Greening of Nordic electricity industry: policy convergence and diversity

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Abstract

With a comparative focus on policy similarity and diversity, this report[1] gives an overview of the main elements of electricity-related environmental policy in the Nordic countries, following the launching of a common electricity market in the 1990s.

The report points out that the electricity related environmental policy positions of the Nordic countries showed a noticeable lack of coordination in the 1990s. Nordic divergence is observed both in terms of general policy orientations and at the instrument and incentive levels, in spite of the pioneering development of a common integrated electricity market and ambitious environmental policy goals. The report then highlights how the recent Swedish "green" certificate market model has created new momentum for market-based "greening" with a potential for stronger convergence in Nordic renewable energy policy.

In spite of signs of convergence, the report shows how the development of Nordic electricity-related environmental policy still contains considerable ambiguity: Unequal resource endowments, under simple resource-based interest formation should indicate that there is little room for convergence in Nordic renewable energy policy. Shifting the environmental policy focus from existing technologies and resources to potential innovations, however provides a more open arena where the Nordic countries may see themselves served by the dynamic scope of a broader Nordic market based on a common policy approach, such as a green certificate market.

In explaining why the Nordic arena may be an interesting locus for common renewable energy policy, the report points out that small countries, like the Nordic, may need an "intermediary" arena to aggregate size and scope in order to generate a European momentum in regulatory competition with larger European states. Similarly, Nordic companies may consider the opportunity to gain first mover advantages by partnering with government as local experimentation may be seen as useful pilot experience. Together with the precedence of a common Nordic electricity market and the development of common market institutions, the aspiration to be in a stronger position to shape European policy provides arguments for collective Nordic solutions even under increased Europeanization of both market and policy making.

Keywords: Renewable Energy, Environmental Policy, Green Certificates, Green Electricity

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Introduction

In the mid- and late 1990s the Nordic countries developed pioneering free trade in electricity. At the core of the Nordic system Nord Pool, the power exchange, integrated Norway, Sweden, Finland and Denmark in a far-reaching integrated liberal market system. The emergent Nordic internal energy market was, however, in no way followed by a parallel integration of electricity-related environmental policy[2]. At a first glance, this situation is paradoxical, as the Nordic countries have for several years been among the international forerunners in voicing environmental considerations (Midttun and Hagen 1997).

This situation is paradoxical, as the Nordic countries have for several years been among the international forerunners in voicing environmental considerations (Midttun and Hagen 1997) and it is commonly recognised that integrated markets should be followed by some kind of integrated regulation in order to reap their full welfare potential.

There are, however, both economic and cognitive reasons for why Nordic energy industry, for nearly a decade, has operated a common electricity market policy, while at the same time maintaining highly nationalistic, non-harmonised environmental policies.

Unequal resource endowments can explain some of the problems of finding a Nordic environmental policy consensus. The structural diversity of the Nordic electricity industry with a Norwegian hydro-system, the Swedish mixed nuclear and hydro, the Danish dominantly coal-based system and the Finnish mixed coal, nuclear and hydro, implies that common environmental policies would have widely different distributive effects among the Nordic countries and thereby give them different vested interests. A common Nordic environmental policy for instance in the form of a strong common polluter pays principle would, dramatically penalise the Danish and Finnish coal-based systems.

However, the challenges to a common Nordic environmental policy have also been of cognitive and institutional nature. Policy-makers in the Nordic countries have for a long time held divergent understandings and positions on environmental policy issues. Procedures and actual choice of policy instruments and support mechanisms have also differed.

More recently, however, one can observe signs of an emergent policy harmonisation in the area of renewable energy promotion. The start-up of a Swedish green certificate market[3] and the Norwegian political flagging of a move towards a similar policy, may provide the foundation for a certificate market, with a potential Nordic scope, and hence possibly deliver a common and more integrated policy track. The dormant Danish

[2] Referring to policies promoting electricity generated by renewable energy sources.
[3] Called the Swedish Electricity Certificate market (Elcert)

green certificate plan, which, was suspended to the advantage of an environmental bonus scheme, may also be reactivated as part of this process. Yet the dominant reality of Nordic electricity-related environmental policy is still one of national divergence.

With a comparative focus on policy similarity and diversity, this report gives an overview of the main elements of electricity- related environmental policy schemes in the Nordic countries, following the launching of a common electricity market in the 1990s. It starts out with green electricity policies[4] in the 1990s and then proceeds to investigate such policies in the early 2000s. For both periods there is a focus on the general policy- level where the reference is to the regulatory framework,[5] and at a more detailed instrument[6] level, where the reference is to incentives and the actual commercial stimulus that government regulation provides. Further details on national policies are given in the appendix.

By way of conclusion this report analyses the background for underdeveloped environmental policy co-ordination of the Nordic market and the potential for future convergence from three perspectives:

1. a material interest perspective
2. a broader cognitive perspective
3. an institutional arena perspective.

The discussion under the first perspective highlights the robustness of the convergence and divergence alternatives in terms of their acceptability to national industrial interests under a simplistic resource based constitution of interests. The discussion under the second perspective shows how interests may be cognitively shaped along other dimensions, and relates the Nordic policy diversity back to basic policy approaches ranging from a dominantly static efficiency focus in Norway to a stronger focus on industrial policy and dynamic efficiency in Sweden and Finland, to a broader public service oriented policy in Denmark, however, also with strong industrial policy emphasis.

The discussion under the policy arena perspective highlights the relevance of the Nordic arena compared to other arenas such as the EU or the global arena in electricity-related environmental policy-making as an arena for environmental policy alternatives. A final comment is also given on the effects of the choice policy instruments on the negotiability of common policy integration.

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[4] Green electricity is here defined as electricity generated from renewable energy sources.

5 More specifically: by regulatory framework we refer to the basic orientation of the government regulation. This includes whether it is based on plan and control intervention, general price based incentives (taxes or subsidies), or on quantum based regulatory market-arrangements such as tradable permits, auctions etc.

[6] By instruments we refer to the specific instruments that are employed under each regime. This includes the specific form of interventions such as the specific tax and subsidy forms, the formation of the trade able permit system or the forms and types of subsidies.

The late 1990s: environmental policy divergence under electricity market integration

General policy level

The Nordic countries have shared an ambitious environmental policy ambitions and integration towards a common electricity market under a common regulatory regime. Yet, the electricity related environmental policy positions of the Nordic countries in the 1990s have shown a conspicuous lack of coordination both at the general policy and at the instrument and incentive levels.

At the general policy level, the Nordic countries have traditionally been counted as pioneers in the field of environmental policy. Sprinz and Vaahtoranta (1994) rank them as the front runners of environmental policies and argue that they figure in the front line with the most ambitious policy goals in international fora, and in some cases take radical domestic environmental initiatives (Andersen and Liefferink 1997). Sweden, Norway, Denmark and Finland have signed a number of international environmental declarations covering, for example, air pollution and ozone depletion, and ratified most of the resulting conventions or related protocols. In this regard, the Nordic countries have been among the first to make strong environmental commitments.

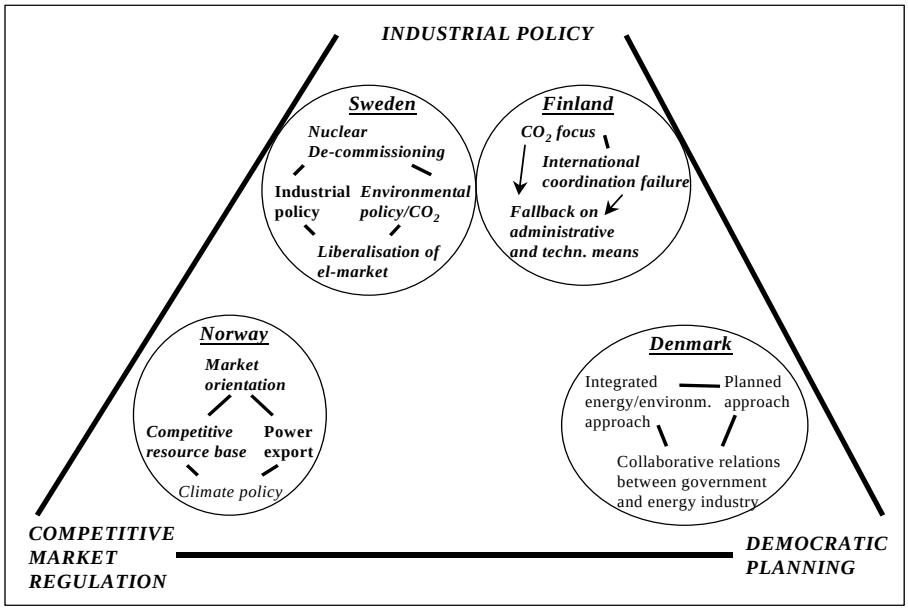
Furthermore, the national emission targets of the Nordic countries are generally equal to or stricter than those found in international agreements (Nordic Council of Ministers 1994). Thus, the Nordic countries have elected to be exponents for environmental protection by introducing national objectives which in several areas are more ambitious than the commitments agreed to in international treatises (International Energy Agency (IEA) 1994). Generally, ambitious environmental policy has also ranked high on the agenda of Nordic political parties (Midttun and Hagen 1997). The current challenge to Nordic environmental policy is to continue and reinforce the "greening" of energy industry within the context of an integrated and competitive energy market.

Yet, the communality in proclaimed ambitions did not translate into a similar communality in electricity related environmental policies. A previous study from the late 1990s (Midttun 2001) pointed out distinct and fairly different policy positions among the Nordic countries. In terms of basic cognitive orientations, the conceptualisation of energy and environmental issues among high level Nordic government officials revealed a Danish policy tendency towards democratic planning, a Norwegian

tendency towards market orientation and Swedish and Finnish tendencies to define electricity related environmental policy in a more industrial policy/ technology-oriented understanding, although with market-orientated emphasis (figure 1).

The conceptual framing presented by Danish policy decision makers, pointed to the democratic planning orientation as a core element in the Danish profile. The focus was on such issues as integrated energy/environmental planning and collaborative relations between government and energy industry. The Norwegian international competitive market orientation came just as clearly across in the three core elements, which characterised the Norwegian decision-makers: market orientation, competitive resource base, and power export. Similarly, the main focuses of the Swedish decision-makers were industrial policy, liberalisation, environmental policy and nuclear decommissioning. The Finnish industrial policy orientation did not come as clearly across as the Swedish. However, the "fallback" on administrative and technical measures, following the international CO^2-tax co-ordination failure, revealed a Finnish focus on industrial policy and technical development.

Figure 1. Comparative Analysis of Basic Positions of Nordic Energy-related Environmental Regulation[7]



[7] From Midttun (2001)

Issues of national salience

In addition to their basic orientations in regulatory style, the Nordic countries also differed in the specific issues that were salient on the national energy and environmental agenda:

In Sweden, nuclear decommissioning figured prominently as the most salient energy and environmental issue, clearly expressed as a central concern with Swedish decision-makers. Following the referendum on nuclear power in 1980, the Swedish government has been formally committed to close down nuclear stations. However, political as well as industrial reluctance to implement the decommissioning commitment had for long kept Swedish energy policy in a stalemate.

Similarly, the CO^2 tax issue and the failure of international co-ordination had a strong impact on Finnish energy policy making. Finland took on a first mover role for a European combined CO^2-energy tax. When the European process broke down, Finland found itself in the traumatic position of impairing its own electricity industry by having a national CO^2 tax. This was because Finland at the same time imported electricity from CO^2 emitting Danish coal plants, which were not subjected to CO^2 taxation.

The competitive resource base in Norway has made energy export a viable option. Norway has therefore persistently looked for market opening and trading opportunities both in the energy and the environmental field. This has posed great challenges to Nordic power cooperation and exchange because of large differences in short term marginal costs of production.

Besides its strong orientation towards democratic planning, Denmark was unique in implementing an integrated approach to energy and environmental governance, which was institutionally followed up through an integrated environmental and energy ministry in 1994. As part of this orientation, Denmark ambitiously tried to turn around its energy system towards sustainability. The tool employed was innovation policy with a particular focus on wind power technology.

Links between basic orientations and issues of national salience

Our study in the 1990s (Midttun 2001) revealed clear and logical linkages between the basic orientations in regulatory style and the issues of national salience explicitly expressed by Nordic decision-makers.

