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The consequences of an expanded electricity certificate market

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Preface

The Government has instructed the Swedish Energy Agency to investigate the expected consequences of an expanded electricity certificate trading market. The main purpose of the work is to identify and assess the consequences of short-term and long-term effects, to identify and analyse the basic criteria that will need to be fulfilled by the countries, and to present and evaluate possible models for assigning quotas to the countries. The work also includes consideration of the implications of EU legislation on an expanded market, together with a presentation of any necessary legal changes that will be required.

Production of the report has been a joint effort. Thomas Sundqvist and Viktor Jonsson have written Chapter 3, 'Theoretical conditions for an expanded market', while Chapter 4, 'Conditions in Sweden and Norway', and Appendix 1 have been written by Viktor Jonsson and Anna Nilsson. Anna Nilsson has also written Chapter 5, 'The purpose of an expanded electricity certificate trading market' Thomas Sundqvist has written Chapter 6, 'Requirements for a smoothly operating electricity certificate trading market'. Chapter 7, 'Models for deciding ambition levels and quotas' and Chapter 8, 'Long-term structural effects', have been written by Karin Sahlin. Chapter 9, 'Short-term consequences on the Swedish market' has been written by Anna Nilsson. Chapter 10, 'EU legal aspects of an expanded market', has been contributed by the National Board of Trade. Chapter 11, 'Necessary legislative changes', has been written by Eva Albäck. Göran Andersson and Stefan Holm have also contributed valuable comments and views to the project. Overall management of the project has been by Mathias Normand. The report was originally prepared in Swedish, and has been translated into English by Neil Muir, of Angloscan Manuscript Ltd.

Decisions as needed in the work have been taken by the Agency's Director General, Thomas Korsfeldt. In addition, the final work on the document has brought together Deputy Director-General Håkan Heden, Development Director Lars Tegnér, Head of Administration Susan Linton, the Agency's Chief Lawyer Fredrik Selander, Heads of Department Tommy Ankarljung, Josephin Bahr, Zofia Lublin, Andres Muld, Birgitta Palmberger, Pernilla Axelsson and Thomas Levander, together with the Project Manager Mathias Normand, who also presented the various items for discussion to the meetings.

Thomas Korsfeldt
Director General

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Project Manager

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1 Summary

The Government has instructed the Swedish Energy Agency to investigate the expected consequences of an expanded electricity certificate trading market. The main purpose of the work is to identify and assess the consequences of short-term and long-term effects, to identify and analyse the basic criteria that will need to be fulfilled by the countries, and to present and evaluate possible models for assigning quotas to the countries. The work also includes consideration of the implications of EU legislation on an expanded market, together with a presentation of any necessary legal changes that will be required.

The Swedish Energy Agency's overall conclusions

The same objectives and purposes, but in a broader geographical perspective

- This has the effect of changing the electricity certificate system from being seen in a national production and security of supply perspective to being seen in an international perspective.
- On an expanded market, the objective/ambition would be expressed in terms of the total quantity of renewable electricity (TWh) produced on the joint market.
- The objective/ambition of each individual country would be expressed in terms of how much renewable electricity production each individual country is prepared to *finance*. Individual countries would no longer be able to determine where new investments should be made.

Why expand the electricity certificate market to more countries?

- Renewable electricity production objectives can be achieved with better cost efficiency. Calculations indicate that the resulting total system costs would be lower on a common Swedish/Norwegian market than on two separate markets.
- A number of other benefits arise in the way in which the market operates (e.g. greater liquidity, reduced price swings, lesser political risks for the parties involved).

A number of requirements should be satisfied before expanding the existing electricity certificate market

- An expanded electricity certificate market requires some changes if it is to operate effectively, to fulfil its objectives and to be accepted in the wider society.
- The Agency believes that the following factors *must be coordinated* between the countries concerned: that the system must be based on quota obligations, that the quota obligation applies to the user side, that declaration and cancellation dates need to be decided, as do system life and long-term quota setting, quota obligation fee, the validity, value and life of certificates, linking of the registers, and controlled exit from the market.

- The Agency believes that the countries' ambition levels and quotas should be determined in such a way as to achieve stable pricing on the joint market. Avoiding substantial changes in price helps to create stability and the ability to look ahead on the original market, thus in turn creating confidence in the system and creating the right conditions for long-term investments. The Agency suggests a model to produce a range of reasonable ambition levels. We are also of the opinion that, within this range, any country joining the system should be able to decide its own exact ambition level.

Long-term structural effects of an expansion of the market to include Norway

- The long-term structural effects on investments and pricing depend on the aggregated ambition level on the joint market and on the production conditions in the individual countries. We have performed model calculations to illustrate these effects.
- The worked example using the lower aggregated ambition level suggests that a greater proportion of certificate-entitled electricity production would probably occur in Norway (from hydro power and wind power), rather than in Sweden. Electricity certificate prices would be low, as the 'cheap' electricity production would suffice to meet the objectives.
- The worked example for a higher aggregated ambition level suggests that Sweden would produce more renewable electricity, entitled to certificates, than would Norway, as Swedish offshore wind power and biofuelled power would be cheaper than the more expensive Norwegian wind power alternatives. Electricity certificate prices would be higher when more expensive production facilities are required.

In the short term, expansion of the market to include Norway would involve some uncertainties for Swedish parties

- The main short-term effects on the Swedish market of creating a joint market with Norway would be primarily pricing uncertainty, which could affect willingness to invest in the short term.

Legislative changes would be needed for an expanded market

- The Agency points out that several changes would be required in the Act (2003:113) concerning Electricity Certificates and in the Ordinance (2003:120) concerning Electricity Certificates.

EU legislative aspects of an expanded market

- The National Board of Trade is of the opinion that there should not be a problem if only two countries participate at first, although feels that this arrangement should be checked with the European Commission. The proposal also needs to be reviewed in the light of Directive 98/34/EC.
- The National Board of Trade is of the opinion that it must be possible to motivate any departures from the requirements of Directive 2001/77/EC.

The Swedish electricity certificate system on an expanded market

The purpose of the electricity certificate system must be seen in an international perspective

The Agency wishes to emphasise that the purpose of the Swedish electricity certificate system would be altered if the national considerations of production and security of supply are changed to those of an international perspective. On an expanded market, the focus shifts from the amount of renewable production to be encouraged in Sweden to considering instead how much renewable production we in Sweden are prepared to finance, regardless of whether such production itself actually occurs in Sweden or in some other country. This means that the environmental value of renewable electricity production should therefore follow the certificates, so that Sweden as a nation could fulfil its objectives by redeeming the number of certificates as required by its quota, regardless of where in the joint market the electricity has been produced. This would mean that the objective/ambition for the quantity of renewable electricity to be produced (in TWh) would therefore be determined by the total for the combined market. The individual countries can express their objective/ambition for the amount of renewable electricity to be produced, via their quotas, only in terms of what they are willing to finance.

… acceptance of these changes is decisive for success

The Agency believes that it is most important for the success of the electricity certificate system that the various parties involved in it, including the electricity consumers, accept the benefits of a joint market and the possible consequences thereof. Decision-makers and public authorities will be under considerable pressure clearly to understand the reasons for the system and the resulting changes in the way in which it is seen.

An expanded market is more cost-efficient and effective …

The Swedish Energy Agency agrees with the Government's and Parliament's earlier committee reports1 that the full benefits of the electricity certificate system will come only with international trade. The bigger the market, the more the cost efficiency of the system will improve due to the fact that the same objective can be achieved at a lower overall cost than if the individual countries themselves attempted to do so. Expanding the market also creates the right conditions for a more effective market, with lower price swings, less risk of market domination and potentially less political risk.

[1] See Bill no. 2001/02:143, Bill no. 2002/03:40, Committee Report no. 2002/03:NU6 p.56, Notification Document no. 2002/03:133 and Bill no. 2003/04:170.

… but some changes will be needed in order to arrive at an effective market, objective fulfilment and system acceptance

The greatest benefits of international trade are achieved if there are no restrictions on, or obstacles to, the trade. The Agency believes that, if an expansion of the Swedish electricity certificate market - and, in the longer term, expansion of a joint Swedish/Norwegian market - is to be accepted and to operate effectively, it will be necessary to make a number of changes. These relate primarily to the fact that there should be some formal expectations in respect of the ambition levels and quotas of countries joining the system, in order to achieve price stability and a reasonably distributed spread of consumers. In addition, the Agency is of the opinion that, if a market is to operate effectively, there must also be requirements in respect of certain parts of the individual countries' electricity certificate systems being constructed in a similar manner.

Requirements for an effective market

Certain basic coordination requirements for the Norwegian and Swedish electricity certificate systems must be expressed if an effective common electricity certificate market is to be created. Other factors should be similar, although the market can operate satisfactorily without them actually being coordinated. There are also factors that do not need to be coordinated.

The Swedish Energy Agency's conclusions and recommendations:

The Swedish Energy Agency is of the opinion that the following elements ***must*** be coordinated:

- Quota-based systems (a prerequisite)
- Quota obligations for electricity users
- Quota periods and declaration and cancellation times
- System life and long-term quota assignment
- Regulated exit from the system
- Quota obligation fees
- Validity, value and life of electricity certificates
- Linked registers

The Agency is of the opinion that the following aspects ***should*** be coordinated

- The main principle defining what is regarded as certificate-entitled electricity production
- The length of time for which plants should be included in the system
- The legal status of electricity certificates
- Other not competitively neutral support systems
- Similar support and monitoring functions
- A common (or, alternatively, linked) certificate register
- Official information to those involved in the market

The Agency is of the opinion that the following parts of the electricity certificate system ***must be coordinated*** in order to avoid distortions that could affect the ability of the Swedish electricity certificate system to achieve its objectives and desirable control effects, and to establish the necessary bases for a smoothly-functioning certificate market.

A quota obligation-based system

The prospects for linking voluntary and obligatory systems to form a joint market are poor, as the two systems are based on completely different fundamental principles. Introduction of a *mandatory* quota-based electricity certificate system is a *prerequisite* for being able to participate on a common electricity certificate market with Sweden.

Quota obligation on the user side

Attempting to link a system in which there are no quota obligations on the user side to the Swedish system would be very difficult, as the demand for electricity certificates with an alternative set-up would not be linked to the use of electricity. Attempting, for example, to link a production-based system to a user-based system would probably not be possible.

Quota periods, declaration and cancellation time

In the interests of avoiding confusion of market participants, it is desirable to coordinate the quota periods with the calendar year, and also to coordinate the other dates relating to the fulfilment of quota obligations.

The cancellation of electricity certificates has shown itself to be a powerful factor in affecting the prices of electricity, as information on the number of certificates cancelled (fulfilment of quota obligations) is important in assessing future supply of certificates. It is therefore desirable that the redemption dates for certificates should be the same in all systems, in order to minimise price distortions during each quota period. If the redemption dates are coordinated, then the declaration dates and the actual quota periods should also be coordinated. A further factor to consider is that the declaration and redemption dates affect the ability to borrow certificates between quota periods.

System lifespan and long-run quota setting

Long-term stability of the electricity certificate system is essential in order to create the right conditions for an well-functioning market. An important element in ensuring a well-functioning market is that the long-term demand level (quota level) should be assured. On an international market, the demand for electricity certificates would be determined by *the sum of the individual countries' quota levels*, with the long-term element depending on the life of the systems. It is therefore important that these elements of different systems should be time-coordinated.

Regulated exit

The sensitivity to change of an electricity certificate market is affected by the number of systems (countries) connected to the market. In the case of a market consisting of only two systems, there will be considerable effects both on demand and on price if either of the countries decides to terminate its system. There would also be a similar sensitivity with respect to quota changes in either of the countries. However, on a larger market, bringing together several systems, decisions of individual countries could be expected to have a considerably less dramatic effect. It is therefore essential that both systems should be constructed in such a way as to ensure long-term stability of the market. This would create the right conditions for new investments. Particularly on a bilateral market, the potential for severe disturbance from the exit of one country makes it important that there should be some form of regulated exit procedure in the agreement between the countries.

Penalty

Although it is perfectly possible to have different penalty levels on an integrated electricity certificate market, it will in fact be the lowest penalty (the price cap) that will dominate the market. This means that it is unimportant if the penalties vary between the different systems, as it is the lowest penalty that will act as a price cap for the entire market. It is therefore preferable to coordinate the penalties between systems, set at some common level that provides the necessary incentives for fulfilment of quota obligations.

Validity, value and lifespan of certificates

Regardless of their country of origin, certificates traded on an international electricity certificate market must all be of the same value if the exchange of certificates is to operate effectively. Certificates must be valid in all systems on the joint market, regardless of where and how they have been produced

How the environmental value of certificates is to be credited must also be decided before an international market can be established. This requires political agreements as to how, and on what bases, certificates may be credited against (in particular) international objectives within the framework of international electricity certificate trading (known as political credit). Although the way in which the environmental value of certificates is to be credited will not necessarily affect the efficiency of the common electricity certificate market, it is probably something that, for the sake of clarity, will need to be determined before the market is set up.

Differences in the extent to which electricity certificates can be saved (known as banking) or borrowed must be avoided, as this will complicate trading. The same applies for the energy quantity represented by each certificate.

Linked register function

A prerequisite for being able to trade certificates on a common electricity certificate market is that the certificate registers in each country can communicate with all other registers. It must be possible to transfer certificates between registers/systems, preferably by not later than the date when a common market is established.

In addition to the above, the Agency believes that there is ***reason to consider coordination*** in respect of the following elements of the electricity certificate system, in order to ensure an effective certificate market.

The main principle of what is regarded as certificate-entitled electricity production

The definition of renewable energy as set out in the Renewable Energy Directive should determine the selection of certificate-entitled production in the systems trading on the common market, primarily with regard to the possible entrance of a third party. Individual limitations in participating countries' legislation in relation to what is permitted by the Directive would probably not result in significant market disturbances, as long as each certificate traded in the market can be credited in each system and represents the same value. Substantial differences between systems should be avoided from a legitimacy point of view.

Length of time for which a plant may be included in the system (limitation of entitlement)

As far as international trade in electricity certificates is concerned, the lifespan of the plants in the respective systems is unlikely to be anything that needs to be coordinated between national systems in order to ensure that certificates can be traded between systems. The main consideration is that each of the countries should consider the effects of possible closure of production facilities when determining the quota levels. As the effect of introduction of an entitlement restriction is to increase prices, there could be justification for coordinating this on the common certificate market. Differences in respect of entitlement periods will also affect the relative competitiveness between countries. The Agency is of the opinion that the length of entitlement period of production facilities in the system should be limited, if the electricity certificate system is made permanent in accordance with the Agency's earlier recommendations in its review of the electricity certificate system.

The legal status of electricity certificates

Differences in the legal status of certificates can significantly complicate exchange between the Swedish and Norwegian systems, and this will particularly be the case if differences lead to certificates carrying different values, depending on their country of origin. This could occur, for example, as a result of certificates being liable for value-added tax in one country, but not in another. In addition, the legal implementation could exclude market participants and trading exchanges that could contribute important functionality to the certificate market. Direct harmonisation would not be necessary if these problems can be resolved by appropriate changes to the legislation in each country and avoidance of exclusion of parties important to efficient operation of the market. However, if it is not possible to avoid this problem by legislative means, it would probably be desirable to harmonise the legal status of electricity certificates in order to ensure that certificates can be traded as efficiently as possible. This must apply, regardless of whether electricity certificates in Norway are given the status of financial instruments, or whether the status of Swedish certificates is changed to bring them into line with Norwegian certificates.

Other targeted economic support systems

Most types of support systems (for example, the Swedish environmental bonus) distort competition between the forms of energy on the electricity certificate market, and thus affect the ability of the market efficiently to allocate production resources within the common certificate market. This indicates that it is desirable that such targeted economic support systems should be harmonised as far as possible.

Similar support and monitoring functions

If the electricity certificate market is internationalised, procedures for approval of plants, the issue of certificates, quota obligation fulfilment etc., should be similar between different systems if the market is to be able to operate transparently and without problems. The same applies for monitoring, reporting and surveillance functions, although there will probably not be an absolute requirement for coordination.

Common register or linked electricity certificate registers

From a practical point of view, there is justification for coordinating the register functions, not only in connection with the possible accession of a third country to the market, but also to prevent double-counting. This can be done either by directly linking the separate registers, or by establishing a common register.

Official information to market participants

It is likely that it would be desirable to coordinate information to those acting on the market from official sources, concerning aspects such as approved plants, information on issued and transferred certificates, weighted average prices etc. This could be arranged, for example, by setting up a common web site on which information from the various certificate registers could be published.

A model for determining ambition levels and quotas in a joint market

In an expanded market, the prices on the overall market will be affected by the ambition level of a joining country (i.e. the total quantity of renewable electricity production that the country wishes to finance via the electricity certificate system), and by the country's production circumstances. This means that conditions for investment are indirectly affected by the price of electricity certificates, as are the total costs of the other countries on the joint market. It is therefore important to find a model for determining the ambition levels and quotas of countries joining the market, in order to ensure that those investing in the market, as well as other parties involved in it, have confidence in the system so that investments are actually made and production actually occurs.

The Agency's conclusions and recommendations:

- The Agency is of the opinion that the quotas in the individual countries should be set in relation to the quantity of renewable electricity production (in TWh) that the country is prepared to finance, i.e. in relation to the country's ambition level. This means that the ambition (in TWh) will be distributed across that country's own quota-obligated electricity use.
- The Agency suggests that a model should be employed in order to determine ambition levels and quotas for each country wishing to join the common electricity certificate market. The Agency is of the opinion that a 'reasonable ambition level' interval should be determined for each country, in order to create long-term stable prices on the established market, thus providing the necessary conditions for long-term investment decisions. The starting point for such calculation is each country's production facilities for renewable electricity production.
- The Agency is of the opinion that, within the limits of the 'reasonable ambition levels', each joining country should be able to determine its exact ambition level. It has not been possible to define any universally valid criteria for determining an exact fair assignment of costs. One of the reasons for this is that countries' starting points can differ both in economic terms and also in respect of earlier political direction, particularly of the energy sector.

Quotas should be set in relation to each country's individual ambition level

The Agency is of the opinion that the quotas for individual countries should be set in relation to the ambition level expressed by the country, and thus be applied to the country's quota obligation electricity use. This means that quotas can differ from one country to another. In this way, each country has greater flexibility of determining its own ambition level, i.e. the number of TWh financed by the country in the form of its assigned quota (its quota obligation electricity use).

Determine a 'reasonable ambition levels' interval that will create long-term stable price setting

The Agency is of the opinion that the starting point for assessing the 'reasonable ambition level' for a new entrant country should be determined by relating the country's ambitions in terms of the quantity of renewable electricity that it is willing to finance to its ability to produce renewable electricity. By starting from the new entrant country's specific potentials and costs for producing renewable electricity, and relating them to how they affect prices on the existing market at various ambition levels, it becomes possible to establish an interval of 'reasonable ambition levels'. The purpose of doing so is to create stable conditions for investment by avoiding significant price effects on the existing established market.

Within the 'reasonable ambition levels' interval, each country determines its exact ambition level

The Agency is of the opinion that each new country should determine its own exact ambition level within the given range of 'reasonable ambition levels'. The Agency does not feel that it is possible to produce criteria for 'fair' assignment determination that would be generally valid, and nor is this any requirement in respect of establishment of an international market. As the environmental value of certificates follows the quota level that the country finances within the framework of the system, a low production target results in a correspondingly low environmental benefit credit.

Long-term structural effects

Expansion of the Swedish electricity certificate market to Norway will have long-term structural repercussions, both in Sweden and in Norway. The long-term effects on investments and pricing on a common Swedish/Norwegian electricity certificate market will not be clear-cut, but will be determined to a considerable extent by the total overall ambition level on the market as a whole, as well as by costs and potentials for expansion in the individual countries. We have run models of various scenarios in order to assess their effect (particularly) on investments, as well as on the prices of electricity certificates and of electricity itself. It is important to bear in mind that the calculations are merely forecasts of an uncertain future, based on several assumptions, and must therefore be interpreted with care.

The Agency's conclusions and recommendations:

- With a low overall ambition level, Sweden would be a net purchaser of electricity certificates, i.e. a relatively large proportion of production would be established in Norway.
- With a high overall ambition level, Sweden would be a net seller of certificates, i.e. a relatively large proportion of production would be established in Sweden.
- Very high or very low ambition levels would require the introduction of new technology, which would mean that the prices of electricity certificates would rocket.
- A joint market has positive long-term effects on stability and competition in the market.
- For a given quantity of renewable electricity production, a common Swedish/Norwegian electricity certificate market would have clearly lower costs than the costs of producing the electricity on two separate markets.

With a low overall ambition level, Sweden would become a net purchaser of electricity certificates

A *relatively lower ambition level case* that has been modelled is that in which the combined ambition level amounts to a total of 31 TWh of renewable electricity on the joint market in 2016, made up of 10 TWh in Norway and 21 TWh in Sweden (including the existing production), which would be financed by each country's respective quota obligations. For this ambition level, the 'cheap' electricity production would be sufficient to meet the targets. As much of the cheap power production (hydro power and wind power) is in Norway, the greater part of actual production would occur there. Although Sweden's quota in this case is 21 TWh, actual Swedish production would be about 16 TWh, made up of about 10 TWh of biofuelled production, about 4 TWh of wind power and about 2 TWh of hydro power. Sweden would therefore have to import certificates if the total ambition level was set at this value. However, the cost of financing the 21 TWh assigned in the quota would be less for Swedish consumers, because the price of the necessary electricity certificates for each year in the model would be considerably lower on a joint market than if the same target was to be achieved on a national market. The model calculations show that the price of electricity would be only very slightly lower on a joint market than on two separate markets.

