

Green Electricity in the Nordic Countries

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Introduction

This report summarizes renewable electricity policy measures in four Nordic countries as part of the REALISE project on the interaction between liberalised markets and measures supporting the market penetration of RES-E. The report is divided into two parts.

A first part presents an overview over policy instruments promoting green electricity in the Nordic countries. The overview is based on available policy documents and other documentation provided by energy industry and public authorities. The overview presents the policy instruments employed in the 1990s as well as the current policy instruments and approaches.

A second part presents the outcomes of dialogues with selected stakeholders in each of the four countries. These dialogues provide further background on the policy thinking as well as opinions of major actors that shape Nordic energy policy.

A final third part draws conclusions and present comparative analysis of Nordic policies as a stepping-stone towards the broader European comparison in the Realise project.

Part I

Nordic Green Electricity Resources and Policies, an Overview

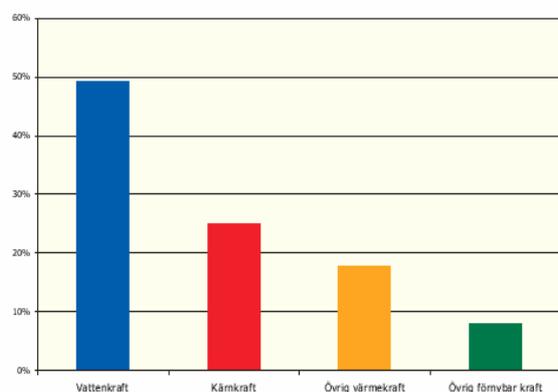
Renewables in the Nordic Electricity System: Current Status and Estimates for 2010¹

The Nordic region and particularly in Norway and Sweden, is fairly special in so far as they have large volumes of hydropower available to offer a bulk supply of large quantities of renewable electricity. In addition, specialised programmes for new renewable technologies supply limited amounts of renewables available for narrower niche markets. Figure 1 and 2 give an overview of electricity generation by sources for the Nordic region as a whole and for individual Nordic countries

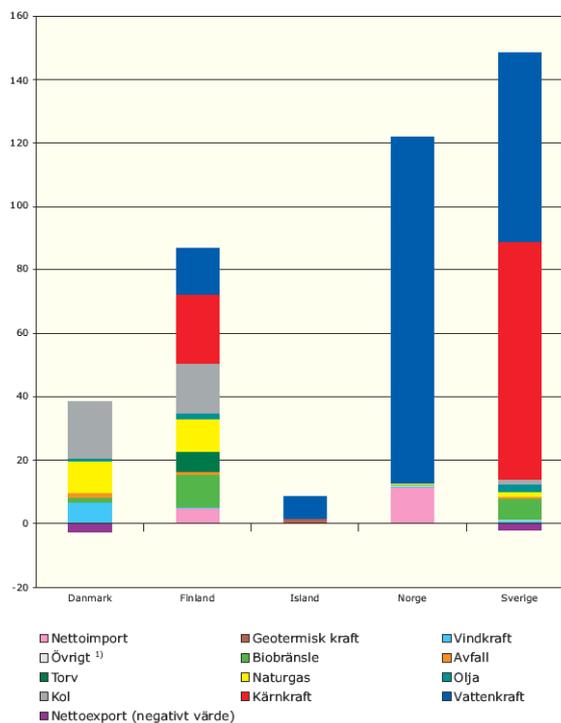
Figure 1 and 2: Electricity Generation by sources for the Nordic Region and Individual Nordic countries²

Elproduktion

S10 Total elproduktion inom Nordel 2004



S12 Elproduktion per energityp samt utbyte av el 2004, TWh



¹⁾ Danmark: Vindkraft

¹ Estimates for 2010 is largely based on Gundersen and Midttun (2004)

² Source Nordel www.nordel.org

The underlying production system consists of an installed capacity of about 92.6 MW whereof about 57 comes from renewables, dominantly from hydropower. 8.8 comes from other renewables than hydropower, and includes biofuels 4.3 MW and wind 3.8 MW (table 1).

Table 1

Installed Generation Capacity in the Nordic Electricity System³

S1 Installerad effekt den 31 december 2004, MW

	Danmark	Finland	Island	Norge	Sverige	Nordel
Installerad effekt totalt¹⁾	12 710	16 488	1 475	28 327	33 551	92 551
Värmekraft	8 888	11 094	117	121	15 274	35 494
- kärnkraft	-	2 671	-	-	9 471	12 142
Övrig värmekraft²⁾	8 888	8 423	117	121	5 803	23 352
- kondens- och värmekraft, fjärrvärme	8 237	6 627	-	8	3 863 ³⁾	18 735
- värmekraft, industri	381	996	-	49 ⁴⁾	317	1 743
- gasturbiner mm.	270	800	117	64	1 623 ³⁾	2 874
Förnybar kraft	3 822	5 394	1 358	28 206	18 277	57 057
- vattenkraft	11	2 986	1 156	27 925	16 137	48 215
Övrig förnybar kraft	3 811	2 408	202	281	2 140	8 842
- vindkraft	3 122	79	-	158	442	3 801
- biokraft	418	2 198	-	96	1 545	4 257
- avfall	271	131	-	27	153	582
- geotermisk kraft	-	-	202	-	-	202
Tillskott 2004	67	187	5	481	323	1 063
Bortfall 2004	188	-	6	254	132	580
"Malpåse"⁵⁾	100	255	-	-	500	855

¹⁾ Effekten visar summan av de enskilda aggregaternas nettoeffekt i kraftsystemet och kan därmed inte betraktas som den totala tillgängliga effekten vid en viss tidpunkt.

²⁾ Fossila bränslen (kol, olja mm.)

³⁾ Inkl. effekt i stationer som ingår i avtalen om effektreserv i Sverige.

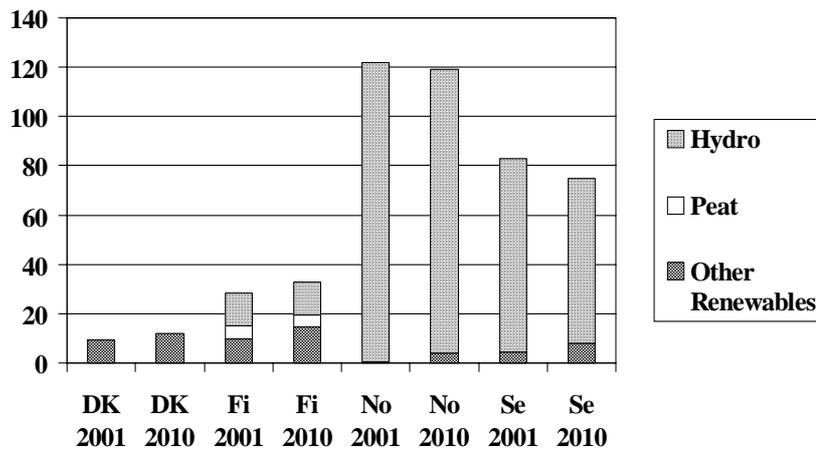
⁴⁾ Värmeåtervinning från industri.

⁵⁾ Anläggningar som ligger i malpåse är kapacitet som kan drifställas inom en viss tid och då ägaren till anläggningen så önskar. Kapaciteten är inte inkluderad i den totala installerade effekten.

In spite of stagnant growth, hydro will remain the dominant source for electricity generation also in 2010. Figure 3 presents an overview of hydropower and other renewable generation by country.

³ Source Nordel www.nordel.org

Figure 3 Electricity generation in the Nordic countries based on renewable energy

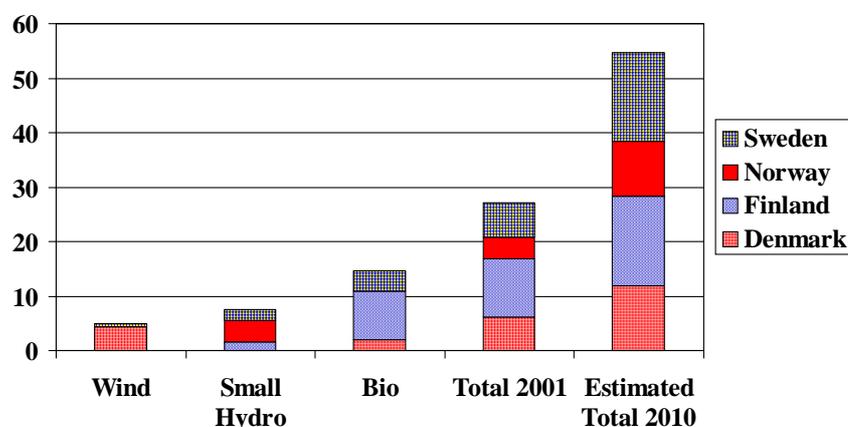


sources, in 2001 and 2010 (TWh)⁴

In addition to traditional energy sources including hydro-based electricity, the Nordic countries have a considerable portfolio of new renewable energy totalling about 29 TWh for the Nordic region as a whole in 2001. This includes wind power, particularly in Denmark, bio-fuel, particularly in Finland, and small-scale hydro particularly in Finland, Norway and Sweden. The volume of new renewables in the Nordic region is expected to almost double in 2010 (figure 4).

⁴ Source: www.nordel.org and Eurelectric

Figure 4. Supply of electricity based on new renewable energy sources in the Nordic region (TWh) 2001⁵



It is hard to get reliable forecasts on future electricity supply from new renewable energy sources to estimate the future renewable energy supply in 2010 shown in the last column. The Finnish estimate is based on a projection by Energiategollisuus ry⁶, which, by year 2010 estimates that the generation of electricity in Finland using wood-based bio fuels will increase to 8,75 TWh per year and to 6,25 TWh per for peat-based generation. This projection also expects a small increase in the use of wind power. The generation from small-scale hydropower (<10 MW) is estimated to 1,6 TWh⁷ in 2010.

In Sweden more than 90% of the electricity generation is derived from hydropower and nuclear power. It is assumed that the closing of nuclear power plants will commence after the year 2010. Replacing generation would primarily be composed of combined cycle plants firing natural gas and plants using renewable energy sources. The estimates for the Swedish new renewable supply are based on the Swedish Government energy initiative⁸, which emphasises an increasingly rapid growth in electricity generation from renewable energy sources. In accordance with this objective, electricity generation from renewable energy sources would increase from the current level of 5 TWh by 10 TWh to about 16 TWh in 2010. The initiative

⁵ The small scale hydro (<10 MW) generation is based on numbers from EU's Atlas project (http://europa.eu.int/comm/energy_transport/atlas/html/renewables.html)

⁶ Finnish Energy Industries Federation (www.energi.fi)

⁷ Atlas Project for EU

⁸ Regjeringens energiproposition 2001/02:143

expects most of the increase to come from wind power. It assumes that in 2015, wind power plants would provide as much as 10 TWh.

The Norwegian supply of new renewables in 2010 is based on forecasts by the energy industry association EBL⁹. This forecast assumes that regulated hydropower generation will not increase much in the future. However, it is possible to increase the hydropower capacity by 10-15 TWh by bringing on stream additional capacity provided by the modernisation and extension of existing hydropower plants. In addition to this, Energiutvalget (a government committee), has as part of its analysis of the energy- and power balance up until 2020, estimated a potential of biomass and heat pumps to 10 TWh and wind power to 6 TWh. When it comes to wind power, the Norwegian Water Resources and Energy Directorate (NVE) has been processing several applications for license to build windmills in Norway. If all these projects were to be accepted Norway would be able to produce 6 TWh from wind power within year 2010¹⁰. In addition to the wind power the small-scale hydro generation in Norway is also important and is calculated to about 4 TWh¹¹ in figure 4. The policy-shift from a certificate system to a feed in system with very low tariffs has, however, changed this scenario. Expectations for future renewable capacities here now considerably lower.

The Danish estimates are based on the two government plans Energy 2000 (1990) and Energy 21 from 1996. These plans have had CO₂ reduction as a main objective and have focused on renewable energy development as main pillars in the Danish strategy. The official Danish long-term energy plan, Energy 21 set a target of achieving 20% of electricity consumption (6,8 TWh) from renewables in 2003, this target has already been surpassed. Forecasts indicate that Denmark will reach 27% electricity (9,2 TWh) coming from renewables by 2003¹². It is assumed that most of the new electricity generated in Denmark up until 2010 will come from wind power.

⁹ Norwegian Electricity Industry Association (www.ebl.no)

¹⁰ Aftenposten 03/03/03

¹¹ 4 TWh from small scale hydropower is a moderate estimate based on information from NVE

¹² www.windpower.org Wind Energy News from Denmark, February 10, 2003

Major support instruments for RES-E in the Nordic Countries

The Nordic countries host a wide menu of different support systems for electricity generation from renewable sources. Furthermore, these systems have, in some countries, changed considerably over time. We shall here present a brief overview of the policy approaches and instruments in the 1990s and subsequently review the present approaches in the early 2000s.

Support Systems in the 1990s

The Nordic countries have taken quite diverse positions on regulatory instrumentation (table 2). Denmark has for several years efficiently used a feed in tariff model in order to support suppliers of electricity from renewable energy sources. In this model a long-term minimum price was guaranteed for electricity obtained from renewable sources. The feed-in tariffs have varied between DKK 0,33 and DKK 0,60 per kWh and have been highly influential in promoting electricity from especially wind power in Denmark by creating good conditions for investments in renewable generation capacity. In combination with standardised costs for grid connections and short lead times, this pricing system made it possible for developers to obtain financing for investments in e.g. wind power installations.