The Norwegian market-orientation, both in terms of the underlying electricity market, but also in terms of the preferred measures in environmental regulation was clearly and explicitly related to its export ambitions and its competitive resource base.

Similarly, the Danish integrated energy-environmental orientation was closely linked to democratic planning, co-operative government-industry relations and a programme of industrial policy to stimulate

development of wind technology and its diffusion. The Swedish industrial policy orientation was closely linked to the nuclear decommissioning issue, and climate change mitigation, where technical alternatives to nuclear were encouraged by industrial policy means. The additional requirement is that Sweden must meet its CO^2 commitments. This dictated, that new production alternatives must be environmentally sound.

Likewise, the Finnish fallback on technical and administrative standards and the subsidisation of alternative energy through industrial policy means was closely connected to its negative experience with its pioneering role in CO^2-energy taxation.

Instrument and incentive level

Like at the general policy-level, the Nordic countries have taken quite diverse positions on regulatory instrumentation (table 1). Denmark has 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 technology (see table 1). 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 more market conform way.

In Norway, Finland and Sweden, the main support instruments in the 1990s were investment support and tax incentives. 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 investment support level depends on the innovative technology used. The maximum investment support given in Norway, to wind power, has been 25%[8]. The investment support in Sweden given to wind power is 15%, while biofuels may receive as much as 25% in support.

[8] There are specific criteria required for the location, for more details see table 1

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, hydropower[9] 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[10]. To electricity generated from other renewable energy sources 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 are given by an energy tax exemption on renewables. This tax is instead paid to the producers via an environmental bonus. In addition to this, the green electricity generators are also faced with a reduced grid fee.

The support systems have led to different developments in renewable energy sources in the Nordic countries. While Denmark has seen a great expansion of wind power due to stable and favourable feed-in tariffs, Finland and Sweden have stimulated expansion in the use of biofuels. As indicated in table 2, Denmark, Finland and Sweden thereby figure as international leaders in renewable energy while the development of new renewable energy sources in Norway has been modest

There are several explanations for the different developments in the Nordic countries. There are different drivers, resource bases and support schemes. Denmark has had large Co2 emissions from their power generation, there was therefore a strong need for an environmental supplement or replacement. The feed-in tariffs has successfully given a boost to the wind energy industry, and therefore made this energy source very important for Denmark.

In Sweden and Finland bio fuels contribute to a large extend to the renewable portfolio. This energy source has been supported through high investment support. This may not be the only explanation for the large contribution of this energy source. Bio fuel may also be used in already existing infrastructure from CHP power stations this makes the switch to this energy source less expensive.

[9] with capacity less than 1 MW

[10] 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 by 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.

Table 1: Support systems for the Greening of Electricity Industry in the 1990s[11]

Support Systems of the 1990's	**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.	**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 : 10-20% (Varmeanleggsordningen)	Bio fuel/CHP: 25% Hydro<1,5 MW: 15% Wind <1,5 MW: 15% Solar heating: SEK 2.50 / kWh

[11] For Further details see appendix

Table 2: Market shares for new renewable energy technologies

CHP % of EL consumption (1997)		***Bio fuel % of energy consumption (1997)***		***Wind % of EL consumption (1997)***	
Denmark	39	Finland	25	Denmark	6
Finland	34	Sweden	19	Netherlands	0.5
Netherlands	30	Denmark	10	Germany	0.4
Austria	23	Switzerland	5.5	Spain	0.2
Czech Republic	18	Norway	5	Sweden	0.16
Germany	14	France	4	England	0.16
Portugal	13	Canada	3.8	Ireland	0.06
Hungary	12	Austria	3		
Italy	11	USA	3		
Poland	10	Germany	1		

Sources: Inside Energy 1997, IEA/OECD statistics-Electricity Information 1997, Energistyrelsen 1997 statistics. Http://www.iea.org

Norway, on the other hand, has generated almost all its electricity from hydropower and the need for other renewable energy sources, has not been obvious during the 1990s. The investment support given, and the energy tax relief were introduced in the late 1990s[12] and have been to low to motivate large development of any new renewable energy sources in the relatively short time when the support has been available.

[12] St prp nr 54 (1997-98) Grønne skatter

Signs of environmental policy integration in the early 2000s

General policy level

New policy developments in the early 2000s are blurring some of the previous positions and policy orientations. The Danish liberal-conservative government since 2001 has been revising the Danish planned economy position turning to a more market oriented policy design. The Norwegian Centre-Christian Democrat and Christian Democrat-Conservative governments have revised the Norwegian orientation by introducing stronger innovation oriented policy elements to supplement the dominant efficiency oriented paradigm. This has brought the two Nordic extremes closer to the Swedish and Finnish industry-oriented positions. At the same time, obligations under global climate policy have brought trans-national and economic environmental policy instruments higher on the political agenda.

The Swedish green certificate initiative has created new momentum for trade-based "greening", further given the Norwegian signals of possibly following Sweden, and the "shelved" existing Danish green certificate plans, these initiatives represent interesting developments that have the potential for stronger convergence in Nordic environmental policy.

The following sections summarise some of the changes at the general policy level in each of the four Nordic countries in the early 2000s:

Sweden

The nuclear phase-out has continued to be central on the Swedish energy and environmental policy agenda. A major premise for the phase-out is, however, that the supply of electricity should be based on indigenous and for renewable energy sources. The Swedish energy programme, therefore, includes measures aimed at decreasing the consumption of electricity for heating purposes and utilising the existing electricity system more efficiently. Swedish policy for promotion of renewable energy sources is consistent with the industrial policy tradition and has a specific technology focus which is tied to the promotion of wind power, hydropower, CHP using biomass and small-scale electricity (maximum 1500 kW).

Sweden's transition from the investment and feed-in type of support scheme to a quota-based certificate trading system was launched in

November 2001[13], integrated in a new energy bill[14] presented in March 2002 by the Swedish government and approved by the legislative council on April 3rd 2003[15]. The certificate market has been in operation since May 1st, 2003. The argumentation behind the certificate model refers to cost-efficiency in renewable capacity development, competition between renewable technologies / resources, compatibility with market principles and international market integration

Initially the Swedish certificate market has an exclusive national scope, as only electricity produced in Sweden will be included. Swedish policy-makers have, however, signaled that the market may be opened for international trade, under the assumption that certain criteria are fulfilled by the trading partner(s). Criteria under consideration include that foreign certificates must fulfill Swedish requirements: that there is reciprocal opening of electricity markets and that there are no parallel subsidies apart from certificates. Presumably there will also be requirements on quota demands in the other trading country (ies).

Denmark

Danish el-related environmental policy has gone through dramatic changes in the early 2000s. Firstly, as mentioned in the previous section, the earlier Danish government initiated a process in 1999 to replace the feed-in model with a quota-based system with tradable green certificates as an attempt to continue support schemes in a more market conform way. However, this attempt stranded due to problems inherent in the Danish certificate model. These problems related to market concentration in the supply of certificates with only two major market players; as well as low liquidity due to the many transitional pay schemes which would keep large shares of the renewable electricity outside the certificate market. The Danish model was also harshly criticised by the wind power lobby (especially the Danish wind industry association) which pointed out the problem of immature renewable energy technologies and also attacked the mixing of biomass and wind into one certificate and one market. The wind power lobby also pointed to the lack of European harmonization that may fuel expectations of multiple market collapses[16].

[13] Swedish government commission report (Electricity Certificate Investigation ElCERTH SOU 2001:77)
[14] "A secure, efficient and environment-friendly energy supply" 2001/02:143
[15] With a few proposals for adjustments. Some art of the wood-industry should also be exempted from the quota obligation. It was also suggested to include straw as eligilble source for certificates, however EU must accept this last proposal.
[16] Krohn (2001), paper available at http://www.windpower.dk.

While the introduction of the certificate market model was aborted, the change of Government in November 2001 with a new liberal-conservative constellation, led to radical changes in policies affecting renewable energy. Firstly, energy issues were moved from the Ministry of Environment and Energy to the Ministry of Economics and Business and a review of support systems was initiated with a focus on cost-effectiveness. The subsequent year (2002) became a year of change in the framework conditions for renewable energy in Denmark. The research programme for renewable energy"[17] was cancelled and the budget of the Energy Research programme was cut extensively. Almost all investment support has been brought to an end, and the mandate on the utility sector to develop three of the five off-shore wind parks was removed, possibly paving the way for a national or international tendering procedure to realise future offshore wind power projects[18]. June 19th, 2002, the Government reached an agreement with the Social Democrats, the Socialists, the Radical Left Party and the Christian Democrats about the future terms of payment for wind power, which involves substantively lower support in terms of an environmental bonus paid in addition to the market price.

Finland

Compared to the Swedish and Danish development, Finnish el-related environmental policy has been more stable. The most radical move in Finland is probably the Finnish Parliament's decision to support the building of a fifth nuclear power plant unit. The motivation was related to security of supply, cost-effectiveness and to climate policy.

However, Finnish policy-makers have continued to support renewables. A special action plan has been developed to make energy produced by renewable energy sources competitive in the open market. Important measures are development and commercialisation of new technology and economic means such as energy taxation and investment support. The Finnish Government also continues to give production subsidies to electricity generated by wind power, small hydro power (less than 1 MW) and CHP production using wood or peat with a maximum capacity of 40 MW.

[17] Udviklingsprogrammet for vedvarende energi

[18] There was an agreement between the previous Danish government and Danish utilities that they should establish five wind farms each of 150 MW capacity before year 2008. The sites for these five offshore farms have been decided and the first farm is planned to be in operation during 2002. Political negotiations have indicated the possibility that the last three of these offshore farms may be subjected to a tender procedure. This will depend on the government's decision on how best to tackle Denmark's CO2 obligation and the reduction of green house gases with 21% by 2008 compared to 1990 levels.

An in house working group at the Energy Department of the Ministry of Trade and Industry has recommended that the present subsidy scheme shall be developed so as to provide competition between investors. The working group also supported a quota based green certificate system provided that it differentiated between different types of green electricity generation (due to the fact that e.g. wind power needs more support than biomass based generation). However, the working group did not propose such a system for Finland at the moment, because different green certificate systems are under development; and the group expects that there will be a joint model for the internal market (EU) in the future.

Norway

Norway has recently been moving somewhat away from a one sided efficiency-oriented towards a supplementary innovation-oriented environmental policy. One of the recent changes in Norwegian el-related environmental policy has been the establishment of a new government agency, Enova, in March 2001. By gathering strategic policy responsibilities in a small, flexible and market oriented organisation, the intention has been to stimulate energy efficiency by motivating cost-effective and environmentally sound investment decisions. Enova is also supposed to focus on the development and introduction of new technology, including the aspiration to develop wind power technology better suited for Norwegian conditions.

The Norwegian Parliament has also taken steps to strengthen Norway's focus on green certificates. A 2002 Government white paper signalled a wait and see attitude, assuming that Norway would not be among the front-runners, but rather follow the EU development. However, Parliament took a more active role and persuaded the Government to speed up its certificate plans. A Norwegian certificate model is under development with a focus on the already existing Swedish certificate market. The Norwegian model proposal will be presented during the spring of 2004, with a possible start-up date for certificate trade in 2005.

Instrument and incentive level

The evolution of general policy positions on greening of Nordic electricity industry has also been followed at the instrument and tariff levels (table 3). In Denmark the evolution of policy-instruments has come in two distinctive steps: a first step, taken by the previous Social Democratic government to replace the feed in instruments with a certificate model (see table 4) and a next step by the new Liberal Government to a revised support scheme. While

the certificate model was never implemented, we shall nevertheless briefly review it, since it represents an interesting premise for possible Nordic policy-convergence.