With a high overall ambition level, Sweden would become a net seller of electricity certificates

A *high total ambition level case* has also been modelled: a total of 41 TWh of renewable electricity on the combined market in 2016, made up of 20 TWh for Norway and 21 TWh for Sweden (including the existing production), to be financed from the countries' respective quota obligations.

With a combined ambition level of 41 TWh, it will be necessary to resort to more expensive forms of electricity production in order to meet the quotas. A greater part of each country's potential will also be utilised, with reduced trading between the countries, as the differences in production costs for marginal power at this high ambition level do not differ to the same extent. In one of the cases with this ambition level, it is likely that Sweden would produce more renewable electricity than its quota requires, thus exporting certificates to Norway, as Swedish offshore wind power and biofuelled power production would be cheaper than the more expensive alternatives of Norwegian wind power. Although, in this case, Sweden's quota remains at 21 TWh, actual Swedish production would be about 25 TWh, made up of about 14 TWh of biofuelled production, about 9 TWh of wind power and about 2 TWh of hydro power. Sweden would thus be a net exporter of certificates in the case of a high combined ambition level. The model calculations indicate that, in this case, the price of electricity certificates on a joint market would be somewhat higher for Sweden in 2016 than if the same quantity of electricity was produced separately on the two national markets. However, the price of the certificates on a joint market would be lower than on an individual Swedish market in 2009 and 2023. The model indicates that the actual price of electricity would be only negligibly less when changing from two separate markets to a single market.

Very low or very high ambition levels would require new technology to be employed

Scenarios have also been calculated for combined ambition levels of 45 TWh and 55 TWh of renewable electricity in 2016. The extremely high level would require new technologies to be employed, such as black liquor gasification in Sweden and wave power in Norway. This would also result in extremely high electricity certificate prices (approaching SEK 900/MWh in the extreme case). However, there is a considerable element of uncertainty in the model calculations concerning technical development potentials and production costs.

A joint market would have positive long-term effects on market stability and competition

The Agency believes that stability of the electricity certificate market would improve with increasing market size. A larger market would be less sensitive to individual events, or to variations in annual precipitation, wind conditions, or the size of district heating heat sinks. The parties on the market also feel that political risks, in terms of the decision-makers changing conditions or regulations without sufficient advance warning, would be reduced if the market was larger, which would contribute to long-term stability and favourable conditions for long-term investments. In addition, the Agency is of the opinion that competition would be enhanced on a larger market, and that the risk of reducing the influence of the market would be less on a larger market.

A joint Swedish/Norwegian electricity certificate market would have lower costs than two separate markets

The model calculations made for the Agency indicate that total system costs for a joint Swedish/Norwegian electricity certificate market would be clearly less than if the same quantity of renewable electricity production was to be supplied by two separate markets. Over the next 20 years, the annual cost difference would amount to about SEK 100-200 million: in other words, a joint market would save about SEK 100-200 million each year, in comparison with two separate markets required to produce the same quantity of certifiable electricity production with quota sizes as analysed in the MARKAL model. These savings would include those arising in connection with the actual trading of certificates as a result of certificates being produced wherever it is cheapest to do, as well as savings resulting from cost changes arising in other parts of the system outside the actual certificate system. It can also be noted that, in this context, annual savings of SEK 100-200 million are relatively small. However, in addition to these savings, there should be efficiency savings resulting from such mechanisms as increased competition (due to a greater number of parties being involved), increased liquidity (due to a greater market size) and reduced annual price variations resulting from variations in annual precipitation, wind conditions or district heating heat sink sizes. However, the effects of such possible savings on a real market have not been analysed.

Short-term effects for Swedish parties

Creation of an expanded electricity certificate market would have a number of short-term effects (from now until about six months after 1st January 2006) on the Swedish electricity certificate market. Not only would there be a number of uncertainties afflicting the Swedish parties in the market, but there would also be a number of practical problems that would have to be dealt with in the short term.

The Agency's conclusions and recommendations:

- Planning for an expanded electricity certificate market introduces a number of uncertainty factors concerning not only Norwegian conditions, but also possible changes in the system as a result of discussions with Norway.
- In the short term, the most significant consequence is that the expansion would result in a greater price risk, which would mean that parties on the market would tend to wait and see what happens, so that no investments were made.
- The uncertainties would mean greater risks for Swedish parties, which would manifest themselves as a greater volume risk and changes in the political risk.

- Once the system has been decided upon, and conditions are known, both uncertainties and risks would be considerably reduced.
- Several practical problems would need to be sorted out in the short term, such as creation of a working infrastructure so that each of the countries has access to the other's system, and so that all parties on the market have access to the same market information, regardless of the country of origin or receipt.

Several factors in the plans for an expanded market with Norway are regarded as uncertain…

Planning a joint market creates uncertainties concerning the conditions in Norway. How would Norway's ambition level affect the price of electricity certificates? What is the Norwegian production potential, and how would it affect certificate prices? What are Norwegian production costs, and how are the Norwegian politicians likely to react? There would also be uncertainties in connection with possible changes to the Swedish system as a result of the discussions with Norway, such as in the definition of certificate-entitled electricity production, possible changes in the length of the periods for which producers remain qualified for certificates, or changes in quotas.

…which represents a risk to Swedish parties

The expanded market represents a greater *volume risk* through uncertainty of the amount of weather-dependent production that would be brought into the system. If an expanded market results in more wind power or hydro power in the joint system than in a solely Swedish market, there would be greater fluctuations in the amount of certificate-entitled production available. An expanded market also involves a greater *price risk* in the short term, as a result of expected effect on pricing. These expectations may arise from suppositions of how the quota levels will be set, and of how much new production capacity will be brought into the system. The *opposite party risk* is not particularly large in the Swedish system, and is not likely to increase as a result of market expansion. In the long term, political risk will probably decrease, although it is likely to increase in the short term, due mainly to the fact that actual operating regulations and legislation will probably be decided at a quite late stage in the planning process.

The consequences of the greater price risk are most significant in the short term

In the short term, the most significant consequence is that expansion of the market will increase the price risk. Norwegian accession to the market could result in speculations on expected price changes, thus producing a volatile and unpredictable price structure. Expectations of a fall in certificate prices would have the effect of bringing forward any price reduction, while expectations of a rise in certificate prices would correspondingly result in an increase in prices before expansion of the market. Any forecasts of future prices could be self-fulfilling, in that the actual expectations of changed prices would affect the prices in the short term. If the forecasts turned out to be wrong or exaggerated, they could result in fluctuating certificate prices until the prices had settled to reflect actual conditions. The most significant consequence of this increased price risk is that it could create an investment vacuum, with investors hanging back, and therefore delaying the construction of new production capacity. It is important to note that a considerable element of this uncertainty arises from the fact that the formal regulations for the system have not yet been agreed. Once all the draft legislation is available, and all the details have been decided, uncertainty will be considerably reduced.

Several practical problems must be resolved

Several practical problems must be resolved in the short term, such as establishment of a working infrastructure to provide each country with access to the other's systems, and ensuring that all parties have access to the same market information, regardless of in which country they are.

Legislative changes needed in an expanded market

An expanded electricity certificate market will require a number of legislative changes. The Agency lists below the changes that may be necessary as a result of analysis of the effects of an expanded electricity certificate market.

<u>The Agency's conclusions and recommendations:</u>

- The Agency is of the opinion that several changes will be required to:
- The Act (2003:113) concerning Electricity Certificates
- The Ordinance (2003:120) concerning Electricity Certificates

- The Agency is of the opinion that it is very likely that changes will also be required to:
- The Act (2003:437) concerning Guarantees of Origin of Renewable Electricity

- As a result of its analysis, the Agency is of the opinion that the following statutes do not require any changes:
- The Debt Enforcement Act (1981:774), 4 Chapter 30 § and 6 Chapter 2 §,
- The Rights of Priority Act (1970:979), 4 §,
- The Secrecy Act (1980:100), 8 Chapter 29 §,
- The Bankruptcy Ordinance (1987:916), 12 § 16 p,
- The Ordinance (1995:1301) concerning Handling of Compensation Claims against the State 4 §,
- The Ordinance (1999:716) concerning Metering, Calculation and Reporting of Transmitted Electricity 9 §,
- The Act (2001:1227) on Personal Tax Declarations and Confirmatory Information 11 Chapter 12, 13 §§,
- The Income Tax Act (1999:1229), 17 Chapter 4, 22 a §§

Changes in the Act (2003:113) concerning Electricity Certificates

The significant changes here apply to the definition of electricity certificates, transfer of electricity certificates within a system or between two separate systems, access to equal information for parties on the market, determination of quotas and calculation of quota levels.

The results of the analysis indicate that it may be necessary to make adjustments concerning certificate-entitled production, the life of system production facilities, changes in quota obligation categories and calculation of quota obligation fees.

Other changes

The analysis indicates that changes in certificate-entitled production could affect the definitions of fuels covered by the Electricity Certificates Ordinance, as well as the definition of qualifying production plants in the Electricity Certificates Act and in the Act concerning Guarantees of Origin of Renewable Electricity.

EU-legislative consequences of an expanded market

The National Board of Trade has analysed the EU legislative consequences of an expanded electricity certificate market. The Swedish Energy Agency has not evaluated the Board's conclusions and recommendations.

The National Board of Trade's conclusions and recommendations

- An open system for trading electricity certificates between states would further the benefits of a certificate system.
- The fact that only two countries participate at first should not be a problem, although the Board feels that this arrangement should be checked with the European Commission. The proposal also needs to be reviewed in the light of Directive 98/34/EC.
- It must be possible to justify any departures from the requirements of Directive 2001/77/EC.

2 Introduction

2.1 Background

The Swedish electricity certificate system came into force on 1st May 2003, with the aim of increasing the use of electricity from renewable energy sources by 10 TWh/year between 2001 and 2010.

In its bill, *Cooperation for a secure, efficient and environmentally benign energy supply system* (Bill no. 2001/02:143), the Government set out its view on international trading in electricity certificates. The bill stated that cross-border trading in electricity certificates is desirable, and that the Government intends to pursue the question of such international trading within the EU and within the Nordic sphere of cooperation. The Government further developed this view in its bill entitled *Electricity certificates to encourage renewable energy sources* (Bill no. 2002/03:40). Parliament approved the Government's proposal (Committee Report 2002/03:NU6, p. 56, and Notification Document 2002/03:133). The Government supported its view by pointing out that it will be particularly when international trade in certificates occurs that the benefits of the certificate system will be fully felt. It will then be possible to site renewable production facilities wherever conditions are most favourable, which assists the competitiveness of renewable electricity production in the long term. However, an international electricity certificate market would require certain fundamental requirements to be fulfilled by the participating states.

The Norwegian Parliament has asked the Norwegian Government to take the initiative for a joint Norwegian/Swedish electricity certificate market. The Norwegian Government put forward its submission to the Parliament in December 2003 (Parliamentary Notice no. 18, pp. 90-91), in the form of a proposal to take steps to establish such a joint market, with the aim of it coming into force on 1st January 2006.

The Norwegian electricity certificate system was given form in a draft legislative submission from the Ministry of Oil and Energy in November 2004, based on establishment of a joint market with Sweden. In line with this, it was stated that a joint electricity certificate market would be based on the Swedish model. The aim is that both national systems should exist side by side, linked by a joint market on which electricity certificates could be traded, which presupposes that the value of a Swedish and a Norwegian certificate would be the same and that they could be credited in both countries.

In December 2003, the Government instructed the Swedish Energy Agency (reference N2003/9037/ESB [partly]) to prepare a general review of the method of operation of the electricity certificate system, to prepare statistics on the system, to assess future quota levels, to analyse the future role of peat as a renewable energy source in the system, to review the structure and function of the quota obligation fee, to identify and analyse consumer conditions, to analyse the effects of wind power and to produce an overall assessment of the present exception of electricity-intensive industries from a quota obligation. The final report from the review was published on 1st November 2004, with the Swedish Energy Agency recommending that the electricity certificate system should be made permanent as an integral part of Swedish energy policy, and that ambition levels and quotas should be determined on a long-term basis in order to improve investment prospects. Given this, the Agency is of the opinion that conditions are favourable for achieving the established target of 10 TWh/year of new renewable electricity production by 2010, relative to the value in 2002. In addition, the Agency recommends that the quota obligation should be transferred to the electricity suppliers, instead of to end users as is at present the arrangement, and that the certificate price should be included in the price of electricity.

2.2 The commission

The Swedish Energy Agency has been instructed by the Government to analyse the consequences of an international expansion of the electricity certificate market, with particular consideration of the effects of a joint Swedish/Norwegian electricity certificate market[2]. The main purpose of the work is to identify and assess the consequences of short-term and long-term effects, to identify and analyse the basic criteria that countries must fulfil, and to present and evaluate possible models for setting quotas in the respective countries. The work also includes analysis of the consequences of an expanded electricity certificate market in the light of Sweden's undertakings in connection with EU cooperation, with particular emphasis on the ramifications of an EU legislative context.

The Agency is due to publish its report by not later than 1st January 2005. The Government's instructions are reproduced below in their entirety:

> Expansion of the electricity certificate market can result in certain short-term effects arising on the Swedish market and for the parties involved in it. The Swedish Energy Agency should identify and analyse these consequences.
>
> In the longer term, of about ten years into the future, an expanded electricity certificate market could have structural consequences over and above the short-term and long-term economic effects. The Agency should analyse the long-term effects, such as those on pricing, competition, market stability and the effects of how production facility investments might develop in a joint electricity certificate market.
>
> The Agency should also analyse the requirements that must be fulfilled by countries involved in order to achieve the desired objectives and guide effects, and to ensure that electricity production from renewable energy sources competes on equal terms.

[2] N2003.9037/ESB 'Commission to the Swedish Energy Agency to investigate the consequences of an expanded electricity certificate market'.

Various methods can be used for setting the quota levels for the partner countries. The Agency should analyse potential models for determining such quota levels. The reference alternative should be that of setting the quota levels for the individual countries on the basis of each country's conditions and aims. The Agency should pay particular attention to how differences in assigned quota levels, and in definitions of certificate-entitled production, can affect the efficacy and target achievement of an expanded electricity certificate market.

If the right conditions for favourable development of the electricity certificate market are to be created, the market itself must be stable and reliable. A known, stable quota level creates the appropriate conditions for those involved in the market to forecast development and set it in a long-term perspective. This, in turn, assists long-term establishment of prices, which also encourages investments. The Agency's commission (N2003/9037/ESB) for a review of the electricity certificate system includes investigation of future quota levels and of the length of the quota period. In addition, in its analysis of a joint Swedish/Norwegian electricity certificate market, the Agency should also consider coordination of the length of the quota period and of what other functions that must or should be coordinated in Sweden and Norway in order to create an effective market with long-term stability.

The Agency should also analyse the consequences of an expanded electricity certificate market in the light of Sweden's undertakings to the EU, and particularly with respect to the effects of or on EU legislation.

The Agency should list changes in legislation that would be required as a result of the findings of its analysis.

2.3 Limitations

The various consequence analyses in the report are concentrated on the results of establishing a joint Swedish/Norwegian electricity certificate market. However, the fact that, at some time in the future, a third country might be connected to this joint market is important, and has been considered in the report, although the effects have not been analysed in more than general/theoretical terms.

The report starts from the premise that a common electricity certificate market involves linking two or more electricity certificate *systems* by arranging for electricity certificates to be traded between the countries, and by coordinating certain basic factors. This means that the report is concentrated on *the market* and on the roles and factors that should be established in order to enable the market to operate. Each electricity certificate *system*, and each country's legislation, can be different, provided that they meet the necessary criteria for an effective joint *market*.

2.4 Definitions

A number of terms as used in the report are central to the discussion of an expanded electricity certificate market, and therefore need to be carefully defined, as follows.

Renewable electricity production = certificate-entitled electricity production: Unless otherwise stated 'renewable electricity production' as used in this report, is the same as 'certificate-entitled electricity production'.

Aggregated ambition level: Indicates the production of renewable electricity (in TWh) expected on the joint market. It does not, however, say anything on how the costs for achieving it are to be assigned between the countries in the market or where investments in production facilities will be made.

The individual countries' ambition levels: In a joint market, each country's ambition level is expressed as the quantity of renewable electricity that the country is prepared to finance on the joint market. This ambition level is expressed in TWh, which is then converted to a percentage quota by setting it in relation to the country's quota-obligated electricity use. It does not, therefore, say anything about the amount of renewable electricity production in the country, but only about the quantity of renewable electricity that the country is willing to finance.

Quotas / quota level: The quota is the proportion of the quota-obligated electricity use to be supplied by renewable, certificate-entitled electricity production. Quotas are expressed as percentages, and for each individual year. For Sweden in 2010, for example, the quota is 16.9 %.

Quota obligation: The quota obligation is defined in the Act (2003:113) concerning Electricity Certificates, and is an obligation to hold, by a given date each year, the proportion of electricity certificates as indicated by the quota for that year. The number of electricity certificates required by the quota is calculated from the value of the quota and the electricity use by the parties required to fulfil quotas.

(Party) required to fulfil quotas: The (party etc.) is the consumer etc. required to hold, on a specified date, the quantity of electricity certificates as specified by the quota. In Sweden, it is the end user of the electricity who is the party responsible for holding the necessary number of certificates. In Norway, it is proposed that it should be the electricity supplier who is the party required to hold the quota certificates.

Quota-obligated electricity use: The quota-obligated electricity use is the total quantity of electricity to which the quota applies. Quota-obligated electricity use in Sweden in 2003 was about 96 TWh.

2.5 The structure of this report

This report is divided up into seven main chapters (Chapters 5-11) which reflect the overall questions in the assignment. However, Chapter 3 starts the report off, with a discussion of the theoretical conditions for an expanded market. It also includes descriptions of other theoretical investigations of international trade in electricity certificates that have been carried out earlier. Chapter 4 describes the conditions applicable to the Swedish and Norwegian electricity markets as a whole. These conditions, which form an important starting point for the continued analysis, are presented and commented on in more detail in Appendix 1. Chapter 5 describes the results of an analysis of how the purpose of the Swedish electricity certificate system would be changed by an expansion of the market. Chapter 6 follows by identifying and analysing the factors that must or should be coordinated in the countries establishing a joint electricity certificate market. Chapter 7 analyses various models used to determine ambition levels and quotas when an existing certificate market is expanded to bring in additional countries. Chapter 8 analyses the long-term structural effects on investments, pricing, competition and market stability that could arise in an expanded market. Chapter 9 analyses the short-term effects that could arise on the Swedish market. Chapter 10, which has been written by the National Board of Trade, describes the various EU legislative aspects that must be considered when expanding the Swedish market to include Norway. Finally, Chapter 11 describes the necessary legislative changes that will be required as a result of the Agency's analysis.

3 Theoretical preconditions for an expanded market

Figure 1 is a schematic illustration of the simple economic principles of an integrated certificate market (see also Mozumder and Marathe, 2004). Two countries, A and B, have differing marginal costs for electricity from renewable energy sources, illustrated by the two supply curves S_A and S_B.3 In the same way, the two countries have differing quota levels, Q_A and Q_B, with corresponding demand curves, D_A and D_B.4 In a situation in which no trading in certificates is possible or allowed, the certificate prices in each country will be determined solely by the supply conditions on the respective national markets and by the nationally determined quota levels. These prices are represented in figure 1 by P_A and P_B.

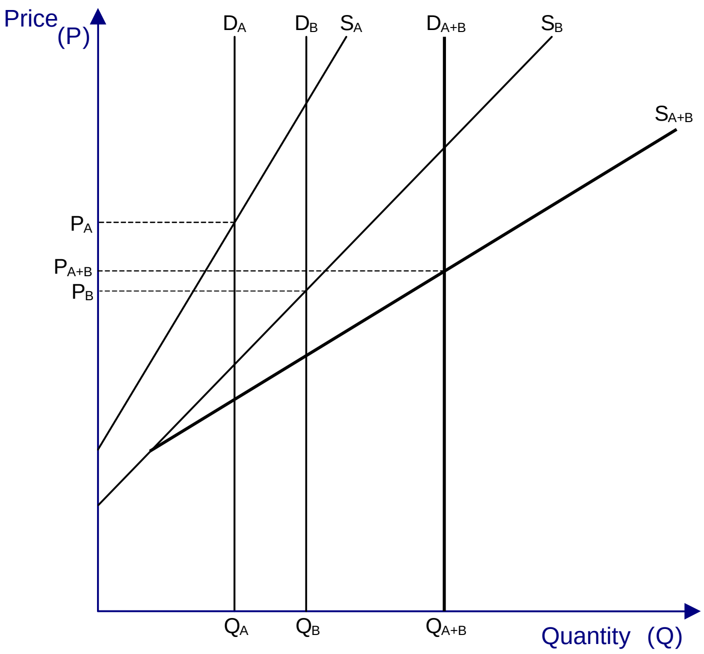

Figure 1: An integrated electricity certificate market

The introduction of cross-border certificate trading produces a larger integrated market. The supply of certificates is given by the horizontal sum of the two national supply curves, i.e. curve S_{A+B} in figure 1. The aggregated quota for the

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[3] The two-country example can easily be generalised to show the effects of trading between several countries by saying that country B represents an aggregation of all the other countries/systems participating in the joint electricity certificate market.

