Green electricity trade in the Nordic region: Markets, products and transactions

Atle Midttun and Mari Hegg Gundersen (eds.)

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Abstract

This report examines the potential for- and institutional framing of green electricity trade in the Nordic region in general and for trade in standardised green products on a commodity exchange in particular. The discussion includes both mandatory, politically initiated trade as well as commercially and idealistically motivated trade. Rather than focusing on equilibrium and price formation within given institutional constraints, institutional analysis focuses on the institutional framework itself and how different institutional elements are constituted and affect market outcomes.

The report shows how demand and supply of green electricity in the Nordic market comes out of a complex interplay of political and commercial forces. On one hand, political specification of mandatory green electricity demand and support schemes for green electricity defines the premises for a political market segment. On the other hand, there are also commercially defined market niches where demand and supply arise out of purely commercial or idealistic interests. Furthermore even politically defined green electricity markets rely on commercially driven processes under a deregulated and trade oriented policy regime.

Taking the discussion of a common Nordic mandatory green electricity market as a point of departure, the report estimates a mandatory Nordic demand on the basis of several assumptions, ranging from demand based only on existing political objectives in each of the Nordic countries to a Nordic implementation of the Danish certificate model at the high end.

The report also focuses on the voluntary demand for renewable electricity. In the Nordic region this demand has primarily consisted of the Swedish Society for Nature Conservation (SSNCs) eco-labelling scheme for renewable electricity, “Bra Miljøval” and the Finnish label Norppa. In Sweden in 2001 the electricity sold under this label was 14 TWh or close to 10% of the total marked. In addition comes demand for green el from foreign markets, notably the Dutch market, where extensive amounts of green electricity have been traded from Nordic suppliers.

The report documents that highly different pictures of the “old” and “new” renewables characterize the Nordic green supply-demand - or “power balance”. The abundant hydropower supply inherited from a century of investment, in Norway and Sweden in particular, has left the region with a vast supply surplus when compared to the demand for eco-labelled green electricity and the almost disappearing external European market for such supply. As opposed to the market for “old” renewables, the power balance for the new renewables may, under some scenarios, be characterized by supply shortage.

The report also points out that the current cost range of the new renewable technologies posit them outside the interesting price-range of

most commercial green el buyers. This market segment will thereby largely be driven by politically defined demand.

The report argues that, in a market that, like the market for green electricity is in an early build-up phase, lack of standardisation of products, lack of insight among actors and lack of liquidity/volume clearly necessitates broker-mediated trade. However, increasing volumes in green electricity trading, possibly following mandatory demand in Sweden and other Nordic initiatives, may allow trade on a commodity exchange to take place.

Given that sufficient trade volume would allow emergence of trade on a power exchange, the well-established Nordic power exchange, Nord Pool, would at first sight seem an obvious arena for exchange-based green electricity trade. However, the report points out that fairly simple internet based systems for continuous trade may be easily challenged by new actors, and competing tools for standardised trade may emerge from brokers that seek to expand into standardised trade from their specialised trade position.

The report also focuses on assurance. It points out that as the environmental qualities that are the basis for price differentiation are not observable by the customer, assurance (certification, verification and registration) of the product quality must therefore play a critical role. The report documents that assurance, like trade intermediation, is under rapid transformation and one may observe several models displayed in the Nordic context. From a branded package solution under the “bra miljøval” label with an assurance scheme uniquely designed for one product, the RECS system has introduced a more universalistic model, which could facilitate assurance for several labels. The Swedish Electricity Certificate System again reverts back to a mixture, where elements of the RECS are used, but with an over-layered government control. The report points out that such government intervention may increase domestic credibility, but may at the same time limit international or Nordic trade. While the overlapping models may constitute unnecessary complexity a certain rivalry in assurance may at the same time constitute useful pressure on transaction costs.

Based on the experiences with green electricity trading targeted at the Dutch electricity market, the report highlights the problems of linking green electricity trade to physical delivery.

In a concluding section the report briefly discusses the arguments for taking a Nordic rather than a European focus in the internationalization of green el markets.

Table of Contents

Introduction

Trade in renewable (green) electricity has come into focus as a consequence of several recent developments, among others:

- Increasing pressures to step up environmental policy measures following global climate policy and national anti pollution policies
- Deregulation of electricity markets that has triggered a search for parallel market based orientations of environmental policy.
- The failure of European CO2 taxation and the search for alternative regulation tools for integrated European policy solutions

The limited size and scope of national green electricity markets for small countries, like the Nordic, motivate attempts to seek larger arenas in order to allow economics of scale and scope. Given the successful pioneering role of the Nordic electricity market, it would seem natural for the Nordic countries to focus on the Nordic arena as a context also for green electricity trade.

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.

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 environmental policy harmonisation. The start-up of a Swedish green certificate market[1] 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 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.

This report examines the potential for- and institutional framing of green electricity trade in the Nordic region in general and trade in standardised green products on a power exchange in particular. The discussion includes

[1] In Sweden called Electricity Certificates (Elcert)

both mandatory, politically initiated trade as well as commercially and idealistically motivated trade.

This report summarizes findings and analyses in several underlying reports[2]. We gratefully acknowledge economic support from the Norwegian Research Council to the research work on which this report is based.[3]

[2] The reports include: "Trade Intermediation", Knut Rabbe(Nordpool), "Handel med "Grønne sertifikater", en vurdering av handelssystemer", Morten Johnsrud (Nordpool), "Prinsipielle betraktninger vedrørende utforming av handelsplass for grønne sertifikater i Norden", Arne Jakobsen (GreenStream Network), "Renewable energy in Holland", Marianne Waage Fougner (Norsk Hydro).

[3] The report comes out of the project named "Grønne Handelssystemer" sponsored by the Norwegian Research Council (project # 145294/210)

Institutionalising green electricity trade in the Nordic electricity systems

From an institutional point of view, markets are social constructs with design-characteristics that strategically shape trade possibilities and market outcomes (Polany 1998, Parsons 1975, Parsons & Smelser 1966, Burns et al 1987). Rather than focusing on equilibrium and price formation within given institutional constraints, institutional analysis focuses on the institutional framework itself and how different institutional elements are constituted and affect market outcomes.

Institutionalisation of a market includes both the constitution of supply and demand, which in an institutional perspective are societal constructs, dependent on social definitions, socially/politically designed preferences, rules and incentive systems (Burns 1987) as well as the constitution of the market arena itself (Parsons & Smelser 1966).

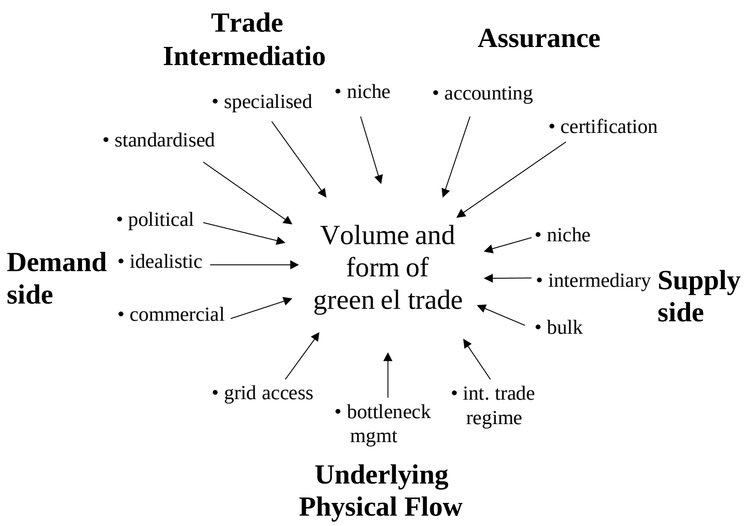
A central part of the market construction is also the provision trust (Nooteboom 2003) to secure credibility in the market. Trust may be anchored in various forms of regulatory interventions and/or other forms of third party support that are regularly a part of the institutional repertoire to secure an efficiently functioning market. Furthermore, certain products may be dependent on provision of specialised infrastructure and hence require special institutional arrangements to facilitate trade. In the case of Nordic green electricity trade the institutional elements are defined as follows:

- The constitution of supply and demand: In the case of green electricity trade, where a previous externality is transformed into a marketable product, the constitution of the market, also involves constituting both a demand- and a supply side through explicit political regulation and/or through societal and industrial self-organisation.
- The constitution of the market arena: In the context of electricity trade this involves a provision of trade intermediation ranging from standardised trade on the power exchange to bilateral trade.
- The provision of trust/assurance: In the electricity arena this involves accounting and certification to provide credibility to the green electricity trade. The “hidden character of greenness”, as electrons received by the consumer is neither green nor black or grey, calls for such intervention.
- The provision of specialised infrastructure: In electricity this involves management of the underlying physical electricity flow, involving grid access, bottleneck management and cross border trade arrangements. Such issues are obviously relevant in the case where

green electricity trade must involve physical flows across borders and/or over congested transmission lines.