Table 3 Support schemes in the Nordic countries in 2003

Today's support scheme (2003)	**Denmark**	**Finland**	**Norway**	**Sweden**
Regulatory Framework	-Plan and control intervention	-General price based incentives (taxes and sub.)	-General price based incentives (taxes and subsidies)	-Quantum based regulatory market arrangements
Regulatory instruments	Reduced Feed-in tariffs	Support scheme based on investment support (bidding) and tax rebate	ENOVA; allocation of the Energy Fund, through investment support. ENØK and reduced electricity tax.	Tradable green certificates system
Incentives/ Tariffs	Feed-in tariff for existing wind power not on transitional scheme: DKK 0,10/ kWh (in addition to the market price, limited to 20 years) A ceiling of market price + tariff = DKK 0,36 /kWh New wind power: Environmental bonus + market price = or < DKK 0,36/kWh	Same as in the 1990's Refunded el tax equal to 0,69 Euro cents/kWh for wind El produced by small hydro, biomass qualifies for a refund like 0,42 Euro cents/kWh. Investment support from 15 to 40%, depending on the innovative technologies used	Investment support Wind: 10% ENØK and heat: 25% Solar/Wave: 25% Production support: 50% of the electricity tax, equal to NOK 0,0475 /kWh	-Elcert-model (See Table 4) - Environmental bonus/feed in for wind until 2008 Reduced in steps from SEK 0,18/kWh

Table 4 Nordic Certificate Models

Certificate Model	**Denmark**	**Finland**	**Norway**	**Sweden**
Status	Planned and designed, Postponed until 2005	No plans for a certificate model	The Parliament has asked the government for a report on a certificate model. To be published spring 2004.	Designed and accepted. Started up May 2003.
Ambition	-20% consumer quota (to be increased)		Not decided	-Consumer quota 2003-2010 (7,4-16,9% by 2010).
Max price ***Min price***	DKK 270/MWh DKK 100/MWh		Not decided	-Max: :SEK/MWh 175(2004)/240(2005) -Min: SEK/MWh 60 (reduced in steps to 0)
Actors Administration	-Consumer/retailer -Elkraft-System and Eltra		Not decided	-Consumer/retailer -Svenska Kraftnät, Swedish E. Agency
Eligible Sources	-Wind, Small Hydro (<10MW), Biogas, biomass, solar, straw, wood.		Not decided	-Wind, Solar, Geothermic, some Biofuels, Wave, Hydro <1,5 MW, new plants, improved/increased production. Plants 1,5 – 15 MW under certain conditions (see appendix)
International Trade	-Under reciprocal conditions, transparency in subsidy arrangements, "additionality". -devaluation of foreign certificates.		Wants an international model. First look at trade with Sweden.	-Under reciprocal conditions - Export of certificates is possible, not import so far
Exemptions	-None			-El intensive industry
Additional support system	None			-Wind: cert + feed-in tariff until 2008

The Danish certificate model defined renewable electricity as electricity from; windmills, biogas, biomass, solar energy and wave energy, and hydropower plants below 10 MW, but did not include gas or heat. Demand for certificates were established by a consumer obligation of 20% of electricity demand to be covered by RES-E[19] by 2003. No subsequent percentages were outlined but buying obligation would supposedly be moved upwards year by year in order to achieve the *Energy 21* target of 50% electricity from renewables by 2030. Each green certificate should represent a production of 1 MWh of RES-E. The model guaranteed a minimum price of DKK 100 per certificate and a maximum price of DKK 270.

The Danish Government and the Danish Energy Agency (DEA) signalled an interest in the promotion of international certificate trade in order to stabilise certificate prices. Specific conditions of common criteria were not decided upon, but the DEA outlined the following considerations for import of certificates: transparency in subsidy arrangements, technology type and acceptance of certificates following the Danish RES-E definition and the "additionality" principle meaning that the Danish RES-E quota should be fulfilled by a real growth in total RES-E production[20]. Only foreign certificates from other RES-E quota-based systems would be accepted.

Original start up date for the new support framework was year 2000 but this date was postponed several times until June 19th, 2002, when a parliamentary agreement was reached to postpone the introduction of a Danish certificate market until it is possible to establish a common market with a number of EU countries.

As a replacement for the postponed certificate market the parties agreed on a support scheme for the renewable electricity production, which would have been entitled to certificates. Existing wind power production (not on a transitional pay scheme) receives a payment of DKK 0,10/ kWh[21] in addition to the market price. A ceiling of market price + production support at DKK 0,36 /kWh is set. Additional support is limited to a 20-year period. New wind power development established after 1.1.2003 will also receive the DKK 0,10/kWh, also with total max payment[22] set at DKK 0,36/kWh

As part of the current support scheme one may also mention the "scrap guarantee" for machines taken off line between March 1999 and December 2003. To encourage replacement of old turbines[23] the "scrap

[19] Electricity generated from renewable energy sources (RES-E)
[20] meaning that it should be possible to use foreign certificates if they represent a production, which would not have taken place without the trade
[21] This is equal to the CO^2 tax, and minimum certificate price
[22] Market price + support
[23] 100 kW or less

guarantee" promises a guaranteed payment (DKK 0,60 / kWh) for 12.000 full load hours of production[24] to new machines with three times the capacity of the scrapped unit. Terms of payment to older mills with higher production costs and to biomass and biogas plants are yet to be decided.

Sweden has embarked on a transition from the feed-in type of support scheme to a quota-based system with trade in renewable electricity certificates. The Swedish certificate system has many similarities with the postponed Danish model (see table 4). Similar to the Danish model each green certificate should represent a production of 1 MWh of RES-E. The model guaranties a minimum price of SEK 60 the first year reduced in steps to 0 after 6 years. The penalty charge is 150 % of the average certificate price during the year but with a maximum of SEK 175 for certificates that should be reported during 2004, and SEK 240 for certificates for 2005. Like in the Danish model, the demand for certificates is created, by imposing a quota on electricity consumption. The electricity suppliers manage the quota obligations for all its customers, and the cost of the electricity certificates is passed on to consumers, trough their electricity bills.

Sources eligible for certificates in Sweden are equal to the Danish model when it comes to solar power, wind power, wave energy, geothermal and biomass. The only difference is the eligibility of hydropower. Denmark accepted small-scale hydro, defined as less than 10 MW, to be eligible for certificates. In Sweden, hydro power meeting the following criteria qualify for certificates; existing plants with capacity not exceeding 1500 kW, plants that have not been in operation after July 1st 2001 but start production after the certificate law comes into effect, production plants with a capacity between 1,5 MW and 15 MW under certain conditions, increased installed capacity / production enhancements in existing plants by measures undertaken after July 1st, 2002 and also new hydro plants which started operation after July 1st, 2002.

Due to the different resource base in Denmark and Sweden the difference in hydropower eligibility seems natural, but may cause problems if trade is to occur between the two certificate systems. Another difference between the two models is the exemption of quota obligation on electricity consumed in the manufacturing process in Sweden; Denmark has no exemptions. Both certificate models are open for the possibility of international trade, however the conditions are strict, and reciprocal conditions are required in both models.

The Swedish certificate system will be supplemented by additional support to wind power via an environmental bonus the first years. This bonus will be phased out in 2009.

[24] The number of full load hours may be converted to production by multiplying the capacity effect (KW, MW) with the number of full load hours. Example: 200 kW x 25,000 flh = 5.0 mill. kWh. For the larger turbines average production is 2000-2200 full load hours per year signalling 5-6 year.

Norway has taken steps in several directions in the debate over how to promote renewable energy sources. In spring 2000, new Norwegian energy objectives were approved and these were to limit energy use considerably and to increase annual use of central heating based on new renewable energy sources, heat pumps and waste heat by 4 TWh/year by the year 2010; to install wind power capacity of 3 TWh/year by the year 2010 and to increase the onshore use of natural gas[25].

In the near future, the main "tool" to reach the renewable energy objectives, is the new government agency ENOVA. In March 2001, Stortinget approved the establishment of Enova, to ensure a more cost-effective use of public funds. The reorganisation was due to the fast growing national use of electricity over the past few years and the need for a more dynamic organisation that can develop and carry out successful policy initiatives while at the same time take changes in national and international economic, political, legal and environmental conditions into account.[26]

The establishment of Enova transferred the administration of the Energy fund from NVE[27] to Enova. The energy fund consists of the 0,03 NOK/kWh from the electricity transmission tariff estimated to about NOK 200 million in 2003 and a state contribution of NOK 279 million in 2003. Enova may spend nearly NOK 500 million on the different programs in 2003.

Enova supports renewable energy sources through different programmes. The investment support given to wind projects, are now reduced to 10% of the investment costs. It is also possible to apply for investment support related to development of new wind power technology. In addition to wind power, Enova has programmes for heat and energy conservation and projects in these categories may receive as much as 15% of the project costs. Other renewables like solar energy and wave energy is supported by 25% of the investment costs, under certain requirements.

In Finland, the support schemes from the 1990's are still in place. However, a certificate model has been discussed in Finland and the country clearly has a potentially large supply of green certificates, on the other hand, there seems to be little focus on establishing demand for the same certificates at the national level. The target set for renewable electricity in Finland corresponds to the target set for Finland in the EU Directive on the promotion of electricity produced from renewable energy sources (the "RES-E" Directive), which specifies that electricity produced from renewable energy sources should account for 31.5 per cent of the total consumption of electricity in Finland 2010.

In order to meet the target set for RES-E, the earlier mentioned working group in the Ministry of Trade and Industry, recommends that funds

25 White paper No. 29 (1998-1999)
[26] (Source: www.enova.no)
[27]The Norwegian Energy Directorate (NVE)

reserved by Tekes[28] for technology programmes and specific projects shall be kept at least at the same level as now. Moreover, bio energy projects should be emphasized in the introduction of innovative technology. The group proposes that taxation must be developed further so as to favour renewable energy sources. Tax subsidies for renewable electricity must be developed as required by the competitiveness of each production mode or fuel and in keeping with the EU legislation on state subsidies. Investment support should be increased and new financing models should be studied.

It is too early to draw any conclusions about the existing support schemes for the Nordic countries, since most of them are changing. It is also hard to evaluate the different systems, since the evaluation will depend on the goals for the system, which may differ. What is clear is that after the new Danish system was introduced; there has been a drop in wind power investments in new capacity development. The new conditions for the wind industry are not seen as good enough for new large investments.

The latest development in support schemes for Norway is a possible certificate model. Norwegian actors are exporters of certified hydropower and some wind power today, due to favourable support schemes for renewable energy in Europe. In order to continue this export, Norway may have to set targets for the renewable electricity consumption like EU members have on the basis of the RES directive. EU members have to present their accounts to show compliance with the directive's indicative targets / national RES-E goals; further, once they have to do this, they will most likely want to take credit for certified green power that has been imported as well as the domestically produced RES-E. Hence for Norway disclosure and double counting is an issue to be dealt with in the near future. There is a rising concern that a (black) share of European electricity production, may be assigned to Norway if all Norwegian "greenness" / environmental value has been exported.

In Norway, NVE has received many new applications for building windmills just the last year, it seems however that it is the favourable prices and support mechanisms in other countries that have triggered these investment possibilities, and not the existing support scheme in Norway. Sweden has introduced a total new support scheme, the electricity certificate system. The increase in electricity from new renewable sources due to this support scheme is not yet seen. What has happened this first month of trading is that there are many buyers and very few certificates in the market. The prices have therefore been driven above the maximum limit. A positive result of the Swedish model is that it has drawn the attention from Norway and other European countries. Further, this may in turn lead to an integrated Nordic support scheme that seta support levels via the market and stimulates cross-country competition as well as competition between renewable energy technologies.

[28] National Technology Agency

Concluding reflections

The development of Nordic electricity-related environmental policy has left us with considerable ambiguity as to whether we are heading towards Nordic policy convergence or whether we will see continued diversity. By way of conclusion we shall discuss the sustainability of both the convergence and a divergence positions from three perspectives:

- a material interest perspective
- a broader cognitive perspective
- an institutional arena perspective.

The discussion under the first perspective highlights the robustness of the convergence and divergence alternatives in terms of their acceptability to national industrial interests under a simplistic resource based constitution of interests. The discussion under the second perspective shows how interests may be cognitively shaped along other dimensions, and relates the Nordic policy diversity back to basic policy approaches

The discussion under the policy arena perspective highlights the relevance of the Nordic arena compared to other arenas such as the EU or the Global arena in electricity-related environmental policy-making as an arena for environmental policy alternatives. A final comment is also given on the effects of the choice policy instruments on the negotiability of common policy integration.

Nordic policy integration seen from a resource based interest perspective

From a resource based interest perspective, the choice between policy convergence or continued policy divergence of green electricity policies in the Nordic countries can be seen as derived from interest positions in a policy game, where the policy-outcome is highly contingent on the interest structure and the game setting. The interest positions may, in turn, in a very simplistic model, be derived from the resource endowments of the participating nations and the distributive issues arising there from.