[4] For simplicity, the quota obligations are shown here in absolute terms, i.e. TWh. In addition, it is assumed that there is no potential for saving or borrowing (i.e. a completely price-insensitive demand).

region as a whole is, of course, also naturally higher (Q_{A+B}). The resulting equilibrium price on the integrated market will lie somewhere between P_A and P_B (P_{A+B} in this example). It can be seen that, for society as a whole, there is a clear saving in permitting cross-border certificate trading: it makes it possible to utilise the renewable energy resources in the region in a more efficient manner, thus meeting the aggregated quota of renewable energy at a lower cost than if each Country Attempts to achieve its national quota on its own. We can see, for example, in figure 1 that relatively expensive power in Country A is being replaced by cheaper power from Country B.5 It is really only in the (somewhat unrealistic) situation in which the marginal costs of renewable electricity (less the price of electricity) are exactly the same in both countries that there are no savings to be made, and thus no incentive for cross-border trading in certificates. The simple model described above provides a good illustration of the economic benefits – cost savings – resulting from an expanded electricity certificate market, which is also one of the main reasons for now suggesting such a market for Sweden and Norway.

3.1 Previous theoretical analyses

Several workers have previously carried out a number of investigations which, in various ways, have investigated international electricity certificate markets in theoretical or quantitative terms. It can be interesting to look at some of the results of these investigations, in order to obtain a theoretical insight into the effects of changing conditions on electricity prices, certificate prices and electricity production on such a market.

Nese (2003) starts from a market having a percentage quota level and uses comparative statics in a partial equilibrium model to show what happens if the quota level is changed. In a situation with two countries having separate electricity certificate systems, but with a joint market and with no obstacles to cross-border transmission, a percentage increase in quota level in country A will mean that the total demand for 'brown' electricity will fall in both countries. This will reduce the market price for the electricity, thus also reducing the production of 'brown' electricity. However, we cannot say with certainty whether production of 'green' electricity in country A will increase in absolute terms. A higher quota level will cause the price of certificates to rise and, if this feeds through to a rise in the price of electricity to the end user, demand will fall. If the consumers are particularly price-sensitive, an increase in the price of their electricity will result in such a fall in the demand for electricity that it will not be necessary to increase the production of renewable electricity. However, it is commonly perceived that the demand for electricity is relatively price-insensitive, which means that this effect is fairly unrealistic in practice (see Ek, *et al.*, 2004). However, what Nese

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[5] The national economy benefit effects of electricity certificate trading are split between the parties required to purchase quotas and the producers in both countries. In Country A, the cost to these parties for fulfilling quota Q_A is reduced, as is production in that country, due to Country B's lower costs for the production of renewable electricity. On the other hand, the cost of meeting quota obligations in Country B rises, although its national production increases.

shows is that an increase in the quota level in country A will always result in increases in both use and production of ‘green’ electricity in country B. This is because as the price paid to the producers has fallen, and the quota level is the same in country B, the price to end users will fall and consumption will rise. The increased demand for electricity must be met in various ways, including an increase in the production of ‘green’ electricity in order to maintain the percentage quota level.

Nese shows that, if both the certificate markets are integrated, the same effect will occur in respect of demand for ‘brown’ electricity – i.e. that demand will fall and therefore also production will fall – if country A increases its percentage quota level. However, conversely, it is not possible to say what would happen to the production of ‘green’ electricity in either of the countries. In other words, in an extreme situation, it could be that an increase in the percentage quota level in one country does not result in any increased production of ‘green’ electricity in either of the countries, or that the entire increase in production occurs in the other country.

Hindsberger *et al*., 2003, use a numerical model to show that the cost of purchasing emission rights on an international electricity certificate market that also includes emission rights trading will be internalised in the price of electricity on the spot market. If fewer emission rights are available, their price will rise and so will the price of electricity. On the other hand, increasing the quota level for renewable electricity production will have the opposite effect. If the proportion of renewable electricity production increases, the amount of electricity available on the spot market will increase and the assumption that renewable electricity production has low marginal costs will mean that ‘brown’ electricity will be replaced by renewable electricity and the spot market prices will fall. However, the electricity certificate price will rise if the proportion of renewable electricity production increases, although the price of electricity to end users will be affected only marginally.

There have also been investigations based on MARKAL model analyses of the entire Nordic electricity system. Nordleden (2003) has looked at a Nordic electricity certificate market. The results show that a quota level of 10 % would be required on the Nordic electricity market in order to activate the certificate system. Certificate prices would then rise when the percentage quota level increases and significant investments are made in certificate-entitled production. Coal-fired and oil-fired production would decline together with natural gas-fired production as the quota level increases. However, the price paid to producers would tend to fall, due to the fact that marginal production cost falls as certified production capacity enters the system. (Compare this with Hindsberger *et al*., 2003.) Under the conditions assumed in the model, the results show that the price of electricity to end users would tend to fall with joint quota levels up to 30 %6.

A current investigation by Amundsen and Bergman (2004) is developing a numerical simulation model to analyse the effects on prices, production and trade on the Nordic electricity market when allowance is made for trading both in electricity and certificates between Sweden and Norway. The model assumes free trade in electricity, subject to physical limitations imposed by the grid connection capacities between the two countries.

The model calculates the equilibrium prices and the quantities on the electricity markets in Denmark, Finland, Norway and Sweden. In addition, it also determines the equilibrium prices, quantities and traded volumes on the electricity certificate markets in Sweden and Norway. Among other points, the investigation considers how a given percentage quota level of renewable electricity affects the electricity market, depending on whether the certificate markets are national (isolated) or based on free cross-border trade (a joint market). The results presented in the report are intended to apply for 2006, and show that several changes have already occurred when moving from a market without certificate trading to a Swedish certificate trading market model having a quota obligation of 12.8 %. According to the results, the (joint) Nordic producer price for electricity can be expected to fall, while the Swedish consumer price rises slightly. The Norwegian consumer price would fall, which would have the effect of increasing the use of electricity in Norway. (cf. Nese, 2003.)

The investigation then introduces a Norwegian certificate market having a 2 % quota obligation (about 3 TWh). As the model processes are intended to represent 2006, this is a low quota value. The model assumes that unrestricted trading in electricity certificates between Sweden and Norway is permitted, and that the market is characterised by full competition. The results indicate that the producer price of electricity would be further reduced when Norway introduces a certificate market, and that the Swedish consumer price would be somewhat lower than in the previous situation, although the Norwegian consumer price would increase somewhat. This would result in total electricity use increasing in Sweden and decreasing in Norway. The prices of the certificates are the same in both countries, but would increase somewhat in Sweden in comparison with the situation with only a Swedish certificate market. Production of renewable electricity in Sweden would fall, while imports from Norway would rise, as the latter country would be producing more renewable electricity than it was consuming.

Summarising, it can be said that it is not clear what effects would arise in terms of electricity prices and certified electricity production when the conditions on a

[6] In reality, as the price paid to producers falls, and the price of electricity certificates rises, the net effect to end users is uncertain and would depend on the parameters of the models. (See also Unger, Ahlgren, 2003)

certificate market change. To greater or lesser extents, the results can depend on the conditions and parameter values assumed in the models. However, several of the analyses show that even if the certificate prices rise in response to a higher quota level, a higher end user price will not necessarily follow, as the production prices tend to fall when renewable electricity production enters the system. Numerical investigations that have specifically looked at the Nordic electricity market show that a quota level above 10 % is required in order to activate the certificate trading system, after which the certificate prices will rise and more renewable electricity production will come on line. These models also show that a joint electricity certificate market would operate as expected, and that the quota obligation mechanism would have the intended positive effect in the production of 'green' electricity.

4 Conditions in Sweden and Norway

As a first step towards understanding how a joint market might work, it is interesting to look at the conditions in the two countries. This chapter therefore provides a brief description of the electricity markets, electricity production, electricity use, grid transmission, production costs and potentials, national objectives, guide measures that affect overall conditions, and concession processes in Sweden and Norway. Table 1 (below) summarises the most important conditions in numerical terms. The interested reader is referred to Appendix 1, which provides a more detailed description of conditions in the two countries.

The electricity market

The Swedish electricity market is characterised by a very large market concentration on the production side, with the three largest utilities accounting for no less than 86 % of Swedish electricity production. In Norway, on the other hand, the proportions are very different, with the ten largest utilities supplying 60 % of the country's electricity. On average, over the last five years, electricity prices for major industrial users and larger domestic customers have been lower in Norway, while Sweden has had lower electricity prices for small domestic customers.

Electricity production

In both countries, electricity produced from renewable energy sources has a dominant position. The major differences between the two countries is the fact that hydro power is the main power source in Norway, and that there is a considerably greater production of biofuel-based power in Sweden. The proportion of electricity production from wind power is very small in both countries.

Electricity use

In comparison with most other countries, Sweden and Norway both have a very high per-capita electricity use. Norway's per-capita electricity use is, in fact, the highest in the world today, and is 55 % higher than that in Sweden. Although the use of electricity is increasing in both countries, the rate of increase is higher in Norway than it is in Sweden. If this development continues at the present rate, the difference in per-capita use between the two countries will increase. However, electricity production in Norway has not increased to a corresponding extent, which means that Norway has increasingly often been a net importer of power over the last ten years.

There is a greater variation in electricity use from one year to another in Norway than in Sweden.

Cross-border links

Although Sweden and Norway exhibit a number of differences, there are also similarities which make the combination of the two countries unique. One of the ways in which a Swedish/Norwegian electricity certificate market differs from a similar market in any other country is the fact that the grid transmission connections between two countries are excellent.

Production costs and potentials

There is quite a considerable difference in conditions for the production of renewable electricity in the two countries. Norway has a considerably greater potential for both wind and hydro power production than has Sweden. Sweden, on the other hand, has a greater production of biofuelled power, both now and as far as production potentials up to 2015 are concerned. The *reasonable* production potential for wind power and hydro power in 2015 is somewhat greater in Norway than in Sweden. On the other hand, the reasonable production potential for biofuelled power is significantly greater in Sweden than in Norway.

National objectives

The two countries are starting from somewhat different conditions and with somewhat different reasons for their support of renewable electricity production. While Sweden wants to increase the proportion of its electricity supplied from renewable sources, regardless of the actual type of renewable source, Norway wants to increase its diversity by bringing in other forms of power production than the totally dominating large-scale hydro power production.

Guide measures that affect conditions

Both countries have support systems for renewable electricity production. Norway has provided investment subsidies, with the size of the subsidy based on the overall investment cost. These subsidies have been given primarily to wind power production, although they are also available for wave power and solar power. Sweden has admittedly also provided investment subsidies, but has paid out production subsidies in parallel. A production subsidy in the form of an environmental bonus for wind power is still running, in parallel with the country's electricity certificate system. The type of support that renewable forms of energy have previously received becomes important when electricity certificate systems are introduced, and can influence the overall structure of the system.7

[7] If electricity certificates are to replace a previous investment subsidy, it will probably be necessary for them to have a relatively short and limited issue time. This is because high electricity certificate prices over a short period of time are more similar to investment subsidies than if the subsidy was instead paid out over a longer or unlimited period, which would result in low certificate prices. If production subsidies are required in order to support production, it is instead the duration of the subsidy rather then its level which becomes decisive in maintaining existing production and encouraging increased production capacity.

Concession processes

It seems as if, under present conditions, the Norwegian concession process is operating more smoothly than the Swedish process, and particularly at local level. This preliminary result probably has the effect of assisting the Norwegian competitive advantage as far as wind power is concerned. However, in the longer term, it is possible that the concession process and physical planning of new wind power facilities in both countries will become more harmonised. A possible development might be that, over time, the Swedish concession process becomes more efficient while the Norwegian process instead becomes a little slower.

Table 1 Summary of the most important conditions in each country.

	Sweden	Norway
Population	9,0 million	4,5 million
Total electricity use, 2002 (gross)	151,5 TWh	120,8 TWh
Total electricity use, 2015 (gross)	161,5 TWh	141 TWh
Quota obligation for electricity use, 2002	98,1 TWh	80,5 TWh[8]
Forecast quota obligation electricity use, 2015	105,8 TWh	94 TWh[9]
Renewable electricity production, 2002	71,6 TWh	130,0 TWh
Contribution of renewable energy sources to electricity use, 2002[10]	47,3 %	100 %
Indicative objective in accordance with the RES-E Directive	60 % (52 % more reasonable, according to Sweden)	90 % (not confirmed)
Reasonable production potential for wind power[11]	10 TWh to 2015	12 TWh to 2016
Reasonable production potential for hydro power	2,5 TWh to 2015	7 TWh to 2016[12]
Reasonable production potential for biofuelled power	13 TWh to 2015	0,5 TWh to 2016
Electricity price for larger domestic customers (20 000 kWh), including taxes and levies, January 2004	111,9 öre/kWh	75,7 öre/kWh
Electricity tax, 2004	24,1 öre/kWh	12,0 öre/kWh

[8] Provided that there are the same exceptions for quota obligations as in Sweden.

[9] Calculated by subtracting 35 TWh for electrically-intensive industries and subtraction of an estimated 10 TWh losses and 2 TWh own energy use from the forecast gross value for electricity use in 2015.

[10] According to the RES-E Directive, 2001/77/EC (renewable production/gross electricity use). In some years, renewable production in Norway would exceed gross electricity use, and so we have assumed 100 % renewable electricity use, with the surplus being exported.

[11] The reasonable production potentials for all the technologies in the table include present-day production for Sweden, while those for Norway are additional production capacities since 1st January 2004.

[12] Norway regards hydro power plants ≤ 10 MW as being small-scale hydro power.

5 The purpose of an expanded electricity certificate market

This chapter describes the change of emphasis (i.e. its present effect as a guide measure) of the Swedish electricity certificate system when it becomes part of an expanded electricity certificate market.

The Swedish Energy Agency has come to the following conclusions:

Sweden's electricity certificate system interacts with, and affects, conditions for achieving several national and common EU objectives in the energy sector. In order to understand the reasons why a country should choose to use an electricity certificate system, it is therefore of value to consider the objectives that the country wishes to achieve, and for which the electricity certificate system is merely one of several means of achieving these objectives.

In an expanded electricity certificate market, it is unavoidable that the emphasis shifts from being concerned with the amount of renewable electricity production that the system can encourage in the host country to being concerned instead with the amount of renewable electricity production that the country is prepared to support, regardless of in which country the electricity is actually produced. An expanded electricity certificate market therefore makes it essential to see security of supply, employment and export revenues in a wider geographical perspective than most countries have, of tradition, previously done.

It is decisive for the success of an expanded market that this view should win acceptance. As the purpose of an electricity certificate system is partly changed when it evolves from being a national system to an international system, it is also interesting to examine the various reasons for supporting renewable electricity production. The suitability of belonging to an international electricity certificate system as a support system can therefore vary from one country to another, depending on what each country sees as its prime reasons for increasing its proportion of renewable electricity production.

5.1 Encouragement of renewable electricity

The reasons stated by the EU for encouraging the production of electricity from renewable energy sources are to improve the security of energy supply, to diversify the sources of supply, to protect the environment, to support social and economic cohesion and to assist employment, particularly for small and medium-sized companies and for independent power utilities. Greater use of electricity from renewable energy sources is also an important part of the measures needed in order to fulfil Kyoto Protocol commitments (Directive no. 2001/77/EC).

Definitions of renewable energy and renewable energy sources differ between countries. When countries define what they mean by renewable energy, the definition is often primarily dependent on each country's particular national strategy for security of supply. National conditions and existing infrastructures also affect the definition. An excellent example of these differences is provided by the varying definitions of what is regarded as being biomass. Even the EU uses different definitions in different contexts. The definition of 'renewable' in the RES-E Directive is intended really only to apply for the purposes of the directive, but is often regarded as the official EU definition of renewable energy. This particular definition is very wide, and includes essentially all the sources considered by the EU member states (TemaNord, 2004).

The purpose of the RES-E Directive is to encourage an increase in the use of renewable energy sources for electricity production, and to create a basis for a future legislative framework at EU level for doing so. The directive sets reference values for member states' national objectives for the contribution of renewable energy sources to gross electricity use in 2010. The member states are required to take suitable actions to encourage greater use of electricity from renewable sources, with such actions being in proportion to the objective.

In the directive, the EU also states that an important means of achieving the objectives of the directive is to guarantee that the various existing and national-level support mechanisms for renewable energy sources should continue to operate effectively until an EU-wide legislative framework becomes operative. For this purpose, the national incentive and support measures that are named are green certificates, investment subsidies, tax exemption or tax relief, tax refunds and direct price subsidy systems. It is felt that it is still too early to decide on an EU-wide regulatory framework for subsidy systems. However, after a sufficiently long transition period, it will be necessary to make alterations to the subsidy systems to accommodate the growing single market for electricity. The criteria for a community-wide regulatory framework are that it must assist fulfilment of national objectives, be compatible with the principles for a single market in electricity, allow for the special features of various different types of renewable energy sources, be simple and simultaneously as effective as possible – particularly as far as costs are concerned – have a sufficiently long transition period (at least seven years), and retain investors' confidence and avoid non-recoverable costs. In addition, the directive points out that it is important, in connection with development of the market for renewable energy sources, to consider the potential positive effects on regional and local development potentials, export opportunities, social cohesion and employment.

5.2 The purpose of the Swedish electricity certificate system

The Swedish electricity system is linked primarily to Sweden's objective of increasing the proportion of electricity from renewable energy sources. In the long term, the purpose of this objective is to achieve a sustainable energy system based on the use of renewable energy sources. It is hoped that the electricity certificate system will bring this about, while at the same time encouraging other energy policy objectives. The certificate system has therefore been designed to fulfil the objectives which, as set out in applicable political guidelines, should determine the design of a model to support renewable electricity production. These objectives are to encourage the new establishment of electricity production facilities from renewable sources, to encourage technical development and cost efficiency, to create reasonable operating conditions for existing facilities, to avoid upsetting the operation of the electricity market, to establish stable operating rules regardless of national financial conditions, and to facilitate international harmonisation.

There are several reasons why Sweden chose an electricity certificate system as a solution. Certificates transfer financial support for renewable electricity away from the national budget, thus ensuring continuous support that is independent of the country's finances. Money is transferred from consumers to producers of renewable energy, without passing through the national budget. In addition, the system provides a solution to the problem that EU harmonisation requires the elimination of national subsidies. Other countries have chosen other solutions: in fact, the entire spectrum of the various alternatives for supporting renewable electricity, as set out in the RES-E Directive, is employed by the member states. Germany, for example, uses a fixed price system, while the UK employs a quota-based system similar to the Swedish electricity certificate system.

The basic thought behind the electricity certificate system is that it is the ability to produce renewable electricity at a low marginal cost that should determine the amount of the support received by the producer. There is no difference between different methods of electricity production. Support does not find its way to immature forms of power production that need more assistance in order to become competitive, or to production methods that would be best from an environmental point of view, and nor is it dependent on where the electricity is produced.

5.3 Changes in the purpose resulting from internationalisation

Internationalisation of the electricity certificate system will put renewable electricity production in the most favourable position for it. Payments, in the form of electricity certificate fees, made by consumers in one country will not necessarily support actual production of the electricity in their own country. As a result, and unavoidably, the emphasis of an expanded electricity certificate market will shift from the amount of renewable electricity production to be encouraged in any given country to the amount of renewable electricity production that the country is willing to support, regardless of where the production capacity is. An expanded electricity certificate market therefore makes it essential to see security of supply, employment and export revenues in a wider geographical perspective than most countries have - of tradition - previously done. It is decisive for the success of an expanded market that this view should win acceptance.

When a country decides to introduce an electricity certificate system to encourage renewable electricity production, it reduces its scope for macro-management. The certificate system does not allow, for example, any setting of priorities between different forms of certificate-entitled electricity, and nor is it possible to consider regional interests in the same way. The next step - of moving up from a national certificate market to a joint market with another country - further reduces the nation's scope for macro-management. By joining a joint electricity certificate market, a country surrenders to some extent its ability to control renewable electricity production, e.g. determining the siting of production capacity. What does remain is the possibility of deciding the country's ambition level, although this provides a freedom only to influence the proportion of electricity use from renewable energy sources, and does not make it possible to set priorities for different forms of energy or to accommodate local interests.

As long as certificate-entitled electricity production accounts for only a small proportion of a country's total electricity production, there is no threat to security of supply as a result of uneven allocation of production capacity between countries. However, the ambition levels that are being discussed in Sweden and Norway represent a considerable volume of new production capacity, which will probably cover both the expected increase in electricity use and replace a certain amount of existing non-renewable production. This could therefore have an effect on national security of supply. However, security of supply in a single electricity trading area, such as the Nordic countries, will be enhanced by the electricity certificate system.

