majority of biodiesel produced to Germany and Sweden.

## 4 Current Application and Conversion Technologies

The bioenergy technology value chain consists of a *biomass processing* of agricultural, forestry and renewable wastes into, for instance, small bales for straw, wood chips for wood, dry mixed and wet for solid waste. The *transformation* of the processed biomass includes the digestion of animal manure, the solid fuel combustion of pellets or bales or the fermentation of energy crops into bio-ethanol or the Esterification of oil seeds into Biodiesel. The *conversion* technology is less unique to the bioenergy sector and includes technologies ranging from household stoves, district heating to gas turbines and automotive engines. The final *application* of biomass into heating, electricity or transportation can be realised through a wide combination of technology chains.

The Nordic countries show a generally strong complementarity in bioenergy technology strongholds.

- *Denmark* holds a leading position in the demonstration and commercial operation of biomass combustion, biogas technologies, grate firing of municipal solid waste and large-scale centralized biogas plants using animal manure. Denmark also holds a leading position in the prospects of using enzymes in second generation ethanol production.
- *Finland* holds a leading position in the commercialisation and use of biomass combustion from farm level to the world's biggest power plants. Whereas Denmark has experience in grate firing, Finland is specialised in fluidised bed combustion technology that allows for low-grade fuel like bark and sludge.
- *Sweden* is leading in the use of biomass in district heating and has a fast maturing market for pellet production with over 80 factories and a strong market for pellet boilers, pellet burners and stoves. Also, Sweden has a relatively long experience in the production of energy crops such as *Salix* and is leading among Nordic countries in the development and implementation of a functioning biofuel market, including production of cars and ethanol and setting up an efficient distribution network.

## 5 Current Policies and Measures

Different targets for renewable energy and bioenergy exist in the Nordic Countries. Not all have a specific target for bioenergy, although the sector in all countries is set to play an important role.

- Targets in *Denmark* include an increase in the share of renewable energy to 30 per cent by 2020, where the Biomass Agreement for electricity production plays a significant part.
- In *Finland*, the national targets for renewable energy follow the targets set by the European Commission in An Energy Policy for Europe. This aims at increasing the share of renewables from final energy consumption from 28.5 per cent in 2005 to 38 per cent in 2020. As bioenergy represents 85per cent of the renewable energy in Finland, this target is primarily linked to the increase in the application of bioenergy in the energy system.
- In *Norway*, a proposed target for bioenergy has been set to increase the use of bioenergy by 14 TWh by 2020, which is close to a doubling from current use (16 TWh/year). As part of this includes the target by 2012 to generate 4 TWh of heat from bioenergy. A general ambitious target is 30 TWh more renewable energy and energy savings compared to 2001.
- *Sweden* has an ambitious strategy to break Sweden's dependency on oil by 2020 through the use of energy efficiency and increased use of renewable energy.

Framework conditions and support mechanisms differ between the countries as well. A green certificate market since 2003 in Sweden has proven especially beneficial for the expansion of bioenergy in the electricity generation and the tax exemption for biofuels is one of the corner stones in the Swedish efforts to increase the use of biofuels in the transportation sector. Tax exemptions for biofuels and green certificate systems are not currently in place in the other Nordic countries. In Denmark, the biomass agreement from 1993 has been instrumental in introducing straw and wood chips in the electricity generation, while in Finland feed-in tariffs for peat in electricity generation and tax subsidies on renewables support the use of bioenergy. In Norway, focus is on eliminating the main bottleneck for district heating through investment subsidies in the creation of district heating networks. Grants, programmes and R&D are common instruments across the Nordic countries, especially in the area of second generation bio-ethanol, production and processing of domestic fuels, hybrid cars, and biogas.

## **6 Global aspects of Bioenergy Imports**

Global trade in bioenergy is estimated to increase from the current 1,000 PJ to between 80,000 PJ and 150,000 PJ at a global level. The current trade in biomass with and among the Nordic countries accounts for imports of ca. 45 PJ and exports represent ca. 23 PJ. If the estimated development at the global level were to be proportional to the current trade in the Nordic countries, trade in bioenergy could be 80 to 150 times higher than today.

Trade in biomass for transportation is significant and heavily dependent upon the domestic framework conditions. Denmark produces practically the totality of its biodiesel production; Norway plans to import the raw materials for the production of biodiesel and with the current plans for future capacity, it may be likely that part of the biodiesel production will be exported. In Sweden, the large majority of biofuels for transport is imported, and also the large majority raw biomass for the domestic production of bioethanol is imported.

Main issues relating to an increasing import of biomass and bioenergy at a global level relate to the fragile position of emerging economies in terms of adequate environmental, social and land tenure rights. At the same time, the growing importance of biomass offer development opportunities for farmers in the developing world. NGOs and international development agencies, however, warn against large-scale, intensively managed biomass production sites. Risks in terms of food security, loss of biodiversity, deforestation, water- and soil quality need careful attention. International trade agreements and certification systems are important tools to alleviate negative consequences in this respect.