A comparison of two policy games, one with equal resource endowments and the other with unequal endowments, highlights the importance of the endowment factor: In table 5, under the assumption of equal resource-endowments, the implementation of a common environmental policy regime, like a common environmental tax or a green certificate trading model, is foremost a question of co-ordination. The assumption that systems are similarly fuelled, implies that competition takes place on an equal basis, and that a common environmental regulation will

have the same implication for all parties concerned[29]. Under this precondition, the parties have a common interest in reaching an integrated solution (position 1 in table 5), which once established remains a sustainable long-term position.

However, the preference for common solutions remains highly contingent on resource endowment. The extensive variation in fuel sources for Nordic electricity generation undermines a sustainable co-ordination of Nordic environmental policy based on resource-based common interest is, however, not a viable option.

Table 5. Environmental regulation in a two party game with equal endowments

	Part 2 *Common regulation, calibrated to the international market*	*Part 2* *Nationalistically orientated environmental policies*
Part 1 *Common regulation, calibrated to the international market*	1 +/+	2 --/++
Part 1 *Nationalistically orientated environmental policies*	3 ++/--	4 -/-

In Denmark and Finland, there is a strong reliance on fossil fuels and thermal generation. Norway is predominantly hydro based, while Sweden generates electricity from nuclear and hydro sources (table 6).

[29] The plusses and minuses in table 5, presents the welfare gains for each strategy-combination seen from the side of both parties. As illustrated in table 5, gains and losses are similar and symmetric. Both parties have incentives to co-operate to develop a system of environmental regulation, from which they both individually profit, because of the welfare gains from economies of scale and scope and increased competition (+/+ in square 1). Given the assumption that the common policy is applied systematically throughout the whole market area, this would also constitute the most effective solution from the point of view of the integrated market system as a whole.

However, without co-ordination both parties have incentives to fall back to nationalistically defined environmental policies that lead to a far less preferable solution (-/- in square 4) when both parties' strategies are combined, possibly because of the impediments to competition and increased transaction costs of diverse regimes.

In this case, both parties would end up with less attractive policies, out of fear that one-sided general application of the polluter pay principle, would lead to exploitation from the other party.

Table 6. Resource Base of Nordic Electricity Generation

Source	*Denmark*	*Finland*	*Norway*	*Sweden*
Total generation	36 TWh	72 TWh	122 TWh	152 TWh
Hydro Power		19 %	99 %	50 %
Thermal Power	88 %	51 %	1%	6 %
Wind and Geothermal Power	12 %			
Nuclear Power		31 %		44 %

With unequal resource endowments, under simple resource-based interest formation, the sustainable Nordic environmental policy thereby remains the divergent one. In table 7 the assumption that systems are differently fuelled, implies that competition takes place on an unequal basis, and that common environmental policy approaches will have very different implications for the parties concerned[30].

Even with credible co-ordination, the Nordic countries, according to this game structure cannot reach common solutions. The reason is that some countries stand to win while others stand to loose and the losers are likely to

[30] The commercial effects presented in the table may by summed up as follows, listed square by square:
The square 1 combination: joint common policies such as polluter pay or green certificate strategies calibrated to the integrated market from both parts suffers from highly biased commercial effects, providing the less endowed party with clear disincentives to enter into this position. While the better-endowed party will harvest extensive gains from price increases and an increased market share (++), the less endowed party may stand to loose large market shares (--) due to prohibitive tax burdens. In spite of its distributive effects, this is clearly the most beneficial strategy-combination seen from an environmental point of view, for the market-system as a whole.

The square 3 combination of an open, common policy, calibrated to the entire market system from the less endowed party, and protective nationalist green electricity regulation from the well endowed is highly unlikely, because the interest to open up markets and go for collectively oriented regulation is likely to come from the better endowed party. For the weaker party this is a worst case, although hardly much worse than in square 1 (therefore (-1)), since the well-endowed actor would anyhow be in a strong competitive position. The stronger party will, therefore, not have strong needs for protection, and therefore have little gains from its protective strategy.

The square 2 combination: polluter pay orientation from the well endowed party and protective, nationalistic environmental regulation from the less endowed, allows the weaker party to maximise its commercial interests by protecting its home market, therefore +, while the stronger party, with an open polluter pay-oriented strategy, calibrated to the international market, will expose itself to environmental dumping from the weaker actor, therefore -.

Finally, the square 4 combination: mutual nationalistic protective environmental regulation strategies represent the equilibrium position in which both parties will end without authoritative pressure. This is a closed and protective economy position, which is clearly sub-optimal to both parties (0/0), because it serious limits scale and scope economies and utilisation of comparative advantages, but where they have no better alternative combination of strategies, which are acceptable from both sides.

block common solutions. The result may be that countries find themselves locked into nationally protected strategies.

Table 7 Environmental Regulations in a Two Party Game with Unequal Endowments

	Part 2 *Weakly endowed* *Common regulation, calibrated to the international market*	*Part 2* *Weakly endowed* *Regulation oriented at protecting national actors and resources*
Part 1 *Well endowed* *Common regulation, calibrated to the international market*	*1* *+ +/--*	*2* *-/+*
Part 1 *Well endowed* *Regulation oriented at protecting national actors and resources*	*3* *++/-- (-)*	*4* *0/0*

The simple-minded interest analysis under unequal resource endowment therefore easily ends up with a scenario projecting continuation of national environmental policy diversity where each of the Nordic countries plans policies tailor-made to domestic interests.

Nordic policy integration seen from alternative cognitive framings

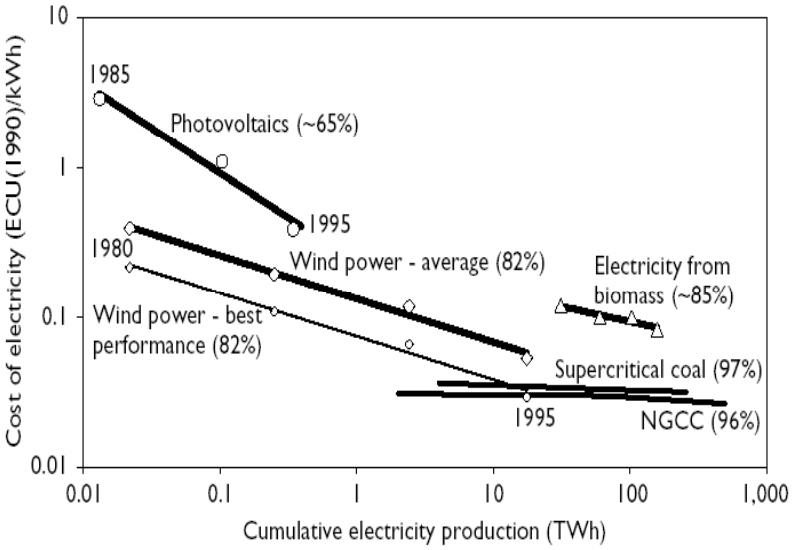
Moving beyond the simple resource based interest perspective, one may see green electricity policy as shaped by more complex cognitive framing. This opens up for policy positions less absolutely derived from natural endowments. For instance, taking a static rather than a dynamic efficiency view, or basing evaluation on the broader premises of public planning may lead to different interpretations of interests and thereby to different positions in the policy "game".

The *static efficiency perspective*, for instance, leads on to an internalisation of marginal externalities approach to environmental policy based on the notion that environmental deterioration caused by energy production constitutes a welfare loss, which needs to be compensated. Such compensation may typically, in this perspective, take place by internalising environmental costs into the price of energy, e.g. through taxation on

emissions. The polluter will thereby incur costs in running energy supply with conventional technology with the emissions that this entail, and will face different costs than less polluting technologies. It follows from the least cost optimum that one will choose the most competitive technology available at the time, and the energy price will be set thereafter. The internalisation of externalities thus shifts the cost curves for polluting technologies, to the effect of making less polluting technologies more competitive and more polluting technologies less competitive. The focus on resource optimisation, as a cognitive framework easily leads on to a zero sum game under unequal resource endowments as it typically leads to a lock in to established least cost solutions.

A more dynamic innovation focus, on the other hand, may more easily lead actors to perceive a positive sum game. As opposed to the static perspective, the *innovation-perspective* typically implies a learning approach where a major goal is to develop environmental policies that promote new renewable technologies both through research and development and through exploitation of the so called "experience curve". The so-called "experience curve" codifies the insight that learning through market experience reduces prices. Taking the cost of energy production per unit as an indication of technological development, the learning curve theorem, based on numerous empirical studies, point out that the same absolute increase in cumulative production will have more dramatic effect at the beginning of a technology's deployment than it will later on. For well-established technology, such as coal power plants using conventional technology, the volume required to double cumulative sales may be extremely large, so the experience effect will hardly be noticeable in stable markets, whereas for new technologies, relatively small volumes may bring down costs at an amazing rate (figure 2). As the curve is a straight line projected on a logarithmic scale in this figure, this means that young technologies learn faster from market experience than old technologies with the same progress ratios.

Figure 2. Learning curves for energy technologies



Source: IEA/OECD 2000

Measures to encourage niche markets for new technologies are generally thought of as one of the most efficient ways for governments to provide learning opportunities. A learning curve perspective is likely to lead to a niche market policy where learning investments are recovered as the new technologies mature.

More easily than the static efficiency perspective, the innovation perspective may, lead beyond a zero sum to a positive sum game focus, because it highlights the growth potential from innovation rather than the limitations imposed on current commercial practice. Shifting the environmental policy focus from existing technologies and resources as distributed among the Nordic countries to potential innovations and new technologies, this provides a more open arena, where the Nordic countries may see themselves served by the scope of a broader Nordic market, facilitated by a common policy approach, such as a green certificate market.

The dynamic perspective does not, however, necessarily lead to collective solutions as niche markets may be designed both at international and at national levels. Since volume is an important driver, larger international markets will, however, provide a greater learning effect.

It is also important to recognize that a standardized certificate market will predominantly serve the most mature new renewable technologies, and must be supplemented with a research and diffusion policy for less mature technologies, to bring down the initial part of the learning curve.

A third basic cognitive framing of the electricity-related environmental policy is the *public planning approach* with a strong focus on public service obligations. Compared to both the static and dynamic economic orientations, this framing gives more direct room for values to guide environmental policy. A public planning framing of environmental policy, therefore, implies that policy is more strongly attached to the public sentiments and the public debate.

There are several possible implications for Nordic green electricity policy. Firstly, the sensitivity to the public debate may further environmental policy ambitions that, legitimated by public opinion, may move beyond industrial vested interests. Secondly, however, the responsiveness of public policy, in the planned mode, to public opinion, may tend to make it idiosyncratic and difficult to generalise across national borders.

Nordic policy integration beyond the unitary state

The previous discussion has been based on the concept of single level negotiation, where each Nordic state represents its unitary vested interests at the international negotiation table. However, as widely recognised in the international negotiations literature (Putnam 1988, Scharpf 1997 among others), national positions at the international bargaining table are frequently shaped by domestic coalitions and the pressure these coalitions exert on national governments. The prospect for an integrated Nordic environmental policy can in this perspective be seen to rely on complex processes of intra-national interest-formation, where the national Nordic positions are derived as outcomes of intra-national policy games.

In environmental politics, two important domestic fractions are traditionally industrial and environmental interests. The former are typically well organised for political lobbying and commanding large resources to protect their vested interests. The latter may also have fairly well organised front-runners, but usually acquire much of their influence only when able to mobilise broad public support. Furthermore, national states may also take more general positions that are derived from other policy fields such as financial policy or technology policy. The Norwegian and Danish policy shifts, documented in the previous sections, are cases in point.

The discussion of Nordic electricity related environmental policy development in the previous sections indicated that Norway supplemented its dominant static efficiency orientation with a more developed innovation focus. The creation of ENOVA, with innovation as one of its main agendas,

is a sign of this. The increased engagement in building up a green certificate model is another.

Denmark's new liberal-conservative government, on the other hand, has increased its cost-efficiency focus and seems less willing to support a strong unilateral Danish niche market strategy. This might also imply greater willingness from Danish policy makers to economise on learning investments by joining forces with others.