Together with favourable feed-in tariffs, investment support schemes were in place for renewable energy plants varying between 15-40 % depending on technology¹³. In 1999, the former Danish government initiated a process to replace the feed-in model with a quota-based system with tradable green certificates as an attempt to continue support schemes in a postulated more market conform way, but then abandoned the certificate idea and went for a combination of CO₂ quotas and a moderate and flat support for renewables in combination with project based support for offshore windmills.

¹³ Investment grants varied depending on technology: Solar: max 30%, Small biofuel units: max 16%, Heat pumps: max 15%, Biogas: 30-40%. Wind grants phased out in 1989.

Table 2

Support systems for the Greening of Electricity Industry in the 1990s¹⁴

Support Systems of the Past	Denmark	Finland	Norway	Sweden
Regulatory Framework	Plan and control intervention	General price based incentives (taxes and subsidies)	General price based incentives (taxes and subsidies)	General price based incentives (taxes and subsidies)
Regulatory instruments	-Feed-in tariffs -Purchase obl. on local utilities -Energy plans with detailed RES targets. -PSO on el sector, imposed by government. -R&D support -Investment support to wind (-89), bio (-01), solar, heat pumps (-02)	-Investment support to the development of, and investment in, projects reducing the energy consumption, using energy from renewable sources and reducing pollution. -Tax incentives	-Investment tax relief. -Production support for wind, solar and bio. -Investment support for central heating based on renewable energy sources. -R&D support. -Energy saving information.	-Tax incentives -Purchase obligation on local utilities -Exempted from energy tax -Investment support for wind, bio fuel, small hydro, solar.
Incentives/ Tariffs	Example Wind: Distribution companies pay 85% of the retail rate (consumer price ex. taxes and subs.) correspond to about DKK 0,33/kWh. Average payment close to DKK 0,60/kWh consisting of 0,33 + 0,27 (clean energy subsidy)	Ex Wind: The refund for el delivered to the network was equal to the electricity tax in category I, which was equal to 0,69 Euro cents/kWh. El produced by small hydro, biomass qualified for a refund like the electricity tax in category II, which was 0,42 Euro cents/kWh.	Ex Wind: Production support equal to 50% of the tax paid on electricity corresponded to NOK 0,0465/kWh	Ex Wind: No energy taxes are paid. The energy tax is repaid in form of an environmental bonus of SEK 0,162 /kWh (-01), 0,18 /kWh (-02) Reduced grid fee to el generators < 1500 kWh: SEK 0,09/ kWh
Investment support:	Wind: 0 Solarheat:30% Biogas:30-40% Bio fuel u.:16% Heatpumps:15%	Projects receive from 15 to 40% financial support of the invested amount depending on the innovative technologies used	25% (max 8000 NOK/kW). The windmill must produce >500 kW, and be part of a plant with a production > 1500 kW	Bio fuel/CHP: 25% Hydro<1,5 MW: 15% Wind <1,5 MW: 15% Solar heating: SEK 2.50 / kWh

¹⁴ For Further details see appendix

In Norway, Finland and Sweden, the main support instruments in the 1990s were investment support and tax incentives (in some cases seen as production support). The investment supports in the three countries have varied between 15% and 40%, and the energy sources supported are wind, solar, small hydro and bio fuels. The requirements for the support also vary among the countries and the energy sources. In Finland, the percentage of support to investment depends on the innovative technology used. Advanced technology solutions and new innovations can get subsidies up to 40 %. In most of the cases the support has been between 20 to 35 %. The maximum investment support given to wind power in Norway has been 25%. The investment support in Sweden given to wind power is 15%, while biofuels may receive as much as 25% in support. In Norway, there have also been specific criteria for investment support, namely that wind projects should use windmills with a minimum production capacity of 500 kW, and co-location in terms of wind parks.

Tax incentives in the three countries, in the 1990s have different forms and levels. In Finland, it was possible to apply for a production subsidy for electricity produced by wind power, hydropower¹⁵ and CHP production using wood or peat with a maximum capacity of 40 MW. In 2001, the refund to wind generated electricity delivered to the network was equal to the electricity tax in category I,¹⁶. To other RES-E the refund was equal to the electricity tax in category II.

In Norway, wind power and other new renewable energy sources have been exempted from an investment fee of 7%. In addition to investment related support, wind power producers have received production support equal to 50% of the tax paid on electricity.

In Sweden the tax incentives were given by an energy tax exemption on renewables. This tax was instead paid to the producers via an environmental bonus. This bonus amounted to 0,162 SEK/kWh in 2000. In addition to this, the green electricity generators are also faced with a reduced grid fee.

The support systems led to different developments in renewable energy sources in the Nordic countries. While Denmark has seen a great expansion of wind

¹⁵ with capacity less than 1 MW

¹⁶ Electricity is taxed on the basis of category II if it is used in the mining of minerals, industrial manufacturing and processing of goods or professional glasshouse cultivation and if the amount of electricity can be measured by delivery. All other cases fall under category I. The tax rate in category I was 4,1 Finnish penny and in category II 2,5 Finnish penny.

power due to stable and favourable feed-in tariffs, Finland and Sweden have stimulated expansion in the use of biofuels. Compared to the average EU pattern, the Nordic countries stand out, in the field of renewable generation, with extensive hydropower in Norway and Sweden, extensive wind power in Denmark and extensive biomass in Finland (table 3)

Table 3: Electricity Generation by sources¹⁷ⁱ

2003	Country/Region							
% of total	Norway	Sweden	Denmark	Finland	EU 15	EU 25	OECD Total	World
Coal	0,1 %	3,1 %	54,7 %	31,8 %	27,7 %	31,8 %	38,7 %	39,9 %
Oil	0,0 %	2,9 %	5,1 %	1,1 %	5,4 %	5,2 %	5,6 %	6,9 %
Gas	0,3 %	0,4 %	21,2 %	16,6 %	19,0 %	17,7 %	17,4 %	19,3 %
Biomass	0,2 %	3,9 %	3,6 %	11,2 %	1,3 %	1,2 %	1,1 %	0,8 %
Waste	0,2 %	0,3 %	3,2 %	0,9 %	0,9 %	0,8 %	0,6 %	0,4 %
Nuclear	0,0 %	49,7 %	0,0 %	27,0 %	32,5 %	31,2 %	22,4 %	15,7 %
Hydro	98,9 %	39,3 %	0,0 %	11,4 %	11,2 %	10,4 %	13,3 %	16,3 %
Geothermal	0,0 %	0,0 %	0,0 %	0,0 %	0,2 %	0,2 %	0,3 %	0,3 %
Solar PV	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %
Solar thermal	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %
Wind	0,2 %	0,5 %	12,0 %	0,1 %	1,6 %	1,4 %	0,6 %	0,4 %
Other sources	0,1 %	0,0 %	0,1 %	0,0 %	0,1 %	0,1 %	0,0 %	0,0 %
Total EL prod	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %
Total share renewables	99,5 %	44,0 %	18,9 %	23,6 %	15,2 %	14,0 %	15,9 %	18,2 %

The early 2000s: Current Development

One may observe considerable change in Nordic green-el policy in the early 2000s. The general trend has been towards more market based policy instruments, led by Sweden's development of a certificate market, which was supposed to be followed by Norway. However also the Danish policy has implicitly taken a stronger market twist, as a feed in system has been partly dismantled under the liberal-conservative Fogh Rasmussen government leaving a combination of CO2 markets and high electricity prices to be the major drivers for renewables. In addition offshore wind parks and replacement of existing old facilities are receiving ad hoc support. Finland has continued a policy of tax relief and production subsidies.

¹⁷ Source: <http://www.iea.org/Textbase/stats/index.asp>

Example World data from the electricity choice:

<http://www.iea.org/Textbase/stats/electricitydata.asp?country=World&SubmitA=Submit>

Wind data retrieved from the renewables section:

<http://www.iea.org/Textbase/stats/renewresult.asp>

Denmark

Following a period of strong policy-driven greening in the nineties, Denmark has had a clear liberal policy reorientation under the two liberal Fogh Rasmussen Governments. As pointed out in a recent strategic document (Energy Strategy 2005), Danish renewable energy policy is now dominantly based on exemption from energy levies and indirectly on the price lifts in the energy market created by CO₂ quotas on fossil fuels. Further development of wind power is supported through reinforcement and expansion of the electricity grid. The liberal-conservative government has also maintained some support to generators. In their scenario analysis, the Government expects these mechanisms to be sufficient to give considerable volumes of new renewable energy both biomass and wind, once the overcapacity generated by the previous support regime has been saturated. In addition, funds amounting to around 30 million DKK per year are allocated to research and development.

The Fogh Rasmussen government settled renewable energy policy with the opposition in an agreement in March 2004. This agreement includes a commitment to invest in two offshore windmill parks of 200MW each. Furthermore, the duty to give priority to electricity from wind generators was taken away and substituted by a flexible support system, depending on the electricity price. The agreement also contained a fee amounting to 12øre kWh to support dismantling of old and badly located windmills,.

Sweden

The Swedish Electricity certificate trading system initiated May 2003 marked a major shift in the Swedish support system for renewable electricity generation. It targets electricity generated from: Photovoltaics, wind power, biomass, geothermal energy, wave energy and small-scale hydro (under 1.5 MW, with some exceptions). In the first round, the objective was to achieve a 16.9% share of RES-E in electricity consumption by 2010.

The system included a quota obligation, ranging from 7.4% in 2003 to 16.9% in 2010, it obliged consumers to have this percentage of their electricity consumption as 'renewable' through certificates. In practice, the suppliers handled the quota, and could charge their customers for the electricity certificates. Energy-intensive industries were exempted from the obligation.

The certificate price was set on the market, initially with a minimum price and a fixed penalty. The minimum price was the buy-out price at which the government promises to buy certificates from producers. This started at 60 SEK/MWh in 2003 (about 0.66 ct/kWh). The penalty for non-compliance was set at 175 SEK/MWh in 2003 and 240 SEK/MWh in 2004, and then set to 150% of average annual market price in 2005.

In a recent law reform in Swedish authorities have prolonged the certificate system until 2030. The electricity certificate system was given a new ambition-level, where the goal was to have renewable energy generation shall increase to 17 Twh, in 2016, where after the quota will remain fixed. New production units will get certificates during 15 years, and production units existing when the system started, will get certificates until 2010, 2012 or 2014. The revision also involves will be transferral of quota obligation from consumers to electricity suppliers. At the same time, electricity intensive industry was given exemptions from quota obligations.

After a brief introductory period around 150 SEK pr MWh, the price of green certificates went up to the ceiling of 250 SEK more or less throughout 2004 and has since fallen below 200 SEK in 2005. For renewable generation entitled to green certificates, the total payment (including the electricity price) would then amount to between 450 and 600 SEK pr Mwh¹⁸ as of autumn 2006 (see figure 5).

¹⁸ The total payment to renewables generators must not be confounded with the market price for electricity in Sweden. The elcert price is only included for a small portion of the total electricity consumption.

Figure 5: Elcert prices and electricity prices

(source Greenstream)



Parallel to the revision of the certificate system, new support mechanisms for wind power were also proposed: The wind power investments and projects will get financial support in the physical planning process. Government will also extend the R&D on wind power production and get increased knowledge of impacts of production. Important instruments for stimulate to new investments in wind power is reduced real estate tax (from 0,5% to 0,2%) and simplified procedure of approval of smaller wind projects.

As part of the support, government will establish a new centre for wind power information. The revised strategy from the Swedish government is a part of an action plan to develop Swedish independency from use of oil for electricity production.

Provinces and local government will get extra financial support to accelerate the processes of wind power projects to make the procedure to go faster

The new specialised support scheme for wind comes in addition to traditional measures. Since 1994, small-scale RES-E production has been partially or totally exempted from the energy tax. This is beneficial for small-scale electricity producers. Furthermore, producers and consumers of biomass-based electricity have traditionally been exempted from various environmental taxes, such as the CO₂ tax, the sulphur tax and the NO_x levy. This is also part of the regulation under Act 1994:1776 and has been a part of Sweden's strategy for climate change.

Norway

The major shift in renewables policy in the 2000s in Norway has been the creation of ENOVA with a general and flexible support programme and the preparation for a Norwegian association to a joint Swedish-Norwegian certificate market.

Enova SF was officially created on June 22, 2001 and became operational on January 1, 2002. Enova SF is a public enterprise owned by the Norwegian Ministry of Petroleum and Energy.

Enova's 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.

The establishment of Enova signals a shift in Norway's organization and implementation of its energy efficiency and renewable energy policy. By gathering strategic policy responsibilities in a small, flexible and market oriented organization, Norway has wanted to create a pro-active agency that has the capacity to stimulate energy efficiency by motivating cost-effective and environmentally sound investment decisions. Enova SF enjoys considerable freedom with regard to the choice and composition of its strategic foci and policy measures.