Figure 1 sum up these main dimensions of the institutional analysis, which are briefly elaborated in the following text.

Figure 1. Institutional dimensions of trade in green electricity



Constitution of demand

Starting out with the demand side, one may distinguish between demand arising in three institutional/social contexts: 1) mandatory politically defined demand 2) voluntary commercial demand and 3) idealistically defined demand.

Politically defined demand

Political defined demand involves political aggregation processes where public authorities and national assemblies, through legal processes and administrative decrees determine demand volumes and/or demand qualities for green electricity. Critical questions are here, to what extent and how national interests may be reconciled. Distributive effects of common solutions among the Nordic countries therefore become a focal point and the institutional challenge becomes one of staging collective action (Olson 1971). We have elsewhere elaborated on collective action challenges of environmental regulation (Midttun & Koefoed 2001, Midttun & Koefoed 2003) and discussed how collective action concerns may motivate considerable modification of economic first-best solutions.

Commercially defined demand
Commercially defined demand for green electricity involves demand generated by commercial actors, presumably motivated by needs for green certification (EMAS, ISO etc) and/ or green profiling vis a vis buyers in their supply chain or final customers. A critical focus is here on the renewable energy and how "necessary greening" may be achieved through least cost solutions.

Idealistic demand
Idealistic demand for green electricity is also, like commercial demand determined voluntarily by the market actors. However, it is motivated directly by personal consumer preferences, without further commercial advantages attached. This consumer segment constitutes a niche market where quality overrides cost. Analytically the commercially versus the idealistically derived markets for green electricity can be understood as two forms of market differentiation (Hax & Majluf 1991, Porter 1980): Commercially defined green electricity, with a focus on least cost "greening" solutions, constitute the basis for a volume-based price competition strategy from the suppliers, whereas the idealistically defined demand supports a quality-based market segmentation. Politically defined demand could be seen to lie somewhere in between.

Constitution of supply

Like for the demand side, the supply side is also heterogeneously composed, reflecting, in part, a differentiated institutional environment. Firstly, Nordic suppliers, particularly in Norway and Sweden, have large volumes of hydropower available to offer a bulk supply of large quantities of renewable electricity. Secondly, specialised programmes for new renewable technologies have provided institutionally sheltered contexts for limited amounts of renewables available for narrower politically and voluntarily defined niche markets at fairly high prices. Thirdly, some new renewables are maturing into standard technologies and are becoming available in greater quanta through semi-commercial processes at intermediary prices.

Both through R&D funding and environmentally motivated subsidies, the Nordic supply lends itself to meeting quality-based demand with a niche production strategy (Kemp 1997) while at the same time meeting the volume orientated commercial market through the vast supply of hydropower provided in the regular electricity market.

Provision of trade intermediation

A functioning market for green electricity must obviously include some form of trade intermediation. Intermediation may take several institutional forms, ranging from fully developed power exchange with standardised products and publicised prices, to specialised OTC trade or even bilateral trade. The form of trade intermediation is obviously strongly related to the type of demand and supply interests. Specialised niche products are clearly more suitable to specialised OTC or bilateral trade, whereas bulk and standardised products are more suitable as standardised exchange products.

Analytically the alignment of trade and institutional form of the transaction arena is traditionally discussed from a transaction cost theory point of view (Williamson 1975). Applied to green electricity trading, transaction-cost analysis predicts that open markets (such as Nord Pool) have an advantage when the contracting need is infrequent and with low asset-specificity, assuming that transaction fees of the exchange system can be kept at a competitive level. Bilateral or trilateral networks may constitute optimal governance under medium levels and frequency of asset specificity. Hierarchic governance stands out as the most attractive under high frequency and asset-specificity.

The establishment of assurance

Successful constitution of renewable markets relies on credible certification and accounting systems, which provide the necessary assurance to the market actors and government authorities. Various initiatives have been taken, both at the industry and government levels to institutionalise such assurance by facilitating accounting and verification. One such initiative is the so-called RECS regime, initiated by energy-industry. Another regime is the “Bra Miljöval” regime, initiated by the Swedish Nature conservation association. Critical questions are here how these regimes contribute to diminishing the risk-exposure and transaction costs of the trading parties.

Underlying physical flows

In the case where green electricity trade is tied to underlying physical flows of electricity, the facilitation of such flows takes on critical significance. International trade in particular obviously involves the whole set of issues such as regulation of grid access, bottleneck management and cross border trade regimes. As the institutional coordination of grid regimes is weakly developed in Europe, physical flow requirements may impose great trade barriers on international green el trade. The green electricity trade models practiced in and proposed for the Nordic market, do not involve physical flow constraints, we shall therefore not pursue this theme in any depth. However, we will illustrate the challenge posed by physical flow-based electricity trade through a brief outline of trade and flow management in Nordic-Dutch green electricity trade in 2001-2002.

Supply and demand side issues

Mari Hegg Gundersen and Atle Midttun

Demand and supply of green electricity in the Nordic market comes out of a complex interplay of political and commercial forces. On the one hand, political specification of mandatory green electricity demand and of support schemes for green electricity defines the premises for a political market segment. On the other hand, there are also purely commercially defined market niches where demand and supply arise out of purely commercial or idealistic interests. Furthermore even politically defined green electricity markets rely on commercially driven processes under a deregulated and trade oriented policy regime.

The demand side

Starting out with the demand side, one may distinguish between mandatory politically defined demand and voluntary commercial and idealistically defined demand. Politically defined demand involves political aggregation processes where public authorities and national assemblies, through legal processes and administrative decrees determine demand volumes and/or demand qualities for green electricity. Commercially defined demand for green electricity involves demand generated by commercial actors, presumably motivated by needs for green certification (EMAS, ISO etc) and/ or green profiling in relation to buyers in their supply chain or final customers. Idealistic demand for green electricity is also, like commercial demand determined voluntarily by the market actors. However, it is motivated directly by personal consumer preferences, without further commercial advantages attached.

Mandatory politically defined demand

Sweden is the only Nordic country, which has decided to introduce a market for green certificates[4] in 2003 with a quota obligation placed on consumers.

[4] The following renewable energy sources qualify for certificates in the Swedish Model: 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

The quota obligation is planned to increase from 7,4 of consumed electricity in 2003 to 16,9[5] of electricity consumption in 2010 with some industries exempted[6].

Denmark has also developed a model for green certificates although the implementation of this model has been postponed until 2005[7]. In this model 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 the buying obligation would supposedly be moved upwards year by year in order to achieve the *Energy 21*[8] target of 50% electricity from renewables by 2030 that is the current official plan for greening of the Danish energy system.

In *Finland* 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. The working group is sympathetic to a green certificate system given that there will be differentiation of certificate support for different types of green electricity generation, but awaits a joint model for the internal market (EU) in the future.

Implicitly, however, Finnish action plans for renewable energy sources imply considerable increase in green electricity demand. The Plan, which was launched in 1999 and was revised in December 2002, has the vision of doubling utilisation of renewable energy sources by 2025, as compared to 1995. By 2010, the plan foresees that use of renewable energy sources should be 50 % higher than in the reference year 1995, giving renewables roughly 30 % of the total consumption. The increase in use of renewable energy sources will be obtained almost entirely from bio energy. This corresponds more or less to the indicative target for Finland set in the RES-E Directive.[9] The target is that 31,5% of total electricity consumption

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certain conditions, increased installed capacity / production enhancements in existing plants by measures undertaken after July 1st, 2002 and new hydro plants which started operation after July 1st, 2002

[5] Regeringens proposition 2002/03:40, Elcertifikat för att främja förnybara energikällor, (www.stem.se)

[6] Energy intensive industries are exempted.

[7] At a hearing arranged by the Parliament's Committee for Energy Policy in September 2001[7], 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.

[8] Official Danish long-term energy plan, Energy 21 from 1996.

[9]The directive concerning the promotion of electricity produced from renewable energy sources in the internal Electricity market, the so-called RES-E directive, was passed in the autumn of 2001 /Official Journal, L 283/33. Targets set for the other Nordic countries in the RES Directive are; Sweden 60% and Denmark 29%.

shall be produced using renewable energy sources [10] and wood based fuels and recycled fuels are seen as playing a leading role.

The *Norwegian* government has until recently followed the Finnish government by supporting a green certificate system in principle, but delaying any implementation until a common European policy has been reached[11]. However, a recent revision of Norwegian energy policy launched an investigation into how Norway might join a common Norwegian-Swedish green certificate market. The Parliament asked the Government in March 2003[12] to take initiatives towards a common Norwegian-Swedish certificate market, which in turn can be integrated into a larger international certificate market. A proposal for such a market is expected during the spring of 2004.