The winter 2002-2003 price hike in the Nordic electricity market due to a combination of very limited investment in new capacity over the last decade and a special combination of climatic conditions, may also have caused an indirect interest in stimulating new renewable electricity capacities. This interest in renewable capacity has by some been seen as part of a broader interest in capacity building to avoid future scarcity crises. As the power balance will have to be solved on a Nordic basis[31], the scarcity concern would tend to support environmental policies with common Nordic commitment.

However, there are obviously competing conventional energy candidates for capacity investments such as gas projects in Norway and nuclear projects in Finland. Mainstream electricity industry might also be highly ambivalent about the price –dumping effects of large subsidised volumes of green electricity capacity in the Nordic market.

Common Nordic policy positions may thus be based on complex intra-national negotiations where several interests and perspectives are played out. A common green certificate scenario, for example, presumes a dynamic innovation-orientation, and policy anchoring beyond existing industrial interests, responding also to contextual change such as the recent price hike in the Nordic electricity market.

Nordic green electricity policy integration and alternative policy arenas

We have so far discussed coordination of electricity related environmental policies, taking the Nordic context for granted. However, the issue is not only one of interest aggregation, but also one of choice of policy arena.

There are at least three potential geographic arenas for collective policy focus: the Nordic, the (EU) European and the Global climate policy arena, which set different contexts for the issue of policy aggregation.

The three arenas obviously differ in terms of their inclusiveness. The Nordic arena is a small and geographically close 4-5-country arena, the (EU) European arena is a medium sized 15-25-country arena while the Global Climate Policy a mega arena.

[31] The Nordic market is among the most integrated in Europe, with price effects to all four major Nordic countries.

The three arenas also differ in their decision- and implementation capacity and styles. The Nordic arena is characterised by cultural closeness, but weak decision-making and implementation. With some notable exceptions, it is in many respects perhaps more of an arena for sharing of ideas and voluntary coordination than an arena for strong policy control.

The Global arena, as far as climate policy is concerned is now gaining more importance as a policy regime. With the expected Russian ratification of the Kyoto Protocol, the signatory countries will be obliged to reduce greenhouse gas emissions by 8% by the year 2012.

The EU arena is clearly the most operative both in terms of policy formulation and policy implementation. The federal character of decision-making, implies that the member countries are not only facing consensus – negotiations towards common policies, but also majority decisions implemented under a quasi-legal regime, where member countries have some discretion in implementation style but are strongly pressured towards common functional realities. Given that the Nordic arena has the least "mandatory" power, one may ask why Nordic countries might find any use in integrating policies at this level?

Firstly, the resource-diversity does not seem to be any less demanding in the Nordic case than in other cases. Possibly, one might count on a common high environmental policy-awareness in the Nordic region, at least when compared to some of the poorest EU countries. The latter have traditionally been more concerned with an industrial growth agenda, and have generally opted for exemptions from environmental restrictions. Nordic environmental policy awareness may, in other words, possibly constitute a basis for harvesting first mover advantages from higher standards of regulation (Porter and Van der Linde 1995).

The institutional first mover advantage, may, arguably, be most relevantly sought at the stronger institutionalised EU arena and not in the weak Nordic arena. A successful policy-launch in the EU would result in shaping a common implement able policy across the whole EU and ESA regions as a consequence of authoritative implementation of federal policy (Heritier et al 1996).

Small countries, like the Nordic, might, however, need an "intermediary" arena to aggregate size and scope in order to generate a European momentum in regulatory competition with larger European states. Similarly, Nordic companies might consider the opportunity to gain first mover advantages by partnering with government, where local experimentation might be seen as a useful pilot experience. Together with the precedence of a common Nordic electricity market and development of common institutions related to this market, the aspiration to be in a stronger position to shape European policy seems to be the strongest arguments for collective Nordic solutions.

A note on instrumentation

The choice of instrumentation for common policies should also be mentioned as a major factor in policy coordination. Firstly, positive instruments obviously constitute a better basis for negotiation of common agreement than negative instruments, such as taxation. The failure of the European CO^2 tax and the present minimal EU taxation are cases in point. A static efficiency focus under unequal resource distribution easily leads to a zero sum game, with the EU construction giving ample scope for veto-players. A similar lack of Nordic environmental tax integration is just as conspicuous. New policy instruments such as green certificates opens up a more promising policy integration agenda. As a positive instrument with dynamic focus, this instrument opens up an innovation agenda, which may attract broader interest also for badly endowed parties. As previously argued (Midttun and Koefoed 2001) environmental policy has to strike a complex balance between efficiency and negotiability and due consideration must be taken to both sides. In terms of negotiability, the positive instruments generally stand to win.

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Appendix[32]

[32] All four cases are written for the NFR/EBL project no 146690/210; The Energy-related Environmental Policy Game.
NFR# 146690/210 – December 2002.

The case of Denmark

By Anne Louise Koefoed

The general situation

The total primary energy consumption in Denmark was 831 PJ / year in 2001 (DEA, Energy Statistics 2001[33]. The renewable energy production in Denmark in 2001 was 94 PJ[34] (26 TWh). Hence the renewable energy share of energy consumption in 2001 was 11,3% compared to 6,4% in 1990 and 3,4% in 1980; and the renewable share has increased with about ½ a percentage point annually[35]

The energy plans guiding energy developments since 1990 have been Energy 2000 (1990) and Energy 21 from 1996. These plans have had CO_2 reduction as a main objective and de-central and renewable energy development have been / are main pillars in the Danish strategy. The official Danish energy targets for renewable energy sources (RES) are that the share of renewable energy is to grow to:

- ✓ 12-14% of primary energy supply by year 2005 (corresponding to 97 PJ / 27 TWh)
- ✓ and to approx. 35% (230 PJ / about 64 TWh) coverage by year 2030[36]

Total consumption of electricity in 2001 was 35,4 TWh and total electricity production was 36 TWh[37]. The official Danish energy plan, Energy 21 (1996) set a target of achieving 20% of electricity consumption (6,8 TWh) from renewables by 2003. In 2001, the percentage distribution of electricity production according to energy source was as follows:

Electricity Generation	Hydro power	Nuclear power	Other thermal power	Other renewable power
36 TWh	0	0	88	12

Source: http://www.nordel.org

As it concerns *electricity produced with renewable energy sources (RES-E*), the most detailed targets have been set for wind power, and in this context a

[33] http://www.ens.dk/graphics/publikationer/statistik/stat_01/tab0_brutto.htm)
[34] (http://www.ens.dk/sw2111.asp)
[35] http://www.ens.dk/graphics/publikationer/statistik/stat_01/fig1_priprod.htm
[36] Energy 21 (1996), pg. 23.
[37] Annual statistic available at http://www.nordel.org

target for *10% RES-E from wind by 2005* and capacity levels at 1,500 MW has stimulated wind power developments in the 1990s. A target of *30% RES-E from wind* is set for year 2030[38]. At the end of year 2000, wind power contributed to 13% of electricity consumption well ahead of the target for year 2005.

Looking to the individual renewable energy sources in more detail[39]: Solar energy is used in several ways. There are approximately 35,000 solar heating systems (hot water) in Denmark. There were subsidies for such systems for a number of years, but the subsidy was withdrawn on 1.1.2002. Solar cells (producing electricity) are known from, among other things, the project SOL 300, in which 300 detached houses were supplied with solar cell systems. In 2001 a new nationwide solar cell project, SOL 1000, was begun with solar cell systems for 1000 houses.

Heat pumps are used today for industrial purposes, heat recovery, individual heating (room heating and for heating process water) and district heating supply[40]. In Denmark today, approximately 35,000 small heat pump systems are installed for heating single homes and approximately 5000 large systems are installed for block heating, use in agriculture and industry, etc.

Waste incineration for energy purposes has increased in Denmark since the 1980s, and waste is commonly included in the category of biofuels (straw, wood, biogas, waste), which is planned to account for about 10.5% of the 12-14% renewable target by year 2005. As it concerns combustible waste, this is predominantly used in co-generation plants, and the production was about 4 PJ (1,11 TWh) electricity and 26 PJ heat. This corresponds to 3,4 % of electricity production and 22% of district heating production.

Concerning the use of biomass for energy purposes[41] (excl. waste), the production was 38 PJ (10,55 TWh) in 1999 corresponding to close to 5% of Danish energy consumption (gross). Little over half (20PJ) was used for individual heating purposes in straw; firewood, or pellet boilers. District heating and private producers used about 25%, and CHP plants used the last 25%. Production in biogas plants was 2,7 PJ (0,75 TWh) in total.

The integration of wind power in the electricity system has received most attention internationally due to the fact that Denmark has one of the highest shares of installed wind power generation capacity in the world, and

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[38] See Energy 21 (1996), pg. 41-42.

[39] The information on renewable energy sources presented below is from the Danish Energy Agency and was accessed on 28-10-02; http://www.ens.dk/sw185.asp

[40] The energy used to drive them is normally electricity. Depending on the temperature level of the heat source and the desired temperature level of the heat supplied, the annual efficiency of a heat pump system today may be up to approximately 5, i.e. the quantity of heat supplied is 5 times as high as the drive energy supplied. If 'high'-temperature heat sources such as industrial process heat, other heat recovery or geothermic heat are used, the efficiency may be higher.

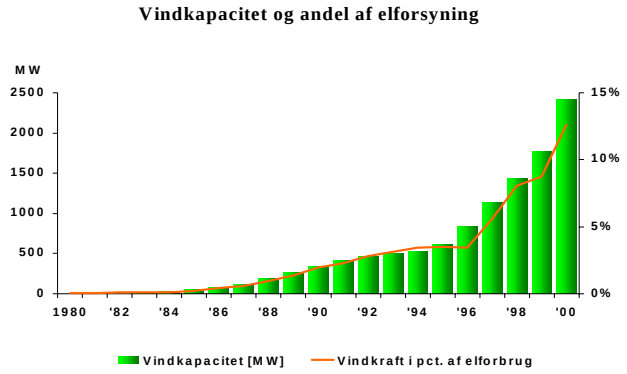
[41] http://www.ens.dk/sw214.asp accessed 28-10-02.

because of the industrial leadership in the manufacture of wind turbine technology and the associated world market shares. Due to favorable and stable policies directed toward renewable energy investors, a more or less ongoing growth in wind generation capacity was seen in the 1990s.

With the energy reform (1999) and change in support schemes, the stable pattern in investments was disrupted. A record of 600 MW of wind capacity (bringing capacity levels to about 2300 MW) was installed in Denmark in year 2000 due to the fact that orders from 1999 promised a longer standing fixed tariff. The market thereafter plunged to 77 MW in 2001, where wind power sales in Denmark were the lowest since 1994[42].

With the capacity level installed by 2000, wind was expected to meet 16% of Danish electricity demand in year 2001[43]. The current status, however show that wind power accounted for 12,1% of electricity supply in 2001. Development in capacity and the related production does not always co-evolve because of the natural phenomenon called "wind". Year 2001 was a relatively "poor" wind year almost 20% below a normal year[44]. The figure below shows the chronological development in levels of capacity and the related share of electricity supply.

Figure 1 Chronological development in levels of capacity and the related share of electricity supply



Source: Danish Energy Agency [45]

[42] http://www.windpower.org/news/index.htm , 26 June 2002.
[43] See Windpower Monthly, March 2001, pg.32.
[44] http://www.ens.dk/graphics/publikationer/statistik/stat_01/fig1_priprod.htm
[45] http://www.ens.dk/graphics/ENS_Forsyning/Vindmoeller/vindkap2000.ppt

Support schemes for renewable energy sources in Denmark

Support schemes dominating the past

Denmark has used the feed-in model (FIM) and the average buy-back or feed-in tariffs paid to wind power producers were negotiated voluntary between 1978-1991 and were regulated by law since 1992. In this model a long-term minimum price was guaranteed for electricity obtained from renewable sources. The feed-in tariffs have varied between 7,7 and 9,3 eurocent per kWh and have been highly influential in promoting electricity from especially wind power in Denmark by creating good conditions for growth in renewable generation capacities, In combination with standardised costs for grid connections and short lead times, this pricing system made it possible for developers to obtain easy bank 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 10-40 % depending on technology[46]. These have now been abolished, since the Danish Energy Agency decided to phase out investment support to small bio-fuelled plants as of November 1st, 2001, and investment support schemes to heat pumps and solar power were abolished in the Finance Act of 2002. Now the only investment support frameworks involve initiatives to enhance energy efficiency in houses of retired people and support granted to initiatives to the conversion of electricity-based heating to heat generated using natural gas or district heating[47].