Enova's objectives, adopted by the Norwegian Parliament in the spring of 2000, are:

- to limit energy use considerably more than if developments were allowed to continue unchecked;
- to increase annual use of water-based central heating based on new renewable energy sources, heat pumps and waste heat of 4 TWh by the year 2010;
- to install wind power capacity of 3 TWh by the year 2010
- and increase environmentally friendly land-based use of natural gas

Enova focuses its efforts on both the energy supply and the energy demand side, and the development and adoption of reliable methodologies for performance measurement and verification of results are high priorities. To achieve our objectives, the Norwegian Parliament set up an Energy Fund and indicated grants within a framework of up to NOK 5 billion (app. 650 million Euro) over a ten-year period.

The funding comes from a levy on the electricity distribution tariffs.

Enova manages the Energy Fund and finances programmes and initiatives that support and underpin national objectives. Enova has the freedom to choose its policy measures and the responsibility to establish incentives and financial funding schemes that will result in cost effective and environmentally sound investments.

In addition, under the previous conservative-liberal-christian democrat government Bondevik II (oct 01 to Oct 05) Norway planned to join the Swedish certificate market. The initiative came from Parliament in their debate over gas policy in 2003. Encouraged by Parliament, Government then mandated the Energy Agency to prepare a report, which was presented in 2004

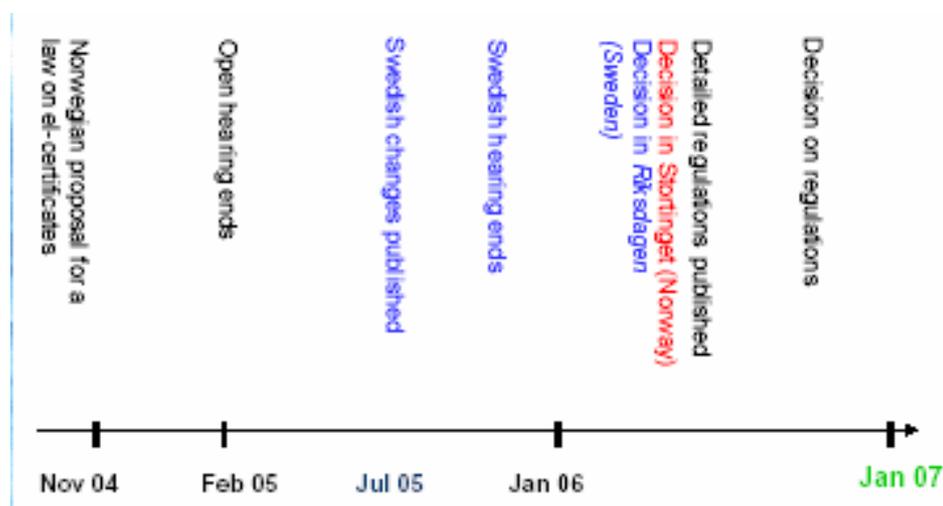
The report was positive to the creation of a joint certificate market and outlined some critical elements, including the following:

- In order to secure an attractive market for investment in renewables, the joint quota for 2016 should be set relatively high. The ambition must be more than 10 TWh and could be as high as 20 TWh
- Norway should, as far as possible follow Sweden's definition of renewables
- The certificate system should concern all investments in renewable generation, also current generation entitled to support
- The certificate system should be both size and technology neutral
- A trading-arena should be established with liquidity and transparent prices, which again presupposes standardised products and low transaction costs.
- Some transition arrangements should be put in place in order to interface constructively with ENOVA

The Norwegian Water Resources and Energy Directorate has been working constructively with STEM, its Swedish counterpart to settle technical details.

Implementation of the joint certificate market was originally planned for 2006, but has been postponed to 2007 to await a Swedish revision.

Figure 6 Schedule for Swedish-Norwegian Certificate Market¹⁹.



With the new labour-socialist-centre party government since October 2005, Norway chose to opt out of the plan for a joint Swedish-Norwegian certificate market. After having signalled an alternative support system for some time, further details of the Norwegian system were presented with the State budget in early October. Norway here opts for a feed in system, but combined with a long term new renewables target of 30 Twh in 2016, including also energy efficiency measures. Hence the renewables target is de facto considerably lower. The feed in system will be financed through a government fund of 20 billion NOK, with an expected return of 880 million NOK. The operative management of the system is largely left to ENOVA.

The new Norwegian feed in system will provide 4 øre, or about 0.48 Eurocent for small hydropower, 8 øre, or about 0.96 Eurocent pr kWh for windpower; 10 øre, or about 1.20 Eurocent pr Kwh for bioelectricity and immature technologies.

In addition to the feed in system, the new Norwegian government proposes a separate programme for support for infrastructure for district heating; support arrangements for households, and increased investment in energy efficiency.

Finland

The Finnish support system has remained fairly stable. They have continued a policy of investment subsidies and tax refunds from the 1990s and there seems to be a broad

¹⁹ From Mari Hegg Gundersen The Norwegian Water Resources and Energy Directorate. Presentation at a REALISE/International Energy Forum seminar October 2005

agreement that this policy approach has worked well. This policy apparently rests on a broad industrial and energy-industrial consensus.

Some of the new policy elements are flagged in the Finnish Ministry of Trade and Industry's Action Plan for Renewable Energy Sources in Finland. In the Action plan targets are given for the development of electricity production from renewable energy sources. The program objective is to enhance the penetration of RES technology on the market and increase the consumption of electricity from RES in absolute terms by 50% from the year 1995 to 2010. However, as the primary energy consumption will also grow in the future, this increase is not as high in relative terms. The same target of doubling the output also applies to electricity generation using renewable energies.

The main policy instruments used in Finland for renewable support are fiscal incentives - a refund for RES-E producers from tax revenues - and investment subsidies. The most important programmes before 1997 were the Bio energy Promotion Programme, approved by the Government in 1994 and the Wind power Programme drawn up by the Ministry of Trade and Industry in 1993. The objective of the Bio energy Promotion programme was to increase the use of Bio energy by 25% between 1992 and 2005. The wind power programme aims at construction of 100 MW of wind power capacity by 2005.

In 1997 the Finnish government approved the Finnish Energy Strategy. In this strategy the role of renewable energy sources was:
guiding the energy production structure towards an energy balance with a lower carbon content, promotion of the use of bio energy and other indigenous energy, maintaining the high standard of energy technology, ensuring the security of supply in the energy sector.

In April 1999 the Finnish Ministry of Trade and Industry published an Action Plan for Renewable Energy Sources in Finland focused on stimulating the production of renewable energy sources including wind, biomass, small hydro < 1 MW where the electricity tax paid by consumers is refunded as subsidy to the producer.

- Wind: 0.69 ct/kWh
- Biomass: 0.42 ct/kWh
- Small hydro: 0.42 ct/kWh

In addition, wind and other renewables may be supported by investment subsidies. The Council of State decision 29/99 sets maximum percentages of subsidy of 40% for wind power investment and 30% for other investments in renewable energy.

A working group, in 2003 prepared an updating of the 1999 action plan which recommended that the engagement of the National Technology Agency (Tekes) should be kept at least at the current level. It further proposed that the focus in the introduction of new technology should be placed on bioenergy projects. The working group also proposed stronger tax incentives for energy sources. The group also suggested that the over all target set for renewables by year 2010 should imply an increase of 30%.

More recently guidelines for Energy and Climate policy in the near future – a national strategy for implementation of the Kyoto Protocol, was presented by the Finnish government to parliament in November 2005 presents an ambition to maintain the renewable share of primary energy at around 30% under the coming 10-15 years. With an expected increase in total energy consumption in the same period of 25% this nevertheless implies considerable expansion of renewable energy. The goal of the Finnish government is particularly to increase the use of waste wood, energy crops, waste burning and biogas.

EU commitments

The three Nordic EU member countries have made substantive commitments to contribute to reaching European RES-E goals, as indicated in table 4. According to 2004 reports, however, both Sweden and Denmark have some way to go before they achieve the target.

Table 4: RES-E Nordic Countries

	1997	2002	2004	2010
Sweden	49.1		50	60
Denmark	8.7		20	29
Finland	24.7	25	28	31.5
Norway	99		94	90

Norway, however, starting from around 99% will be on a track towards substantive reduction, following the build-up of some gas-based electricity generation.

Sweden

In the EU Renewables Directive, the indicative target for Sweden has been set at 60% of the electricity consumption in 2010 (including large hydro). This is an increase of more than 10% compared to the share of 49.1% in 1997. Furthermore, a 'planning objective' is proposed by the Government and states a national target for wind power of 10 TWh by the year 2015. The main purpose is to make wind power visible in physical planning and in connection with the granting of permits

Denmark

Denmark has taken upon itself the most ambitious scaling up of renewable energy, from 8.7% in 1997 to 29% in 2010, mainly through wind power and biomass based electricity. However, Denmark started from an exceptionally low level in a Nordic context.

Finland

In April 1999 the Finnish Ministry of Trade and Industry published an Action Plan for Renewable Energy Sources in Finland. The program objective is to increase the consumption of electricity from RES in absolute terms by 50% from the year 1995 to 2010. Targets in the EU directive on Renewable Energy Sources are an increase up to 31.5% RES-E in 2010. (Act. Plan) from 24.7 in 1997.

Norway

As opposed to the other Nordic countries, Norway is on a track towards reduction of renewable electricity's share of electricity generation from around 99% in 1997 to around 90% in 2010, to give room for some growth in gas power. Since most of Norway's electricity is already generated from hydro plants, the national targets focus more on the introduction of specific technologies (wind energy and heat production from biomass) than on general increase of RES.

Voluntary green el markets

Alongside policy-driven stimuli, renewables are also promoted by voluntary arrangements. Given the extensive freedom of consumer choice of supplier in liberalized electricity markets, with relatively low switching costs, consumers have chosen to opt for renewable energy on a voluntary basis.

The voluntary demand for renewable electricity in the Nordic region has primarily been facilitated by the Swedish Society for Nature Conservation (SSNCs) eco-labelling scheme for renewable electricity, “Bra Miljøval” and the Finnish label Norppa.

As a private labelling system, “Bra Miljøval” was introduced in the fall of 1995 by the SSNC, and was designed to facilitate environmental choice in the electricity retail market in the coming liberalised market. The system does not see the development of new renewable capacity development as its main priority, but is rather focused on redirecting supply towards green capacities and stimulating the phase out of the most environmentally undesirable plants²⁰. The scheme thereby includes hydropower and thereby offers large volumes at cheap prices²¹.

Under new criteria in place from January 1st 2002, the certification criteria have been tightened. The power content from the other renewable electricity sources must make up at least 5 % of the delivered and labelled volume. There are also restricted criteria on the hydropower.

Demand volumes in the voluntary market

In Sweden in the year 2000, 7% of all electricity sold to final consumers was sold under labelled contracts adding up to about 9 TWh. In 2001 the electricity sold under this label was 14 TWh²². Finland does also have a voluntary label, “Norppa”, which is the equivalent to the “Bra Miljøval” label in Sweden. The demand for this label however, is much lower in Finland than in Sweden, only 80 GWh was certified under this label in 2001.

²⁰ See Naturskyddsföreningen (1995)

²¹ Renewable energy sources eligible for certification under the environmental labelling system (under the first set of certification criteria between 1996-2001) include: wind, solar, bio fuels, and hydro resources. The hydroelectric plants must have been built before 1996, meet minimum flow standards, and contribute to an impact mitigation fund. The premium on the green electricity has varied according to the source. For solar energy a premium of 17 Swedish ore/kWh has been paid. For hydropower the premiums were from 0 to 0,5 ore/kWh.

²² (<http://www.snf.se>).

Assuming a modest growth rate of 5% a year up until 2010 the total voluntary demand for labelled electricity in Sweden would amount to 21,7 TWh in 2010. Taking into consideration the latest criteria for this label, 5% of the certified electricity should come from new renewable energy sources (or about 1,1 TWh). There has only been very low demand for green el in Norway, possibly reflecting the fact that electricity in Norway is close to 100 % from renewables.

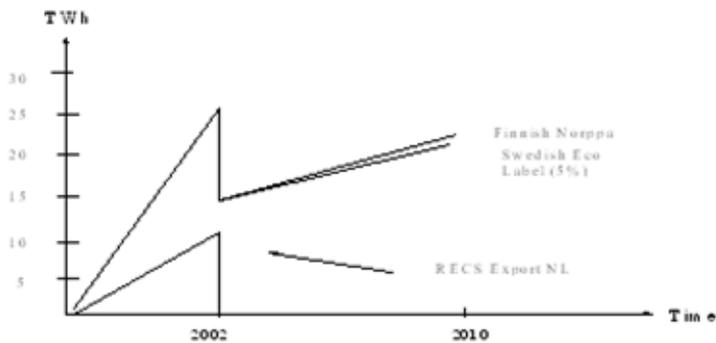
In addition comes demand for green el from foreign markets, notably the Dutch market, where extensive amounts of green electricity were traded from Nordic suppliers. By the end of year 2002 about 13 TWh from the Nordic countries was certified according to RECS²³. Most of these certificates were sold to the Netherlands.

The very beneficial Dutch support system to green electricity producers outside Netherlands, however, has changed dramatically²⁴ as the country has moved from a green certificate model to a feed-in tariff model in order to support new renewable energy.