However, like in Finland, green electricity policy objectives in Norway have implicit demand implications. The Norwegian energy objectives approved by the Parliament (Stortinget) in spring 2000 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[13].

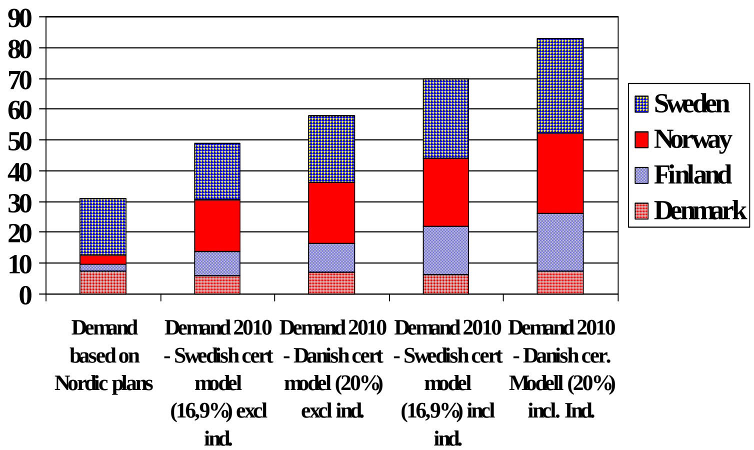
Demand volumes in a possible Nordic mandatory market

While no consensus has yet been reached on a common Nordic mandatory "green" electricity market, such a market is nevertheless being discussed. In figure 2, we have therefore estimated a mandatory Nordic demand on the basis of several assumptions, ranging from a Nordic demand based only on existing political objectives[14] in each of the Nordic countries to a Nordic implementation of the Danish model at the high end. As indicated in the figure, the existing plans[15] in the Nordic countries (the first column) are far

[10] Energy Market Authority (www.energiamarkkinavirasto.fi)
[11] This view was described in the White paper, which was send to the Storting in November 2002 (Stortingsmelding nr. 9 (2002-2003)). The Storting will discuss this paper in during March this year.
[12] Decision no. 351 (2002-2003)
[13] These goals were set out in a white paper (Report No. 29 (1998-1999) and are supposed to be achieved through grants of NOK 5 billion over a ten-year period and by active engagement by the newly established government agency, Enova. (www.enova.no)
[14] Published targets for RES-E
[15] For Sweden the mandatory demand of 16,9% of consumed electricity excluding the energy intensive industry is used. The Danish demand is based on the Danish certificate model requiring 20% of all electricity consumed to come from new renewables. The basis for the Norwegian demand is the objective of 3 TWh electricity from wind power assuming that supply equals demand The Finnish demand in this figure is like the Norwegian very small. The reason is that the Finnish objective when it comes to renewable energy sources is based on the RES Directive stating that 31,5% of electricity consumption in Finland should come

less ambitious than an implementation of the Swedish and Danish certificate models (certificate targets) applied to the total Nordic market. The very modest targets in Finland and Norway are clearly the factors that contribute to this result. If a Nordic certificate model would be introduced based on the Swedish or the Danish model the mandatory demand for new green electricity would increase extensively.

Figure 2. Estimated demand for electricity based on new renewable energy sources in 2010 (TWh)[16].



Voluntary demand

The voluntary demand for renewable electricity in the Nordic region has primarily consisted of the Swedish Society for Nature Conservation (SSNCs) eco-labelling scheme for renewable electricity, "Bra Miljøval" and the Finnish label Norppa.

As a private labeling system, "Bra Miljøval" was introduced in the fall of 1995 by the SSNC, and was designed to facilitate environmental choice in the electricity retail market in the coming liberalised market. The system does not see the development of new renewable capacity

from renewable energy sources in 2010. In 2001 renewable energy sources, including large hydro, counted for 32% of the electricity generations (or 27 TWh). Nordel has estimated the electricity consumption in Finland in 2010 to 93 TWh, 31,5% of this equals 29 TWh. Based on these estimates and the assumption that no more hydro capacity will be installed, the Finnish new renewable energy sources in 2010 will come from bio mass and count about 2 TWh

[16] Source: Nordel/SSB/Svenska Energimyndigheten

development as it main priority, but is rather focused on redirecting supply towards green capacities and stimulating the phase out the most environmentally undesirable plants[17]. The scheme thereby includes hydropower and thereby offers large volumes at cheap prices[18].

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

Demand volumes in the voluntary market

In Sweden in the year 2000, 7% of all electricity sold to final consumers was sold under labelled contracts adding up to about 9 TWh. In 2001 the electricity sold under this label was 14 TWh[19]. Finland does also have a voluntary label, "Norppa", which is the equivalent to the "Bra Miljøval" label in Sweden. The demand for this label however, is much lower in Finland than in Sweden, only 80 GWh was certified under this label in 2001.

Assuming a modest growth rate of 5% a year up until 2010 the total voluntary demand for labelled electricity in Sweden would amount to 21,7 TWh in 2010. Taking into consideration the latest criteria for this label, 5% of the certified electricity should come from new renewable energy sources (or about 1,1 TWh)

In addition comes demand for green el from foreign markets, notably the Dutch market, where extensive amounts of green electricity have been traded from Nordic suppliers. By the end of year 2002 about 13 TWh from the Nordic countries was certified according to RECS[20]. Most of these certificates where sold to the Netherlands.

The very beneficial Dutch support system to green electricity producers outside Netherlands is changing [21], and the country is moving

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[17] See Naturskyddsföreningen (1995)

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

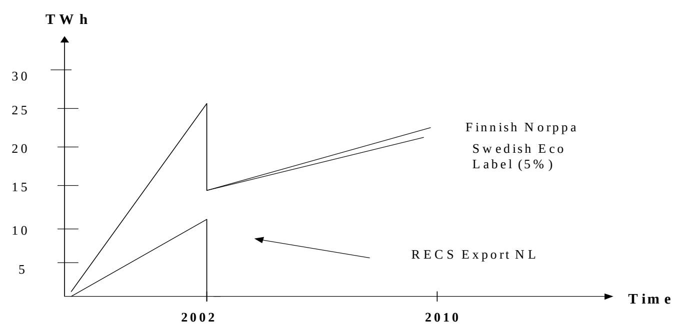
[19] (http://www.snf.se).

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

[21] The Dutch MEP-law (Environment Quality and Environment Production (MEP)), in which fixed tariffs for national renewable energy producers guaranteed for ten years, is regulated.

from a green certificate model to a feed-in tariff model in order to support new renewable energy.

Figure 3. Accumulated volume in the voluntary markets in 2002,[22] *and projections for 2010.*



The supply side

Like for the demand side, the supply side is also heterogeneously composed. Firstly, Nordic suppliers, particularly in Norway and Sweden, have large volumes of hydropower available to offer a bulk supply of large quantities of renewable electricity. Secondly, specialised programmes for new renewable technologies supply limited amounts of renewables available for narrower niche markets.

Supply of large scale hydro

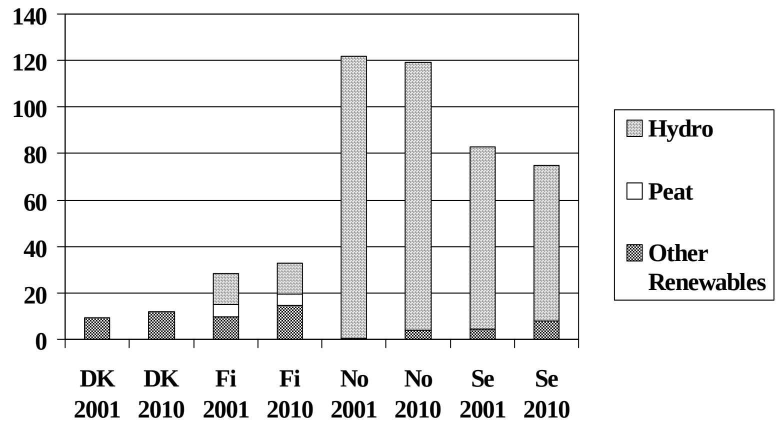
Abundant hydropower supplies serve the supply of large-scale hydro for the commercial market for green electricity from Norway and Sweden. The hydropower supply in the Nordic region in 2001 yielded 220 TWh out of a

The implementation of the feed-in tariffs for Dutch renewable energy producers will supposedly take place the 1st of July, or maybe June. (www.greenprices.com)

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

total supply of 395,3 TWh (or about 56%). The installed hydro-based generation capacity is expected to remain more or less stable over the next decade. However, 2001 was a wet year, and the figures for 2010 are calculated on the basis of average precipitation, thereby causing a decline in hydro based electricity generation. In spite of stagnant growth, hydro will remain the dominant source for electricity generation also in 2010. Figure 4 presents an overview of hydropower and other renewable generation by country.