Some of the underlying reasons for increasing the proportion of renewable electricity production are strengthened by internationalisation of the system, while others tend to be weakened or - as we have previously expressed it - must be seen in a broader geographical perspective. Many countries regard a greater proportion of renewable energy as an important national element of their Kyoto Protocol commitments. However, reduced climate impact is only one of several reasons for supporting renewable energy. If a country does not feel that the other reasons for supporting renewable electricity are supported by an electricity certificate system, it would be better for it to employ internal national renewable energy support programmes that are better suited to its particular national interests. This would mean that, for example, a country's need to support particular forms of energy, or to determine the siting of new facilities, could be met in a completely different manner.

It can therefore be seen that participation in an international electricity certificate market can be more or less appropriate for any given country, depending on what its objectives are. Support for renewable forms of energy is often expressed in the form of slogans such as 'higher employment' or 'indigenously produced energy'. One of the effects of an international electricity certificate market is, as described above, that consumers in one country may be paying for expansion of renewable electricity production in another country. This makes it more difficult for politicians and public authorities to justify support for renewable energy based on higher employment or indigenously produced electricity. It is therefore important, in the interests of legitimacy and acceptance, to emphasise the positive effects of the certificate market in the *Nordic* environment and economy, instead of as previously the effects on the Swedish environment and economy.

5.4 An expanded electricity certificate market and national objectives

If electricity certificates are to provide a means of achieving national objectives even in a joint certificate market, there has to be a system for crediting their performance against national objectives, such as the use of renewable energy or reduced effect on climate. As far as objectives for renewable energy are concerned, it is only natural that the associated environmental benefits should be represented by the certificate. In this respect, it is the quota obligation that is available to each country with an electricity certificate system for achieving national objectives. If a country is to be able to decide its own quota obligations, it is therefore essential that each country that purchases certificates must be able to credit itself with the associated renewable production. The starting point – that the certificates carry an environmental value – should be the same if the certificates are to be linked to national climate objectives. The national progress reports that countries submit to the IPCC, for example, provide information on steps taken by the countries. Membership of an international electricity certificate system can then be listed, with the environmental value being the quota obligation for the country (the sum of the certificates held by the country's consumers). In addition, the magnitude of the effect is dependent on the amount of non-renewable electricity production replaced by the renewable production. This discussion can then complement description of the measures.

An interesting aspect is whether an international electricity certificate system would affect our ability to fulfil international commitments or our national climate objectives. If an international electricity certificate system results in a considerable proportion of renewable production being outsourced to another country, while at the same time fossil-fuel based production increases in Sweden, then the effect is to increase national emissions. However, this does not automatically mean that Sweden's prospects for achieving its climate objectives have deteriorated. The main reason for this is that, with effect from 1st January 2005, emissions from the electricity production sector will be covered by the EU emissions trading system, within which the emission objective is set for the EU as a whole, and not individually for each country. In our work on preparing material for the Government's evaluation of its performance in achieving the Swedish climate objective (Status Report 2004), we put forward a proposal that Sweden's national climate objective should be replaced by a new form of objective structure that better accommodates the new joint EU guide measures. The proposal suggests that emissions from the trading sector should be equated with the number of emission rights assigned. This would mean that crediting of achievements against the climate objective would not be significantly complicated for Sweden by a common electricity certificate market.13

Sweden's planning objective for wind power is an example of a national objective that would be more difficult to achieve with an international electricity certificate market. However, the planning objective is not the same as the production objective, but should rather be seen as an expression of the ambition level for creating the right conditions for future expansion of wind power production. There are similar planning objectives in other countries as well. It can be tempting for a country to tinker with the electricity certificate system, or to apply parallel support systems, in order to achieve its particular national interests to as great an extent as possible. However, this introduces a risk of production capacity for renewable electricity not ending up where the electricity could be produced at the lowest cost, which would tend to negate an important positive effect of an expanded electricity certificate market.

[13] The situation could be complicated if the amount of emission rights for the trading sector was to be slightly increased. If this happened, then (in accordance with the proposal for the new objective structure) emissions from the other sectors would have to be reduced to a somewhat greater extent. Such a situation could arise if the greater part of production of renewable electricity ended up in another country or countries, while fossil fuel-based production was expanded in Sweden *and* that this new fossil fuel-based production received free emission rights. However, in the opinion of the Agency, this is not a serious problem.

6 Requirements for a well-functioning electricity certificate market

The purpose of this chapter is to identify how distortions that could affect the ability of the Swedish electricity certificate system to achieve its objectives and desirable control effects can be avoided. The chapter also seeks to identify what needs to be coordinated between (primarily) the Swedish and Norwegian electricity certificate systems in order to ensure well-functioning trade of certificates on the common electricity certificate market.

The Swedish Energy Agency has reached the following conclusions:

The Agency is of the opinion that the following parts of the electricity certificate system ***must be coordinated*** in order to avoid distortions that could affect the ability of the Swedish electricity certificate system to achieve its objectives and desirable control effects, and to establish the necessary bases for a smoothly-functioning certificate market.

A quota obligation-based system

The prospects for linking voluntary and obligatory systems to form a joint market are poor, as the two systems are based on completely different fundamental principles. Introduction of a *mandatory* quota-based electricity certificate system is a *prerequisite* for being able to participate on a common electricity certificate market with Sweden.

Quota obligation on the user side

Attempting to link a system in which there are no quota obligations on the user side to the Swedish system would be very difficult, as the demand for electricity certificates with an alternative set-up would not be linked to the use of electricity. Attempting, for example, to link a production-based system to a user-based system would probably not be possible.

Quota periods, declaration and cancellation time

In the interests of avoiding confusion of market participants, it is desirable to coordinate the quota periods with the calendar year, and also to coordinate the other dates relating to the fulfilment of quota obligations.

The cancellation of electricity certificates has shown itself to be a powerful factor in affecting the prices of electricity, as information on the number of certificates cancelled (fulfilment of quota obligations) is important in assessing future supply of certificates. It is therefore desirable that the redemption dates for certificates should be the same in all systems, in order to minimise price distortions during each quota period. If the redemption dates are coordinated, then the declaration dates and the actual quota periods should also be coordinated. A further factor to consider is that the declaration and redemption dates affect the ability to borrow certificates between quota periods.

System lifespan and long-run quota setting

Long-term stability of the electricity certificate system is essential in order to create the right conditions for an well-functioning market. An important element in ensuring a well-functioning market is that the long-term demand level (quota level) should be assured. On an international market, the demand for electricity certificates would be determined by *the sum of the individual countries' quota levels*, with the long-term element depending on the life of the systems. It is therefore important that these elements of different systems should be time-coordinated.

Regulated exit

The sensitivity to change of an electricity certificate market is affected by the number of systems (countries) connected to the market. In the case of a market consisting of only two systems, there will be considerable effects both on demand and on price if either of the countries decides to terminate its system. There would also be a similar sensitivity with respect to quota changes in either of the countries. However, on a larger market, bringing together several systems, decisions of individual countries could be expected to have a considerably less dramatic effect. It is therefore essential that both systems should be constructed in such a way as to ensure long-term stability of the market. This would create the right conditions for new investments. Particularly on a bilateral market, the potential for severe disturbance from the exit of one country makes it important that there should be some form of regulated exit procedure in the agreement between the countries.

Penalty

Although it is perfectly possible to have different penalty levels on an integrated electricity certificate market, it will in fact be the lowest penalty (the price cap) that will dominate the market. This means that it is unimportant if the penalties vary between the different systems, as it is the lowest penalty that will act as a price cap for the entire market. It is therefore preferable to coordinate the penalties between systems, set at some common level that provides the necessary incentives for fulfilment of quota obligations.

Validity, value and lifespan of certificates

Regardless of their country of origin, certificates traded on an international electricity certificate market must all be of the same value if the exchange of certificates is to operate effectively. Certificates must be valid in all systems on the joint market, regardless of where and how they have been produced

How the environmental value of certificates is to be credited must also be decided before an international market can be established. This requires political agreements as to how, and on what bases, certificates may be credited against (in particular) international objectives within the framework of international electricity certificate trading (known as political credit). Although the way in which the environmental value of certificates is to be credited will not necessarily affect the efficiency of the common electricity certificate market, it is probably something that, for the sake of clarity, will need to be determined before the market is set up.

Differences in the extent to which electricity certificates can be saved (known as banking) or borrowed must be avoided, as this will complicate trading. The same applies for the energy quantity represented by each certificate.

Linked register function

A prerequisite for being able to trade certificates on a common electricity certificate market is that the certificate registers in each country can communicate with all other registers. It must be possible to transfer certificates between registers/systems, preferably by not later than the date when a common market is established.

In addition to the above, the Agency believes that there is ***reason to consider coordination*** in respect of the following elements of the electricity certificate system, in order to ensure an effective certificate market.

The main principle of what is regarded as certificate-entitled electricity production

The definition of renewable energy as set out in the Renewable Energy Directive should determine the selection of certificate-entitled production in the systems trading on the common market, primarily with regard to the possible entrance of a third party. Individual limitations in participating countries' legislation in relation to what is permitted by the Directive would probably not result in significant market disturbances, as long as each certificate traded in the market can be credited in each system and represents the same value. Substantial differences between systems should be avoided from a legitimacy point of view.

Length of time for which a plant may be included in the system (limitation of entitlement)

As far as international trade in electricity certificates is concerned, the lifespan of the plants in the respective systems is unlikely to be anything that needs to be coordinated between national systems in order to ensure that certificates can be traded between systems. The main consideration is that each of the countries should consider the effects of possible closure of production facilities when determining the quota levels. As the effect of introduction of an entitlement restriction is to increase prices, there could be justification for coordinating this on the common certificate market. Differences in respect of entitlement periods will also affect the relative competitiveness between countries. The Agency is of the opinion that the length of entitlement period of production facilities in the system should be limited, if the electricity certificate system is made permanent in accordance with the Agency's earlier recommendations in its review of the electricity certificate system.

The legal status of electricity certificates

Differences in the legal status of certificates can significantly complicate exchange between the Swedish and Norwegian systems, and this will particularly be the case if differences lead to certificates carrying different values, depending on their country of origin. This could occur, for example, as a result of certificates being liable for value-added tax in one country, but not in another. In addition, the legal implementation could exclude market participants and trading exchanges that could contribute important functionality to the certificate market. Direct harmonisation would not be necessary if these problems can be resolved by appropriate changes to the legislation in each country and avoidance of exclusion of parties important to efficient operation of the market. However, if it is not possible to avoid this problem by legislative means, it would probably be desirable to harmonise the legal status of electricity certificates in order to ensure that certificates can be traded as efficiently as possible. This must apply, regardless of whether electricity certificates in Norway are given the status of financial instruments, or whether the status of Swedish certificates is changed to bring them into line with Norwegian certificates.

Other targeted economic support systems

Most types of support systems (for example, the Swedish environmental bonus) distort competition between the forms of energy on the electricity certificate market, and thus affect the ability of the market efficiently to allocate production resources within the common certificate market. This indicates that it is desirable that such targeted economic support systems should be harmonised as far as possible.

Similar support and monitoring functions

If the electricity certificate market is internationalised, procedures for approval of plants, the issue of certificates, quota obligation fulfilment etc., should be similar between different systems if the market is to be able to operate transparently and without problems. The same applies for monitoring, reporting and surveillance functions, although there will probably not be an absolute requirement for coordination.

Common register or linked electricity certificate registers

From a practical point of view, there is justification for coordinating the register functions, not only in connection with the possible accession of a third country to the market, but also to prevent double-counting. This can be done either by directly linking the separate registers, or by establishing a common register.

Official information to market participants

It is likely that it would be desirable to coordinate information to those acting on the market from official sources, concerning aspects such as approved plants, information on issued and transferred certificates, weighted average prices etc. This could be arranged, for example, by setting up a common web site on which information from the various certificate registers could be published.

This chapter discusses the following parts of the commission:

- The Agency should analyse the requirements that must be fulfilled by countries involved in order to achieve the desired objectives and guide effects, and to ensure that electricity production from renewable energy sources competes on equal terms.
- In addition, in its analysis of a common Swedish/Norwegian electricity certificate market, the Agency should also consider coordination of the length of the quota period and of what other functions that must or should be coordinated in Sweden and Norway in order to create a well-functioning market with long-term stability.

6.1 Introduction

This chapter aims to identify:

- How distortions that could affect the ability of the Swedish electricity certificate system to achieve its objectives and desired policy measures can be avoided.
- What needs to be coordinated between (primarily) the Swedish and Norwegian electricity certificate systems in order to ensure well-functioning exchange of certificates on the common electricity certificate market.

To some extent, an understanding of how conditions in each country are affected by different structures of the market is required, if it is to be possible to analyse how distortions can be avoided and to identify what needs to be coordinated in order to ensure effective operation of the expanded electricity certificate market. This can then be followed by a discussion of the necessary requirements in terms of coordination and structure of the market in order to ensure that it operates well. Where appropriate, the analysis also considers the effect of giving third parties access to the market.

The analysis described in this chapter is based largely on theoretical foundations. This is, in fact, necessary, as there is no actual experience from other countries of internationalising electricity certificate markets that could provide a basis for the analysis. In addition, the lack of previous experience means that, throughout, the analysis suffers from some degree of uncertainty as far as actual results are concerned.

The starting points for the discussion in the chapter are the structure of the existing Swedish system (SFS 2003:113), preparatory work for the Swedish Electricity Certificates Act (SOU 2001:77; Ds 2002:40; Bill no. 2001/02:143; Bill no. 2002/03:40), the results from the Agency's review (Swedish Energy Agency, 2004a; 2004b), the Norwegian Water Resources and Energy Directorate's electricity certificate report (NVE, 2004), the Norwegian bill (OED, 2004a) and the Norwegian Ministry of Petroleum and Energy's comments on the bill (OED, 2004b). Throughout the chapter, the analysis is extended in those areas where the Norwegian proposal differs from the existing Swedish system.

6.1.1 A discussion of the objectives[14]

The objective of the Swedish electricity certificate system is to increase the country's production of electricity from renewable sources by 10 TWh/year by 2010, as a result of encouraging technologically-neutral and thus cost-efficient expansion of such production, which at the same time:

- results in further technological development
- creates reasonable operating conditions for existing facilities
- provides stable regulatory conditions, independent of the state budget
- does not distort the functionality of the electricity market, *and*
- allows international harmonisation.

The fact that the system is technology-neutral – or, putting it another way, that it does not discriminate between different types of renewable electricity production – results in competition between the various forms of energy in the system. This competition should encourage cost-efficient expansion of production facilities, as it primarily provides an incentive to pursue the investments that are the most competitive at any given time (i.e. associated with the lowest production costs).

Similar arguments are being used in Norway in order to support the introduction of an electricity certificate system. However, for liquidity reasons, introduction is contingent upon establishing a common electricity certificate market with Sweden.

In Sweden, there is also a link to the Renewable Energy Directive (Directive 2001/77/EC) and to the national planning targets for increasing the use of renewable energy sources as given in the Annex to the directive. Norway has not implemented the directive, and does not therefore have any corresponding EU targets to fulfil. However, the comments on the Norwegian Electricity Certificates Bill indicate that Norway does intend to implement the directive (OED, 2004b), although it is still unclear as to when this will happen.

6.1.2 Structure of the analysis

The Agency's instructions from the Government state that one of the starting points of the analysis must be that the exchange of certificates on the common certificate market must function well. This can be linked to achievement of the efficiency gains, as described in Chapter 3. According to Ek *et al*. (2004), the prerequisite for achieving these efficiency gains is that trade in electricity certificates should be as uncomplicated as possible. This means that trade in certificates must be separate from the actual physical supply of electricity, and

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[14] See Chapter 5 for a more detailed discussion of the purpose and objectives of the Swedish electricity certificate system, and of how they can be affected by internationalisation of the Swedish system.

that the certificates must have the same value regardless of their origin (in exactly the same way as a MWh of electricity is the same wherever it has been produced on the Nordic electricity market).

In a mandatory system, such as the Swedish system, the system is determined by the quota obligation, which determines the demand for certificates, and by the types of production that are entitled to certificates, which determines the supply of certificates. Figure 2 uses this as a starting point, and shows the various flows in the certificate system, in terms of demand (on the left) and supply (on the right). In the middle of the diagram are the support functions in the system. Trading of certificates occurs mainly between the demand side (those with quota obligations) and the supply side (the producers of renewable electricity).

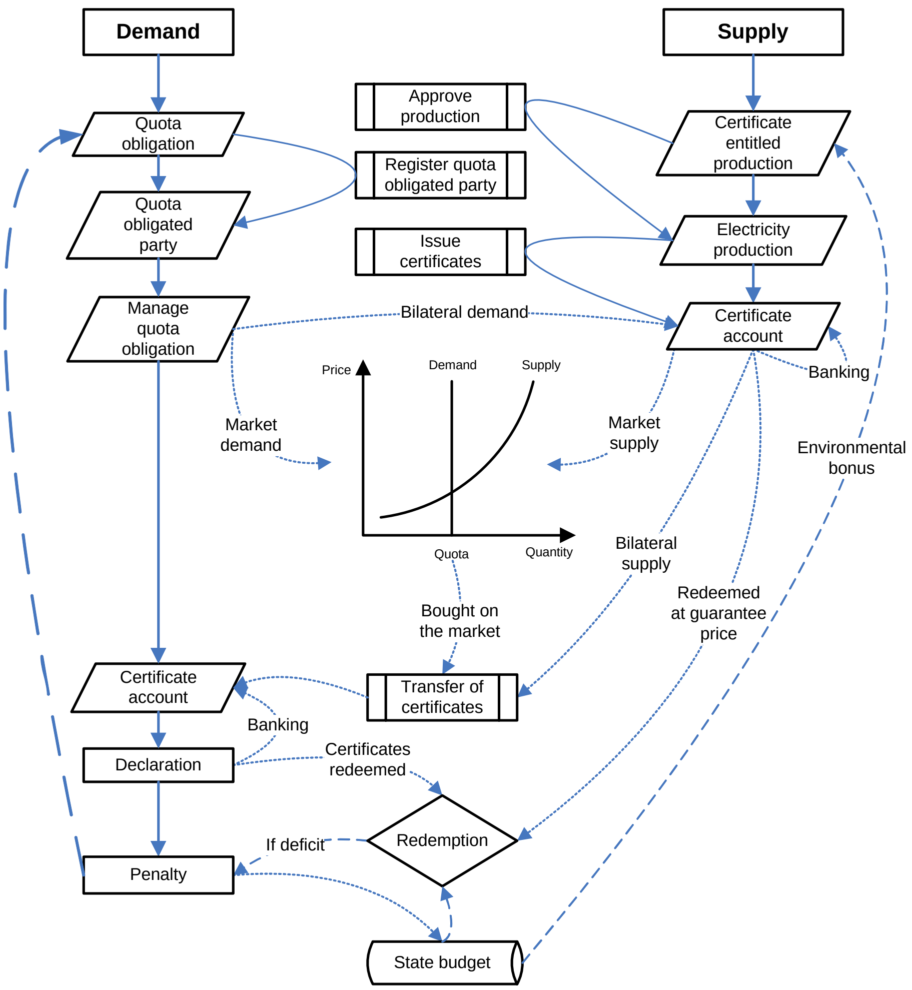

Figure 2: Flows in the electricity certificate system

The discussion of what needs to be coordinated, and of how any changes would affect operation of the certificate system, starts from this overall classification of the system, i.e. the remainder of this chapter is divided into the following sections:

- Demand
- Supply

- Electricity certificate market
- Support and control functions

In order to ensure that the common market functions well, it is desirable that as many points of the two systems should be coordinated as possible. However, some parts of the system are more vital than others for proper functionality of the market, and must therefore be coordinated in order to avoid undesirable distortions. The following analysis concentrates on identifying those parts of electricity certificate systems for which absolute coordination is essential. In addition, further elements which may also need to be coordinated are identified.

6.2 Demand for certificates

6.2.1 Quota obligation

Quota obligation-based systems

Both the existing Swedish system and the proposed Norwegian system (OED 2004a) are based on the fact that there is a requirement, for those having a quota obligation, to purchase and return to the state a certain number of electricity certificates each year, with the required number being set in proportion to their overall use of electricity. This is what is meant by a quota-based system: the quota obligation is therefore the element that creates a demand for electricity certificates.

Voluntary certificate systems, without obligations, also exist. One example of this can be found in the Dutch electricity certificates system, although this is soon to be disbanded.15 In a voluntary system, demand arises entirely from individual preferences for the environmental value represented by renewable electricity production.

The electricity certificate system is a mandatory system, with the authorities determining quotas for quota-obligated parties that set the amount of renewable electrical energy that the quota-obligated party must purchase. In principle, the system is therefore a quantitative regulation with market-like elements. It creates a demand for renewable electricity, but this demand is based on a predetermined quota and not on the preferences of the individual end users for renewable energy.