As it concerns the feed-in model, the previous Danish government initiated a process in 1999 to replace the feed-in model with a quota-based system with tradable green certificates as an attempt to continue support schemes in a more market conform way. Next the proposed certificate model is presented.

A quota-based model with tradable green certificate

Model design

The proposed system for renewable electricity support through a system of green certificates trade has the following design:

- ✓ Renewable electricity is defined as electricity from the following sources: wind mills, biogas, biomass, solar energy and wave energy, and hydropower plants below 10 MW.

[46] 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.
[47] http://www.ens.dk/nyt/index.htm posted 10-4-2002-

- ✓ The certificate system will not include gas. The certificate system will not include heat.20% of the electricity demand should be covered by RES-E by 2003 establishing a demand for green certificates. No subsequent percentages were outlined but buying obligation would supposedly be moved upwards year by year in order to achieve the *Energy 21* target of 50% electricity from renewables by 2030.
- ✓ Each green certificate will represent a production of 1 MWh of RES-E
- ✓ Issuing bodies would be: Elkraft-System and Eltra
- ✓ The green certificate would only exist in an electronic form in a register of RES-E producers with information concerning date of issuing, geographical site, technology etc.
- ✓ The lifetime of the certificate is in principle infinite
- ✓ Penalty for not fulfilling the 20% consumer quota was set at DKK 0,27 / kWh (0,036 euro).
- ✓ Minimum and maximum prices were defined for green certificates. These are 0,10 and 0,27 DKK per kWh respectively.
- ✓ Transitional payment schemes would exist that pay a base-line price for 10 years as well as a specified subsidy for a number of full load hours to wind power plants before the plant would enter the certificate market means that e.g. in year 2002 only mills from year 1992 or older would be ready to enter the certificate market.
- ✓ Multiple transitional payment schemes financed by PSO payments from consumers would co-exist with the certificate market. In 2003 20% of consumers electricity consumption should be based on RES-E. But the share of RES-E in the certificate market would be much lower due to the transitional pay schemes. This means that not all renewable production would be issued certificates, and that the total amount of RES-E should be 20% (i.e. % in certificate market and % RES-E on transitional pay schemes). In 2002 it was expected that the quota for certificates would be around 6% of consumption.
- ✓ An estimate communicated by the DEA to the Danish Nord Pool representative indicated that there would be certificates corresponding to 0,7 TWh in 2002[48]. Going back to the calculation above, which indicates that the 20% quota corresponds to about 7 TWh RES-E, this means that about 6,3 TWh would be covered by transitional payment schemes as financed by PSO payments from consumers[49].

[48] Email correspondence from Anders Plejdrup Houmöller, 17/12/2000.

[49] PSO costs will continue to make up a standard element in Danish consumers electricity bill. The base-line payments outlined in the description of the transitional payment schemes

International trade and the national certificate market

The Danish Government and the Danish Energy Agency (DEA) signalled an interest in the promotion of international certificate trade in order to stabilise certificate prices. Specific conditions of common criteria were not decided upon, but the DEA outlined the following considerations for import of certificates:

- ✓ Transparency in subsidy arrangements
- ✓ Technology type and acceptance of certificates following the Danish RES-E definition
- ✓ The "additionality" principle meaning that the Danish RES-E quota should be fulfilled by a real growth in total RES-E production (meaning that it should be possible to use foreign certificates if they represent a production, which would not have taken place without the trade)
- ✓ Only foreign certificates from other RES-E quota-based systems would be accepted.

Implementation of the Danish certificate market – delays and future prospects

Original start up date for the new support framework was year 2000 but this date has been postponed several times. At a hearing arranged by the Parliament's Committee for Energy Policy in September 2001[50], the implementation date (January 2002) was postponed for what appeared to be an additional two years indicating that the certificate market would not be operational before 2005. June 19th, 2002, a parliamentary agreement was reached to postpone the introduction of a Danish certificate market, until it is possible to establish a common market with a number of EU countries.

The postponements were due to problems inherent in the Danish certificate model creating fears of the workability of the two-part trading system for renewable electricity. Problems relate to the issue of concentration in the supply of certificates among two major market players in a national market; the issue of low liquidity due to the many transitional pay schemes keeping large shares of the renewable electricity outside the certificate market as well as due to the fact that it is a national market. The Danish model has been harshly criticised by the wind power lobby (especially the Danish wind industry association) still searching for a sound economic analysis of the proposed trading system and pointing out that only administrative details concerning measurement and registration of electricity

guarantee RES-E (Electricity from renewable energy sources) production, established prior to 2003, a certain level of payment for 10 years.

[50] Høring i Folketingets Energipolitiske Udvalg, 28. september 2001

consumption and production from wind turbines were successfully sorted out during 30 months since the original 1999 reform agreement. The problem of immature renewable energy technologies as well as the mixing of biomass and wind into one certificate and one market was also pointed out, as well as the lack of European harmonization that may fuel expectations of multiple market collapses[51].

Another factor affecting the September 2001 postponement of the certificate system was the upcoming Danish election in November 2001. This election led to a new constellation of ruling parties and a liberal-conservative government, which quickly after its entering upon office signalled radical changes in policies affecting renewable energies. The well organized wind energy industry association has since then characterized the new government as carrying out a vendetta against the previous government's policy on renewable energy[52].

After the change of government in November, energy issues were moved from the Ministry of environment and energy to the Ministry of Economics and Business affairs going back to the old structure with a separate Ministry of Environment. At the same time, a review of support systems was begun with a focus on cost-effectiveness.

Year 2002 has been a year of change in the framework conditions for renewable energy in Denmark. During the spring, the research programme "Development programme for renewable energy"[53] was cancelled; the budget of the Energy Research programme was sliced, almost all investment support has been brought to an end, and the mandate on the utility sector to develop three of the five off-shore wind parks were removed possibly paving the way for a national or international tendering procedure to realise future offshore wind power projects[54]. Future developments in renewable energy policy are also linked to the goal of cost-efficient compliance with the climate obligation, and Danish policymaking is therefore also awaiting EU decision-making on the directive on emissions trade.

The terms of payment for renewable electricity production have been in a process of re-negotiation. A future support model needs to be in

[51] Krohn (2001), paper available at http://www.windpower.dk.
[52] (Søren Krohn 7. february, 2002, http://www.windpower.org/news/index.htm.
[53] Udviklingsprogrammet for vedvarende energi
[54] There was an agreement between the previous Danish government and Danish utilities that they should establish five wind farms each of 150 MW capacity before year 2008. The sites for these five offshore farms have been decided and the first farm is planned to be in operation during 2002. Political negotiations have indicated the possibility that the last three of these offshore farms may be subjected to a tender procedure. This will depend on the government's decision on how best to tackle Denmark's CO2 obligation and the reduction of green house gases with 21% by 2008 compared to 1990 levels.

place before the end of 2003 where the EU state aid approval of existing terms of payment runs out.

June 19th, 2002, the Government entered into agreement with Socialdemokratiet, Socialistisk Folkeparti, Det Radikale Ventre and Kristelig Folkeparti about the future terms of payment for wind power. The agreement is said to result in consumer savings of about DKK 2 billion by 2008, and the obligation to purchase prioritised el, in this context wind power, will gradually be removed. Financial support to wind power will be DKK 0.10 / kWh corresponding to the CO2 tax on electricity, and in addition, a max ceiling for the combined support and market price is set. New wind mills (expected to be offshore plants) will be part of this new system, which is to consist of the market price and an environmental bonus to CO2 neutral electricity production, and a combined max price of DKK 0.36 / kWh.

Current support schemes for RES-E in Denmark

In the parliamentary agreement from June 19, 2002, it was agreed to postpone the introduction of a quota-based marked with tradable certificates until it is possible to establish a common marked with other EU countries.

As a replacement for the postponed certificate market the parties agreed on the following support scheme for the *renewable electricity production, which would have been entitled to certificates*.

- ✓ Existing wind power production (not on a transitional pay scheme) receives an additional payment of DKK 0,10 per kWh (equal to the CO2 tax, and minimum certificate price) in addition to the market price.
- ✓ A ceiling of market price + production support at DKK 0,36 per kWh is set.
- ✓ Additional support is limited to a 20 year period.
- ✓ New wind power development established after 1.1.2003 will receive an additional environmental bonus (level to be decided during December 2002), but a total max payment (market price + support) is set at DKK 0.36 / kWh[55].

As part of the current support scheme on may also mention the "scrap guarantee" for machines taken off line between March 1999 and December

[55] Needless to say, this is a drastic change from the past where the average buy-back or feed-in tariffs paid to wind power producers were negotiated voluntary between 1978-1991 yet has been regulated by law since 1992. Distribution companies have been obliged to pay 85% of the retail rate (consumer price excluding taxes and subsidies) for wind this corresponding to about DKK 0,33 / kWh (0,044 euro / kWh). The average payment to wind has been close to. DKK 0,60 (0,075 euro /kWh) consisting of the 0,33 + a 0,27 subsidy.

2003. Present expectations indicate that approx. 250 MW new capacity will be installed under the scrap scheme before it expires at the end of 2003[56].

- ✓ To encourage replacement of old turbines (100 kW or less) the "scrap guarantee" promises a guaranteed payment of DKK 0,60 / kWh for 12.000 full load hours of production[57] to new machines with three times the capacity of the scrapped unit.

Terms of payment to older mills with higher production costs and to biomass and biogas plants are yet to be decided.

Sources

Ecofys/Greenprices; *Green Energy in Europe, Strategic Prospects to 2010*, Reuters Business Insight (2002)

Email correspondence from Anders Plejdrup Houmöller, Nord Pool DK, 17/12/2000.

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Liberalisering af energimarkederne: *Regeringens vækststrategi – Vækst med vilje*, Government report September 2002, ISBN trykt udgave: 87-7862-153-4, ISBN elektronisk udgave: 87-7862-154-2, available at: http://www.oem.dk

Meyer, Niels I. & Koefoed, Anne Louise: *Danish Energy Reform: Policy Implications for Renewables*, forthcoming in Energy Policy.

Recs *Country report for Denmark week 5, 2000*: available at: http://www.recs.org

[56] See http://www.windpower.org/news/index.htm , (16 August 2002).

[57] The number of full load hours may be converted to production by multiplying the capacity effect (KW, MW) with the number of full load hours. Example: 200 kW x 25,000 flh = 5.0 mill. kWh. For the larger turbines average production is 2000-2200 full load hours per year signalling 5-6 year.

Vindformation: Nyheder fra Vindmølleindustrien, nr. 28, Juli 2002.

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The case of Finland

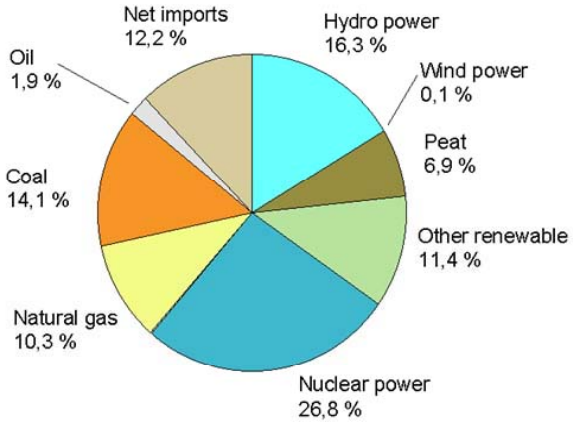
By Mari Hegg Gundersen

The general situation

Finland has been focusing on reduction in energy use and renewable electricity production for many years, and among other policy instruments, it was the first country in the world to introduce a carbon tax in 1990. Finland is one of the EU member states that generate the highest proportion of its electricity using renewable energy sources. Of total Finnish electricity production in 1999, 26% came from renewable energy sources, mainly large-scale hydro and biomass. The use of biomass is highest in Finland, where it accounted for 14% of the electricity generation in 1998.

The figure below shows the distribution of electricity production on different energy sources and demonstrates that nuclear power plays a central role.