Figure 4. Electricity generation in the Nordic countries based on renewable energy sources, in 2001 and 2010 (TWh)[23]

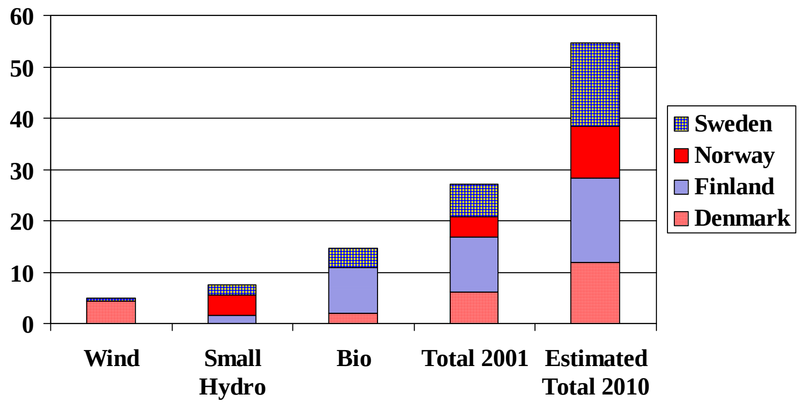


New renewable energy sources

I addition to traditional energy sources including hydro-based electricity, the Nordic countries have a considerable portfolio of new renewable energy totalling about 29 TWh for the Nordic region as a whole. This includes wind power, particularly in Denmark, bio-fuel, particularly in Finland, and small-scale hydro particularly in Finland, Norway and Sweden (figure 5).

[23] Source:www.nordel.org and Eurelectric

Figure 5. Supply of electricity based on new renewable energy sources in the Nordic region (TWh) 2001[24]



It is hard to get reliable forecasts on future electricity supply from new renewable energy sources to estimate the future renewable energy supply in 2010 shown in the last column. The Finnish estimate is based on a projection by FINERGY[25], which, by year 2010 estimates that the generation of electricity in Finland using wood-based bio fuels will increase to 8,75 TWh per year and to 6,25 TWh per for peat-based generation. This projection also expects a small increase in the use of wind power. The generation from small-scale hydropower (<10 MW) is estimated to 1,6 TWh[26] in 2010.

In Sweden more than 90% of the electricity generation is derived from hydropower and nuclear power. It is assumed that the closing of nuclear power plants will commence after the year 2010. Replacing generation would primarily be composed of combined cycle plants firing natural gas and plants using renewable energy sources. The estimates for the Swedish new renewable supply are based on the Swedish Government energy initiative[27], which emphasises an increasingly rapid growth in electricity generation from renewable energy sources. In accordance with this objective, electricity generation from renewable energy sources would increase from the current level by 10 TWh to about 16 TWh in 2010. The initiative expects most of the increase to come from wind power. It assumes that in 2015, wind power plants would provide as much as 10 TWh.

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[24] The small scale hydro (<10 MW) generation is based on numbers from EU's Atlas project (http://europa.eu.int/comm/energy_transport/atlas/html/renewables.html
[25] Finnish Energy Industries Federation (www.energia.fi)
[26] Atlas Project for EU
[27] Regjeringens energiproposition 2001/02:143

The Norwegian supply of new renewables in 2010 is based on forecasts by the energy industry association EBL[28]. This forecast assumes that regulated hydropower generation will not increase much in the future. However, it is possible to increase the hydropower capacity by 10-15 TWh by bringing on stream additional capacity provided by the modernisation and extension of existing hydropower plants. In addition to this, Energiutvalget (a government committee), has as part of its analysis of the energy- and power balance up until 2020, estimated a potential of biomass and heat pumps to 10 TWh and wind power to 6 TWh. When it comes to wind power, the Norwegian Water Resources and Energy Directorate (NVE) is processing 17 applications for license to build windmills in Norway, if all these projects are accepted Norway will be able to produce 6 TWh from wind power within year 2010[29]. In addition to the wind power the small-scale hydro generation in Norway also important and is calculated to about 4 TWh[30] in figure 4.

The Danish estimates are based on the two government plans Energy 2000 (1990) and Energy 21 from 1996. These plans have had CO_2 reduction as a main objective and have focused on renewable energy development as main pillars in the Danish strategy. The official Danish long-term energy plan, Energy 21 set a target of achieving 20% of electricity consumption (6,8 TWh) from renewables in 2003; this target has already been surpassed. Present forecasts indicate that Denmark will reach 27% electricity (9,2 TWh) coming from renewables by 2003[31]. It is assumed that most of the new electricity generated in Denmark up until 2010 will come from wind power.

The green "Power Balance"

Old renewables

Highly different pictures of the "old" and "new" renewables characterize the Nordic green supply-demand - or "power balance". The abundant hydropower supply inherited from a century of investment, in Norway and Sweden in particular, has left the region with a vast supply surplus when compared to the demand for eco-labeled green electricity and the almost disappearing external European market for such supply (figure 6).

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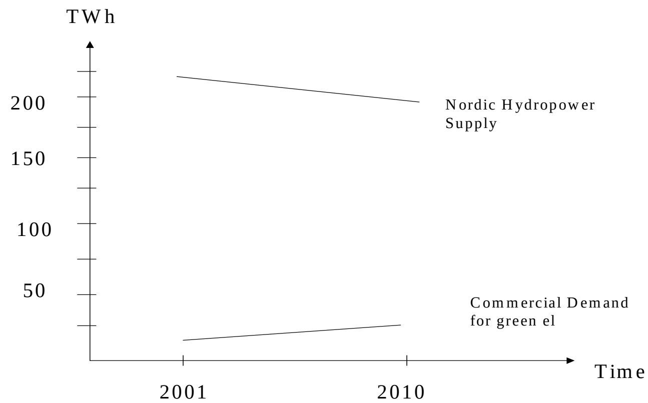
[28] Norwegian Electricity Industry Association (www.ebl.no)
[29] Aftenposten 03/03/03
[30] 4 TWh from small scale hydropower is a moderate estimate based on information from NVE
[31] www.windpower.org Wind Energy News from Denmark, February 10, 2003

Figure 6. Supply/Demand balance for commercial green electricity



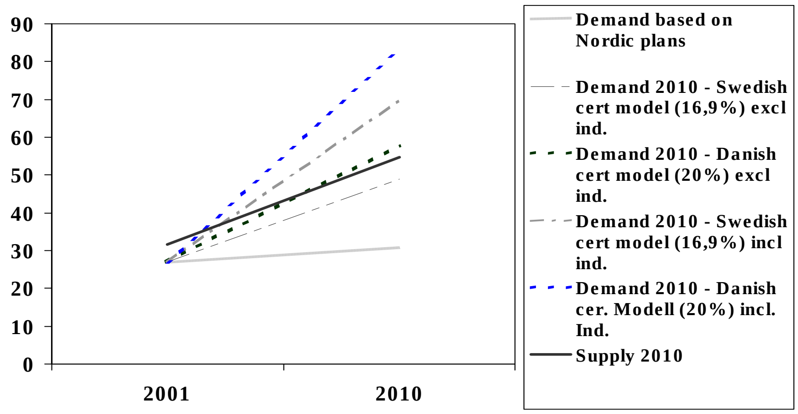
The large supply surplus obviously serves to push prices down to a minimum and green electricity from large hydropower plants thus sells at prices with a marginal "green premium". However, new requirements of a mandatory 5% of traded volume to come from new renewables[32] has made the eco-labeled electricity more expensive, and has contributed to somewhat lower traded volumes.

New renewables

As opposed to the market for "old" renewables, the power balance for the new renewables may, under some scenarios, be characterized by supply shortage. In figure 7, the different Nordic demand curves are based on the assumptions made in figure nr. 2, ranging from a target of 20% of all electricity consumed in 2010 coming from new renewable energy sources (the Danish model), to the demand for RES-E based on today's politically defined goals/targets. The supply curves for 2010 are taken from figure 5.

[32] See previous discussion of SSNC's eco-labelling

Figure 7. Demand and supply, new renewable energy sources (TWh) 2010



Hypothetically assuming an integrated Nordic market for new renewables the figure shows that the estimated supply is above the demand based on today's targets. There are several explanations for this. First of all Norway has a very modest target for new renewable energy sources, only 3 TWh. The potential, including wind power and small-scale hydro,[33] is estimated to 10 TWh. The same is the case of Finland, which only need to increase the generation of renewables by 2 TWh, in order to meet the target set for 2010. The supply possibilities however, are much higher, including peat, wood-based fuels and small-scale hydro. The target used for Denmark in this report is based on the Energy plan from 1996, this target is already met, so we could argue that the target of 50% from renewables in 2030 may be more appropriate. It does show that Denmark has a much more ambitious target than the 20%.