It can therefore be seen that voluntary and mandatory systems are based on different fundamental principles. In addition, Mozumder and Marathe (2004) point out that, as the quota-obligated party in a mandatory system is (generally) subject to some form of sanction if he/she does not meet his/her quota obligations

[15] In the Dutch system, the demand for electricity certificates can be said to be linked to the tax refund which is offered to electricity users if they elect to purchase electricity from renewable energy sources. It is therefore doubtful whether the demand for certificates in the Dutch system can be regarded as having been linked solely to preferences for or against renewable electricity.

(the 'quota obligation fee' in the Swedish system), while a voluntary system does not have any form of sanction, trading between voluntary and mandatory systems would be further complicated.

As it would be extremely difficult to link voluntary and mandatory systems on a common market, because the two types of systems are based on completely different fundamental principles, the introduction of a *mandatory* quota-based certificate system is a prerequisite for being able to participate in a common electricity certificate market with Sweden.

Who is the quota-obligated party?

In the Swedish system, it is the end user (the electricity user) upon whom the quota obligation rests. However, the electricity distributors are required to manage their customers' quota obligations, unless the customers have themselves specifically elected to manage their obligations. In its review of the electricity certificate system, the Swedish Energy Agency suggests that the quota obligation (for households) should be transferred to the electricity distributors (Swedish Energy Agency, 2004b). The Agency is of the opinion that other end users should continue to be allowed to manage their own quota obligations if they wish to. In Norway, it is suggested that the quota obligation should be applied to the distributor or supplier of electricity (OED, 2004a). This means that the quota obligation would be the responsibility of the electricity supplier, or of electricity producers who supply electricity directly to end users. The Norwegian proposal does not include any option for end users to manage their own quota obligations.

As long as the quota obligation lies with the user side, the actual final choice of person or party to bear the obligation does not significantly affect the ability to trade electricity certificates, as it will largely be the electricity suppliers/bulk power traders/companies who will be in the demand side of the electricity certificate market, regardless of which part of the user side is required to bear the quota obligation. Any effects that might act to distort the market are probably also limited.

However, attempting to link a system in which the quota obligations are not on the user side to the Swedish system would be more complicated. In the Italian electricity certificate system, for example, the quota obligation is borne by the electricity producers and importers. This means that, in the Italian system, the demand for certificates is not linked to the use of electricity. Attempting to link a production-based system to a user-based system would therefore probably be problematic.

Exception from quota obligations

The following uses of electricity are exempted from quota obligations (SFS 2003:113) in the Swedish system:

- Electricity supplied to the grid in order to maintain operation of the grid (losses).

- Electricity that a supplier has supplied without charge to a user under the terms of a property right encroachment compensation agreement. However, this applies only for energy supplied at powers of less than 50 kW (compensation power).
- Electricity used in manufacturing processes in steelworks or metal works, the pulp and paper industry, the wood-based sheet/board industry, the base chemicals industry, the mining industry, the cement industry or petroleum refineries.
- Electricity that a user has himself produced and used, provided that the generator has a rated power output not exceeding 50 kW.
- Electricity used as auxiliary or ancillary power for the production of electricity.

The Government's Bill no. 2002/03:40 motivates the exception for electricity-intensive industries by saying that the international competitiveness of these industries would be at risk if they were required to bear quota obligations, as the corresponding industries in other countries do not have to carry a corresponding cost.

The Norwegian proposal (OED, 2004b) puts forward two alternatives for determining the magnitude of the quota obligation:

Alternative 1:	All supplies of electricity should be considered when determining the quota obligation.
Alternative 2:	Electricity supplied at a reduced charge should not be considered.

Under Alternative 1, no electricity use is exempted from the quota obligation. According to OED (2004b), Alternative 2 would exempt about 46 % (as in 2003) of net electricity use in Norway from the quota obligation, as such electricity would have been used by electricity-intensive industries. In Sweden, it is estimated that about 34 % of net electricity use is exempted in this way.

The introduction of exemptions from quota obligations in a country means that others in the country that are liable for quota obligations have to carry a higher cost, and are therefore subsidising the electricity use of the exempted parties.[16] This reasoning can be generalised to an international market only if the quotas are assigned over the entire market. Nevertheless, from the point of view of fairness, there can be justification for recommending coordination between the different systems, as this makes the quota levels more comparable and because those bearing a quota obligation in each country would probably regard the system as fairer. At least, in any case, the country that does allow exemptions should be prepared to allow corresponding exemptions in the other country. However, from the point of view of market functionality, there are no particularly compelling reasons for coordination in this respect.

[16] When some electricity use is exempted from a quota obligation, the percentage quota of the remaining electricity has to be increased in order to achieve the final (or annual) TWh objective.

One type of criticism that has been raised against the Swedish exemption for electricity-intensive industries is that the exemption tends to complicate long-term certificate trading, as the electricity-intensive industry is the type of customer that would have been particularly interested in purchasing certificates on long contracts. If a corresponding exemption is introduced in Norway (Alternative 2), it will also affect the ability or opportunity for long-term certificate purchasers with Norwegian parties.

6.2.2 Quota period

Annual quota period

In an electricity certificate system having mandatory quotas, those required to meet quotas must know when and how their obligations must be fulfilled. In both the Swedish system and the proposed Norwegian system, the quota period is the same as the calendar year. In both systems, users must submit a declaration for the previous quota period to the operating authority by 1st March. These certificates will then be redeemed in the register on 1st April, on the basis of the information in the return. As OED (2004b) points out, it is natural that these dates should be the same in both systems, as experience from the Swedish system shows that the redemption date strongly affects the trade on the certificate market.17 However, the trading pattern is determined primarily by the fact that certificate trading is dominated by forward contracts, with the delivery date being determined by the redemption date. Trading is carried out throughout the year. In addition, certificates must be issued before they can be transferred. A further factor in this context is that it is most advantageous for the purchasers of certificates for the certificates to be supplied as close to their redemption date as possible (at least in the same quarter as redemption). This is because there is a charge for storing the certificates in the certificate account (in the form of fees to Svenska Kraftnät).

However, the actual redemption of certificates has shown itself to be a powerful factor in affecting the price of certificates. This is because information on the number of redeemed certificates (fulfilment of quota obligations) is important when assessing the future supply of certificates. From this, it is probably desirable that the redemption dates should be the same in both systems, with the aim of avoiding price shocks during the quota period. If the redemption dates are coordinated, it is correspondingly also only natural that both the declaration dates and the actual quota period should be coordinated. A further factor to consider in this context is that the declaration and redemption dates affect the ability to 'borrow' certificates from the next quota period.

[17] This refers to the trade flows reported in Svenska Kraftnät's accounting system for electricity certificates (Cesar).

System lifespan and long-term quota setting

No specific length of life has been decided for the Swedish electricity certificate system, but quotas have been set up to 2010. Criticism of the short time horizon for the Swedish system has been raised from many quarters. The Swedish Energy Agency, for example, recommends (2004b) that the system should become a permanent feature of Swedish energy policy by setting long-term quota levels. The Norwegian proposal (OED, 2004a) suggests that the certificate system should run until 2025. Initially, quotas would be set for the period 2006 to 2015, forming an escalation period leading to the overall ambition level for the system.[18]

A long-term system, with quota levels set for a longer period, is essential in order to reduce the uncertainty of an electricity certificate system as seen by the parties involved. Potential investors, for example, need to be assured that the demand for electricity certificates will remain over a sufficiently long period, and in a sufficiently high quantity, in order to guarantee the return on investments. This depends on the lifespan of the system, on the level of the quotas and on the number of years ahead for which quotas have been set. In this context, the long-term view can be guaranteed in various ways: see, for example, Schaeffer *et al*., 2000). An alternative would be, as in Norway, to set an end date (with both escalation and de-escalation periods), which is sufficiently far in the future to ensure that investments are made. Another way of guaranteeing a long-term approach is to set the system up without an end date, as proposed by the Swedish Energy Agency in Sweden. Provided that the quotas so permit (i.e. that they are maintained at a constant level over a longer period of time), a system without a defined end date could phase itself out if/when the cost of renewable electricity drops to the same cost level as that of electricity from conventional sources. This would mean that the certificate system would phase itself out by the price of certificates dropping towards zero when, as a result of (say) technical development, renewable electricity production no longer needed support to enable it to compete with other electricity production.[19,20]

The sensitivity to change of an electricity certificate market is affected by the number of systems (countries) connected to the market. In the case of a market consisting of only two systems, there will be a considerable effect on demand and probably also on price if either of the countries decides to terminate its system. There would also be a similar sensitivity in respect of quota changes in either of the countries. However, on a larger market, bringing together several systems, decisions of individual countries could be expected to have a considerably less

[18] According to the Bill, quota levels after 2016 should be linked to a de-escalation phase, although just when these quotas would be decided is unclear in the Bill and in the OED comments (OED, 2004a; 2004b).

[19] It is not necessarily a falling production cost for renewable electricity that can make it competitive: it can also become competitive as a result of a rising price of conventional electricity production due to, for example, rising oil or natural gas prices.

[20] The MARKAL calculations described in Chapter 8 show that electricity certificate prices on a joint Norwegian/Swedish certificate market would tend towards zero when the total quota level no longer increases.

impact. It is therefore essential that both systems should be constructed in such a way as to ensure long-term stability of the market, and thus create the right conditions for investment. This applies particularly with respect to the political risks associated with two electricity certificate systems that are integrated by commercial mechanisms. In this respect, Ek *et al*. (2004, p. 41) make the following recommendations:

> "On the basis of our analysis, it seems that it is very important that both the countries should commit themselves to a long-term sustainable structure of the certificate system. One of the effects of this would very probably be that the countries would have to divest themselves of various mechanisms for taking national decisions that affect the conditions for investments in renewable electricity production facilities. It is also vital that the countries should agree on a relatively long life for the certificate trading system, and that there should be some type of mechanisms in the agreement that would make it difficult (or expensive) for either party to abrogate the agreement."

Given that long term politically stable conditions are required in operation of the certificate system in order to create the right conditions for a properly functioning market, it is also important for the long-term demand level for certificates to be assured. On an international market, the demand for certificates is determined by the sum of the individual countries' quota levels, and the long-term stability follows from the lifespan of the system. It is therefore probably very important that these elements of the respective systems should be coordinated in time terms.

6.2.3 Implementation of quota obligations

As far as actual implementation of the quota obligation is concerned, the Norwegian proposal differs from the existing Swedish proposal with its annual percentage objectives. NVE recommends an annual objective in absolute TWh terms. There is therefore a need for a discussion on how the annual quota obligation should be expressed, and a review of how the format of expression would affect operation of the certificate system. There is also a need to discuss whether this is something that would be affected by and/or must be the same, if the electricity certificate market should be internationalised, e.g. by establishing a common certificate market with Norway. These points are discussed below, starting from the views put forward by NVE in its report on a Norwegian electricity certificate system (NVE, 2004).

NVE's arguments

The NVE report presents the following arguments in the choice between a relative percentage target and an absolute annual TWh target:

- A percentage target varies with total electricity use, and is affected by any change in the amount of electricity used.
- A TWh target is independent of total electricity use, and is therefore not affected by any changes in electricity use.
- A TWh target provides a better basis for forecasting by electricity producers, as uncertainty due to variations in electricity use is avoided.

- A TWh target is more accurate in terms of quantitative targets for expansion in the system.
- If the quota obligation is expressed as a percentage proportion for the entire time period, the actual amount of TWh expansion is uncertain.
- A percentage proportion obligation can be calculated each year from a TWh target, adjusting it against the extent of target fulfilment during earlier quota periods.
- Although the national planning targets in the Renewable Energy Directive are expressed as percentages of electricity use, the total EU target is expressed in TWh terms.

NVE suggests that the quota obligation should be expressed as a TWh target, in order to avoid uncertainties relating to the demand of electricity certificates as a result of annual variations in electricity use. The Norwegian bill (OED, 2004a) proposes that the quotas should be expressed in TWh. OED further suggests that NVE should calculate a preliminary percentage quota each year, based on forecast electricity use for the coming year. Redemption of certificates would be carried out against actual electricity use on the basis of an annually determined definitive percentage quota (OED, 2004b).

The main points of the NVE's arguments can be summarised as follows:

- Relative or absolute annual quota obligation
- Forecastability
- Accuracy
- Practical implementation.

In addition to these points, there is a further area that should be discussed in connection with proposals for an expanded electricity certificate market:

- A communicable common target.

These points are individually discussed below. However, before we continue and discuss, we should provide a brief overview of electricity use in Sweden and Norway.

Electricity use in Sweden and Norway21

In 2003, total net electricity use amounted to 145 TWh in Sweden and 115 TWh in Norway (Nordel, 2004). Electricity use is affected by the price of electricity: the more electricity-intensive a country is, the greater the effect a higher price is likely to have on the use of electricity. Bearing in mind the fact that per-capita electricity use is considerably higher in Norway than in Sweden, it is natural that the relative effect of the higher prices of electricity in recent years should be greater in Norway than in Sweden (cf. Figure 3).22

[21] Appendix 1 provides more detailed statistics of electricity use in the two countries.
[22] In 2003, per-capita electricity use in Norway amounted to about 25 200 kWh, as against about 16 200 kWh in Sweden (Nordel, 2004).

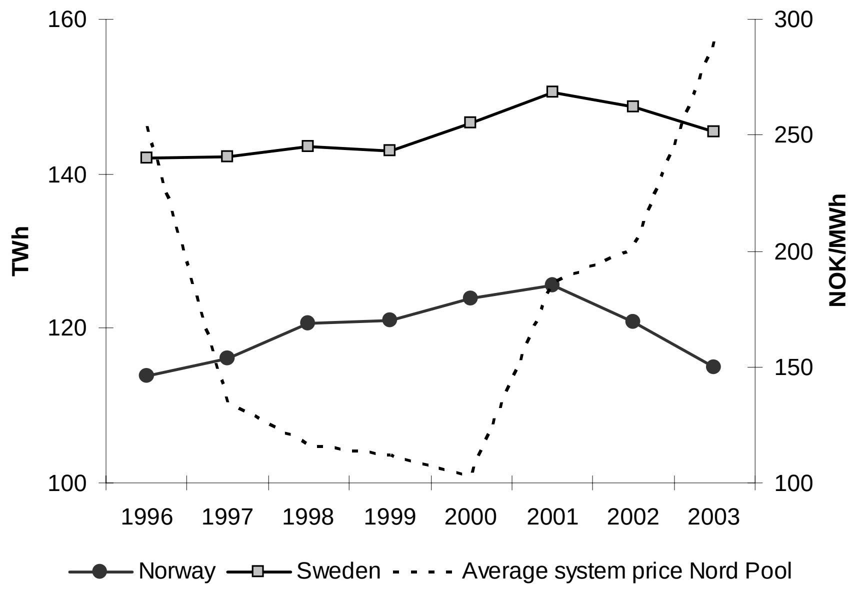

Figure 3: Total electricity use and average system price, 1996-2003

Sources: Nordel (2004) and Nord Pool.

As far as determination of annual quota obligations is concerned, the question is how electricity use changes in overall terms. Figure 4 shows how electricity use varies in each country, both in absolute and in relative terms.

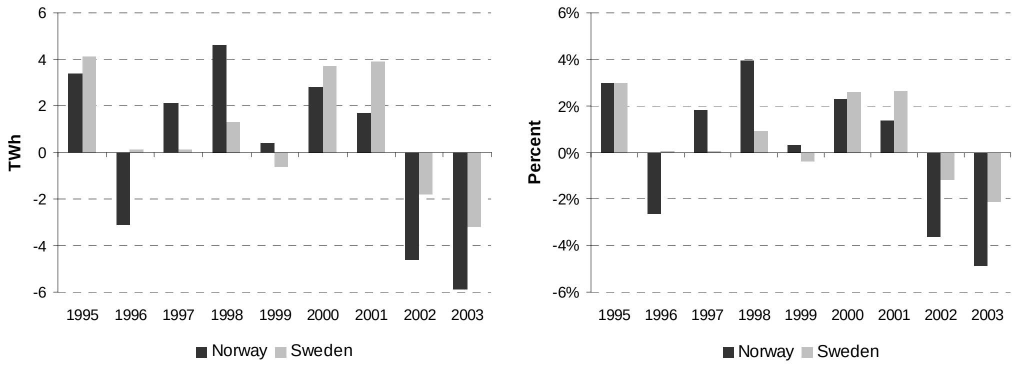

Figure 4: Changes in total electricity use in relation to the previous year, 1995-2003

Source: Nordel (2004).

The annual variations in electricity use are greater in Norway than in Sweden, with the average change over the period amounting to 3.2 TWh (2.7 %) per annum in Norway, as against a corresponding figure for Sweden of 2.1 TWh (1.4 %) per annum. A greater variation in electricity use in Norway than in Sweden would probably mean that the uncertainty of demand with a percentage target would be greater in Norway.

Relative or absolute annual quota obligation

As can be seen in Figure 5, the demand (D_1) - with the quota obligation expressed in TWh - is given by the quota level (Q_1), while the equilibrium price of certificates (P_1) is given by the intersection with supply curve S_1. In this case, the demand for electricity certificates is completely price-insensitive (price-inelastic). An inelastic demand means that there is no means for parties having quota obligations to adjust to price signals that indicate that some other consumption pattern would be desirable. With a percentage quota, on the other hand, the quota level is not exactly known in advance, as electricity use can vary and there will thus be some flexibility in the demand for certificates (D_2). The variation in electricity use can be ascribed to various factors, including price and precipitation (i.e. the amount of rainfall or snowfall) effects. With a percentage quota objective, the demand for electricity certificates becomes more price-sensitive, as the parties having quota obligations can adjust their electricity use in response to the price signal from the electricity certificates.23

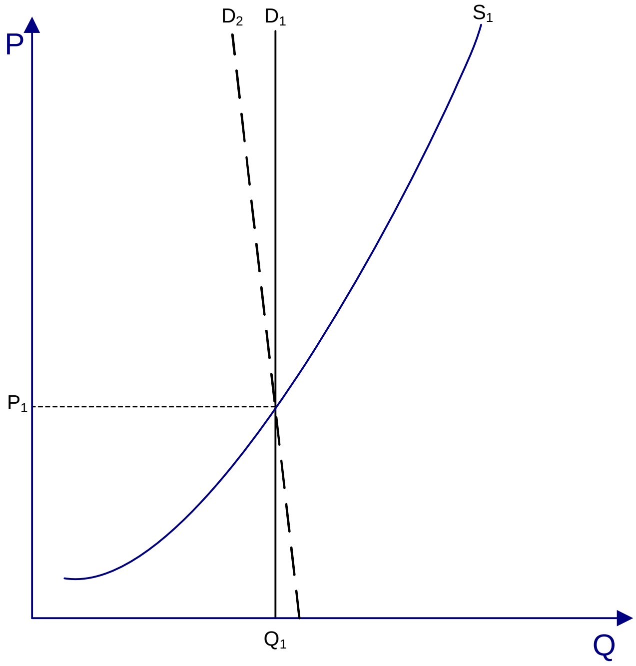

Figure 5: Schematic diagram of the effect of the type of quota obligation basis on the electricity certficate trading market

As the production of renewable electrical energy is affected by weather variations, such as precipitation, the supply curve will fluctuate with time. With an inelastic

[23]. Normally, the demand for electricity is very price-inelastic and, as the quota obligation is expressed as a proportion of electricity use, the inherent price elasticity of the demand for electricity certificates will probably be even less (Ek et al., 2004). In practice, some elasticity occurs in the demand for electricity certificates, as a result of the possibility to bank an unrestricted number of electricity certificates from one quota period to another and of the limited ability to borrow certificates from future quota periods. However, all other things being equal, flexibility is always greater in systems having a percentage objective.

demand and fluctuating supply, the market will tend to be characterised by price swings, thus creating uncertainty concerning the price level of certificates. All other things being equal, a more price-sensitive demand results in a less fluctuating price curve for certificates, as users have some ability to adjust their demand to the current cost level. From an investment point of view, it is advantageous if the price level of certificates (the support level) is stable with time.

Summarising, a TWh objective encourages investment in new production capacity through the price of certificates (the support level). A percentage objective, on the other hand, simulates investment in production capacity and encourages changes in consumer behaviour on the basis of the price signals from the certificate market to those having quota obligations. A percentage objective, therefore, creates a 'competition situation' on the electricity users' side; between the cost of the certificates (the cost of fulfilling quota obligations) and the cost of modifying electricity use.24

Forecastability

From the point of view of forecastability, investors are helped by receiving information on the quota obligation in absolute terms. A TWh quota provides clear information on the future need for electricity production, without any uncertainty concerning the future demand for electricity certificates. However, a quota obligation in absolute terms is totally inelastic, and results in greater price fluctuations on the certificate market (higher volatility) in response to such factors as weather-dependent demand fluctuations, as there is no flexibility for the demand to adjust itself. This means that the support level can be more difficult to forecast.

For existing producers of renewable electricity, exact information on demand is probably not of the same importance. What is important for producers is that they receive certificates for the electricity that they produce, and that the revenue from the sale of the certificates is sufficient to justify continued production. Prices on the certificate market are determined by current and future ambition levels in the system, i.e. by the actual level of the quota and by the supply of certificates. As a percentage-based objective can be partly achieved with reduced electricity use, the actual demand can vary when the quota is expressed as a proportion of electricity use. However, fluctuations in the support level in the certificate system are counteracted by a percentage-based objective due to the fact that electricity users can modify their demand in response to possible changes in supply, and thus reduce the volatility of the market.