²³ The 'Renewable Energy Certificate System' - RECS - is a unique initiative that enables international trade in renewable energy by uncoupling environmental value from the associated physical energy. RECS provides a mechanism for representing a specific instance of the production of a megawatt hour of renewable electricity by a unique certificate which can be transferred from owner to owner before being used as proof of generation, or exchanged for financial support. (www.recscmo.com)

²⁴ The Dutch MEP-law (Environment Quality and Environment Production (MEP)), in which fixed tariffs for national renewable energy producers guaranteed for ten years, is regulated. The implementation of the feed-in tariffs for Dutch renewable energy producers will supposedly take place the 1st of July, or maybe June. (www.greenprices.com)

Figure 7. Accumulated volume in voluntary markets in 2002²⁵ and projections for 2010.



Endorsed by EU regulation, both the RECS (renewable energy certificate schemes) and GO's (guarantees of origine) have continued to be traded on various European markets. There are two distinct customer groups. The first comprises electricity suppliers, driven by new EU rules which require them to disclose on customer bills from where they are sourcing their power. The second, smaller group is made up of companies and individuals buying certificates to 'green' their electricity consumption. The main buyers are therefore from the countries where the disclosure requirement has been implemented in national legislation, notably Austria and the Netherlands. The sell-side is mostly made up of countries with large volumes of renewable energy-based electricity production and the necessary registries in place, notably the Nordic countries (Nykänen and Müller 2006).

²⁵ The Swedish Eco Label is calculated with a 5% yearly increase, based on 14 TWh in 2001. This is a modest increase and reflects the new and stricter criteria for this label. The Finnish Norppa has had a small increase from 0,08 TWh to 1 TWh. The RECS figures are based on certificates issued by 31.12.2002 and sold to the Netherlands. The figure also reflects the fact that the Dutch demand for RECS certificates from the Nordic countries will disappear after 2002. (www.recscmo.com)

Part II Nordic Green EI policies – Outlook from Major Stakeholders

The following sections summarises the main points from dialogues held with the most important stakeholders in each of the four Nordic countries.

Danish green ei policy – Outlook from Major Stakeholders

Introduction

Some of the core issues coming out of the dialogue with Danish stakeholders are: a fairly broad consensus on a liberalist re-orientation from industry and energy industry, combined with some expression of fatigue with playing a pioneering role for green electricity in Europe during the past social-democratic regime.

The new liberalist policy was met by more scepticism from wind energy actors (dominant renewable in Denmark) and to some extent the ecological movement.

There was a joint concern with all stakeholders about the late integration of European CO2 policy and with lacking integration into the North German market.

There was also concern with investment uncertainty and possible capacity limitation in Danish electricity supply as well as price effects of under-investment.

The following summary builds on stakeholder dialogues with selected actors within the Danish energy sector including:

- Det økologiske råd – The Ecological Council²⁶ (EC)
- Dansk Industri – Confederation of Danish Industries²⁷ (DI)
- Dansk Energi – Association of Danish Energy Companies²⁸ (DE)

26 The Ecological Council (Det Økologiske Råd) is a danish NGO founded in 1991. Its main objective is to promote sustainable patterns of development, where environmental concerns, social justice and human well-being are main focal points. The Ecological Council is different from other Danish NGOs in the way that it is an academic organisation dealing with environmental policy on a scientific basis, but at the same time trying to inform and have a dialogue with both politicians and the general public. <http://www.ecocouncil.dk>. Interview with Søren Dyck-Madsen

27 The Confederation of Danish Industries (Dansk Industri - DI) is a private organisation funded, owned and managed entirely by currently 6.400 companies within the manufacturing and service industries. DI aims to provide the best possible working conditions for the Danish industry. DI's membership is comprised by currently 6,100 private enterprises within manufacturing and services covering virtually all sub-sectors. <http://www.di.dk>. Interview with Hans Erik Kristoffersen.

28 Association of Danish Energy Companies is an industry association and umbrella organisation for associations and groups of energy companies in Denmark. The Association's membership is predominantly made up of Denmark's energy companies. Association of Danish Energy Companies' members are affiliated under four main groupings. A

- Energistyrelsen – Danish Energy Authority²⁹ (DEA)
- NESA³⁰
- Vindmølleindustrien – Danish Wind Industry Association³¹ (WI)

Energy-Industrial Consensus on Liberalisation with Scepticism from Wind Industry and the Ecological Council

The liberal-conservative Fogh Rasmussen government was seen by both energy- and industrial stakeholders to shift the Danish greening of electricity policy towards market solutions. The current Government outlook, as presented by the representative of the DEA and as reported in “Energy Strategy for 2025” envisions that the market effect of higher electricity prices, following the high oil prices and high CO2 prices will be sufficient to further renewable energy, with the maintenance of the present support of 10 øre pr kWh.

DE pointed out that the new liberalistic regime implied, among other things, considerable cuts in support to renewable energy, particularly wind. However it was emphasised that this cutback in wind energy support had already started under the latest social-democratic government. DE was thus very satisfied with the over all strategy presented by the current government. They pointed to the fact that the previous planned economy had given Denmark extensive over-capacity, as both the renewables and the traditional energy sector had been allowed to expand at the same time.

number of associate members are also attached to the Association. <http://www.danskenergi.dk>. Interview with Jesper Koch.

29 The Danish Energy Authority was established in 1976, and as of 18 February 2005 is an Authority under the Ministry of Transport and Energy. The Danish Energy Authority carries out tasks, nationally and internationally, in relation to the production, supply and consumption of energy. This means that the Authority is responsible for the whole chain of tasks linked to the production of energy and its transportation through pipelines to the stage where oil, natural gas, heat, electricity etc. are utilised for energy services by the consumer. www.ens.dk. Interview with Henrik Lawaetz.

30 NESA are among the biggest Danish players in the financial electricity market with activities in electricity trading, distribution and transmission. Nesa's grid area numbers around 560,000 connection points and comprises one million people. www.nesa.dk. Interview with Birger Berg.

31 The Danish Wind Industry Association (DWIA) is a non-profit association whose purpose is to promote wind energy at home and abroad. The association was founded in 1981. DWIA today represents 99.9 per cent of Danish wind turbine manufacturing measured in MW and more than 112 companies with activities in the Danish wind industry. <http://www.windpower.dk>. Interview with Jakob Lau Holst.

The DI supports the position of the DE, and the new liberalistic agenda. They are not proponents of special support for green electricity and therefore welcome the new liberal policy approach.

Representatives of the WI are not, however, satisfied with the new policy. They consider the present support for windmills as too weak to constitute a major driver for further expansion. The windmill association did, however, appreciate the establishment of two offshore windmill parks, and the plan to support a modernisation of several existing onshore windmill parks over the next five years.

The windmill association sees a need for better economy and more supportive local planning, and building down of administrative barriers.

The EC experiences the present Danish policy- as a *laissez faire* position, where there are no stable frames. Energy strategy 2025 are “thoughts about the future”, but no stable plan. They point out the insecurity this entails for “green “ investors. EC sees the present Government as not being willing to take on more than already achieved.

The energy policy compromise, as EC sees it is that the energy generation companies are privatised, the transmission remains state owned and the municipalities have taken over local distribution.

The EC is also concerned with the liberal-conservative government’s promise not to raise taxes for any group. It thereby undermines new effective polluter pay policies.

Concern with High Electricity Prices and CO2 costs for Industry

The representatives of Danish Industry (Dansk industri) pointed out that energy intensive industry, including cement, steel and paper & pulp industry is highly affected by high electricity prices. As global actors, these industries are loosing out to competitors from countries that impose lesser environmental burdens.

DI has made analyses of price developments in the CO2 market and have had problems with identifying reasons for price increases. There is concern, therefore that the price formation is skewed. Nevertheless, DI concedes that wind generators have advantages of CO2 based price increases if oil prices remain high and the price of co2 quotas retians its high level, and today’s support remains, DI foresees considerable increase of wind power in Danish electricity supply

Although Denmark is well on track to reach its renewable goals for 2010, the opinion of DI is that the EU as a whole will need both quotas and renewable support systems to reach the goal.

DE joins the DI in being concerned with CO2 quota prices. They are also concerned with rumours that Nordic hydropower producers have acted strategically in the CO2 market.

Wind Energy Beyond the Pioneering Phase

All actors agree that the liberal-conservative government has reduced the support systems for renewable energy. This has strongly reduced construction of new onshore windmills. In addition two new offshore windmill parks are out for tender as result of a specific political compromise. As far as alternative support systems are concerned,

DE has considered the certificate model, but is generally of the opinion that the CO2 emissions trading is sufficient. They argue that politically determined investments will create uncertainty in the market because of political interference in the regulation of private consumption. DE is also concerned that such a system could create large price variations. There is also concern with the fact that only a few countries will participate in this market.

Under the present regime, windmill development onshore largely comes through gradual substitution of old mills. DEA points out that there is no great popular resistance against windmills in principle, the only thing is the localisation. The new mills are larger than the old, and therefore have to carry warning lights for planes. There is some concerns among people about this.

According to DEA there has been some disagreement between the owners of the old mills and the new larger replacement mills about when to undertake the replacement. The owners of the older mills want to have them running as long as possible to harvest profit.

The environmental movement (EC) wishes to see a tighter interplay between wind and heat power systems, in parallel with existing power markets. At the present EC sees the wind system backed up by some flexibility in the thermal system, but this entails a lower market price, which is negative for the wind producers.

Disfavoured in Europe – Want to see a European market with More Common Rules

Danish Industry is clearly oriented at integrating the Danish sector more into a broader EU market with a common CO2 market and common green certificates. Without such measures they experience that competition is skewed against them. Such development could possibly be furthered by EU regulation.

DI points out that there is increasing need for a European agenda on wind power. A coordination, where there is need for investments across national borders. The environmental concerns in Europe is a common challenge, and need common solutions.

DE follows DI's concern with unequal competition in EU quota markets. German power companies have far better framework condition, and this serves to limit competition for new power construction. DE sees Danish energy companies as relatively efficient and fair-playing in a European perspective.

EC also points out that DK, like Germany, has a larger CO2 reduction demand than other countries. When it comes to wind DK has taken upon itself a larger burden than other European countries. The EC joins the general Danish concern about the EU allowing too much diversity in commitments and policy approaches from country to country.

A Nordic Certificate Market?

A common Nordic certificate system is, according to DEA, from a Danish point of view not very relevant at the present. Offshore windmill parks are not adequately financed over certificate markets and the certificate market does not play well together with the auction arrangement for the windmill parks. DEA believes that the common attitude is that Danish actors would like to see a larger certificate market before Denmark would join in.

As far as certificates are concerned, DI points to the fact that the legal basis for certificates is ready, just as is the infrastructure. The question is a political one. Neither government, opposition or industry is prepared to push this issues. The debate may come up again when/if Norway joins the Swedish certificate market, but not before.

WI is of the opinion that the certificate market opens large possibilities for Danish wind industry, but this depends to a large extent on the capacity to accommodate technology in local area planning.

Concern with the Capacity Gap

DI is concerned with uncertainty for investors in the Danish electricity market. With large uncertainty investments will not materialise. DI sees this uncertainty as largely politically created. Against this background, DI is concerned with security of supply. According to DI Government is not willing to stimulate investments before 2015. DI wishes to see a stronger focus on security of supply. DI would also like to see security of supply discussed on a European level.

DE is concerned with price variations contributing to insecurity amongst owners and investors. Industry needs high prices and long-term stability in framework conditions. In a Nordic market, with extensive supply of hydropower, prices will necessarily follow climatic variations (dry and wet years). DE claims that the electricity price must rise to further investments and shift to biomass and CO₂ cleansing by extraction of CO₂ from coal power.

On the other hand, DE expresses concern with prices, over time, going too high, because of lacking investment. This may create political reactions against the market.

Innovation and Investment

When it comes to research and development, DI envisages solutions where one supports entrepreneurs' ability to commercialise their ideas. There is a need to find closer ties between research and markets. A solution may be a combination of publicly facilitated niche markets and venture capital. Both the public sector, industry and venture capitalists may contribute with competencies. DI here presented the US as a frontrunner, where ideas more efficiently than in Europe were presented to the commercial market.

DI points out that German support systems are better developed than in Denmark, resulting in Danish wind industry moving towards Germany and developing collaboration with German industry.

DE is also concerned with present relaxation of investment support for new renewables. When new capacities are needed after 2010, investments will come too late. DE therefore asks for a clearer R&D policy, as this has varied considerably over the latter years.

DE points out that windmill development has stagnated as a result of support failure. This must be rectified to keep up the momentum in development of Danish wind industry. The wish is to have a new phase to further develop offshore turbines, for instance through pilot projects.

DE also points out that investments that are undertaken on a short term basis entails loss of focus on technological innovation. This is seen as one of the negative effects of the market-approach.

DE also wishes to see a stronger integration between stationary energy and the transport sector. There is a potential for such development, but it is limited by present tariffs.

DEA pointed out that the new support policy rejected the certificate model, under the assumption that the regular market price, with the CO2 quota system would, with a small support, be sufficient to support new renewable energy. In addition, comes the decision to build two offshore windmill parks, that came about as an energy policy compromise between government and the opposition.

DEA also underlined that some investors have been concerned with the short time horizons with political stability. The concern with what should happen after 2012 leads to reluctant investors

WI is concerned about being able to create demonstration projects. Current tenders only allows display of yesterday's mature technology and do not give any opportunity for technology demonstration. This concern is also shared by the EC

Grid Access for Wind including Trade Barriers to Europe

DI wishes to strengthen foreign grid connections, especially towards Germany. There are bottlenecks at several points on the border.