As of today, Sweden has the highest ambitions for 2010, and is the only Nordic country that will need to increase the supply of new renewable energy sources in order to meet demand.

Costs and willingness to pay

The current cost range of the new renewables (figure 8) posit them outside the interesting price-range of most commercial green el buyers. This market segment will thereby largely be driven by politically defined demand. Given the ambiguity of the form and volume of public commitment the power balance therefore remains hard to estimate.

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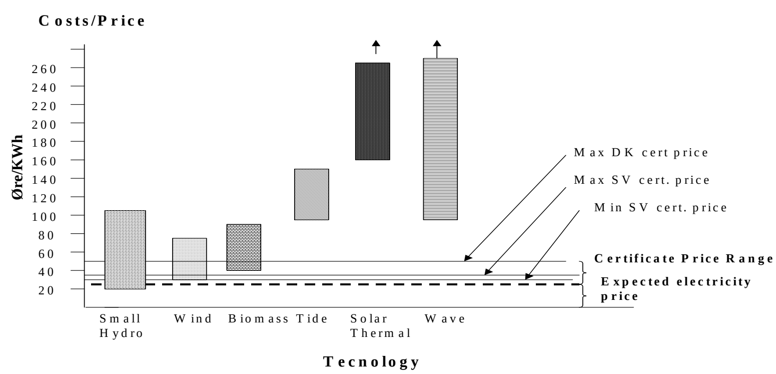
[33] <10 MW

On the demand side, figure 8 shows that with an estimated el price of 0,22 NOK/kWh[34] on “regular” electricity as a starting point, the total price paid to the producer will vary between 0,24 NOK/kWh up to 0,50 NOK/kWh depending on the certificate max or min prices.

Figure 8. Estimated costs and prices in 2010[35]



On the supply side we have used costs from estimates in the EU financed Atlas project. The price interval is given by the Danish and Swedish max certificate prices. This interval will obviously only support some new renewable energy technologies like biomass, small-scale hydro and wind power. Based on the Atlas/EU cost estimates large parts of even this portfolio exceed the current willingness to pay. Costs of less mature technologies like tidal power, solar thermal and wave power are far beyond the present willingness to pay implied in the certificate price limits and must be supported by other means.

[34] The el price is based on NVE’s estimates on future el prices.
[35] The min and max prices are based on the Swedish certificate model and calculated into NOK using an exchange rate of 100 NOK = 85 SEK. After 2007 there are no min and max price in the model. The price interval after 2007 is therefore based on the expected cert price (SEK 120 – SEK 150). The Danish Max price equals 0,27 DKK/kWh, the exchange rate 100 NOK = 104 DKK is used. The costs are from estimates in the Atlas Project, EU (using min and max from 2000 – 2010), and an exchange rate of 7.95 ECU/NOK in the year 1990 is used (Source: Norges Bank). Converted into 2003 values, the exchange rate is 10,88 ECU/NOK (Source: SSB).

Trade intermediation

Morten Johnsrud, Knut Rabbe and Atle Midttun

As an emergent market, the potential for and form of green electricity trade cannot be judged exclusively or even primarily within its present institutional configuration, but must be based on expectations of future development where trading and the emergence of trading platforms, instruments and contractual frameworks co-evolve over time (Malerba 2002). Increases in trade volume may, in other words, influence transaction costs and allow new forms of trade intermediation to develop. This again may stimulate further trade etc.

Although market evolution involves complex dynamic patterns, there are, in principle, limited sets of generic alternatives or types of trade arenas. On the basis of experience from the emergence of electricity markets, we may speak of three:

1. The first alternative involves trading facilitated by specialists in brokerage and advisory services for renewable energy. The products are not standardised. The number of trades and traders are low but trading fees are high. The specialised and idiosyncratic character of this market dictates a bilateral or OTC type of trade.

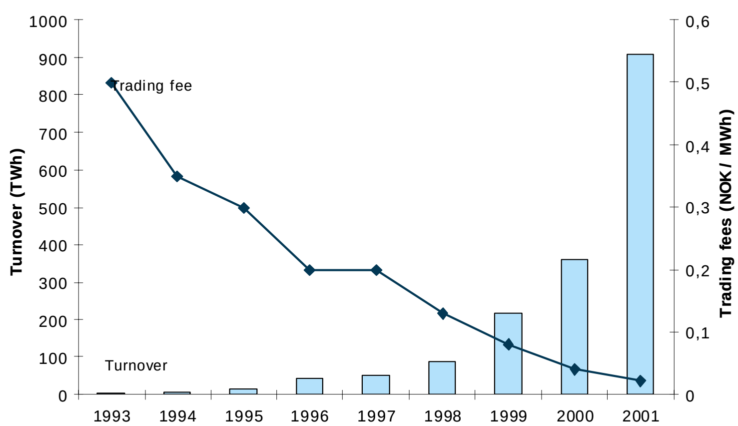
2. The second alternative involves trading driven by more traditional energy brokers probably engaging in the renewable energy market as the liquidity increases. This trading will likely imply semi-standardised products. These brokers operate in other markets with high turnover and will therefore not focus on the complex deals. The number of trades and traders is likely to increase as trading fees decrease.

3. The third alternative involves trading driven by the emergence of exchanges. This increases transparency, as the exchange provides open price signals to the market. This type of trading will only emerge if sufficient convergence on product standardisation and sufficient trade volume is reached to provide liquidity.

In a market that, like the market for green electricity is in an early build-up phase, lack of standardisation of products, lack of insight among actors and lack of liquidity/volume clearly necessitates broker-mediated trade. However, increasing volumes in green electricity trading, possibly following mandatory demand in Sweden and other Nordic initiatives, may allow trade on an exchange to take place.

One of the strong drivers in the development is of trade intermediation is likely to be the struggle for turnover between OTC brokers and the emergent exchange. In a voluntary market where trade on an exchange is not mandatory, competition will arise between trade on the exchange and broker mediated trade. From a transaction cost point of view (Williamson 1975), if the competition creates a strong downward pressure on transaction costs, this is likely to result in considerable increase in market volume. If the analogy to the Nordic financial market for electricity is valid, such competition may indeed lead to significant reduction in transaction costs. The figure below illustrates Nord Pool's trading fee and turnover from 1993 to 2001

Figure 9: Nord Pool's trading fee and turnover



Source: Nord Pool

The precondition is, however, that the volume is large enough to lower the trading fees sufficiently to attract further increase in trade volumes, like in the general market for electricity. With a far smaller total volume, green electricity may not reach the critical mass necessary to move it out of OTC and bilateral trade. The very low willingness to pay in the voluntary bulk market for green electricity may also prevent transferral of least cost oriented

commercially driven trade to standardised open market platforms, due to initial fairly high transaction costs.
Given that sufficient trade volume would allow emergence of trade on an exchange, the well-established Nordic power exchange Nord Pool, would at first sight seem an obvious arena for exchange-based green electricity trade. However, the competitive advantage of Nord Pool, as an incumbent, in comparison with other potential actors would depend on the shaping of the trading platform. In principle, three trading platforms could be used:

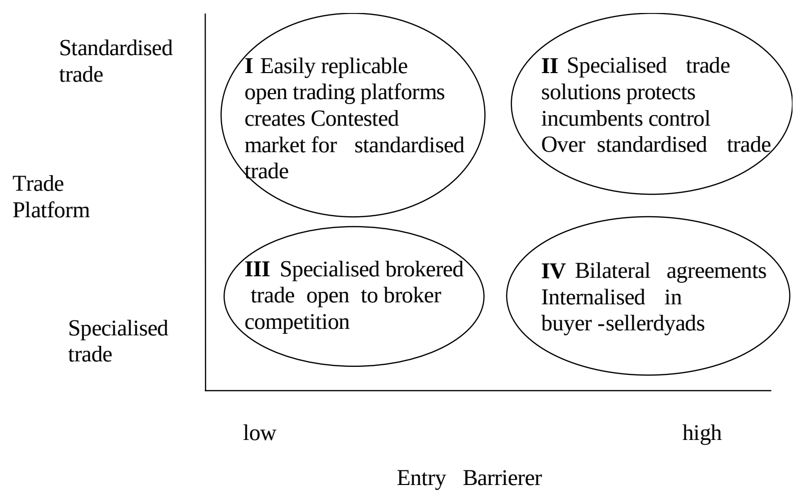
1. Closed auction (like for Nord Pool's physical power market)
2. Open auction, i.e. offers with time limits
3. Continuous trade (like for Nord Pool's financial market)

As the green electricity market is likely to have small volumes at least in an initial phase, and the actors are likely to wish to have information of the market, volumes and price, the first alternative is not likely to be functional. With a high number of products with low liquidity, alternative 2 might be justifiable. However, Nord Pool's interest obviously lies in developing exchange-based trade with liquid and standardised products and this option would therefore not be interesting. Given the interest in concentrating on the market-segments where liquidity can be created, Nord Pool should probably target continuous trade. However, this is a function where Nord Pool probably could face considerable competition.