[24] Although an electricity certificate system results in an additional cost for the use of electricity as a result of the quota obligation, the overall effect on the total cost to electricity users is uncertain, as the system also affects the price of the electricity by reducing the cost of the marginal production. This means that it is difficult to say how the total cost to consumers (i.e. the electricity price plus the certificate price) would change as a result of different quota levels.

A TWh objective creates an uncertainty of future requirements and costs – both in the short term and in the long term – for quota-obligated parties (the electricity suppliers). This applies particularly if, each year, an 'authority' is to forecast electricity use and translate it into percentage quotas, as well as to provide adjustment for the fulfilment of quotas during the preceding period. If such an implementation process is employed, there will be an uncertainty of demand each year, which would not be helpful to any part of the market. As the quota obligation lies with the electricity users, a consumption (usage) target is clearer than is a production target for those having a quota obligation. In addition, it is more natural to express a consumption target as a proportion of electricity use (percentage) than in terms of new production (TWh). A percentage target is also in line with EU national planning objectives.

Nevertheless, in total, forecastability should be good with both types of quotas, provided that they are set for a longer period of time, and not adjusted each year. In such a context, the choice between a TWh or a percentage target can be said to come down to a choice between forecastability for investors and forecastability for those having quota obligations. A TWh objective can be converted to annual percentage objectives, and vice versa.

Accuracy

A TWh target provides an incentive only to increase electricity production, while a percentage target can be achieved through increased electricity production and through a changed pattern of electricity use. Put another way, this means that a TWh target can be achieved only through increased electricity production, and can therefore be said to be more clearly linked to a final quantitative target. With a proportional target, the accuracy of meeting the target may be good in percentage terms, but not necessarily so in absolute terms (TWh).

However, neither TWh targets nor percentage targets can guarantee fulfilment of quota obligations. Both types of target can result in failure to meet the quota obligation. Fulfilment of quota obligations depends on whether the target (whether in TWh or as a percentage) is reasonable in relation to what is practically possible in terms of expansion of production and incentives to fulfil quota obligations. The incentive to fulfil quota obligations depends in turn on the type of sanctions in the electricity certificate system, i.e. the penalty. It is the penalty that provides the mandatory element in the quota obligation, provided that it is structured in such a way as to make it disadvantageous to elect to pay the penalty rather than to fulfil the quota obligation. In its Stage 1 report (2004a), the Agency describes the following possible reasons for those having quota obligations preferring to pay the penalty rather than to fulfil their quota obligations:

- A shortage of electricity certificates (built into the system).
- The cost of certificates exceeds the penalty (indicating a lack of electricity certificates).
- Strategic reasons, based on expectations of prices and future supply of certificates.

- Unfamiliarity with the system and/or lack of interest in it, i.e. that the transaction costs for learning how to use the system and then actually using it exceed the 'benefits' from using the system.

The strongest incentive to fulfilling quota obligations would probably be provided by a variable penalty that is higher than the price of certificates. For this reason, the Agency recommends that the penalty should be linked to the average electricity certificate price, and should be expressed as a percentage (150 %) of the weighted average electricity certificate price during a year.

None of these arrangements can be said to guarantee fulfilment of targets, as the final decisions on investments involve other factors over and above the actual quota obligation: factors such as subsidy level, the long-term element of the system, confidence in the system on the part of investors, banks etc. Long-term views are determined by the lifespan of the system and by the number of years ahead for which the quotas have been set, and not by the exact structure of the quotas. A TWh-based objective guarantees a certain level of demand, but probably tends to create fluctuating levels of support.

Summarising, the emphasis on the accuracy of the certificate system should probably be placed on the structure of the system as a whole, so that it provides as strong incentives as possible to fulfilling quota obligations within the framework of long-term and reasonable quota levels, while at the same time creating security for the various parties affected by the system.

Practical implementation of annual quota obligations

From a practical point of view, there are clear problems in introducing a TWh target, in the form of deciding how the target must be assigned among those having quota obligations. In Norway, it is suggested that NVE should assign the TWh quota obligation in percentage terms, based on forecasted electricity use (i.e. electricity use as relevant for these calculations), offset against actual electricity use (OED, 2004b). It is suggested that, in January each year, NVE should announce the definite percentage quota for the preceding quota period, together with the preliminary percentage quota for the current quota period. In its report, NVE also proposes that it should be possible to adjust the quota obligation, depending on fulfilment of the target over the preceding period (NVE, 2004).

Forecasting electricity use each year is difficult and demanding of resources. In any case, such a forecast would probably never agree exactly with the actual electricity use. As described above, electricity use varies quite considerably from one year to another (particularly in Norway), and is largely dependent on climate conditions, which are in themselves difficult to forecast. The climate conditions also affect the supply of electricity certificates, and so it is probable that any percentage distribution of the TWh objective would probably not agree with the actual result during the year, thus creating an uncertainty of (at least short-term) certificate requirements for producers, investors and those having quota obligations. Although, to some extent, this uncertainty could be offset during the first months of the year by borrowing certificates from the next quota period, a percentage objective is easier to implement in practical terms.

In practice, annual adjustment of the quotas to bring them into line with fulfilment of the previous year's quota would mean that quotas were being set every year, which is undesirable as far as the parties on the certificate market are concerned. Nor is it in line with the opinion previously expressed by the Government. In its Bill no. 2002/03:40, it explains the present system of setting quotas as follows (pp. 113-115):

> "It must be possible to calculate the quota obligation, i.e. the number of electricity certificates that the party with the quota obligation must hold in its certificate account on 1st April each year in order to avoid having to pay the quota obligation fee, on a year-by-year basis, and it should also be possible for the party to obtain an overall picture of quota development. […] It is important for the stability of the system that the quota obligation should be set for a longer period of time, as this means that the electricity producers, and those having quota obligations, can foresee the likely development of the quota obligation over time. A system that involves annual adjustments of the quota obligation does not meet these fundamental requirements."

These principles should continue to determine guidance principles.

A communicable common target

The way in which quota obligations are structured should be coordinated if a common electricity certificate market is established, as it is the quota obligation in itself that is the most fundamental element of an electricity certificate system, with mandatory obligations on certain parties. Although the relative effects may be regarded as limited, it is valuable in the interests of communication and clarity for the quota obligation structures to be harmonised. If one country settles for percentage targets, and the other settles for TWh targets, the information provided to the parties in the two systems is different. In addition, there is a greater flexibility of quota obligation fulfilment in one country, which could be assumed to distort 'competition' between the systems.

From a political point of view, there can be advantages in communicating a common TWh target, as this will benefit investors, and will clearly explain and justify a long-term system to the public. However, it can be asked whether an annual non-mandatory planning objective, expressed in TWh, would provide a sufficiently strong signal in this context.

The EU national planning targets for greater renewable electricity production are expressed in terms of proportions of electricity use. In addition, with a quota obligation for electricity users, a consumption target (which would more naturally be expressed as a proportion of electricity use) is the most reasonable. In this context, we should therefore raise the question of why the end goal of the system must be expressed in TWh for anything other than planning purposes.

With an internationalisation of the electricity certificate market, allowance should also be made for the possible entry of third parties to the market. Bearing in mind the fact that it is very likely that any third party would be another EU state, this state would have an EU target in terms of its renewable electricity use. There is therefore every reason for greater concentration on electricity use and targets (a proportional target), rather than on out-and-out production objectives.

A percentage target also makes it possible for the demand side of the system to react to the electricity certificate cost signals to users to modify their consumption patterns. In this respect, it represents a further link with EU targets for improving the efficiency of energy use.

Discussion

Table 2 summarises the above discussion.

Table 2 Advantages and disadvantages of a TWh target instead of a percentage target

Advantages	Disadvantages
• More clearly linked to a quantitative final target • Easier for investors to forecast future demand • Not affected by variations in electricity use • May be clearer to communicate with a common market	• A more inelastic demand would probably result in greater price fluctuations for electricity certificates (fluctuating support level) • Less flexible and more difficult to forecast for quota-obligated parties • Has to be distributed between those having quota obligations • More difficult to implement and maintain • Not naturally linked to consumption (quota obligation) • Not linked to the EU national planning targets (for third parties)

However, as far as an expanded electricity certificate market is concerned, this is not necessarily something that will have to be coordinated. It would probably be possible to achieve smooth exchange of electricity certificates, even though the methods of applying quota obligations differ.

6.2.4 The penalty for non-compliance

As described above, pressure to fulfil quota obligations can be directly linked to the structure of sanctions (the quota obligation fee) in the certificate system. In practice, it is the penalty that exercises the mandatory element of the quota obligation. A correctly designed sanction system is therefore essential in order to sustain the demand for certificates.

In the Swedish electricity certificate system, the penalty for non-compliance has been set at 150 % of the weighted average price of certificates on the market over the period from 1st April to 31st March. In 2003 and 2004, the penalty was capped at the levels of SEK 175 and SEK 240 respectively. In its review of performance of the system, the Agency concluded that an extension of this cap would be unfortunate, primarily because it tends to influence price development on the electricity certificate market (Swedish Energy Agency, 2004a). The Agency is also of the opinion that the effect of a variable penalty, as applied from now on, can reasonably be expected to have only a limited influence on the certificate market, which means that it should therefore be retained. The Norwegian proposal for a certificate system states that the penalty should be set as a function of the average certificate price on the market during the year (OED, 2004b), but does not give details of the exact structure of the sanction system.

Although the penalty may be variable, it operates in practice as a price cap for electricity certificates, as it sets the alternative cost of not fulfilling the quota obligation. In this context, Mozumder and Marathe (2004) point out that although different levels of the penalty are fully possible on an integrated certificate market, it will nevertheless be the lowest penalty (the price cap) that will dominate the market. This means that it is immaterial whether the penalties vary between different systems, as it is the lowest figure that will set an effective price cap for the entire market (see also Ek *et al*., 2004). It is therefore preferable that the penalty should be coordinated between the systems, and that it should be set at a (common) level that provides the desired pressure to fulfil quota obligations.

There is an inherent conflict of objectives when setting the level of the penalty. On the one hand, the penalty can be used to protect consumers from excessively high electricity certificate costs, while on the other hand it is intended to serve as a sanction encouraging fulfilment of quota obligations. Ek *et al*. (2004, p. 41) reached the following conclusions in this respect:

> "In the negotiations over a common certificate market between Sweden and Norway, it is therefore important that the two countries should have a similar view of the part to be played by the price cap. If a penalty is to be seen as first and foremost a sanction, it should be set high. In practice, it is quite likely that both countries would also like to see a 'consumer protection' aspect of the price cap, but even in this context there are several important questions that need to be considered. The combination of a relatively low price cap and a price-inelastic demand for certificates [can easily] lead to the price cap tending to determine the price, which would mean that the quota obligation would lose its role as a functional policy parameter. The risk would then be that the certificate system changes to an inefficient fixed price system. In other words, the two countries would then be faced with a situation in which they have to strike a balance between, on the one hand, setting the price cap sufficiently high so that it does not tend to determine the price of certificates, and on the other hand setting it sufficiently low to prevent consumers from suffering from excessive electricity prices. The two countries may have differing political views as far as this is concerned, but it is nevertheless important that they should reach a long-term sustainable agreement."

6.3 Supply of certificates

6.3.1 Electricity production entitled to certificates

The Swedish electricity certificate system recognises the following forms of electricity production: electricity from wind power, solar energy, wave energy, peat (from April 2004), certain biofuels and certain hydro power (primarily small-scale power and capacity expansions in large-scale hydro power production facilities). The Norwegian proposal (OED, 2004a) recognises grid-connected electricity production from hydro power, wind power, solar energy, ocean energy, geothermal energy and bio-energy. OED states that this design has been chosen so as not to reduce the potential for value creation in Norway, and the design should not lead to inefficient utilisation of valuable natural resources (OED, 2004b). In this context, it is clear that the Norwegian proposal is more general, with fewer conditions on bio-based or hydroelectric electricity production. In addition, the Norwegian proposal is linked to the Renewable Energy Directive. OED argues that, by starting from the directive in its definition of certificate-entitled electricity production, the way will be opened for third parties to connect to the system. The Swedish National Board of Trade, which has investigated the legal aspects of an expanded electricity certificate market (see Chapter 10), recommends that the definitions set out in the directive should be followed as closely as possible as, if not, the beneficial effects of the system can be assumed to be reduced, with the prospects for all parties to participate in the system risking not being seen as sufficiently harmonised (if the directive is not followed). Table 3 presents the general definitions, as given in the Renewable Energy Directive.

Table 3: Definitions as given in the Renewable Energy Directive

Type	Definition
Renewable energy sources	Renewable non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases).
Biomass	The biodegradable fraction of products, waste and residues from agriculture (including vegetable and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste.
Electricity produced from renewable energy sources	Electricity produced by plants using only renewable energy sources, as well as the proportion of electricity produced from renewable energy sources in hybrid plants also using conventional energy sources and including renewable electricity used for filling storage systems, and excluding electricity produced as a result of storage systems.
Consumption of electricity	National electricity production, including own production, plus imports, minus exports (gross national electricity consumption).

Source Directive 2001/77/EC

From an international perspective, it will probably be a prerequisite that it must be possible to cancel all electricity certificates traded on the certificate market in all systems and that all certificates carry the same value. Any intra-market restrictions on certificates, in connection with such factors as the type of fuel, would represent a barrier to trade (see, for example, Mozumder and Marathe, 2004), and would result in the creation of certificates carrying different values. From this it follows that any discrimination with respect to the definition in the Directive should only be permitted with respect to the types of production permitted in the home country. Even if the Renewable Energy Directive is followed, individual restrictions in different countries will affect the total supply of certificates on the certificate market. If some particular type of electricity production is withheld from the electricity certificate market, it will have the effect of increasing the price and thus reducing the effective utilisation of existing resources of the joint market. In its comments on the proposal (OED, 2004b, p.11), for example, OED points out that:

> "Significant differences in Norway and Sweden in respect of which energy sources shall be entitled to electricity certificates would result in inefficient utilisation of the countries' energy sources. It is the differences in the underlying conditions that create the benefits resulting from the establishment of international cooperation on renewable electricity. As far as Norway is concerned, it is important that any limitations on certificate-entitled production should not be significantly more restrictive than in Sweden, as we then, to a greater extent, would finance expansion of renewable energy production in Sweden. Any such restriction in Norway would also result in increased imports of electricity."

In practice, it is difficult to see that differences in what type of production that is regarded as certificate-entitled production could create serious problems on a common electricity certificate market. On the Nordic electricity market, for example, electricity of different origins (such as Danish coal-fired power and Norwegian hydro power) is sold at the same price at the same time. It should be perfectly possible to implement the same principle on an international electricity certificate market. However, in the interests of legitimacy, there can be justification for avoiding altogether too great dissimilarities in the types of electricity that is entitled to a certificate. On the basis of their analysis of the points discussed here, Ek *et al*. (2004, p. 43) give the following recommendations:

> "(a) cross-border certificate trading should be as simple and as transparent as is possible; (b) there are no 'market-related' reasons for applying exactly the same national definitions of what constitutes certificate-entitled production, as long as both countries accept each other's definitions; but (c) these questions of acceptance will, however, in practice be quite strongly debated, and so the definitions should not differ too much in order to avoid excessively drawn-out discussions of differences."

Sweden does not discriminate between existing and new production, while (with certain exceptions) the proposed electricity certificate ordinance in Norway concentrates on new production capacity, having a construction starting date after 1st January 2004. In practice, this means that Norwegian certificate buyers on the common market will be subsidising existing Swedish plants, which can be regarded as unfair and, in the longer term, could create further problems of legitimacy. On the other hand, Norway can benefit from the significant liquidity that already exists on the Swedish market.

Summarising, the definition of 'renewable' as given in the Renewable Energy Directive should determine – primarily in the interests of third parties – the choice of certificate-entitled production in systems on the common market. Although individual limitations in participating countries' legislation on the basis of what is permitted in the directive are possible, they will probably not result in significant market disturbance as long as each certificate on the market represents the same value and can be redeemed in any country on the market. However, in the interests of legitimacy, important differences between systems in this respect should be avoided.

6.3.2 Lifespan of plants in the electricity certificate system[25]

At present, there is no real limitation on the length of time for which a production facility can obtain certificates in the Swedish certificate system. However, both the Norwegian Water Resources and Energy Directorate (NVE) and the Swedish Energy Agency have previously discussed this matter. In its review of the performance of the electricity certificate system, the Agency points out (2004b, p. 9) that:

> "[…] there is justification in looking in more detail at the possible limitation of the length of time for which a plant can obtain certificates, and thus also phase existing facilities out of the system. This is a matter that requires further investigation, and will be considered in the Agency's work of evaluating a joint Swedish/Norwegian electricity certificate market."

In turn, NVE says that (2004, p. 9):

> "The entitlement period, or the period for which the production plant is entitled to certificates, should be similar to the expected frameworks for the financing of loans. Consideration must also be given to ensuring that the price of certificates is acceptable to certificate buyers. An assignment period of 10-15 years would favour wind power and small-scale hydro power, while an assignment period of 25 years would be more favourable to hydro power. The length of the period should be considered in conjunction with the Swedish authorities."

The Norwegian proposal states that approved production facilities can be assigned certificates for a total period of ten years (OED, 2004a). This is justified in the comments on the proposal (OED, 2004b, p. 14) as follows:

> "A revenue stream over a sufficiently long period is essential in order to create a willingness to invest, and an entitlement period of ten years is assumed to meet this requirement. If the price of certificates varies with time, an entitlement period of ten years will also limit investors' risk."

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[25] In this section, the certificate market is assumed to be a well-functioning market, in which the electricity certificate prices are determined by the marginal production in the system. In addition, for simplicity, it is also assumed that there is no possibility for banking or borrowing, nor any other way of modifying the demand level, i.e. that demand is completely price-inelastic. The discussion in this section also disregards what are known as dead-weight losses.

We discuss, in this section, how a limitation of the duration of the period for which a plant may be entitled to certificates affects the certificate market, and to what extent this is something that needs to be coordinated on an expanded market. We start by summarising earlier arguments put forward by NVE and the Swedish Energy Agency.

NVE's and the Swedish Energy Agency's arguments

The NVE report puts forward the following arguments in connection with limitation of the entitlement period for certificate-entitled plants:

- A forecastable revenue stream over a sufficiently long period is essential in order to attract investors.
- Those potentially involved in the scheme claim that a satisfactory return on investment should be assured in a 10-15-year perspective.
- Some parts of the sector maintain that they have problems in obtaining project financing for periods exceeding ten years.
- Although a project may provide revenue for 25 years, investors are looking for sufficient revenue in order to pay off most of the loan during the first ten years of the period, in order to avoid liquidity problems.
- The price of electricity certificates is closely linked to the number of years for which a plant is approved for the receipt of certificates.
- Too short an entitlement period will result in unreasonably high certificate prices, while too long a period reduces the price of certificates to such an extent that loans cannot be financed, thus bringing liquidity problems for the investor.
- A solution under which a plant would qualify for the receipt of certificates for varying numbers of years, depending on profitability, is undesirable, as it requires specific knowledge of each individual project.
- The approval period should be coordinated with the length of any loan financing.
- An approval period of 10-15 years is in accordance with financing conditions.

NVE also points out that further investigation is needed into expected supply curves and quota obligation levels, in order to ensure stable price development. In addition, the costs to certificate buyers need to be considered, as do energy policy objectives in respect of expansion of production facilities. The cost for certificate buyers is strongly affected (and particularly if quota obligations are raised) by the length of the approval period and quota obligation levels.

In its second report in the review of the electricity certificate system, the Swedish Energy Agency puts forward primarily the following arguments for and against limitation of the entitlement period for certificates (Swedish Energy Agency, 2004b):

- Facilities that are profitable today should not receive further support: the system should encourage new investments.
- The cost for certificate buyers would be, or can be, reduced.

- Plants can stop producing electricity, or convert to fossil fuels, when phased out of the system.
- Quotas must be adjusted to reflect the loss of production from plants taken out of the system, which therefore introduces uncertainty concerning long-term quota levels.

The Agency also claims that the following factors require further investigation if limitation of the certificate entitlement time for a plant is to be practically possible:

- What should be the determining criterion for the limitation – years, number of operating hours, number of full-load hours or number of sold certificates?
- For how long should plants be entitled certificates?
- How, and in respect of what criteria, should old plants be phased out of the system?
- How should new investments be handled?
- How should information on production quantities, and on capacity disappearing from the system, be handled and distributed to those involved in the market?
- How would any limitation affect the investment behaviour of those involved in the market?
- Which forms of production are favoured or disadvantaged by various principles of deciding when a production facility no longer qualifies for certificates?
- What would be the effect of possible limitation of the entitlement period on the use of biofuels, bearing in mind the effects of other regulations and incentives such as emission rights trading or the carbon dioxide tax?

We do not attempt in this chapter to provide any specific analysis of these questions, as this does not fall within the remit of the Government's instructions to the Agency. However, they should be investigated in more detail before making any decision on the introduction of a limit for a plant's participation in the electricity certificate system. The main thrust of the discussion that follows concerns the theoretical and practical effects of limitation of the entitlement period of a plant on the certificate market, and on whether this is something that would need to be coordinated between different certificate systems in an expanded certificate market.