DEA is also concerned with transmission capacity to other Nordic countries, as a prerequisite for further wind power.

WI joins the other stakeholders in demanding more investment in European grid connections, so that surplus-production in Denmark can find outlets on the larger European market.

Swedish green el policy – Outlook from Major Stakeholders

Introduction

Some of the core issues coming out of the dialogue with Swedish stakeholders were:

- Mixed opinions about the certificate system, but acceptance that the system was there to stay
- Concerns with the functioning of the certificate system
- Concerns with expanding towards a common market with Norway
- A focus on the need for complementary support systems to the certificate system
- Concern with energy efficiency

The following summary builds on stakeholder dialogues with selected actors within the Swedish energy sector including:

- Svebio (Svenska Bioenergiföreningen) - Swedish Bioenergy association³² (SBA)
- Energimyndigheten (STEM) - Swedish Energy Agency³³ (SEA)
- Svensk Energi - Swedenergy³⁴ SE
- Svenska Naturskyddsföreningen – Swedish Society for Nature Conservation³⁵ (SNF)

³² Swedish Bioenergy Association (Svebio/Svenska Bioenergiföreningen) is a non profit organization and its main objective is to support the development of bioenergy in Sweden. SVEBIO consists of around 400 members, most of them enterprises active in producing/providing biofuel or using biofuels on a larger scale. Among SVEBIO's members there are also manufacturers/providers of burning equipment, machinery for collection and processing of biofuels. www.swebio.se. Interview with Johan Vinterbäck.

³³ Swedish Energy Agency (Energimyndigheten (STEM)) which was formed in 1998, works towards transforming the Swedish energy system into an ecological and economically sustainable system through guiding state capital towards the area of energy. This is done in collaboration with trade and industry, energy companies, municipalities and the research community. www.stem.se. Interview with Thomas Levander and Mathias Normand.

³⁴ Swedenergy (Svensk Energi) is an industry association and umbrella organisation for associations and groups of energy companies in Sweden. Their main objective is to be a speaking channel for the members and also to provide competence building and share information. The Association's membership is predominantly made up of Sweden's energy companies and organizations. www.svenskenergi.se. Interview with Maria Sunér.

³⁵ The Swedish Society for Nature Conservation (Svenska Naturskyddsföreningen) is the biggest nature conservation and environmental organisation in Sweden with 170 000 members and 274 local branches across the whole country.

Certificates

The electricity certificate system is obviously of central concern to Swedish energy- and environmental actors. The certificate system was established by the Social Democrats and the Centre party, but opposed by the Liberal and Conservatives, that have both been critical to certificates and advocated a feed in solution.

SNF was critical to certificates in their hearing at to the proposal. They emphasised that the environmental costs should be embedded in the energy prices according to the polluter pays principle. Furthermore, given that the certificate system was established, they claimed that the ambitions were too low. They were also sceptical to the energy carriers included in the certificate system as well as a number of other features:

- Hydropower, also small, should not be included
- El-intensive industry should not be exempted from the quotas
- The quota levels should be heightened extensively to reach the EU and Swedish goals for climate effects

According to SNF the elcert system should under all circumstances only be utilised for biofuels and land-based wind power, as other, less mature sources would need other support mechanisms.

Along with SNF, Svebio has taken a critical stand to the elcert model. Svebio would prefer a fixed price system that might give more stable prices. The problem with the certificate system is that the quota may be set too low. Biomass has taken as much as 75-80% of the certificate market.

STEM, on the other hand pointed out that the certificate system has been relatively successful. It has achieved considerable progress in expanding new renewable generation at a relatively low cost. STEM pointed out that seen from a fiscal point of view, the system has the advantage of not creating state expenditure. The system is financed by extra prices paid by consumers. Nevertheless, STEM pointed out that the small wind producers have been sceptical to the certificate system, and also wished for a feed in system.

STEM agrees with most other stakeholders in the Swedish market, that the short time horizon, until 2010 has been a problem in terms of triggering major new investments. The system has led to fuel conversion rather than new technology

development. The present proposal to expand the certificate market to 2030 with rising quotas until 2016 is thus welcomed as a stimulus to new investments.

The same critique against the short time horizon is shared by SE. 2010 is too short for investments in new capacity, often with a lead time of 5 years

In spite of a general positive attitude to the certificate market, STEM has been concerned with the lack of transparency in the market. 1/3 of the trading is undertaken on a bilateral basis, 1/3 over brokers and 1/3 within vertically integrated companies. SE, in turn, sees the credibility problem with ever lasting support.

Symmetry in the Coming Swedish-Norwegian Market

Our main stakeholder dialogue with Swedish actors was undertaken before the reversal of the Norwegian certificate policy and therefore reflects concerns about a common certificate market. As STEM saw it, a common market must have fairly symmetric regulation. The targets should be set at the same level, if not one country's citizens would be paying an unacceptable share of the bill. There will also be consideration of market shares for respective national producers in the common market.

SE was positive to the common Swedish-Norwegian market. One is aware that this will provide a more cost-efficient system, leading to lower certificate prices for the customers. In the middle of March 06 there will be a bill to the Riksdag, at which point the outline of the systems on both sides must be clear. SE has had talks with its sister organisation EBL in Norway. There is a certain concern among Swedish actors, however, that Norway may profit most.

SE wished to see a Nordic system in the long run. Finland is fairly sceptical, while Denmark is a bit more open. SE points out that the certificate system has an explicit goal of providing green energy, but that it also has the advantage of increasing security of supply in the Swedish and Nordic region.

Local heat & power

SBA has been concerned with issues around the inclusion of local heat power systems in the certificate market needs further consideration, as these actors operate in a monopoly system locally at the same time as they operate in a larger competitive national market.

Much of the pressure for combined heat and power, as SBA sees it came from taxes on fossile fuels. The CO2 challenge gives incentives for fuel switch in companied heat and power.

Need for other support systems

Many Swedish stakeholders point out that the certificate system, although it has its merits, also has its limits. Offshore windmills and solar cells need support systems beyond certificates.

SNF is also concerned with the fact that the elcert system could reach its goals within existing generation capacity, and would thus not initiate new capacity. SNF points out that Sweden is not going to achieve the RES-E goals of renewable electricity that is described in the RES E directive (2001/3648/EG).

Svebio, along with SNF was highly critical to the reduction of the Swedish research support, which was more than halved. Government is, however, now willing to back up the programme again.

Nevertheless, there are other operative support mechanisms. Besides the certificate system, STEM points out that there is support for wind power and a sum of money for technologies that are not commercially sustainable as of today. SE also points out that the Certificate system is supplemented with other measures. There is an environmental bonus that expires in 2009.

SE is very clear about ELCERT not being an innovation driver. The feed in system was more nuanced, and one could give differentiated support to emerging and semi- mature technologies.

Interplay between markets

The interplay between different market instruments is yet another interesting questions. As pointed out by STEM, the conversion towards bio-based power generation in the electricity sector contributes to lowering of CO2, more than it stimulates investment in renewable energy. The interplay between the two instruments is interesting. If electricity prices rise, the gap between costs of renewable generation and the market price (including CO2 emission prices) will diminish so that the certificate prices will be very low.

Energy Efficiency

SNF claims that the most important environmental goal is to focus on energy efficiency and development towards a sustainable energy system. Government should therefore open up trade with “white certificates”. SNF is strongly against further development of hydropower, inclusive increasing efficiency of existing hydropower.

The fuel debate

Swedish environmental organisations do not accept hydro, even small scale, under the support system. Sweden on the other hand accepts peat, which is not considered renewable in the EU RECS system.

The Nuclear debate

The nuclear debate was not a dominant issue in the dialogues, but implicitly came up with SNF, who, in a recent publication, building on estimates from renewables industry, show that the renewables potential is extensive, and may allow a phaseout of nuclear energy (a professed Swedish energy policy goal) within 15 years (Energipusslet 2020- SNF november 2005).

Norwegian green el policy – Outlook from major stakeholders

Some of the core issues coming out of the dialogue with Norwegian stakeholders were that:

- Until the Government reversal in spring 2006, the orientation of Norwegian energy industry has been focused on the coming certificate market with Sweden. Energy industry has been generally positive, although there has been concern with Norwegian paper and pulp industry about negative discrimination compared to Swedish industry. However large energy consuming process industry has been critical to the idea.
- It seems to be widely accepted both by government and energy industry that high electricity prices and CO2 prices are not sufficient to elicit major investment in new renewables such as wind power.

- Small hydropower seems, however, in many cases to be feasible, at current market prices, and a considerable number of projects have been licensed and are under construction.
- The question of gas power has continued to be debated, ever since it led to a government crisis for the Christian Democrat - Centre government a few years ago.
- Several projects have been licensed, but only one – Kårstø is under construction. It will, however, have to introduce CO2 reinjection within 2009, which is conceived as a very ambitious plan.
- Within industry, some debate has also been raised about how some of the investments in new renewable generation have implications for grid investments, and who should pay for possible grid reinforcement.
- The shift to a Labour-Socialist Government has led to some reconsideration of environmental issues affecting electricity industry. Tensions between the industrially oriented Labour party and the more environmentally oriented Socialist party has materialised particularly over the petroleum exploration in Northern and arctic zones. The Socialist party has also been concerned with probable windfall profits that may result from the certificate market and has therefore been reluctant to promote a technology neutral certificate system, in accordance with Swedish policy.
- The outcome of the Labour-Socialist government was, in the first round a delay of the common market, with Sweden, and then the introduction of a feed in system based on very low tariffs.

The following summary builds on stakeholder dialogues with selected actors in the Norwegian energy sector including:

- The Norwegian Water Resources and Energy Directorate (NVE),³⁶
- The Norwegian Society for the Conservation of Nature (NSCN)³⁷
- The Norwegian Electricity Industry Association (EBL)³⁸
- ENOVA, a public company with agency-like tasks established to stimulate energy efficiency and renewable energy policy³⁹
- GreenStream Network AS⁴⁰

The Certificate market & Swedish-Norwegian coordination

The Norwegian Society for the Conservation of Nature (NSCN) was in principle positive to a certificate market, but argues for changes on several points. A first concern is the windfall profits that one of the last large hydropower projects that is due to be licensed, will get super profits from the certificates on top of already profitable generation at current market prices.

According to NVE, the technical preconditions for a joint certificate market are well prepared, and NVE and their counterpart – STEM have only been awaiting political signals to implement the system. There is an expectation, that Sweden will be a dominant supplier of biofuels, while Norway will be a dominant supplier of small hydro and wind. However, the mix depends extensively on the ambition levels. There

³⁶ The Norwegian Water Resources and Energy Directorate (NVE) is subordinated to the Ministry of Petroleum and Energy, and is responsible for the administration of Norway's water and energy resources. The goals of NVE are to ensure consistent and environmentally sound management of water resources, promote an efficient energy market and cost-effective energy systems, and contribute to the economic utilization of energy. www.nve.no. Interview with Mari Hegg Gundersen.

³⁷ The Norwegian Society for the Conservation of Nature (NSCN) is a Norwegian NGO founded in 1914. FoEN was founded in 1914 and is Norway's largest environmental conservation organization with a total of about 28,000 members. FoEN works with the whole range of important environmental issues. Their main focus is on biodiversity, transport/energy/climate and sustainable consumption and production. The organization has a staff of about 20 full and part-time employees. www.naturvernforbundet.no. Interview with Tore Killingland.

³⁸ Norwegian Electricity Industry Association (EBL) is the trade organisation for around 260 generators, suppliers, distributors and a few water regulation associations. The main purpose of EBL is to deal with industry-related economic and political issues on behalf of its members, to provide as good framework conditions for the industry as possible with respect to financial, legal and technical issues. Internationally EBL represents Norway in Eurelectric – UNION OF THE ELECTRICITY INDUSTRY. www.ebl.no. Interview with Hans Magne Ådland.

³⁹ Enova SF was officially created on June 22, 2001 and became operational on January 1, 2002. Enova SF is a public enterprise owned by the Royal Norwegian Ministry of Petroleum and Energy. Enova SF's 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. Enova SF advises the Ministry in questions relating to energy efficiency and new renewable energy. www.enova.no. Interview with Ingunn Etterstøl.

⁴⁰ GreenStream Network AS is a part of the Northern European company GreenStream Network Ltd. specialising in services related to emissions trading, renewable energy certificates and other environmental derivatives. GSN's principal clients are corporations from the energy, pulp and paper, metal and construction material industries, as well as public organisations. www.greenstream.net. Interview with Arne Jakobsen and Tore Dirdal.

have been discussions in Norway ranging from 10 to 20 TWh, but there are expectations that both countries' ambitions should match.

In our stakeholder interviews before the policy reversal of the Socialist government, the Norwegian Electricity Industry Association (EBL) clearly preferred a joint Swedish-Norwegian certificate system and did not wish guaranteed prices, like in Germany, because they see that this limits the market-dynamics. According to EBL, the system of investment support and some production support that has been promoted by ENOVA has not attract investment in renewables. Wind power projects in Norway were largely financed in part by Dutch support, under the previous Dutch certificate regime. EBL has expressed a clear interest in a technology-neutral support system even since 2003, and clearly prefers a certificate system

Several small hydropower projects were, however, profitable without support, according to EBL, but some of them were probably also triggered by promises made by the previous government that projects started after January 1st 2004 would be included in the coming certificate support system.