Nord Pool's strength as a power exchange obviously lies in the standardised trade (position I and II in figure 10. As a power exchange, Nord Pool cannot enter into active brokerage without compromising its credibility as a neutral market-arena and will therefore have to leave the specialised trade domain (III and IV) to brokers and bilateral agreements. However, there may be strong or weak entry barriers for contesters also in the standardised trade domain. If Nord Pool has unique and suitable trade solutions that demand heavy learning- and financial investments before competitors can enter the market (II in figure 10), then it has a favoured position in the contest for sitting the green electricity trade. However, if the most suitable trade platforms are less unique and demand less up-front investment, then Nord Pool as the incumbent, will be more competitively exposed.

Fairly simple internet based systems for continuous trade may be fairly easily challenged by new actors, and competing tools for standardised trade may emerge from brokers that seek to expand into standardised trade from their specialised trade position.

Figure 10. Trade platforms and entry barriers for incumbents and challengers



Nevertheless, Nord Pool, as an incumbent, may have a competitive advantage in providing add-on's to their general electricity trading tools and might thereby provide attractive options for established actors as part of an extension of the product spectre in the existing trade system for derivatives. Nord Pool would be able to supply trade solutions, which functionally would be more in line with what is used in Nord Pool's financial markets. The interface with new and smaller customers would however have to take place through web-based solutions, where competition with brokers might be hard.

The establishment of assurance

Arne Jakobsen and Atle Midttun

Green certificates basically allow a de-coupling of environmental quality and electricity supply in an integrated centralised system. The buyer, wishing to acquire green electricity may do so through the certification or labelling system securing that an amount of green energy corresponding to his consumption is generated in the system. As the environmental qualities that are the basis for price differentiation are not observable by the customer, assurance (certification, verification and registration) of the product quality must therefore play a critical role

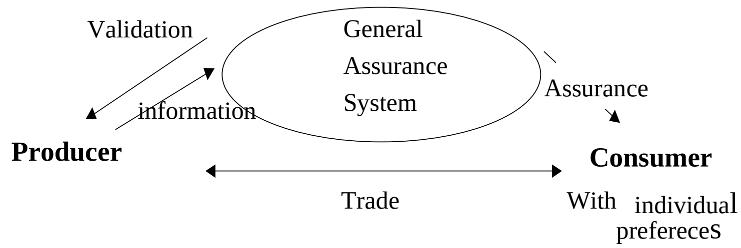
Like for trade intermediation, assurance may be provided by universalistic or by specialised systems. Universalistic systems provide assurance in a general form, which accommodates a plethora of green el definitions. Specialised systems, on the other hand, provide tailor made assurance for one green el brand only.

Universalistic assurance systems, RECS

A universalistic assurance system will validate and register information from the producer and verify this to the consumer, providing the customer with credible substantiation of the fact that green electricity, according to his specification, is actually fed into the electricity system irrespective of the green definition that the consumer chooses to adopt (figure 11). This allows the consumer or his intermediary, to specify his own preference set and then seek supply from producers that meet his criteria. Control and redemption of certificates, then lie outside of the certificate system, internalised in the consumer's own organisation, possibly also interfacing with external actor in charge of more general certification such as EMAS, ISO etc.

The renewable electricity certificate system (RECS) illustrates a universalistic approach. RECS is a joint assurance system developed by the electricity industry. RECS is pluralistic and neutral to specific green electricity preferences and provides a mechanism for representing a specific instance of the production of a megawatt hour of renewable electricity by a unique certificate which can be transferred from owner to owner before being used as proof of generation, or exchanged for financial support.

Figure 11. Assurance in voluntary green electricity trade with general assurance system

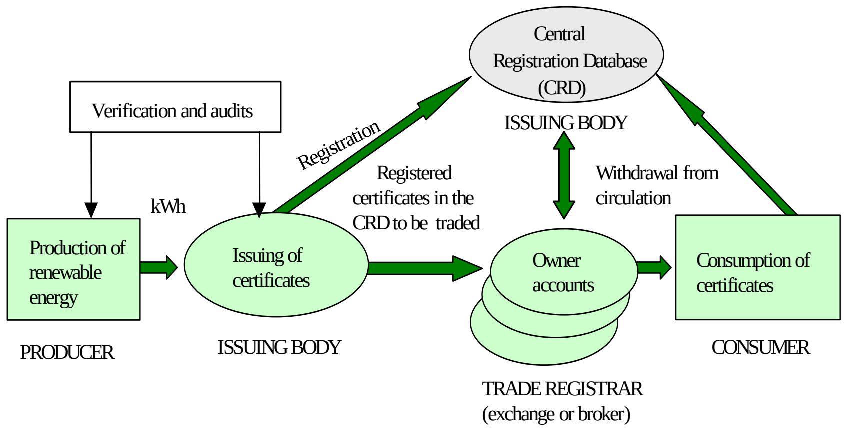


A RECS certificate is issued for, and uniquely relates to, a specific instance of the production of a standard quantity - one megawatt hour - of renewable electricity. Each RECS certificate is registered as belonging to a single party at each point during its life, this being adjusted accordingly following each transfer of its ownership, and are redeemed when they are "used". RECS certificates are created, change owners and eventually redeemed under a carefully developed and managed control structure[36] (figure 12).

[36] The record states what is being certified: the identification of the Issuing Body, the location of the production device, the technology used for the production of the renewable energy and the time the certificate was issued.
The issuing and trading with RECS certificates takes place according to the rules set in the Basic Commitment (BC), which was developed by the international Association of Issuing Bodies (AIB). Based on the BC, the AIB drew up a standard protocol to act as a framework for the national Issuing Bodies to develop its own Domain Protocol, in which the BC has been applied to a specific country.

Figure 12. The RECS model

From issuing to consumption of RECS certificates



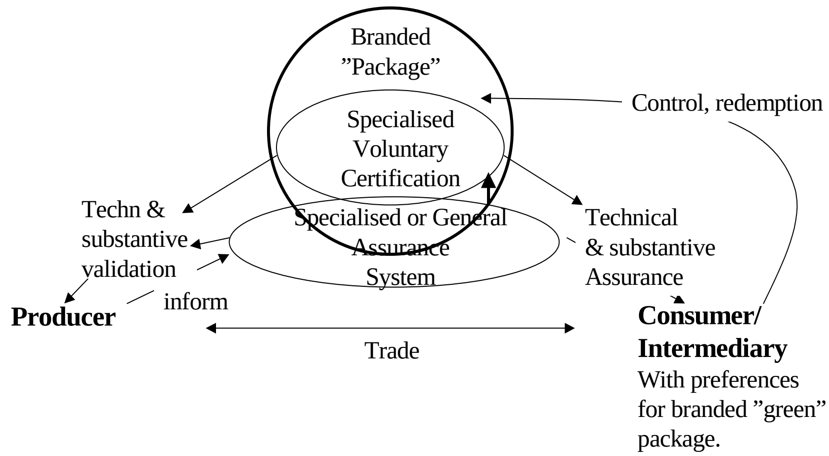
Source: www.recscmo.com

From a political point of view, RECS has the advantage that it can be used to enable many types of schemes, whether voluntary (green energy and green label and incentive schemes) or obligatory (such as portfolio standards and feed in systems), and can provide a means of supporting guarantees of origin and international trade in renewable benefit. RECS uniquely identifies each unit of energy generated by a renewable power station, and can therefore link each certificate to the appropriate public support schemes. Each unit of energy can receive support only once under RECS: when the certificate is redeemed. In this way, RECS guarantees that double counting is avoided.

Voluntary particularistic assurance systems, "Bra Miljøval"

The customer may also chose to buy into a specific branded package for green electricity which specifies the green electricity criteria and also provides assurance for actual delivery under these conditions. In this case the brander (either commercial or idealistic) may either choose to develop its own specialised assurance system, or may chose to utilise a general system (figure 13).

Figure 13. Assurance in branded "Package"



The "bra miljöval" initiative, which was launched by the Swedish Society for Nature Conservation (SSNC) in 1995, may illustrate the voluntary particularistic model. As competition was introduced in the electricity market and customers were free to choose suppliers, the society published its environmental labelling criteria for electricity delivery contracts and set up its own assurance system (SSNC 1995)[37].