Short-term effects of the introduction of limitations of entitlement period of plants on the electricity certificate market

All other things being equal, any limitation of the length of entitlement period of a plant in the electricity certificate system would affect the price of certificates on the market by requiring a given plant to be financially viable before it is phased out of the system (reduced payback time). With an unrestricted life, the producers of renewable electricity can continue to produce electricity for an indefinite time for a price equal to the price of the electricity plus the price of the certificates.

This would not be possible in a system in which the length of entitlement period for certificates was limited.

Figure 6 shows how the introduction of limited length of entitlement period of plants in the system affects the market price of certificates. Without restrictions, the supply is given by curve S_1 which, with a quota of Q_1, gives a certificate price of P_1. Introduction of a limitation increases the pressure on returns for (at least) some of the plants in the system. This makes the supply curve less price-sensitive, as a result of higher marginal costs, moving it to the left (S_2). The shorter the entitlement period, the greater the effect of life limitation on the supply of certificates. With an unchanged quota level, the equilibrium price of certificates on the market would rise to P_2.

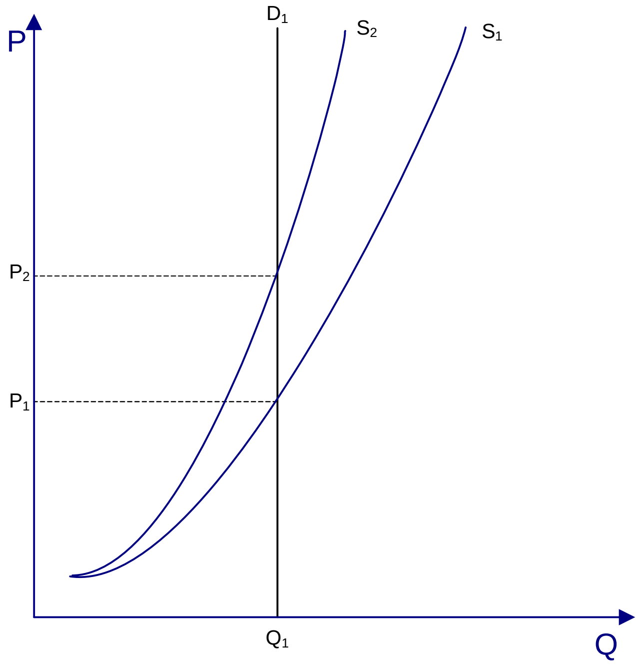

Figure 6: The effect of plant entitlement period limitations on the certificate market

In the short run, the actual introduction of a limitation of the entitlement period of plants would result in a higher price level for certificates and a higher cost level for certificate buyers. With a less price-sensitive supply, an increase in quota level will also result in a relatively greater price increase. However, the total cost for certificate buyers does not need to rise, as they have to support a given plant only for a given period. This means that, in total, it will not necessarily be more expensive for the certificate buyers than in a (long-term) system with unrestricted entitlement period, as the investments to be financed are the same, regardless of the length of entitlement period of the plants in the system. It is only the length of time within which the investments must be repaid that is affected by entitlement duration limitations. If anything, the total cost for certificate buyers in the long run is likely to be lower, as they do not need indefinitely to continue to support plants that have become commercially viable. Further, a limitation of the entitlement period makes it likely that investments that would be profitable in the long run (i.e. for a longer period than embraced by the entitlement period) would never be made.

The effect on the market of phasing plants out of the certificate system

Figure 7 shows the effect on the market of phasing plants out of the certificate system. In the reference state, certificate supply on the market is represented by level S_1. The quota level is Q_1, which gives a demand D_1 and an equilibrium price P_1. With no entitlement period limitation, an annual increase in the quota level, such as to Q_2, would result in a higher demand, D_2, and a higher equilibrium price, P_2.

When plants are phased out, it will probably be the cheapest plants in the system that are first phased out, as it was these plants which first entered the market (assuming that the system is technology-neutral and is operating cost-efficiently). This would have the effect of moving the supply curve parallel to the left, i.e. S_1 to S_2, reducing the supply of certificates on the market. The quota level would also move downwards, reflecting the reduced supply, from Q_1 to Q_3 (D_1 to D_3). It is assumed in this example that the changed quota levels do not exactly match the reduction in supply when existing plants are phased out of the system, i.e. that there are increasing ambition levels in the system, equivalent to the difference between Q_1 and Q_2. This will give an equilibrium price of P_2. It can therefore be seen that the cost for certificate buyers will always be lower when plants are phased out of the certificate system, with the quota level adjusting to allow for this. The price of certificates is not affected, but as the quota level is lower, the total cost for quota-obligated parties is reduced.26

[26] It will never become more expensive for the certificate buyers when the quota level adjusts fully to compensate for plants that have been phased out, i.e. with an constant ambition level. However, if the ambition level is not fully adjusted (i.e., an increasing ambition level), the total cost of fulfilling quota obligations can increase when plants are phased out. The total cost effect on quota obligated parties depends on the marginal cost of the particular renewable electricity production that determines the market price of certificates when plants are phased out. If this marginal production is significantly more expensive than the production that had previously been determining the market price, it can – with a rising ambition level – become more expensive in total for certificate buyers, even though the quota level may have been adjusted downwards in order to compensate for the reduced supply.

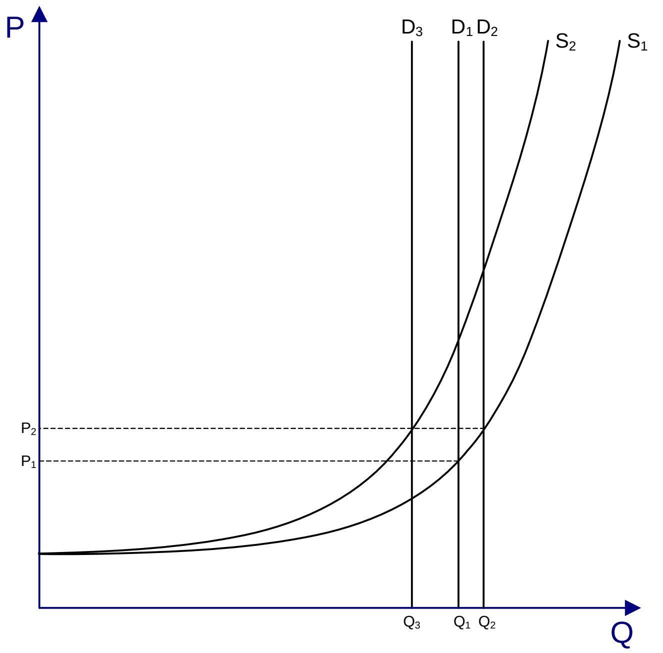

Figure 7: The effect of phasing plants out of the system on the certificate market

Discussion

A supply curve for renewable electricity production in the Swedish certificate system has been constructed (cf. SOU 2001:77), with the aim of linking the above theoretical considerations to 'actual' conditions on the Swedish electricity certificate market. The supply curve is based on actual production during the system's first year, together with the production cost forecasts and potential assessments presented in the Agency's second interim report in the review of the electricity certificate system (Swedish Energy Agency, 2004b). The report presents forecasts of production potential for 2010, 2012 and 2015. The Agency assesses renewable electricity production (including existing production) in the certificate system in 2015 as potentially amounting to about 25.5 TWh/year, of which:27

- Wind power, 10 TWh (limited by the planning target)
- Biofuel-based CHP, 6 TWh.
- Biofuel-based industrial back-pressure generation, 7 TWh.
- Hydro power, 2.5 TWh.

The potential supply curve (Figure 8) provides a possible snapshot picture of long-term supply in the certificate system at different price and support levels on the electricity and electricity certificate markets respectively. The supply curve is restricted upwards by the production cost of offshore wind power.

[27] During the first twelve months of the system, certificate-entitled production amounted to about 10 TWh. Existing production, before the certificate system came into force, was estimated in the preparatory works as amounting to 6.1-6.5 TWh (see SOU 2001:77; Bill no. 2002/03:40).

Investments in new production are based on expectations of future electricity prices and support levels. The Agency estimates that the average price of electricity in 2010 will be 28 öre/kWh. With an increasing ambition level in the system, the present price level on the certificate market can be said to represent a cautious estimate of the future support level. At present, the market price of certificates is about SEK 230/MWh (with delivery up to and including March 2004), which is equivalent to a support level of 23 öre/kWh (Svensk Kraftmäkling, 2004).28

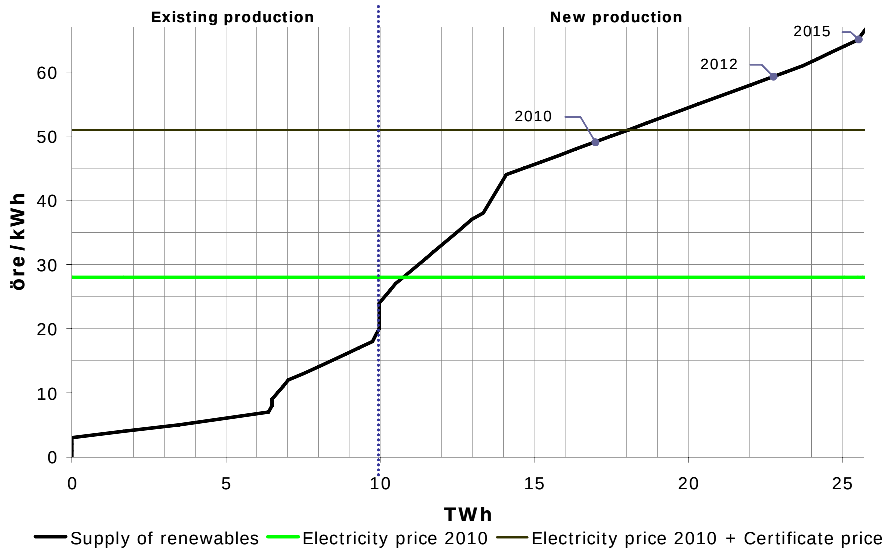

Figure 8: Potential supply curve for renewable electricity production in the Swedish certificate system29

Sources: Swedish Energy Agency, 2004b; SKM, 2004.

As far as Swedish conditions are concerned, and looking at the long term (with increasing quota levels), there is a fairly large proportion of existing plants with relatively low production costs in the certificate system. The introduction of entitlement period limitation would mean that the supply curve of new plants would become steeper as a result of reducing the payback time available. With a relatively high proportion of existing plants, there will be a significant quota adjustment (at least 6.5 million certificates disappearing) if these plants are phased out simultaneously. This would also create pressure for the adjustment of the quota level with increasing ambition levels in the system to be reasonably in proportion to the phased-out production capacity. If the quota level is adjusted by a sufficient amount, and if the marginal production that determines the certificate

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[28] A more comprehensive analysis should also consider effects on non-renewable electricity production, i.e. the effects on all electricity production on the Nordic electricity market should be evaluated.

[29] As fixed costs are regarded as sunk costs, an analysis of existing production need only consider variable production costs, i.e. the short-run marginal cost. In the case of new production, both fixed and variable costs have to be covered in order to justify investment. This means that costs for existing production shown in Figure 8 reflect the short-run marginal costs, while the cost estimates presented for new production represent the long-run marginal cost.

market price is not significantly more expensive than the earlier marginal production, a phasing-out of plants on the Swedish market will probably have only a limited price-escalating effect. This is because there are unlikely to be any significant cost differences between new plants at the production levels that would then set the price (see Figure 8). The variable production cost for wind power, which will probably dominate expansion of new renewable production in Sweden after 2010, is also very low (Swedish Energy Agency, 2004b). However, in a system in which only new production is entitled to certificates, it is more probable that the price effect would be marginal, even though real cost differences exist between different types of new production. This would be due primarily to the fact that construction of new facilities would probably be spread over several years, and so significant production volumes would probably not be phased out in any given year.

From the point of view of investment, a stable price level for certificates (support level) over time is desirable. From this, we see a further effect that should be considered in this context, of whether the supply of certificates would become more volatile after phasing out plants, primarily in response to weather factors. In the stage 1 report, the Agency estimates annual weather-related variations in the electricity certificate system as between 5 % (CHP) and 20 % (wind and hydro power).30 In the Swedish system, certificate-entitled production is dominated at present by existing biofuelled plants, with (primarily) wind power production expected to play an increasing part in the system with time (Swedish Energy Agency, 2004b). In the light of this, it is likely that any limitation of entitlement period would result in greater weather-dependent fluctuations in the supply of certificates, due to the fact that the non-weather-dependent forms of power production would tend to be phased out at an earlier stage. An opposing factor in this case is the fact that such limitation would result in more price-insensitive supply.

In general, any limitation of entitlement period would make the setting of long-term quotas more difficult, which would result in uncertainty for those involved in the market. However, depending on the particular principles or application of limitation, its effects could vary somewhat. A limitation linked directly to the amount of electricity produced (operating hours/full-load hours/number of certificates sold), for example, would give the producer of the power some room to decide for how long support would be available. However, such a principle limits the possibilities for long-term quota setting, as it is not possible at any given time to know how much production capacity will be available in the future. With a limited qualification time in years, e.g. 15 years, quotas can be set for not more than 15 years into the future. This is because the quota-setting authority needs to know how much new production capacity has been added during the present year in order to be able to determine quotas for the next 15 years. As described above, the length of the entitlement period also affects the price sensitivity of the available certificates, and thus the price level on the market.

[30] Back-pressure power production is not weather-sensitive.

The duration of the entitlement period discriminates between different types of electricity production, although this is a two-way effect. For example, a 'short' entitlement period (whether expressed in years or production-related) would probably favour less capital-intensive investments, i.e. investments in capacity having a relatively high proportion of variable production costs. On the other hand, investments traditionally having longer technical and economic lives would probably have to reduce their writedown times, thus becoming less competitive within the system. Applying the National Tax Board’s general guidelines on depreciation and deduction percentage rates for power stations, it can be seen that the economic life of an investment in various types of power production varies considerably, as shown in Table 4 (RSV 2003:6). Wind power and thermal power investments can be said to have a short to medium-long economic life, while investments in hydro power have a long economic life.

Table 4: Depreciation allowances for power station buildings

Type	Annual rate of depreciation	Economic life
Thermal power station buildings	4 %	25 years
Hydro power station buildings	2 %	50 years
Wind power structures	5 %	20 years

Source: RSV 2003:6

Investments that struggle to become profitable within a relatively short period in this context risk requiring major refinancing after expiry of the entitlement period. This means that investments that would be profitable in the long run risks becoming less competitive, or even being crowded out, by too short a entitlement period. It is therefore important that the length of the entitlement period should be sufficient to enable investments in forms of power production that traditionally have economic life. A relatively short entitlement period, such as ten years, would probably tend to favour investments in wind power production at the cost of investments in biofuelled and (particularly) hydro power-based production. However, a long entitlement period also requires guarantees that the certificate system itself will be in existence over a longer period of time.

Bearing in mind the Agency's recommendation that the electricity certificate trading system should be made permanent, there is justification for serious discussion of limitation of the duration of entitlement times, simply because plants cannot continue to require support indefinitely (Swedish Energy Agency, 2004b). If the certificate trading system is seen to be a long-term institution, forming an integral part of Swedish energy policy, some form of entitlement limitation that establishes the right conditions for investment in new production, while not at the same time discriminating between different forms of renewable energy, will be needed.
As far as international trade in electricity certificates is concerned, the life of the plants in the respective systems is probably not a factor that needs to be coordinated between the systems in order to facilitate inter-system certificate

trading. The main factor is that each system should allow for possible phasing-out of plants when setting its quotas. However, as the introduction of entitlement limitation has the effect of raising the prices of certificates, there is justification for coordinating this on a common market. Differences in this respect will affect the relative competitiveness between countries. A shorter entitlement period in Norway than in Sweden, for example, will make Norwegian renewable electricity production relatively more expensive and less competitive. A shorter entitlement period in one country is therefore likely to lead to reduced investments in that country.

6.3.3 The validity, legal status, value and lifespan of electricity certificates

As described above, it is likely that certificates must carry the same value regardless of their origin, and must also be possible to redeem in all countries, if the market is to function well. Electricity certificates are instruments that would naturally be traded on financial markets, with the only physical link to actual electricity production being the fact that the number of certificates that can be issued during any given year is limited by the actual production of electricity in certificate-entitled plants (Mozumder and Marathe, 2004). Related to this is the question of how certificates are defined in the various systems trading on the market. In Sweden, certificates are regarded as financial instruments. The Government's Bill no. 2002/03:40 (pp. 51-59) gives the following assessment:

> "Electricity certificates should be regarded as financial instruments. […] A financial instrument is defined [in the Act (1991:980) Concerning Trading in Financial Instruments] as a security and other right or obligation intended for trading on the securities market. An important characteristic of an electricity certificate is that the person managing the quota obligation, and responsible for ensuring that the certificate is cancelled, avoids liability to pay a quota obligation fee. Seen from this person's situation, electricity certificates should therefore be regarded as carriers of an entitlement against the state; cancellation of the certificate fulfils the obligations of the person responsible for the quota obligation, thus being relieved from liability to pay the quota obligation fee that would otherwise result. [In addition, certificates are] intended to be traded on a market. [These two characteristics {an entitlement against the state and the intention for trading on a market} mean that the certificates] should regarded as financial instruments."

In its comment on the preparatory works, the Swedish Financial Supervisory Authority points out that if electricity certificates are not defined as financial instruments, companies trading in them will require an ancillary activity authorisation in order to trade in the certificates, and that any market for the certificates could not be licensed in accordance with the Act Concerning Security Trading and Clearing Activities. From a financing point of view, it is important that 'financial' parties should enter the market. Such parties would also add activity to the market.

OED are of the opinion that Norwegian electricity certificates are not covered by the definition of financial instruments as spelt out in Norwegian legislation (OED, 2004b). OED argues that electricity certificates should be regarded as generally convertible securities (‘value papers’), which come only partly under Norwegian securities legislation. It is unclear whether this would mean that electricity certificates in Norway would become liable to value-added tax.

The matter of value-added tax is not unimportant. Svensk Kraftmäkling (SKM), for example, points out in its weekly newsletter (SKM, 2004) that as the Norwegian certificates have not been given the status of financial instruments, the effect will be to complicate the proposed Swedish/Norwegian electricity certificate market. This will particularly be the case if Norwegian certificates have to be invoiced with value-added tax, while Swedish certificates are not liable to the tax. SKM also points out that this could result in security traders electing not to participate in the market, as they are not allowed to reclaim value-added tax.

Electricity certificates represent the additional 'environmental value' that society is prepared to pay for electricity production from renewable energy sources. This requires political agreements concerning how, and on what bases, the certificates may be credited against (primarily) international targets within the framework of the international electricity certificate market, referred to as 'political credit’. Probably the only reasonable solution will be for the environmental value to follow the certificate, and for the renewable production which the certificate represents to be credited in the country in which the certificate is cancelled. In this respect, there is also a need for mechanisms within the framework of the system to ensure that the environmental value is not also credited in the country of origin of the certificate. Exactly how the environmental value is to be credited will not necessarily affect the efficiency of the common certificate market, but it is probably something that needs to be decided before establishment of the market, in the interests of clarity.

Differences in respect of the extents to which certificates can be banked and borrowed should also be avoided, primarily because this would complicate the exchange of certificates (Mozumder and Marathe, 2004). This applies also to the unit size of certificates. The Swedish and Norwegian systems issue one certificate per MWh of electricity produced by a certificate-entitled plant, while a certificate in the Italian system is equivalent to production of 100 kWh, i.e. an Italian certificate represents one-tenth of the amount of renewable energy represented by a Swedish certificate.

Summarising, certificates traded on the international market must have the same value, regardless of their country of origin, if exchange of certificates is to operate efficiently. In addition, regardless of where the certificates have been produced, certificates should be valid in all systems linked to the joint market.

Differences in terms of legal status can considerably complicate the exchange of certificates between the Swedish and Norwegian systems, especially if differences in their legal definitions mean that the values of certificates vary, depending on their country of origin. This can arise, for example, as a result of certificates being liable for value-added tax in one country but not in another. The legal status or implementation can also have the effect of excluding parties (and trading exchanges) who/that can provide important functions for the market. If we assume that this problem can be resolved by changing the legislation in the relevant countries in order to remove any barriers to trade and to avoid exclusion of important parties (regardless of their legal status in the respective systems), then direct coordination is not necessary. However, if it is impossible to resolve this problem by means of legislative changes, it would probably be desirable to coordinate the legal statuses of the certificates in order to ensure that they can be traded as efficiently as possible. This applies regardless of whether it means that Norwegian certificates should be given the status of financial instruments or whether the status of the Swedish certificates should be altered to bring them into line with the Norwegian certificates.