EBL remarked that Norwegian wind power actors have not followed Swedish wind power companies in their scepticism against the certificate system. This may have to do with the fact that, as opposed to Sweden, wind power projects in Norway are driven by large traditional energy companies with a broad portfolio of energy technologies.

As far as the environmental concerns with market-driven technology neutral renewables investment is concerned, EBL points out that the regular process of obtaining governmental concessions, with the thorough environmental investigation implied, is a good guarantee for proper environmental scrutiny of renewable generation - as well as all other energy projects.

Given the recent Government rejection of the Norwegian-Swedish certificate market, EBL is sceptical to any breakthrough for certificate systems in the European market. If Norway and Sweden, which have such strong ties, culturally and linguistically in addition to a well-integrated common electricity market, cannot make it, it is hard to imagine that such a market might develop elsewhere.

Greenstream, a leading Nordic green energy broker expresses great concern with the present postponement of the Swedish-Norwegian certificate market. Greenstream confirms the impression of overwhelming support for green certificates from both new renewables and traditional energy companies. Both energy industry

and major “green” stakeholders, therefore see the present feed in regime, with fairly low tariffs as a clear second best option.

The Debate about the size of hydropower projects

NSCN is concerned with the tendency towards decentralising hydropower construction, so that numerous small entities are independently constructed in the same precipitation area. This might, in some cases lead to less environmentally acceptable than large-scale hydro projects.

NSCN is also concerned about the large numbers of small hydro stations constructed, and argues that only micro- and mini- hydropower stations are attractive to the local community, whereas so called small hydro (> 1.5MW), in fact is pretty large, and is primarily managed by larger companies. The Swedish position has been the opposite. Strong forces in the Swedish Association for Nature Conservation want only to have hydropower projects over 1.5 MW included.

As pointed out by NVE, the potential for new hydropower in Norway is large. According to their estimates the potential for small hydropower is 25 TWh, and the potential for upgrading and moderate expansion of existing plants is 18 TWh. NVE is aware of the fact that small scale hydro appears to be profitable even without certificate-support. However, they are concerned that a very narrow cost-focus could undermine efficient exploitation of hydro-resources, and leave out more costly energy generation from the project.

Wind Power

NVE has received applications for close to 20TWh wind power, probably largely motivated by expectations of a common Swedish-Norwegian certificate system. Some of this capacity may be difficult to implement due to local opposition, and some may also be part of a market positioning game. However this marks a huge increase in the Norwegian market, which has been a late comer in wind technology.

As seen by NVE, wind power is best developed in larger parks. This also has to do with grid capacity. The Ministry of environment is considering to develop a general plan for wind power in Norway.

Greenstream points out that the setback for the Norwegian-Swedish certificate market will have serious implications for wind power in Norway. They had brokered

a series of contracts, recently all with the coming certificate market as an explicit precondition.

The grid issue and backup power

According to NVE there is considerable debate about how to finance new grid capacity that may emerge from decentralised electricity generation.

Following NVE, EBL also confirms that grid costs may be one of the important determinants of wind power development in Norway. The uncertainty about who shall pay for grid expansion implies that one may not get as much wind generation as potentially possible.

Similarly, wind supply will also be somewhat dependent on backup power. EBL here wishes to see a further development of a market for regulatory power. With extensive hydropower resources, Norway should be well placed to handle such backup from a technical point of view. Furthermore, new technology in combination with better forecasts allows for more stable and predictable wind supply.

Gas Power

NSCN wishes to see more consistency in taxation of use of on-shore gas, which currently enjoys CO₂ tax exemption. They, therefore, support a more consistent application of the polluter pay principle. NSCN supports gas power if the heat can be utilised and there is a proper CO₂ reinjection and cleaning technology. However, except for the Kårstø project this is often missing in Norway. NSCN sees gas use in Continental Europe more often linked up with adequate heat systems.

As seen by the NVE, there seems to be a societal interest in promoting both gas and the certificate system for renewables. One might argue that with a very ambitious certificate system, the gas would be superfluous, however, this would increase the security of supply, and Norway could revert back to being a net electricity exporter.

As pointed out by EBL, gas power is a question of both environmental issues and security of supply. Gas prices have gone up and one recognises that gas power is expensive. Statoil has withdrawn from the Naturkraft cooperation, that implements the only gas project in process: Kårstø. The project is thus backed by Statkraft and Norsk Hydro each with 50% shares. However, Government has committed to impose

CO2 reinjection technology before 2009, and thus presented yet another cost driving element.

Interfaces between Policy Areas Green el, El-saving and Heat

The Norwegian Society for the Conservation of Nature wishes to see a broader certificate system where not only el-generation, but also heat production is given certificate support. Furthermore, NSCN wants to do away with what they call “climate discrimination” in Norwegian law. More or less hidden subsidies and standards favouring incumbent technologies have to be taken away. As an example, NSCN points out that residents in Northern Norway are exempted from the electricity levy, but if they buy a pellets burner they have to pay VAT. Energy rules in Norway are too well adapted to hydropower, and hinders alternative solutions.

According to NVE there are discussions about more complex certificate systems, where multiple qualities are considered. As there is a concern that one should not undermine the power bourse, by splitting products into smaller and smaller quality niches, a strategy with quality documentation should be completely decoupled from the physical product flow. There is considerable scepticism within the Norwegian regulatory authorities to so called “best available information” based certification. This does not provide sufficient credibility and reliability.

Policy Consistency across Governments

The Norwegian Society for the Conservation of Nature supports policy tools that are not dependent on national budgets. It is therefore supportive of ENOVA’s sustainable technology support which is based on a given % share of the grid tariff.

NVE also stresses that it is important that the support systems are stable, as they affect actors that invest in long term projects. A joint Norwegian Swedish certificate market could be more stable than unilateral national systems. The joint certificate system should also allow other countries to join in.

Finnish green el policy – Outlook from Major Stakeholders

Introduction

Some of the core issues coming out of the dialogue with Finnish stakeholders were:

- Basic acceptance of present support system for renewable energy, with some exceptions
- General satisfaction with the support schemes administered by TEKES and MOTIVA
- No strong debate over alternative support systems like the elcert.
- Concern with possible competition for biomass between traditional paper and pulp industry and new renewable energy industry
- Concern with the international pressure against Finnish peat based el-generation Concern with energy deficit and security of supply
- Accept, in Finland, for both nuclear and renewables to solve the supply deficit and fulfil Kyoto targets.
- The nuclear issue has been much debated, but the building of Europe's largest nuclear station is now politically decided on and scheduled. Financing proves no problem.
- Development of green electricity mainly for political reasons as household consumers show little interest. Some commercial customers, however, are more interested

The following summary builds on stakeholder dialogues with selected actors in the Finnish energy sector including:

- Fortum⁴¹
- Greenstream network⁴²
- Motiva⁴³
- Finnish energy association⁴⁴

⁴¹ Fortum is a leading energy company in the Nordic countries and the other parts of the Baltic Rim. Fortum's activities cover the generation, distribution and sale of electricity and heat, the operation and maintenance of power plants as well as energy-related services. The main products are electricity, heat and steam. www.fortum.fi. Interview with Kari Kankaanpää, Pekka Vile and Jaakko Karas.

⁴² GreenStream Network Ltd. (GSN) is a Northern European company specialising in services related to emissions trading, renewable energy certificates and other environmental derivatives. GSN's principal clients are corporations from the energy, pulp and paper, metal and construction material industries, as well as public organisations. www.greenstream.net. Interview with Jussi Nykänen.

⁴³ Motiva implements the government's decisions on energy conservation and promotion of renewable energy sources. Motiva Oy provides expertise and project services to promote more efficient energy use and to accelerate the uptake of renewable energy sources. The organization produces, refines and disseminates information, develops methods and boosts the introduction of advanced technology www.motiva.fi. Interview with Seppo Hulkkonen.

- Confederation of Finnish Industries⁴⁵
- Ministry of Trade and Industry⁴⁶

Views on present support system for renewable energy

As pointed out by representative of the *Confederation of Finnish Industries (CFI)*, the large picture of support for renewable energy has not changed much over the last years. Basically the support system includes investment support and tax deduction for green generation.

From CFI's point of view there is a fear that a possible certificate market will hit industry with higher electricity prices. CFI therefore favours the present support system, as it is financed over the state budget.

CFI is also positive to the policy developed by MOTIVA, especially when it comes to energy efficiency, where they are actively pursuing contracts with industry. FI also believes that MOTIVA has an active role to play when it comes to promoting renewable energy.

Finnish Energy Industries (FEI) has recently integrated 4 prior organisation and now represents a broad variation of Finnish Energy companies, except for fuel producers and national gas distribution. FEI points to the new Finnish climate strategy, which was launched in November 2005 and which is currently up for debate in Parliament. This strategy document points to the fact that with high oil and CO₂ prices, renewable energy supply will not need strong support besides the market. FEI agrees with this view.

⁴⁴ The Association of Finnish Energy Industries, Energiateollisuus ry, is an energy sector industrial policy and labour market policy organisation founded in 2004. It provides comprehensive representation for companies involved in the production, sourcing, transmission and sale of electricity, district heating and district cooling, as well as related services. www.energia.fi. Interview with Jouni Tolonen.

⁴⁵ The Confederation of Finnish Industries EK is the leading business organisation in Finland. It represents the entire private sector, both industry and services, and companies of all sizes. EK:s member companies represent more than 70 percent of Finland's gross domestic product, and over 95 percent of the export from Finland. EK has 44 different branch federations with a membership of 15.000 companies in all, which employ about 900 000 employees. www.kaupankl.fi/ek_englanti. Interview with Jouni Punnonen.

⁴⁶ As an expert organisation in the field of industrial policy, the Ministry of Trade and Industry is responsible for the operating conditions of enterprises, safeguarding the position of the citizens on the market and tending to the State's corporate assets. www.ktm.fi. Interview with Erkii Eskola.

FEI, therefore, has the view that Government should reduce the instruments that overlap with the emission trade system. The FEI thus, are not in favour of green certificates. As opposed to the environmental organisations, FEI is also against feed in tariffs. The main reason is that this does not entail market competition with the positive effects it may have on efficiency.

Like the CFI, *the Ministry for Trade and Industry* (MTI) points to the positive experience with the present support system as a background for the low interest in green certificates, as well as feed in systems.

Finland's largest electricity company *Fortum* has a different view on the support system from FI, FEI, MTI and most Finnish energy actors. Fortum would prefer a common European support system for renewables. They would then prefer a market-based system, such as a certificate system. Fortum would also prefer that the present Finnish system was replaced by an elcert system.

Fortum's pro-certificate position on internationalization and certificates comes naturally out of their extensive Nordic operations. Being present in several markets leads to a wish for standardisation, and having extensive direct experience with elcert in Sweden is probably one of the backgrounds for Fortum's position.

MOTIVA is a unit owned by the Finnish state, started in 1993 with a main focus on energy efficiency. The unit is set up to help implement environmental targets from Kyoto and the RES-E directive. According to the directive, Finland shall reach a goal of having 31.5% of its electricity generation from renewable sources.

Motiva supplements instruments for early stage technology development that are administrated by another unit: TEKES. However, TEKES has over the last years shifted its focus towards more market-oriented approaches.

As the representative of Motiva sees it, they foresee a stronger political focus on the electricity market and perhaps a need to focus on more systematic policy instruments to support Finland's domestic electricity generation.

Concern with possible competition for biomass between traditional paper and pulp industry and new renewable energy industry

Given the central position of paper and pulp industry in the Finnish economy, there has been concern about the competition for wood as bio-fuel is subsidized and phased into electricity generation.

According to the *FEI* the paper industry is, thus, very concerned about the use of wood for bio-energy, because it may lead to an increase in the wood prices. Similar viewpoints were presented also from the *CFI*. They see the competition for wood as a considerable challenge for the Finnish renewable energy policy. There is a natural limit as to what one may take out of the wood, and if subsidised bio-energy producers are given higher return they may pay more than paper industry for wood in a situation of scarcity. This could have negative consequences also for employment, as tenthousands work places within paper and pulp industry may be lost.

The concern for the pulp industry under stornger competition for wood was also made by *Fortum*. However, the Fortum representatives also pointed out that paper and pulp industry in Sweden was satisfied with elcert because they got support for their renewable energy production from the waste biofuel comming out of the paper and pulp production process.

Peat

According to the *MTI*, there has been a broad discussion about how Peat should be recognized as a renewable energy source. In Finland this RES is considered a slowly renewable fuel. This renewable source is expected to be competitive in the future.

Nevertheless, according to *FEI*, peat producers claim that the peat sector cannot survive without support after implementation of CO₂ trade. Peat has even higher CO₂ emissions than coal pr kWh. One is therefore investigating possibilities for supporting peat plants. *FEI* is opposed to feed in systems and wants support directly given to peat producers. However the *MTI* argues that the state budget cannot be used for such support.

Nuclear energy, security of supply and climate policy

CFI has been an advocate for both nuclear power and renewable energy sources. Given the electricity deficit of around 20%, security of supply issues are high on the Finnish energy policy agenda. According to *CFI*, the climate policy agenda also is central to Finnish nuclear expansion. According to *CFI*, Finnish CO₂ emissions are

today around 80 mill tonnes pr year. According to the Kyoto agreement, Finland must come down to around 71 million tonnes pr year. If this is to be achieved at the same time as electricity consumption increases, there is hardly any alternative to nuclear.