Figure 1. Energy sources in Finland 2001



On May 24, 2002, the Finnish Parliament decided to ratify the favourable decision-in-principle to built a fifth nuclear power plant unit. The decision-in-principle (made by the Government last January), which is now ratified, is based on the view that the nuclear power option is the most cost-effective alternative, both in terms of central government finances and the national economy, for the generation of base load power within the framework of the Kyoto Protocol.

Latest polls show, however, that 56% of Finns are against further expansion of nuclear power, and with the parliamentary election coming up in March 2003 the case is not settled. “The “Greens” will campaign hard for the reversal of the decision, and go to the election with a no to nuclear power manifesto” (Windpower Monthly, July 2002)

Support schemes for renewable energy sources in Finland

In the fall of 1999, the Action Plan for Renewable Energy Sources was published in Finland. This was done as a result of the Kyoto Protocol and EU’s Whitebook on renewable energy sources in the internal market. According to the action plan, 31% of the electricity produced in Finland shall come from renewable energy sources by 2010. Motiva Oy, which mainly functions with the Ministry’s budget funding, is to implement the Action Plan for Renewable Energy Sources by producing, processing and distributing information, by developing methodology and by accelerating the take-up of energy-savings technology.

The aim of the action plan is to make energy produced by renewable energy sources competitive in the open market. Important measures are the development and commercialisation of new technology and economic means such as energy taxation and investment support. In Finland it is also possible to apply for a production subsidy for electricity produced by wind power, hydro power with capacity less than 1 MVA and CHP production using wood or peat with a maximum capacity of 40 MVA. In 2001 the refund for electricity delivered to the network produced by wind power was equal to the electricity tax in category I[58] which was 4,1 Finnish penny/kWh or 0,69 cents/kWh. In the other cases the refund was equal to the electricity tax in category II which was 2,5 Finnish penny/kWh or 0,42 cents/kWh. If the electricity is produced by using wood or wood-based fuels or by using industrial waste gas derived from metallurgical processes, the producer of the electricity may apply for a refund of 0,42 cents/kWh for electricity delivered to the network.

An investment support system is also operative for development and investment projects that promote the use of renewable energy sources. Grants from 15% up to 40% of the approved investment sum are allowed for such investments and depends on the nature of the innovative technologies used. The Ministry of Trade and Industry administer the investment support.

[58] 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 by measured by delivery. All other cases fall under category I.

The quota-based model with tradable green certificate

An in-house working group at the Energy Department of the Ministry of Trade and Industry has studied the applicability of various alternatives for promoting electricity generated with renewable energy sources in Finland. It assessed the means applied at present in Finland for promoting renewable electricity, as well as the applicability of some alternative models or combinations of old and new models in Finland and in the Nordic electricity market. The working group began its work in December 2001, and submitted its report in June 2002.

The *main recommendation* from the working group (WG) is that the present subsidy scheme should be developed in a way such as granting investment support based on open competition (i.e. investors bid their projects and the subsidy is granted to those who are most efficient). There could be different competitions for different generation technologies / types. A *second point* made by the working group is that a green certificate system based on buying quotas could be an efficient system if different types of generation could get different amounts of certificates based on coefficients (due to the fact that e.g. wind power needs more support than biomass based generation). The WG does not propose such a system now because different green certificate systems are under development; however the group does expect that there will be a joint model for the internal market (EU) in the future.

The WG furthermore looked at the system to handle the guarantee of origin requirement (defined in the RES-E directive) and this will be developed in a quick manner. Many Finnish companies are involved in the voluntary RECS initiative and will benefit by gaining experience from this type of green certificate system. The RECS initiative has political support in Finland, and the working group sees it as providing valuable experience but does not recommend a national Finnish certificate system.

Future prospects for a certificate model in Finland

Like Norway, Finland is very active in the RECS initiative and by the end of October 2002, certificates corresponding to 4,6 TWh had been issued to Finland. 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.

Finland clearly has a potentially large supply side of green certificates (considering existing production capacity), on the other hand, there seems to be little focus on establishing demand for same certificates at the national level. Based on the working group’s recommendations and the efforts made to comply with the EU Directive 2001/77, Finland is working on a new action plan for the promotion of new renewable energy sources.

For what we have gathered so far, it seems clear that there will not be a national green certificates market at this point in time, and that a stand by mode has been recommended to await a joint initiative and a possible common certificate market with other EU countries.

Sources:

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Ministry of Finance: www.vn.fi

The case of Norway

By Mari Hegg Gundersen

The general situation

Norway has naturally rich supplies of a number of primary energy sources, including crude oil, natural gas, hydropower and wind. The consumption of electricity is, however, high per capita and there are now concrete plans for reducing the electricity consumption, increase the use of new renewable energy sources and change the heating of buildings from electricity to other technologies. The government also wants to reduce the use of mineral oil for district heating by 25 % within 2012. A strategy for district heating based on renewables was therefore published the summer of 2002.

Electricity production is almost entirely based on hydropower, and it covers about 56% of all energy use. In 2002, petroleum and other fossil fuels accounted for 37 % of Norway's domestic energy use including transport and other renewable energy sources accounted for about 7%. There is, however, limited potential for further development of hydropower production.

Facts about Norwegian electricity production:

	2001	**2000**
Water Power	120 439	142 944
Thermal Power	917	730
Wind Power	30	29
Total Production	**121 386**	**143 703**
Import	10 884	1 669
Export	7 420	20 589
Gross domestic cons.	**124 850**	**124 783**

(Source: www.ssb.no/elektrisitet)

The energy objectives approved by the Parliament (Stortinget) in spring 2000 are; to limit energy use considerably more than if developments were allowed to continue unchecked; to increase annual use of central heating based on new renewable energy sources, heat pumps and waste heat by 4 TWh/year by the year 2010; to install wind power capacity of 3 TWh/year by the year 2010 and to increase the land-based use of natural gas. These goals were set out in a white paper (Report No. 29 (1998-1999)) to Stortinget and to achieve these objectives Stortinget has indicated that it is

willing to provide grants up to a ceiling of NOK 5 billion over a ten-year period.

In March 2001, Stortinget also approved the establishment of a new government agency, Enova[59], to ensure more cost-effective use of public funds. This signals a shift in Norway's organization of its energy efficiency and renewable energy policy. By gathering strategic policy responsibilities in a small, flexible and market oriented organisation, the intention is to create a pro-active agency that has the capacity to stimulate energy efficiency by motivating cost-effective and environmentally sound investment decisions, and to develop key energy and energy efficiency indicators and evaluation guidelines. The reorganisation is due to the fast growing national use of energy over the past few years and the need for a more dynamic organisation that can develop successful policy initiative while at the same time taking changes in national and international economic, political, legal and environmental conditions into account. (Source: www.enova.no)

Support schemes for renewable energy sources in Norway

The Norwegian policy initiatives affecting renewable energy include: *investment support*, government funds administrated by ENOVA, granted to bioenergy, wind power and "use of district heating" independent of the technology used; *information* about energy and electricity saving (ENØK); and investment support in energy-saving technology also administrated by ENOVA. Norway is also taxing oil and electricity in order to increase the relative competitiveness for renewable energy sources. Finally, the Ministry of Oil and Energy (OED) has increased the budget for research on renewables energy sources by NOK 40 million for 2003.

Looking more in detail at wind power, there are many suitable sites for wind power in Norway. In the beginning of year 2002, there were 28 wind turbines in Norway, with installed capacity of about 17 MW. During one year the 28 turbines produce about 50 GWh (0,05 TWh). In 2001, Norwegian wind power production was about 30 GWh. In September this year (2002), the first 40 MW phase of Norway's largest wind farm to date, opened at Smøla. Presently, Norway has five operational wind farms out of 11 licensed so far.

Up until 1997 the wind power production was supported only by grants given to research and development of new technologies. From 1997 up until this year wind power has also been supported by as much as 25% of the investment costs, with a limit at 8000 NOK/kW. The restriction is that the windmill must produce more than 500 kW, and must be part of a bigger

[59] ENOVA was established in 2001.

plant with a production of no less than 1500 kW. Wind power was also exempted from an investment fee of 7% of the investments, however, this fee no longer exist. In addition to investment related support, wind power producers receive production support equal to 50% of the tax paid on electricity; in 2002 this production support was equal to NOK 0,0465 per kWh). This production support also has the above mentioned size requirements to the windmill.

Beginning in 2003, Enova will reduce investment support to wind power plants. Support will still be granted, but Enova will also focus on development of new technology, which will make wind power more competitive in the future.

Looking to other renewable sources, investment support of 15 – 25% is also given for central heating based on renewable energy sources. The goal is to increase the use to central heating based on renewables to 4 TWh a year within 2010. The support schemes are written down in: ”Varmeanleggsordningen” and ”Teknologiintroduksjons-programmet”, and the projects that received this investment support last year produced about 316 GWh energy from renewable energy sources. This energy was produced by 74% bio energy, 8,2% heat (spillvarme) and 17.7% heatpumps. The Norwegian government also supports investments in alternative (non-electric) heating in new houses. This is administered by Husbanken and amounts to NOK 10.000 in investment support and NOK 140.000 as a loan.

Finally, as it concerns the use of information as a policy instrument, el-producers in Norway are obligated by law to inform their customers about energy saving possibilities. To finance energy savings activities 0,3 øre/kWh from the grid tariff is collected and invested in “Energifondet”.

The quota-based model with tradable green certificate

The Ministry of Oil and Energy (OED) published a White Paper to Stortinget, on November 1st, 2002 (Stortingsmelding nr. 9 (2002-2003), on the domestic use of natural gas. In the same White paper, the Government also presented its position and views on a green certificates model to support electricity from renewables. In short, the Government proposes that Norway should contribute to an advanced development of an international market for green certificates. In doing so, consideration should be given to environmental concerns, security of supply and an acceptable management of natural resources in Norway.

With this White paper the government therefore clearly states that there will not be a domestic, national market for green certificates in Norway. Instead, Enova will continue to be the dominant support “scheme” for renewable energy sources in Norway.

Despite this decision on a certificate market in Norway. Norwegian actors are today involved in trading with green certificates in Europe, in

particular the Netherlands. In 2002 Norwegian companies used RECS to certify their electricity production and sent the green certificates as well as the energy to the Netherlands where there is favourable consumer incentives to further demand for electricity produced using renewable energy sources as well as premium support to producers.

Future prospects for a certificate model in Norway

As stated in the White paper from November 1st, there will not, in the near future, be a Norwegian certificate market. There are several reasons for this conclusion. The idea behind a certificate model is to use a market based mechanism to promote the production of electricity from new renewable energy sources. Since almost all the electricity produced in Norway comes from hydropower, the definition of energy sources eligible for a certificate system may be controversial. Including all hydropower, already cost competitive, would make it almost impossible for new technologies to enter the market. On the other hand, by not including hydropower, the market would be very small. Norway therefore considers itself better off within a larger market context, a Nordic or international market.

Today Norway exports certified hydropower to other countries. Favourable support schemes for renewable energy in Europe result in large export of hydropower and wind power from Norway. Once EU members are to present their accounts to show compliance with the directive's indicative targets / national RES-E goals, they will most likely want to take credit for certified green power that has been imported as well as the domestically produced RES-E. Hence for Norway, it seems that an issue to be dealt with in the near future has to do with double- counting, and an awareness of the green or black share of European electricity production, which may be assigned to Norway if all Norwegian "greenness" / environmental value has been exported.

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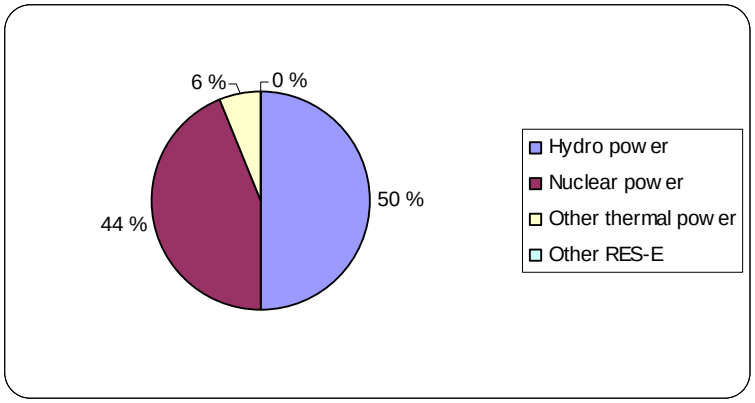
The case of Sweden

By Anne Louise Koefoed

The general situation

Total electricity production in Sweden was 157,8 TWh in 2001 and total consumption was 150,5 TWh. Total installed production capacity is 31,721 MW. The percentage distribution of electricity production is shown in the figure below:

Figure 2 Percentage distribution of electricity production according to source



Source: http://www.nordel.org Annual Statistics 2001

Hydropower amounts to 50% of Swedish electricity production. Normal production is estimated to 64 TWh from 1800 different hydro plants with effect levels varying between some 10 kW to 940 MW. The plant size distribution is presented in the table below.