In order to be allowed to use the environmental label, the electricity supplier must have a licence from the Swedish Society for Nature Conservation to use their label with a set of criteria attached to it[38]. When applying for a license, the applicant is requested to describe how the electricity sold under labelled contracts is to be produced. This requirement

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[37] Under this system an electricity delivery contract may be labelled if and only if:
The supplier commits himself to annually balance the customers' consumption by electricity produced from renewable sources of energy. The plants also fulfil some additional environmental criteria. The supplier accepts an annual audit in accordance with a procedure set by SSNC and the national auditing authority. The supplier has accepted this in a licence agreement with SSNC

[38] The attached criteria are: The use of non-renewable energy in providing the electricity (e.g. diesel fuel to transport fuel to a biomass fuelled electricity plant, etc) must not exceed 10 % of the energy delivered from the plant. Hydropower from plants built after 1996 in previously not exploited waters cannot be included. Ash from biomass-fuelled plants must be returned to soils. If storing ash is desirable for removing metals or radioactivity this may be allowed. Neither household waste, nor peat, is renewable fuel. The ash from recycled biomass must not be distinguishable from fresh biomass, and conform

is a check that the potential licensee has understood the rules and has a plan that makes it possible to fulfil the commitments.

From 2003 supplies based on hydropower will have to be supplemented with electricity from at least one renewable energy source. If the supplementary energy source is bio-fuel or wind power, it shall constitute minimum 5% of the total green electricity supply

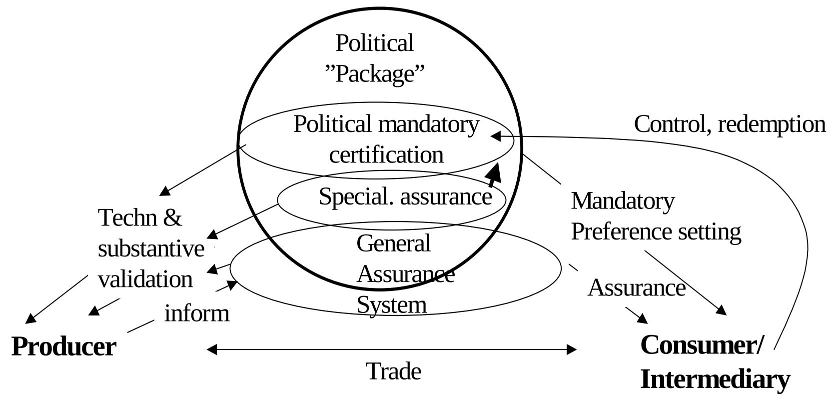
Electricity companies that have license to carry the Bra Miljøval-brand are submitted to yearly audit-control. This implies that an authorised auditor controls that the company has fulfilled its obligation to the scheme and its customers. The audit is developed in cooperation with the Swedish chartered accountants association.

Finland also has a voluntary label, “Norppa”, which is the equivalent to the “Bra Miljøval” label in Sweden with a similar certification system.

Mandatory, particularistic assurance systems

Finally, political authorities may also choose to make use of green certificates as part of market based environmental regulation. From an analytical point of view, this can be seen as an imposition of a political mandatory preference on the consumer or his intermediary. The political system may, in addition, develop its specialised assurance system to control the intangible “greenness” or it may also make extensive use of existing assurance systems (figure 14)

Figure 14. Assurance in political "Package"



The Swedish Green Electricity Certificate System[39] may illustrate this approach. The Swedish mandatory certificate system has made the certification of eligible producers a responsibility of the regulator *"Statens Energimyndighet"*, which also has the right and responsibility of controlling the system, *e.g.* inspecting the producers' facilities etc. The Swedish certificate system demands that the quota-obligated parties[40] submit the green certificates for compliance to the regulator.

In Sweden the Transmission system operator (TSO) *"Affärsverket svenska kraftnät"* is responsible for keeping track of the certificates through the *certificate accounts* in the *certificate register* that it controls. Additionally, the TSO performs the bilateral settlement between market players. It is also the TSO's responsibility to provide public statistical information on market volumes and price levels.

The certificates in the Swedish system have unlimited validity, and is only redeemed when an electricity consumer exploits the certificate to settle his obligation with regard to the state.

[39] Based on Gvt whitepaper on a law on Electricity Certificates (reg. Prop 2002/03:40)
[40] The Swedish government's certificate system obliges the electricity supplier to handle the acquisition of certificates on behalf of its customers. However, from 2004, customers will be free to handle their own quota obligation. The neglect to fulfil the quota obligation entails a non-fulfilment levy. The certificate is therefore the carrier of a right against the Swedish state. In addition it is suitable for trade.

Concluding remarks

Assurance, like trade intermediation is under rapid transformation and one may observe all three models (the general assurance, the branded package and the political package) displayed in the Nordic context. From a branded package solution under the “bra miljøval” label with an assurance scheme uniquely designed for one product, the RECS system has introduced a more universalistic model, which could facilitate assurance for several labels. The Swedish Certificate System again reverts back to a mixture, where elements of the RECS are used, but with an over-layered government control. Such government intervention may increase domestic credibility, but may at the same time limit international or Nordic trade. While the overlapping models may constitute unnecessary complexity a certain rivalry in assurance may at the same time constitute useful pressure on transaction costs.

Green electricity trading and the underlying physical flow

The case of renewable energy in the Netherlands

Marianne Waage Fougner, Mari Hegg Gundersen and Atle Midttun

Green electricity trading may in principle be completely de-coupled from physical flows, which facilitates international trading. One vision behind the green certificate model has therefore been to promote an international market for renewables to optimise on the international resource-diversity and specialisation. However, when such trade is driven by political subsidisation, it raises the issue of reciprocity. The recent Dutch green electricity market is a unique case of green electricity trading under institutional openness. The case illustrates the challenges emerging from international trade asymmetries and also the imposition of physical flow requirements.

General market description

The international trade emerging out of the Dutch green electricity market derives from the Dutch support scheme for renewable energy allowed, up to the end of 2002, for premiums to be paid to green producers and tax incentives for the end-user purchasing wind certificates as set forth in the Dutch Environmental Tax Act:

- Wind and biomass certificates (article 36i of the Environmental Tax Act)
- Sustainable produced energy (article 36o of the Environmental Tax Act)

The incentives did not only result in a market for biomass and wind certificates, but also a market for physical delivery of sustainable produced energy eligible for premiums to green producers. The wind and biomass certificate prices were set by the value for the consumer and the numbers of certificates in the market. The value added on the physical deliveries was related to a premium of 20€/MWh in 2002.

These support measures also applied for imported sustainable energy and green certificates. The Netherlands is so far the only country, which allowed for import of green certificates and renewable energy.

Nordic generators have been active in this market since 2001 and have exported Nordic sustainable energy (small hydro power, less than 15 MW, biomass and wind power) and Nordic wind and biomass certificates on a considerable scale (approximately 11 TWh in 2002).

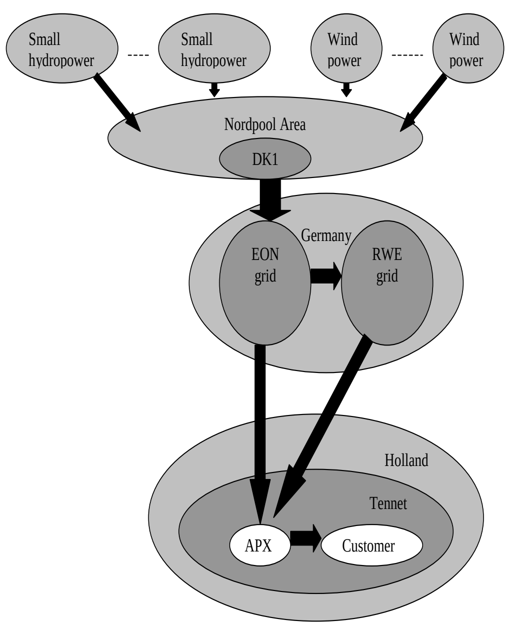
The problem with the Dutch-Nordic green el trade has been its asymmetry. The Netherlands, with the only open regime, ended up subsidising generation in the Nordic countries and indeed in several other European countries on a large scale. The emergence of physical flow restrictions imposed by the Dutch tax authorities must be seen in this perspective.

Dutch tax authorities therefore required that the importer could document and prove that the sustainable energy was actually imported. The importer must demonstrate that the energy was transported on a daily basis through the relevant grids from the Nordic producer to the distributor in the Netherlands and that sufficient import capacity was available.

Due to the favourable conditions for green importers the demand for transportation capacity at both the Danish/German and the German/Dutch border have increased significantly during last year leading to increased transportation cost for both green and grey power. Inevitable, the grid owners have profited from this situation due to increased tariff income.