FEI also points out the general acceptance of the nuclear energy solution in Finland. They acknowledge that there has been a broad debate over the issue, but the opinion has accepted the pro-nuclear decision, and it has not been difficult to finance the reactor, which will be the biggest nuclear plant in Europe.

However, the MTI stresses that there has been a big debate about whether Finland should build out its nuclear power capacity or not, with a lot of protests from the environmental organisations. Nevertheless Parliament voted in favour and the nuclear project will go ahead. One of the reasons for the nuclear strategy is that it is not affected by the emissions trading system.

Renewable electricity, sources and markets

The Finnish position on renewables varies from source to source. The FEI points out that bio energy the most important RE source in Finland, with over half of the biomass comes from Pulp industry. MOTIVA points out that Finland has been particularly good at developing Liquid Bio fuel techniques and technologies. MOTIVA wishes to support further development in this field with the ambition to develop fully commercialised products. This may lead to CO₂ reduction in the CHP sector, but possibly also in the transport sector, however, there limited by the high costs.

The relative advantage of biofuels, as compared for instance to wind, is also underlined by the *MTI*. They point to the fact that Finland has not yet got good results in developing wind power industry. There is today 80MW wind, and the support systems are not good enough for wind power. With a given amount of money, *MTI* argues, Finland gets more results from supporting the biomass sector compared to the wind sector.

The *CFI* points out that stimulation of renewable energy is typically undertaken in the research and development phase. But that there is a lack of support to get pilot-projects on the market.

Fortum is engaged in green profiling of their products. The supply and profiling of green power is, however more a response to the public renewable energy discussion than a response to strong customer demand. The little customer demand

that there is, comes from selected business customers that want green energy to implement their environmental strategies. The environmental organisations are happy to see Fortum doing this, and Fortum has a positive dialogue with these organisations.

Summing up:

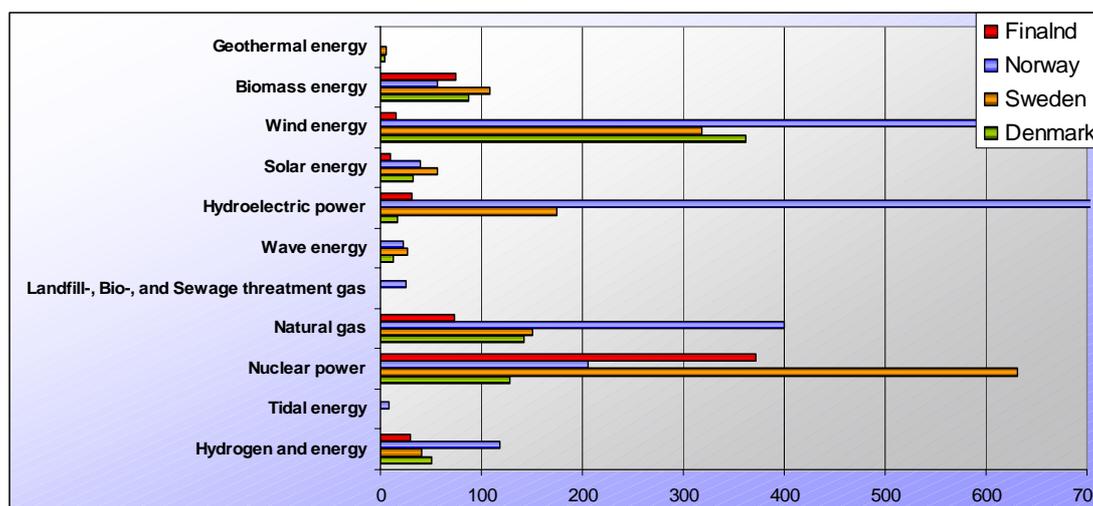
To sum up:

- Finland is one of the few European countries without either feed in or certificates.
They have continued a policy of investment subsidies and tax refunds from the 1990s.
- There seems to be a broad agreement that this policy approach has worked well. There is broad industrial and energy-industrial consensus.
- The dominant renewable is black liquor from the paper and pulp industry.
- Secondly, there is the direct wood utilization, coming out of the remaining elements of the tree, from paper and pulp industry.
- There is some concern with the environmental movement that wind energy does not get a sustainable deal. They would like to have feed in for that sector.
- The ministry of trade and industry is following the certificate and feed in systems closely, but they are not convinced of their efficiency. Particularly, the feed in is seen to lead to inefficient technology and localization development.
- Finland's largest state owned electricity company, Fortum stands fairly alone in their support for a green electricity certificate market, presumably because of their large engagement in Sweden.
- The new climate strategy initiative argues for a modification of the support regime, with less subsidization necessary because of the high energy prices and the co2 emissions price. The subsidy element should be focused on new technology. The subsidy is therefore transformed from general stimulation to technology innovation.

Renewable energy in the Nordic Countries – an international media review⁴⁷

As a complementary approach to the stakeholder interviews we have undertaken a review of the international media focused on energy in the Nordic countries. This review reveals some striking differences, but also many similarities. Figure x presents the number of article hits for some of the most important energy sources in the period 01.01.2004 to 20.01.2006. (figure 8)

Figure 8 Nordic Renewables and other Selected Energy issues in International Media



Wind power

Wind power was clearly the most focused renewable energy in the three Scandinavian countries: Norway, Sweden and Denmark, while it achieved less attention in Finland. The focus was on project plans in Norway and Sweden, while the focus in Denmark has been more on export. There has been an increasing focus on ocean windmills in all three countries. Some examples are:

⁴⁷ The media survey is based on Factiva, an international database that covers about 9000 sources provided by Dow Jones and Reuters. It has its focus on business matters and has a news archive with over 1500 global and national papers, magazines, several of them in both national and European versions.

Among the sources are Financial Times (1981-), Wall Street Journal (1979-), Le Monde (1994-), Frankfurter Allgemeine (2001-) and El Pais (1995-), The Economist (1981-), Advertising Age (1991-), Harvard Management Updates (2002-).

AFX International Focus

18 January 2006

Danish shares close lower on weak US tech results overnight; Vestas up

Shares closed broadly lower following disappointing earnings and guidance from Intel Corp and Yahoo! Inc overnight, but with Vestas Wind Systems rising on an order confirmation, brokers said.

Upstream

23 December 2005

Denmark among leaders in drive to reduce reliance on fossil fuels for country's source of power

Denmark became an early world leader in the development of wind energy, supported by government policy and the wish to get away from an over-reliance on fossil fuels, writes Christopher Hopson.

Upstream,

23 December 2005

Park plans for Scandinavians

Scandinavia is expecting a big boost to renewable electricity generation, with plans to build two of the world's biggest windpower parks off Norway and Sweden.

Reuters News

14 November 2005

Sweden, Norway firms plan big offshore windparks

Projects to build two of the world's biggest windpower parks off Norway and Sweden would be a big boost to renewable electricity generation in the Nordic neighbours, the partners in the plans said on Monday.

Hydroelectric power

Hydroelectric power has also attracted considerable media attention. The focus is here naturally on the two hydro rich countries: Norway and Sweden. In Sweden several articles have expressed concern with new hydropower projects due to environmental constraints. In Norway the discussion has not been so dominant as it has in Sweden, but environmental groups and the Socialist parties have mobilised against an expansion of hydroelectric power.

Reuters News

12 January 2005

WWF urges Norway to drop hydropower project.

The WWF environmental group urged Norway on Wednesday to bar a proposed 2.8 billion crown (\$447.8 million) hydropower project on a river in north Norway, saying it would threaten wildlife ranging from trout to reindeer.

"This hydropower project will suck the life out of the Vefsna (river), with serious impacts on people and nature," Rasmus Hansson, head of WWF Norway, said in a statement.

*Dow Jones International News,
1 July 2005*

Sydkraft Sells Power Plants To Statkraft For SEK4.5B

Energy company Sydkraft AB (SYD-A.OM), a majority owned unit of German E.On AG (EON), said Friday it has signed an agreement to sell 24 hydroelectric power plants.

Biomass

Biomass is also a renewable energy source that gets broad attention. The focus in Sweden is on the growing biomass industry and media writes about how paper and pulp companies in Sweden have become large energy producers through using the biomass for energy production. In Denmark the focus is on biomass, which by far stands for the largest share of energy generated from renewables in Denmark.

*Economist Intelligence Unit - Business Europe
1 November 2005*

Sweden: Industry forecast: Looking to the future

Renewables and biofuels will play an increasingly large part in Sweden's energy policy

*Reuters News
2 September 2005*

Wartsila to supply biomass power plant to Sweden

Finnish engineering group Wartsila said on Friday it would supply a biomass-fuelled power plant to Sweden's Vattenfall AB. It said the deal was worth about 11 million euros (\$13.6 million) and the plant would be fully operational towards the end of next year.

Nuclear power

Nuclear power is prominently on the media agenda in Sweden. The closing of old nuclear plants and the government ambitions of closing down this energy generation is widely covered by the press. The expansion of nuclear power in Finland has also been an important media issue.

*Dow Jones International News
20 January 2006*

Fortum: OKG To Increase Power Of Oskarshamn 3 To 1450 MW

Finnish energy company Fortum Oyj (FUMIV.HE) Friday said its affiliate OKG is going to increase the power of the third unit of the Oskarshamn nuclear power plant to 1450 megawatts from the current 1200 megawatts. The company said OKG will implement and fund the power increase and renovation investments through its own balance sheet.

Platts Commodity News 11 January 2006

Sweden's 870MW Ringhals-B2 to shut for maintenance Jun 20-Jul 19

Sweden's Ringhals-B2 nuclear power plant is to stop production for annual maintenance work on Jun 20, operator Ringhals AB said Wednesday in a message posted on the Nord Pool website.

Solar energy

Solar energy is also on the media agenda for the Nordic countries, especially in Norway and Denmark. In Norway there is a focus on the success of Scan Wafer, which has acquired a strong position in the solar energy market. Danish industry has also been in focus with new technology development.

*Montreal Gazette,
16 July 2005*

Sun power meets plastic in new cell: Cheaper solar energy could result from Danish scientists' work

Danish scientists said yesterday they have built a new type of plastic solar cell that lasts significantly longer than previous versions and could pave the way for cheaper solar power.

*Norwegian News Digests
7 July 2005*

Norwegian ScanWafer Signs IT Contract with Fujitsu Services

Norwegian multicrystalline wafers manufacturing company ScanWafer has signed a three-year IT outsourcing contract, for over 5.0 mln Norwegian crowns (\$755,000/632,000 euro) with Norwegian information technology (IT) services provider ...

Hydrogen energy

A certain media attention is also given to “hydrogen energy” particularly in Norway, however there are reports about research on this topic in all the Nordic countries.

*Professional Engineering
15 June 2005*

Technology - Norway's hydrogen highway.

Norway is pressing ahead with a 580km "hydrogen highway" which it hopes will be complete in 2008. Known as HyNor, the route will stretch from energy-rich Stavanger in the west to the capital city Oslo in the east. The aim is to build the necessary infrastructure for hydrogen vehicles to make the journey.

The Norwegian government has pledged £4.25 million to develop hydrogen fuel, with £2.55 million expected to be used on HyNor. The cash will be used to develop hydrogen filling stations along the way.

Tidal, Wave, Geothermal and Biogas and sewage power

Some attention is also given to new renewable sources such as Tidal, Wave and Bioenergy power, although comparatively far less than for the energy sources presented above.

Wave energy

Wave energy has been a issue in the media both Norway and Denmark. Attention has been given to development and innovation of new technologies and to some small-scale pilot project have taken place in both countries.

Reuters News

14 December 2005

Norwegians, Dutch mix sea and river to make power

"Water will be the coal of the future," French science-fiction writer Jules Verne predicted in 1874.

More than a century later in a world seeking clean alternatives to fossil fuels, Dutch and Norwegian scientists believe they can help turn Verne's dream into reality.

The Dutch Centre for Sustainable Water Technology or Wetsus, and Norway's independent research organisation SINTEF, working with power company Statkraft, have invented devices that generate electricity by mixing sea and river water.

Upstream,

17 December 2004

Wave scheme catches rising tide of interest in Norway

Norwegian Energy Minister Thorhild Widvey last week lent a lustre to the naming ceremony of a new wave power generator, which according to industry tycoon Fred Olsen will be more cost efficient than any other system to date.

Tidal energy

Tidal energy has got some attention in the media, but only in Norway.

Reuters News

14 December 2005

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Biogas and sewage

Biogas and sewage has also gotten marginal attention in international media, and then particularly in Finland.

26 May 2004

Finnish News Digest

Finland To Build 13 Mln Euro Biogas Plant in Ilmajoki

The plant will be located next to the recycling centre of Finnish waste management company Lakeuden Jatekeskus. The planning of the plant has already started and construction works will begin in the autumn of 2004. Construction works are expected to continue 18 months and will employ a workforce of 15 to 20.

Diesel Progress North American Edition

1 November 2005

Biogas-fueled train on track in Sweden

In what officials called a major step toward making public transportation more environmentally friendly, a biogas-fueled passenger train carriage, reportedly the worlds first to run solely on biogas, was presented in Sweden recently. The carriage can carry up to 54 passengers and is expected to start running regularly on the Tjust line, a 72 ml. stretch between Linköping and Västervik, on the country's east coast, said to be one of the most beautiful of Sweden's railway network. Commercial operation is to begin in September this year.