Table 1 Swedish hydropower- plant size and production levels

	< 1,5 MW	1,5- 10 MW	> 10 MW	Total
Number	1 467	148	206	1 821
Total effect, MW	450	600	15 334	16 384
Annual product. TWh	1,7	2,5	60,5	64,7

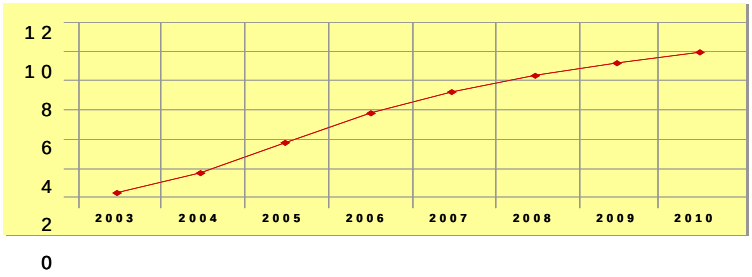
Source: Ds 2000:20(p.32) Elproduktion från förnybara energikällor

Other Swedish RES-E production are: wind power (1999) 215 MW installed effect producing 365 GWh, in year2001 wind generated 0,48 TWh accounting for 0,3% of the total electrical energy generated during 2001. During 2001, biofuels were used for generating about 3,7 TWh of electricity in CHP generation in district heating systems and in industrial backpressure plants, which corresponded to 39% of the electricity generated in these systems. Biofueled plants produced 761 GWh in 1998.

Energy policies in Sweden focus on furthering a supply of electricity that should be based on preferably indigenous and renewable energy sources. Nuclear power should be replaced by renewable energy, and the use of fossil fuels should not be increased. The Swedish energy programme includes measures aimed at: decreasing the consumption of electricity for heating purposes; utilising the existing electricity system more efficiently; increasing the supply of electricity and heating from renewable sources of energy.

The renewable energy policy target that are endorsed by the Government and the Parliament is to increase electricity production from renewable energy sources by 10 TWh over the years 2003-2010, and to 15 TWh by 2012 to be in accordance with the EU directive. The development in the contribution from RES-E is depicted below (TWh) .

Figure 3 Contributions in TWh



(Source: SOU 2001:77

- ✓ New supply of renewable electricity is to come from expansions in existing plants and new developments.

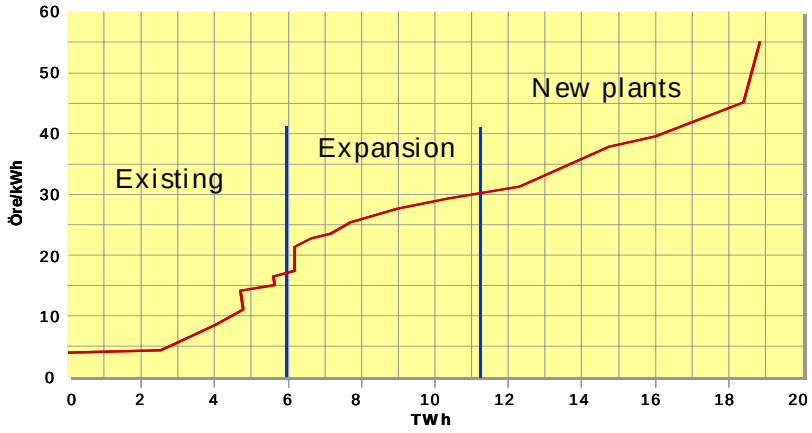
Table 2 RES-E production potential

Expansion within existing plants	5,2 TWh
New Plants:	
Wind power	3 TWh
Hydroelectric power	1 TWh
CHP from biomass	2 TWh
Industrial back pressure	1,5 TWh
TOTAL New RES-E:	7,5 TWh

Source: SOU 2001:77

Overall, the development of the potential and the 10 TWh target is expected to have the following development pattern under the new support system.

Figure 4 Expected supply curve of new RES-E under new support system



Sources SOU: 2001:77 pg. 122

The potential in existing plants concerns mainly the use of biomass in CHP generation and enhancements in small-scale hydro (< 1,5) plants. An expansion phase is estimated to bring about 5 TWh and concerns possible new production in existing plants for example hydro plants taken out of

production for economic reasons, and new fuel combinations using biomass instead of oil in districting heating plants. In combination the existing, expansion and new plant " phase" is expected to contribute with the potential of 10 TWh at a price below 55 øre / kWh.

Support schemes dominating the past

Swedish policy in the promotion of renewables have a specific technology focus and is tied to the promotion of wind power, hydropower, CHP using biomass. Further, the Swedish definition of small-scale electricity refers to effect levels of maximum 1500 kW. The renewable energy targets have in the past been pursued using the following support system:

- Support to investments in wind turbines rated at more than 200 kW and hydropower stations rated between 100 and 1500 kW has been amended from 15% to 10% of the total investment cost.
- Production of wind power is supported at rates equivalent to the electricity tax paid by consumers ((ex. 18,1 øre / kWh in 2002)
- Investments in biofuel-fired CHP are entitled to state grants at the rate of 3000 SEK/kW installed, although not exceeding 25% of the investment cost. Grants are awarded to investment that provide an addition to the power generation capacity.
- A special subsidy of SEK 0,09 per kWh was paid to electricity generators in all types of plants with a rating below 1500 kWh.

These support schemes are to be replaced by the new certificate system.

A quota-based model with tradable green certificate

Sweden has embarked on a transition period from the feed-in type of support scheme to a quota-based system with trade in renewable electricity certificates. A Swedish government commission published a report (Electricity Certificate Investigation ElCERTH SOU 2001:77) in Nov. 2001 proposing the introduction of a Certificate Trading Model (CTM) from 2003. The proposals presented in the SOU were integrated in a new energy bill proposition ("A secure, efficient and environment-friendly energy supply" 2001/02:143) presented in March 2002 by the Swedish government and addressed in Parliament (Riksdagen), June 2002. The legislative text was not approved by the legislative council ("Lagrådet"), which meant that Parliament could not make a formal legislative decision. However, since a majority of the political parties are in agreement about the RES-E certificate system, a favorable decision on the legislative proposal is expected to be made in February / March 2003 and to bring the certificate system into operation from May 1st 2003.

Some principles were set out for the creation of the new system:

- To promote establishment of new el production from renewable sources
- Support technological development
- Provide cost effective solutions
- Set reasonable conditions for existing plants
- Avoid interruptions in the function of the electricity net
- Set stable rules independent of state finances
- Enable international harmonization
- Should aim for competition among different energy sources

Hence, the argumentation behind the model refers to cost-efficiency in renewable capacity development, competition between renewable technologies/resources, compatibility with market principles and international market integration, which have become common arguments in the debate over support models.

Model design

In brief, the proposed system looks the following way:

- Quota-based with obligation for year 2003-2010, quota period is defined as 1 calendar yearQuota expressed as % of consumptionCustomers have ”quota obligation”
- A certificate is valid for an unlimited period of time and may be ”banked”
- The consumers are protected by a maximum price of 200 SEK per MWh / per certificate, the first two years
- A fine serve as a penalty for non-fulfillment of the quota and acts as a price ceiling on the certificate price The fine will be set at 150% of the average certificate price over a one year period, and a maximum fine for the years 2003 to 2007 is not to exceed SEK 200 / certificate (SEK 0.20 / kWh)
- An initial price guarantee reduced in steps (initial 5 ye.) The first years the producers are guaranteed a price of 60 SEK per MWh (SEK 0.06 / KWh). This guarantee will decrease to 0 after six years that is year 2010.Transitional regulation with environmental bonus to wind power (old and new, SEK 0,18 / kWh). Reduction of bonus over a 7 year period
- Electricity intensive industry is exempted from the quota obligation in the beginning. A unified system: all RES-E sources in one system
- Waste used to generate electricity is not eligible for certification.

The Swedish Energy Agency (Energimyndigheten) and the national grid authority (Svenska Kraftnät) have been asked by the government to prepare for the certificate system[60].

The Swedish Energy Agency will be responsible for controlling and verifying electricity producers and plant approvals. The Agency is also responsible for registration of quota obligated el producers and consumers, for controlling the certificate declarations and withdraw / annul the certificates used in the market. It is also the Agency's responsibility to impose sanctions when required.

Svenska Kraftnät will have the role of certifying / issuing certificates to producers, create and maintain registry of producer accounts, and inform the Energy Agency about: owners, transactions, prices and documentation on quota obligations. The el certificates will be distributed every month, not as a paper, but electronically in the certificate database administered by Svenska Kräftnät.

Eligible sources:

The following renewable energy sources qualify for certificates:

- Wind power,
- Solar power,
- Geothermal
- Biomass
- Wave energy
- Hydro meeting the following criteria qualify for certificates:
    - Existing plants with capacity not exceeding 1500 kW,
    - Plants that have not been in operation after July 1st, 2001 but start production after the certificate law comes into effect.
    - Production plants with a capacity between 1,5 MW and 15 MW under certain conditions.
    - Increased installed capacity / production enhancements in existing plants by measures undertaken after July 1st, 2002.
    - New hydro plants which started operation after July 1st, 2002

[60] The model is based on the recommendations from the ELCERTH-research report from the fall 2001 (SOU 2001:77).

Quota obligation

In order to establish a demand for certificates a quota obligation is placed on consumers. Electricity suppliers will most likely handle the quota obligation for their customers; but the customer is free to handle the obligation. The cost of the certificates will be shown separately on the electricity bill. The quota obligation will increase from 6,7% of consumed electricity in 2003 to 15,6% of electricity consumption in 2010.

Year	2003	2004	2005	2006	2007	2008	2009	2010
Obligation	6,7%	7,7%	9,7%	11,7%	13,1%	14,2%	14,9%	15,6%

Price

The estimated certificate price is somewhere between 120- 150 SEK per certificate (ex. vat). The price of the certificates will depend on supply and demand, as a start-up help for the market it is decided that a minimum price of SEK 60 will be granted per certificate in 2003. This minimum price will be phased out by 2008. A maximum price has also been set on the certificates, which equals the sanction for not meeting the quota obligations. This max price is set at 150% of the average price on the certificate during the year and max SEK 200 per certificate in year 2004 and 2005.

The table below shows the step-wise reduction of the initial price guarantee.

Year	2003	2004	2005	2006	2007	2008
Minimum Price	SEK 60	SEK 50	SEK 40	SEK 30	SEK 20	0

Environmental bonus to wind power

The environmental bonus to wind power (new and existing) will be phased out from SEK 0,18 per kWh in 2003 to SEK 0,05 in 2009. After 2009 the bonus will no longer be paid. Large-scale wind power, however, will receive some sort of support for technology development and market introduction purposes.

International Trade

Initially the Swedish certificate market will be a national market. It is only electricity produced in Sweden that is included in the certificate system in the first years. Export of electricity certificates cannot be prevented but import is prohibited.

A sketch from the Ministry of Industry, Employment and Communications, shows that if Sweden is to open for imports the following criteria may be considered[61]:

- Foreign certificates must fulfil Swedish demands
- Reciprocal opening of electricity markets
- No parallel subsidies apart from certificates
- Quota demands in the other country?

Process and process – time table for implementation[62]

- October 2001 — Investigation presented
- March 2002 — Energy bill presented
- June 11th, 2002 — Energy bill accepted into parliament
- June 2002 — Ds – Law for electricity certificates, hearing in August
- November 21, 2002 — New Law Council comments
- December 2002 — Draft law presented into parliament (2-12-02)
- March 2003 — The law can be accepted into parliament
- March 2003 — Regulations /ordinances formally accepted
- May 1st, 2003 — Electricity certificate law comes into force
- June 15, 2003 — First certificates issued

[61] Source: Andersson, Nils (2002)
[62] Source: Andersson, Nils (2002)

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