The physical delivering of renewable energy from the Nordic generators to the Dutch consumer therefore came to involve a complex set of transactions illustrated in figure 15.

Figure 15. Physical trade flow overview



-> Generation of green energy in Norway or Sweden, and supply to the Nord Pool grid.
-> Buying back the energy from Nord Pool at the Danish-German border (DK1)
-> Transporting the energy to Germany (EON grid) through the EON-Eltra cable.
-> Internal transport through Germany and supply of part of the power to the RWE grid
-> Transport of the power from the EON and RWE grid to the Tennet grids (Handled by the TSO auction office)
-> Selling the power on the Dutch spot market APX
-> Buying back the power on the APX to the Tennet grid
-> Transporting the power to the customer through the Tennet grid.

The physical flow requirements obviously implied a non-tariff trade barrier by limiting the volume of green electricity trade into the Netherlands and thereby limit the public expenditure in the subsidising country if the international supply should be too large. However, such flows may also serve to limit CO2 emissions in the recipient country, assuming that the inflow of green electricity replaces domestic generation with CO2 emissions. Furthermore, the physical flow requirement would have a location effect of stimulating build-up of green capacity close to the consumers, a fact that might help legitimate the green subsidy schemes politically.

Certification and certificate generation

As far as assurance is concerned, green electricity trade for the Dutch market have relied on a combination of Nordic and Dutch assurance. In the Nordic market Statnett was appointed as RECS issuing body in Norway, with the task to ensure that the renewable generation plant that wishes to sell certificates complies with RECS international criteria. The certification company, Det Norske Veritas and the electricity trader Lierkraft have been appointed by Statnett to carry out the verification on their behalf.

GCB (Groencertificatenbeheer) was appointed as RECS issuing body in the Netherlands and ensures that the renewable generation that wishes to sell certificates in the Netherlands complies with the criteria for Dutch Green certificates. Based on generation data from each plant Statnett generates certificates in the Norwegian RECS database. Certificates sold to The Netherlands were transferred from RECS to GCB and allocated to the customers account in GCB.

Latest development 2003

Due to trade asymmetry, the framework conditions for the Dutch green electricity market have been rapidly changing and are becoming more restrictive as the trade volume has dramatically increased and the trade is thus coming to an end. Temporary fiscal arrangement (for the first months of 2003) include the following elements

- Generators premium for biomass and small hydro is abolished
- Tax relief for green customers is reduced (wind and biomass certificates)
- Final fiscal arrangement (expected to be valid from April 2003) include the following:
    - Tax relief for green customers is further reduced (wind and biomass certificates)
    - Generators premium for wind will be abolished

The new fiscal arrangements also include a shift from market-based instruments to feed-in tariff (MEP). The story of the rise and fall of the Dutch green electricity trading is understandable against the background of the institutional asymmetry where one country unilaterally opens up to international trade in green electricity without reciprocity from its trading partners. The drain on Dutch financial reserves as well as the super-profits occurring with foreign firms and Dutch mediators without green capacity-build-up in the Dutch region proved unacceptable to the Dutch government and pre-empted a retreat to a more protectionist policy.

Summary and concluding comments

A central focus of this analysis has been to explore the basis for an emerging Nordic market for green electricity trade. As a general point of departure, several positive factors stand out: The Nordic countries share a tradition of close electricity market cooperation and have developed well functioning institutions for electricity trade mediation as well as pioneering electricity trading companies. Furthermore, the Nordic countries have for several years been among the international forerunners in voicing environmental considerations (Midttun and Hagen 1997) and it would seem appropriate to strive for a common market-oriented environmental policy to go with the integrated Nordic electricity markets. Common exposure to integrated electricity market with integrated market prices should also predispose for acceptance of Nordic market oriented environmental policy. In addition, the Nordic companies have also participated actively in a common engagement to build up trust/assurance on a European basis.

Yet several institutional "bricks" still remain to be put in place. The constitution of a common demand for green electricity is at best still in the making. The advent of the Swedish green certificate market marks a new initiative to politically define a mandatory demand for new renewable energy and thereby create a basis for green electricity trading. Policy shifts in Norway following the recent experience of energy shortage in the Nordic region, indicates a possible interest to follow Sweden in a common effort to put more power of all kinds on line. However, the Norwegian political process is still unclear. Denmark already has a master plan for green electricity trade prepared, and might under given circumstances want to harmonise with a broader Nordic initiative. In an optimistic scenario, one could thereby see an emerging Nordic green certificate market with cross-border trade. The resource diversity in Nordic electricity generation implies, however, that careful thought must be given to distributive aspects of a common regime.

The demand volumes for such a market could, as we have previously shown, vary extensively, depending on at which level the Nordic consensus might arrive. With the ambitious Danish policy goals of 20% consumption from new renewable energy sources and no industrial exemption one might be talking about over 80 TWh in 2010. With a Swedish policy goal of 16,9% and industrial exemptions, the volume might be at least 30 TWh lower. Still this would be substantively higher than the current plans.

In addition to the coming politically mandated Swedish certificate market with possible Nordic spillovers, a large voluntary market for certified green electricity exists in the Nordic region. At its peak, in 2002, when it also included the export of certificates to the Netherlands, this market traded more than 25 TWh. However, with the closure of the Dutch market, trade volume is down by 11 TWh and the "Bra Miljøval" now trades about 15 TWh. This market has, however, had rapid growth and could, under favorable conditions, with spread to other Nordic countries, take on sizeable proportions.

The potential for convergence of voluntary and a political mandatory market, is rather small, however, given that the volumes in the voluntary market comes from low priced large hydro and the mandatory market tends to be restricted mainly to so called new renewable energy sources, that are yet more commercially immature. The step taken by the "bra miljøval" brand to include 5% new renewables, however creates an interface with the coming politically mandated market. Yet, this interface still remains fairly small.

As far as supply is concerned, the Nordic countries have vast bio fuel resources, extensive opportunities for windmills with excellent wind conditions, and numerous sites for small hydro. Even with high greening ambitions, there will, therefore, be no problem to meet demand. However, an ambitious mandatory green electricity policy would demand considerable new generation capacity on stream, and should be phased in under realistic consideration of the lead-time necessary for planning and construction.

A well-developed power exchange and an active environment of trading competencies provide potential capabilities in the Nordic arena also for green electricity trade. Nord Pool sees potential interest in providing add-on's to their general electricity trading tools and should thereby provide attractive options for established actors as part of an extension of the product spectre in the existing trade system for derivatives. Nord Pool would have a competitive advantage being able to supply trade solutions, which are functionally compatible with Nord Pool's regular electricity trade, particularly in their financial markets. The interface with new and smaller customers, would, however, most likely emerge through web-based solutions, where the power exchange as an incumbent market place, would have less competitive advantage and where competition with brokers might be hard.

On one hand, rivalry over solutions and market positions may create dynamics that could help to bring down transaction costs and trigger a positive spiral where increases in trade volume may lower transaction costs and allow new forms of trade intermediation to develop. On the other hand, multiple trade arenas may create less transparency and higher information costs. Furthermore, highly differentiated product-characteristics presumably favour bilateral and OTC trade and therefore undermines the volume of standard exchange products.

Given the low prices obtained in the voluntary green electricity market, bilateral trade would probably continue to prevail and trade on the power exchange would not be able to profit from these additional volumes, at least not in the initial stage. The interplay between highly diversified green product definitions and following high transaction costs could therefore lead to a vicious circle. A breakthrough in common product definitions could, however turn this circle in a virtuous direction.

Assurance seems to be the least problematic issue in the Nordic case. Assurance, like trade intermediation is under rapid transformation and one may observe, both the general assurance, the branded package and the political package displayed in the Nordic context. As opposed to the branded package solution under the "bra miljøval" label with an assurance scheme uniquely designed for one product, the RECS system has introduced a more universalistic model, which could facilitate assurance for several labels. The Swedish Electricity Certificate system again reverts back to a mixture, where elements of the RECS are used, but with an over-layered government control. Such government intervention may increase domestic credibility, but may at the same time limit international or Nordic trade. While the overlapping models may constitute unnecessary complexity a certain rivalry in assurance may at the same time constitute useful pressure on transaction costs.

Throughout the analysis so far, we have taken the Nordic focus for given. Why should not the Nordic countries go straight on to a EU solution? With its tradition for weak decision-making and implementation capacity, the Nordic arena is perhaps in many respects more of an arena for sharing of ideas and voluntary coordination than an arena for strong policy coordination.

The EU arena is clearly more 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?

One part of the answer lies in the above documentation of particularly successful institutional coordination in the electricity field. There might, however, also be another argument for Nordic integration. Small countries, like the Nordic, might 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 argument for seeking collective Nordic green electricity solutions.

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