Toronto Star

28 August 2004

Recapturing energy; Sweden has set the gold standard for turning waste into electricity

Treating waste and waste water is a huge financial and environmental challenge for municipalities everywhere. The most important challenge is to alter our production and consumption habits to minimize how much waste and waste water we produce, but we'll always have some.

Geothermal energy

Articles on Geothermal energy, on the other hand, only focuses on Sweden and Denmark

Natural gas

The discussion about natural gas power plants has particularly been on the agenda in Norway. It has been a hot topic on the political scene, and the environmental aspects have been broadly debated. The issue have also to some extent been covered in the Danish and Swedish press.

Agence France Presse

22 September 2004

Norway plans controversial gas power station for 300 million dollars

Norwegian energy giants Norsk Hydro and Statkraft said on Wednesday that they plan to build a controversial gas-fired power plant in Norway to the tune of two billion kroner (292 million dollars, 238 million euros).

The power station, which will be the first of its kind in Norway, will be built on the island of Kaarstoe off the country's western coast and will have a capacity of about 400 megawatts (MW), amounting to an annual production of approximately three Terawatt-hours (TWh).

*Swedish News Digest,
15 November 2005*

Swedish Oresundskraft To Supply Natural Gas for 9.4 Mln Euro to Kemira Kemi

Swedish energy group Oresundskraft said on November 15, 2005 it will supply natural gas worth 90 mln Swedish crowns (\$11 mln/9.4 mln euro) to local chemicals producer Kemira Kemi AB.

Part III Concluding Discussion

Evolution of national support schemes and the role of renewables in the Nordic Countries.

The Nordic countries have featured a complex mix of support for renewable energy, including production support, investment support, special tariffs, tax exemptions etc. Nevertheless, some patterns can be discerned.

Denmark has moved from a system dominated by feed in towards a combination of flat rate price subsidy (10 øre KWh) and prices provided by the regular energy market, including CO2 quota induced price-effects. Additional implicit auctions are put in place on an ad hoc basis for two offshore windmill parks.

Sweden has moved from a system of tax incentives and investment support towards a certificate market, based on consumer obligations.

Norway was, until the change of Government in October 2005 in the process of joining the Swedish certificate market. The social democratic-socialist-centre party government ended the negotiations with Sweden and thoroughly revised its renewables support policy turning to a feed in system as the dominant support mechanism. However with very low tariffs by European standards.

Finland has largely retained its traditional support system with a dominant focus on investment support and tax deduction for green generation. Finnish stakeholders also expressed general satisfaction with the support schemes administered by TEKES and MOTIVA

Barriers for further expansion of renewables in the Nordic countries.

Denmark:

- “liberal fatigue” with high feed in rates and frontrunner policy of previous governments.
- Political commitments to general non-increase of all public tariffs makes for a stiff system.

Sweden:

- Longer term commitments to goals for renewable consumption may unleash longer term investments
- Disagreement with Norway on details may prevent expansion to a common Norwegian-Swedish market

Norway

- A revision of support policy from the new Social democratic- socialist –centre party government has ended negotiations with Sweden on a common certificate market and introduced a feed in system with low tariffs. This has put on halt great expectations and numerous investment projects into new renewable electricity lined up by energy industry.
- Public debate around siting-issues may limit windmills and hydro-projects
- Grid access issues may have to be solved in some locations

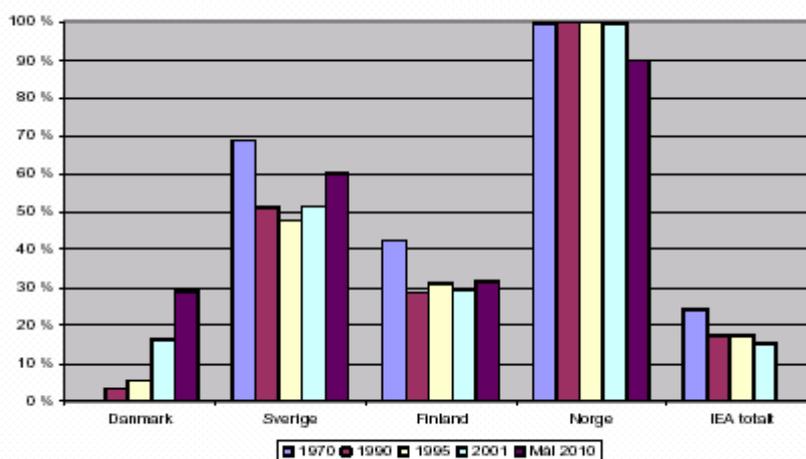
Finland

- Concern with possible competition for biomass between traditional paper and pulp industry and new renewable energy industry may limit renewable energy engagement.
- The Finnish acceptance of the nuclear option may slow down engagement in renewables to fulfil Kyoto targets.
- Development of green electricity mainly for political reasons as household consumers show little interest. Some commercial customers, however, are more interested.

Exceptional natural resources

The Nordic region stands out with exceptional natural resources both with respect to renewable electricity generation and fossil based energy supply. A long tradition of hydropower generation has traditionally provided a high share of renewables in the Nordic electricity systems. Both Sweden and Finland reached the limit of politically acceptable exploitation of hydropower resources several decades ago and Norway only fairly recently. With the exception of Denmark, the Nordic region has therefore been on a track of RES-E reduction since the 1970s (figure 9) as Sweden and Finland embarked on ambitious nuclear energy programmes.

Figure 9 Renewable Electricity Generation in the Nordic Countries⁴⁸



Source: IEA

The Nordic countries, are however, exceptionally well placed to provide a new generation of renewable energy. They hold some of the most promising sites for wind-energy in Europe, they have abundant forest resources and the possibility to orient processes in a world market-oriented paper and pulp industry towards renewable energy generation. The Nordic countries are also well positioned to engage in offshore tidal and wave technology when these technologies mature.

⁴⁸ From Etterstøl (2005)

Among the Nordic countries, Denmark has taken upon itself the most ambitious scaling up of renewable energy, from 8,7% in 1997 to 29% in 2010, mainly through wind and biomass electricity generation. However Denmark started from an exceptionally low level in a Nordic context. As opposed to the other Nordic countries, Norway is on a track towards reduction of RES to give room for growth in gas power.

Perception on features and performances of different support schemes

Three Nordic governments have changed their support systems extensively over the last few years, and obviously also their perceptions on support system performance:

- The Danish Government has revised its strong feed-in policy towards a more market liberalist orientation, well in line with the incumbent energy-industrial stakeholders, but against the interests of wind industry and the environmental movement.
- The Swedish government has adopted a certificate scheme, which is positively evaluated by energy industry as well as biomass industry, and accepted by large segments of the environmental movement, but more critically received within the wind-energy lobby.
- Norwegian Government has, as already mentioned revised its pro-green certificate policy against the interests of almost all energy-industrial stakeholders, and large parts of the environmental movement and embarked on a feed-in system, with support from parts of the environmental movement.
- Finland is the only country with a stable investment support policy throughout the period, a policy which seems to have wide stakeholder backing.

Role of green power in national energy policy

The three Nordic EU member countries have made substantive commitments to contribute to reaching European RES-E goal, including an increase from 50% renewables in 2004 to 60% in 2010 for Sweden; an increase from 20% to 29% for Denmark and from 28% in 2004 to 31.5% for Finland. According to 2004 reports,

however, both Sweden and Denmark have some way to go before they achieve the target. Norway, however, starting from around 99% will be on a track towards substantive reduction, following the build up of some gas-based electricity generation.

The extensive boost in bio-based electricity stimulated by the elcert market and 10 TWh wind power is seen as a major part of the Swedish strategy to meet these demands. The Danish shift to a more market oriented policy with the liberal-conservative government is not seen as sufficient to reach the country's renewables targets, and is therefore supplemented with a 10 øre/kWh support for renewable energy as well as special auctions for two targeted new offshore wind power plants.

The Finnish strategy with a dual focus on nuclear and renewables may solve the Kyoto commitments, but the nuclear does not contribute to the renewable share. Many Finnish stakeholders therefore see a challenge in reaching Finnish 2010 renewables ambitions.

The Norwegian position, with a diminishing renewables from almost 100% to 90% of electricity generation opens up for Norwegian gas-based generation, which the present social democratic – socialist – centre party government is strongly committed too. Like Finland, therefore, Norway also pursues a dual energy strategy where investment in new renewables goes hand in hand with gas, although the socialist government partners are eager to have gas generation with CO₂ reinjection. Current licences, however, allows for conventional gas power, and Government will have to subsidise CO₂ sequestration.

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2003	Country/Region							
in GWh	Norway	Sweden	Denmark	Finland	EU 15	EU 25	OECD Total	World
Coal	123	4187	25304	26766	767037	991413	3842573	6681339
Oil	18	3873	2345	934	150496	162436	561242	1151729
Gas	299	506	9802	13941	526296	551178	1728137	3224699
Biomass	264	5303	1684	9409	36931	38259	111381	138207
Waste	165	427	1479	763	24976	25378	58077	62493
Nuclear	0	67415	0	22731	898234	973674	2223367	2635349
Hydro	106095	53273	21	9591	308812	324167	1317330	2725824
Geothermal	0	0	0	0	5434	5434	34329	53735
Solar PV	0	0	0	0	456	456	546	555
Solar thermal	0	0	0	0	0	0	548	548
Wind	220	631	5561	93	44085	44273	58337	63001
Other sources	84	0	68	0	1697	1892	2467	4405
Total EL prod	107268	135615	46264	84228	2764454	3118560	9938334	16741884
Total Renewables	106744	59634	8745	19856	420694	437967	1580548	3044363

References

EU

Commission of the European Communities. Communication from the commission to the council , the European parliament, the economic and social committee and the committee of the regions on the implementation of the Community Strategy and Action Plan on Renewable Energy Sources (1998 – 2000). Brussels, 16.02.2001

Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market. September 27. 2001.

Denmark

Energistrategi 2025. Perspektiver frem mod 2025 og Oplæg til handlingsplan for den fremtidige el-infrastruktur. Transport- og Energiministeriet, Juni 2005

Energipolitisk redegørelse 2005. Transport - og energiministerens redegørelse i henhold til lov om energipolitiske foranstaltninger. Energistyrelsen

Renewable Energy, Danish Solutions, Background • Technology • Projects. Published by the Danish Energy Authority. Printed in Denmark, September 2003

Strategi for dansk vindenergiforskning. Juli 2004

The Green Certificate Market in Denmark. Status of implementation. September 2001. The Danish Energy Agency, Henrik Lawaetz. September 2001.

Norway

Ministry of Oil and Energy Press communication Nr.: 117/06 Date: 05.10.2006

Et felles norsk-svensk elsertifikatmarked av Finn Roar Aune, Torstein Bye og Petter Vegard Hansen 13.05.05. Statistisk sentralbyrå.

Grønne sertifikater – Utredning om innføring av et pliktig sertifikatmarked for kraft fra fornybare energikilder, Norges vassdrags- og energidirektorat (NVE), 2004.

Høringsnotat

Om utkast til lov om pliktige el sertifikater. Olje- og energidepartementet 24. november 2004

Obligatoriske markeder for grønesertifikater -Virkemiddelbruken i andre land

Rapport for Olje- og energidepartementet av cand. oecon Kjell O. Kristiansen Joule AS, januar 2002

Obligatoriske markeder for grønne sertifikater - Virkemiddelbruken i andre land Rapport for Olje- og energidepartementet av cand. oecon Kjell O. Kristiansen Joule AS januar 2002

On the Price and Volume Effects from Green Certificates in the Energy Market.
Discussion Paper 351, Statistisk sentralbyrå
<http://www.ssb.no/publikasjoner/DP/pdf/dp351.pdf>

Grønne sertifikater - design og funksjon. Statistisk sentralbyrå, april 2002.

Grønne sertifikater, Utredning om innføring av et pliktig sertifikatmarked for kraft fra fornybare energikilder, Rapport 11/2004, Norges Vassdrags- og energidirektorat (NVE)

St.meld. nr. 47 (2003-2004) Om innovasjonsverksemda for miljøvennlege gasskraftteknologiar mv.

Sweden

Konsekvenserna av en utvidgad elcertifikatmarknad ER 2005:07, STEM

Lag om elcertifikat (2003:113)

Översyn av elcertifikatsystemet, Delrapport etapp 1, STEM

Översyn av elcertifikatsystemet Delrapport etapp 2, STEM

Priser och kostnader i elcertifikat-systemet Energimarknadsinspektionens slutrapport i projektet "Transaktionskostnaderna i elcertifikatsystemet" ER 2005:17. STEM.

Förslag om ett utvecklat elcertifikatsystem, Departementsserien 2005:29, Miljö- och samhällsbyggnadsdep.

Finland

Action Plan for Renewable Energy 2003–2006. A Working Group Proposal. Ministry for Trade and Industry. February 2003.

Riktlinjer för energi- och klimatpolitiken under den närmaste framtiden – En nationell strategi för verkställandet av Kyotoprotokollet. Statsrådets redgörelse till Riksdagen. 24 November 2005.

Renewable Energy Certificate Markets in Europe. GreenStream Ltd. Nykänen and Müller 2006. Environmental Finance.