6.3.4 Parallel support systems

The Swedish system includes a guarantee price that is gradually reduced until 2008. Norway, however, (according to the OED comments on the proposal), does not intend to introduce any corresponding minimum price (OED, 2004b), as the existing Swedish market to which Norway intends to be connected reduces uncertainty for Norwegian parties during the starting-up phase. In practice, the Swedish guarantee price will provide a minimum price for all certificates traded on the joint market (see, for example, Mozumder and Marathe, 2004). It follows from this that there is no need to prevent any third parties introducing a guarantee price on the same level as, and corresponding in time to, the Swedish minimum price. Corresponding to the arguments raised above for the lowest price cap, it is the highest minimum price on the market that will dominate market trading. In this context, it is worth noting that the lack of a guarantee price in Norway will mean that the Swedish state will risk financing the entire market if the prices on the certificate market drop below the Swedish guarantee price.

The situation is somewhat more complicated as far as other types of support systems are concerned. Most subsidy systems, such as the Swedish environmental bonus, distort competition between different forms of energy on the certificate market, and therefore interfere with the ability of the market efficiently to allocate production resources (see also Schaeffer *et al.*, 2000). This indicates that it would be desirable to harmonise these different types of support system. In this context, consideration needs also to be given to the various EU national subsidies and single market regulations. At the same time, Ek *et al.* (2004) point out that, in most countries, there is a veritable jungle of politically determined laws and regulations that affect scope for establishing energy production from renewable sources, and which would probably be very difficult completely to harmonise. Ek *et al.* feel that it would be necessary to identify a suitable level of harmonisation, based on the broader benefits to society from renewable energy production and on the various drawbacks associated with establishment of such technologies, and find that (p. 44):

> "A reasonable starting point for finding a suitable level of this 'harmonisation' is that the various support systems and incentives aimed at encouraging the benefits of renewable energy should be as competition-neutral as possible. On an integrated certificate market, the price of certificates will (in principle) be the same in both Norway and Sweden, which implies that the value to society of the 'green component' of electricity production is the same, regardless of in which land it has arisen. […] this means that each country must be prepared to forego some of its national and regional objectives, which are often linked to expansion of renewable energy facilities. However, we do not feel that this represents any particular major 'sacrifices', but rather that it is instead very reasonable to regard the benefits of green electricity as being specifically Nordic (or why not European?), rather than being particularly national and/or regional. […] As far as the negative effects of renewable electricity production are concerned, these are generally of more local or regional character, and so it is reasonable that they should be evaluated at a lower geographical level than that of the entire Nordic countries. In Swedish land use planning, for example, the individual local authorities enjoy a considerable degree of self-determination, expressly so that they can allow for specific local conditions when assessing the effect of various establishments on the surroundings. This indicates that there are no particularly strong reasons for actively attempting to harmonise the concession approval processes in the Nordic countries, and that it is to some extent unavoidable (and often even desirable) that investment conditions for renewable electricity production facilities should vary from place to place."

The electricity certificate market will also be affected by emissions trading, which will be introduced in Sweden during 2005.[31] In general, a higher price for emission rights leads to a higher price of electricity, which therefore tends to lead to a lower price for electricity certificates, as there is less need of support. The price of electricity certificates also affects the price of electricity, in that electricity from renewable sources replaces 'brown' marginal production. The different regulations do not act in isolation, and to some extent send the same signals to those on the market; namely, that new investments should be made in non-fossil production. To some extent, this makes it more difficult to say in the future which system has given which result.[32]

Within the EU, work is continuing on guarantees of origin and with planning for trading in such guarantees (e.g. via RECS). In principle, these guarantees of origin can be said to represent environmental values equivalent to the environmental values represented by the electricity certificates in the Swedish certificate system. Swedish implementation of the guarantees of origin permits certificate-entitled electricity production also to receive guarantees of origin, which in practice means that the producers can sell the 'environmental value' from the production of renewable electricity once more. It is therefore possible for producers to receive further revenue for production that has already received the support of the electricity certificate system. As Norway has not yet implemented the Renewable Energy Directive (2001/77/EC), Norwegian producers cannot

[31] Norway also plans to start emissions trading in 2005.
[32] See also the discussion in Chapter 5.

receive guarantees of origin, which means that the guarantees can distort the operation of the common electricity certificate market.

6.4 Risks and costs of electricity certificate management

Most of the types of risk to which the parties on the certificate market can be exposed when the market is expanded to include Norway are likely to remain unchanged, as many of those involved in the market are familiar with trading and interacting with Norwegian parties. As we have seen before, the political risk will be affected to some extent, but this will not be further pursued in this section. However, as far as the access of third parties is concerned, most types of risk could be affected, particularly if the third party is not from the Nordic electricity market and if the fundamental elements of the respective certificate systems differ significantly.

However, an expanded market does involve a new type of risk to the Swedish parties on the market. The Norwegian proposal does not suggest any coordination of currencies, but suggests that those trading in the market should decide the currency in which they want to trade and should also bear any associated currency exchange risks (OED, 2004a). Exchange risks are not likely to represent any insuperable costs for those on the market, as they have wide experience of trading on the Nordic electricity market. However, this arrangement would tend to favour large traders, familiar with dealing with currency exchange, at the cost of smaller traders. A prerequisite for minimising the risks and costs to which those on the electricity certificate market are exposed is that the market should be long-term and transparent.

6.5 Support and monitoring

As far as the system's support and monitoring functions are concerned, it is suggested that NVE in Norway should play the same role as does the Swedish Energy Agency in Sweden, with practical operation of the certificate register being handled by the Norwegian TSO Statnett, i.e. the same function that Svenska Kraftnät (the Swedish TSO) has in Sweden (OED, 2004a; 2004b). In the event of internationalisation of the electricity certificate market, it is reasonable that procedures for approval of plants, issuing of certificates, fulfilment of quotas etc. should be the same in the separate certificate systems in order to ensure that the market can operate efficiently and transparently. The same applies for monitoring, reporting and surveillance functions, although there does not appear to be any absolute requirement for coordination in these respects.

From a practical point of view, there would seem to be justification for coordinating the register function, not only if needed in response to entry of a third party, but also to prevent certificates from being credited in more than one country. This could be done either by directly linking the separate registers, or by establishing a common register. However, a prerequisite for being able to handle certificates is that each register can communicate with all the other registers, i.e. it is an absolute requirement that certificates can be transferred between registers. This ability should be up and running by not later than the date of establishing the common market. In addition, coordination of information supplied to parties on the market from official sources, such as approved plants, the number of certificates issued and the number transferred, weighted average prices etc., is desirable. This can be arranged, for example, by establishing a joint web site, carrying constantly updated information from the respective registers.

7 Models for deciding ambition levels and quotas

This chapter describes various models for setting ambition levels when more than one country participates in an expanded certificate market.

The Swedish Energy Agency has reached the following conclusions:

Important insight:
Given the countries' production conditions, it is the total ambition level for the encouragement of all forms of renewable electricity production that affects the price of electricity certificates, and thus the total cost of achieving the particular target volume of additional electricity production from renewable energy sources. The price is also affected by which types of production capacity that are entitled to certificates within the remit of the system. Siting of the production capacity is determined by natural and institutional production conditions in each country. Before finally deciding the total ambition level, an analysis of the effects on electricity and certificate prices, the costs incurred by the various parties and the effect on the country's electricity production system (i.e. the physical system) should be carried out.

The quota level – ambition (in TWh) spread across the quota-obligated electricity consumption
The Swedish Energy Agency suggests that each country's ambition (in TWh) should be spread across *that* country's quota obligation electricity use. The percentage quota level can therefore differ between the countries. An alternative would be to assign the combined total ambition (in TWh) for the whole market to all consumers (in all countries). This would provide the same quota level in each of the countries. The proposed principle means that the country's ambition level can be expressed in terms of "the number of TWh that the country *is willing to finance* by means of its quota obligation electricity use". The proposal means that each of the countries would have more flexibility in determining how much it finances, within the framework of the common system.

Following the above principle, the distribution of apportionment between the countries would be determined by the fact of setting an ambition level in TWh.33.

What happens when a further country wants to join an international electricity certificate market?
At present, the electricity certificate market covers only Sweden, although discussions are in progress with Norway concerning its connection with the Swedish market. Looking further ahead, more countries might want to connect to the common system.

[33] It should be noted that if a quota-based percentage objective is chosen, which is the way in which the Swedish system is constructed today, the final assignment of proportions between countries will depend on how quota objective electricity use develops in each country.

The Agency is of the opinion that, when another country wants to join an established certificate market, an assessment of its ambition level (expressed in the form of TWh of additional renewable electricity production) in relation to its ability to produce such electricity should be carried out, *with the aim of avoiding excessive price changes on the established market.* This would help to maintain stable investment conditions for the parties on the existing market. The starting point for such an assessment of an applicant country's ambition should be to relate the country's ambitions (in TWh) to its ability to produce renewable electricity, i.e. potential availability of renewable electricity production. The results would be in the form of a range of 'acceptable ambition levels'.

Can an exact ambition level be found by considering how the 'burden', i.e. the cost, can be distributed between the countries?
The Agency recommends that the applicant country should itself determine its exact ambition level within the specified range of 'reasonable ambition levels'. The Agency does not feel that it is possible to produce generally valid criteria for a 'fair' assignment of burden It is extremely difficult to define what is fair, and this becomes particularly clear when attempting to compare countries with different economic and/or political starting points. Nor is fairness any specific requirement for enabling an international market to be established. In an international electricity certificate system, the quota level set in the country – i.e. the sustainable electricity production financed by the country within the framework of the system – will correspond to the environmental benefit with which the Country Can be credited. This means that a low burden would at the same time return a lower credited environmental benefit.

This chapter is concerned primarily with the following parts of the report:

Different methods can be used to set quota levels in each country, and the Agency should analyse possible models for determination of quota levels. The reference alternative should be the setting of quota levels in each country on the basis of that country's conditions and ambitions. The Agency should pay particular attention to how differences in selected quota levels, and in definitions of certificate-entitled production, can affect the efficiency and target achievement of an expanded certificate market.

Creating the right conditions for favourable development of the electricity certificate market requires stability of, and confidence in, the market. A known and stable quota level creates the right conditions for those in the market to forecast development and approach it in a long-term perspective. This contributes in turn to a long-term price development that also encourages investment.

7.1 Introduction

We have previously noted in this report that there are gains to be made by expanding the Swedish system to include further countries. We have also pointed out that, at the same time, this would mean that the objective of the system would be partly changed: matters relating to security of supply, for example, would no longer be based solely on the national view. In an international market, it is not possible to determine exactly how much production is required in the home country.

In an electricity certificate system, the driving force for new investments is the quota level set within the framework of the system, which represents a legally required demand for renewable electricity production. The quota level is converted from an ambition level in TWh, the magnitude of which requires a political decision. In an international system, it becomes a political decision between two or more countries. However, in order to obtain a proper overview of the entire picture, costs should also be considered, i.e. how the 'burden' (financing of the renewable electricity production) should be distributed between the countries and their consumers.

This chapter provides material for the work of setting ambition levels and quota levels on an international market. The emphasis is on expansion of the present Swedish system to include Norway.

A starting point for determination of quotas for each Country Could be the Renewable Energy Directive, 2001/77/EC. The directive gives reference values for the proportions of each member state's gross electricity use that should be provided by renewable energy sources by 2010. However, the directive is inadequate for the purposes of determining ambition levels and quota levels, as its indicative targets apply only up till 2010, while quotas in electricity certificate systems need to be set at least until 2015.

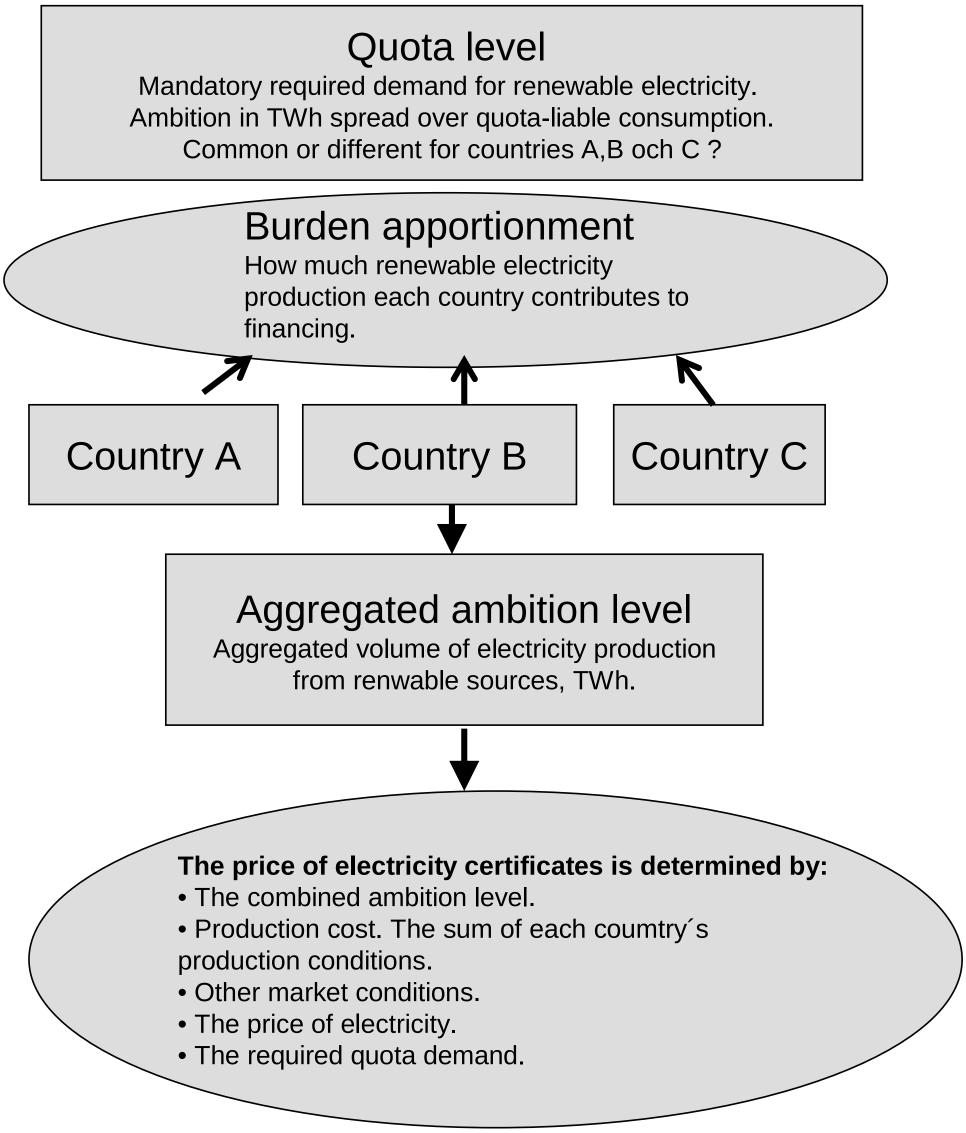

Figure 9 Aggregated ambition and quota setting in different countries

7.2 The countries' starting conditions

Before we analyse different models for determining ambition levels and quota levels in each country, we summarise the different present conditions between Sweden and Norway, prior to possible establishment of a joint electricity certificate system with effect from 2006. Appendix 1 provides more detailed information.

Table 5: Starting conditions in Sweden and Norway

Sweden	Norway
Population: 9 million.	Population: 4.5 million.
Proportion of renewable electricity production varies between 45 % and 59 %.	Proportion of renewable electricity production is 99.2-99.7 %.

The production of electricity from hydro power varies from year to year, depending on the availability of water (between 51 and 78 TWh). Wind power contribution is somewhat over 0.7 TWh. Biofuel-based electricity production is about 7.5 TWh.	Very high proportion of large-scale hydro power, over 99 % of total production. Production varies from year to year, depending on the availability of water. This can be clearly seen in the major variations in net Norwegian trade (import/export) of electricity. In addition, there are about 0.2 TWh of wind power and 0.2 TWh of biofuel-based CHP.
Total electricity use: about 134 TWh (net), 149 TWh (gross), of which the quota obligation is about 96 TWh.	Total electricity use: about 110 TWh (net), 121 TWh (gross), of which the quota obligation is calculated as about 80 TWh.[1)]
Per-capita electricity use: 16 207 kWh (per household, 13 700 kWh). On average, electricity use in Sweden increased by 5 % per annum between 1970 and 1987, after which the rate of increase declined. Total electricity use increased by 8 % between 1990 and 2001. Domestic users account for about 50 % of electricity use.	Per-capita electricity use: 25 193 kWh (per household, 17 900 kWh). On average, electricity use in Norway increased by 4 % per annum between 1970 and 1987. Total electricity use increased by 16 % between 1990 and 2001. Domestic users account for about 50 % of electricity use.
The electricity certificate system came into force on 1st May 2003. Most of the plants that have been approved (i.e. are entitled to certificates) are existing plants, the total production from which amounted to about 10 TWh during the first twelve months of the system. The number of new plants that have been commissioned amounts to 47 (most of which are wind power plants), with an expected annual production of 0.1 TWh. At the end of 2002, it was estimated that about 6.5 TWh of electricity would have been produced during the year in plants that met the future requirements for electricity certificate assignment.	The country has no electricity certificate system at present: instead, there is investment support for wind power plants, amounting to a maximum 10 % of the assumed capital cost of NOK 6 million per MW. Financing support is also available for other renewables, such as wave energy and solar energy, for which it amounts to 25 % of the investment cost.
Sweden has set its quota obligations for the period up to 2010, by when it is intended that the use of electricity from certificate-entitled plants will have increased from 7.4 % in 2003 to 16.9 % in 2010. On the basis of the forecast of electricity consumption used by Parliament, this figure represents an ambition of 10 TWh of new electricity production from renewable energy sources.	No ambition level within the framework of an electricity certificate system. However, there is an objective to increase annual production from wind power to 3 TWh by 2010. Another objective is to use a further 10 TWh of waterborne electric heating, produced using renewable electricity.. In addition to the objectives for various technologies for electricity production from renewable forms of energy, there is also work on carbon dioxide separation from gas power plants.
Sweden has been assigned an indicative target of 60 % of gross electricity use by 2010 under the terms of the RES-E Directive. This includes the country's large-scale hydro power production. In an attached note to the table of indicative targets in the directive, Sweden has	Norway is not included in the RES-E Directive list of countries having indicative targets for the proportion of renewable electricity production. However, the Norwegian Government is at present discussing linking to the directive with the Commission. The

noted that the base year hydro power production should be calculated on the basis of a statistically normal year's production. If the base year is adjusted in accordance with this principle, the note indicates that 52 % would be a more realistic indicative target for Sweden. On the basis of the magnitudes of future quotas, together with the Agency's forecast for electricity use, it is felt that Sweden will almost reach this target. (The calculation indicates a figure of 51 %.) Over the last five years, the average proportion of electricity from renewable sources has been about 49.5 %. With normal year conditions, it would be very difficult for Sweden to reach 60 % by 2010.	proportion of renewable electricity that has been discussed in Norway is 90 %, i.e. lower than its present proportion, which is normally very close to 100 %.
Sweden has an environmental bonus (an operational subsidy) for wind power, which is being reduced to phase-out in 2009. In 2002, SEK 350 million were granted for pilot projects for offshore and upland-based wind power up to 2007. From 1st January 2005, this electricity production sector has been included in the emission rights trading system. CHP production in Sweden is subject to a carbon dioxide tax of about 19 öre/kWh on the heat proportion of its output.	See the frame further up that describes existing investment subsidies for electricity production from renewable forms of energy. However, these subsidies may be removed if Norway decides to introduce an electricity certificate system instead. From 1st January 2005, the electricity production sector is covered by the EU system for trading in emission rights.
Electricity prices in 2003, including tax/VAT: 2) Domestic, 20 000 kWh: 107 öre/kWh Medium-sized industry: 36 öre/kWh (average of the ten most recent charge rates, 31.4 öre/kWh)	Electricity prices in 2003, including tax/VAT: 2) Domestic, 20 000 kWh: 77 öre/kWh Medium-sized industry: 40 öre/kWh (average of the ten most recent charge rates, 28 öre/kWh)
Sweden's latest forecast (from 2004) includes the electricity certificate system until 2010. The forecast assumes that 10 TWh of new electricity production capacity from renewable energy sources will be available by 2010: in addition, 4 TWh of gas-fuelled CHP are estimated as having been constructed. This will mean that Sweden should be able to deliver a net export capacity of 3 TWh. Electricity use is expected to grow at a rate of 0.9 % per annum until 2010. Total electricity use by 2015 is estimated as amounting to 158 TWh, of which the quota obligation amount is 106 TWh)	Norway's most recent forecast is from 2002. Under the present support system – i.e. without a possible future electricity certificate system – it is estimated that renewable electricity production could increase by 8-9 TWh per year by 2010 (10-12 TWh/year by 2015). No new gas-fired power production has been included in the forecast. Electricity use is expected to increase at a rate of 1.2 % per annum until 2010. (The forecast expects total electricity use to have risen to 141 TWh by 2015, with 94 TWh 1) of this being certificate-entitled renewable production.) However, NVE today feels, in the light of recent years' development, that the rate of growth maybe less than this.

1) This quantity is calculated on the same principles as used in Sweden, which means that electrically-intensive industry is not regarded as liable for quotas.

2) See more detailed price information in Appendix 1 (Tables 2 and 3).

7.2.1 The ambition level

If the Swedish electricity certificate system should be linked with a similar system in Norway, the initial status as far as quota levels are concerned would be as shown in the diagram below.

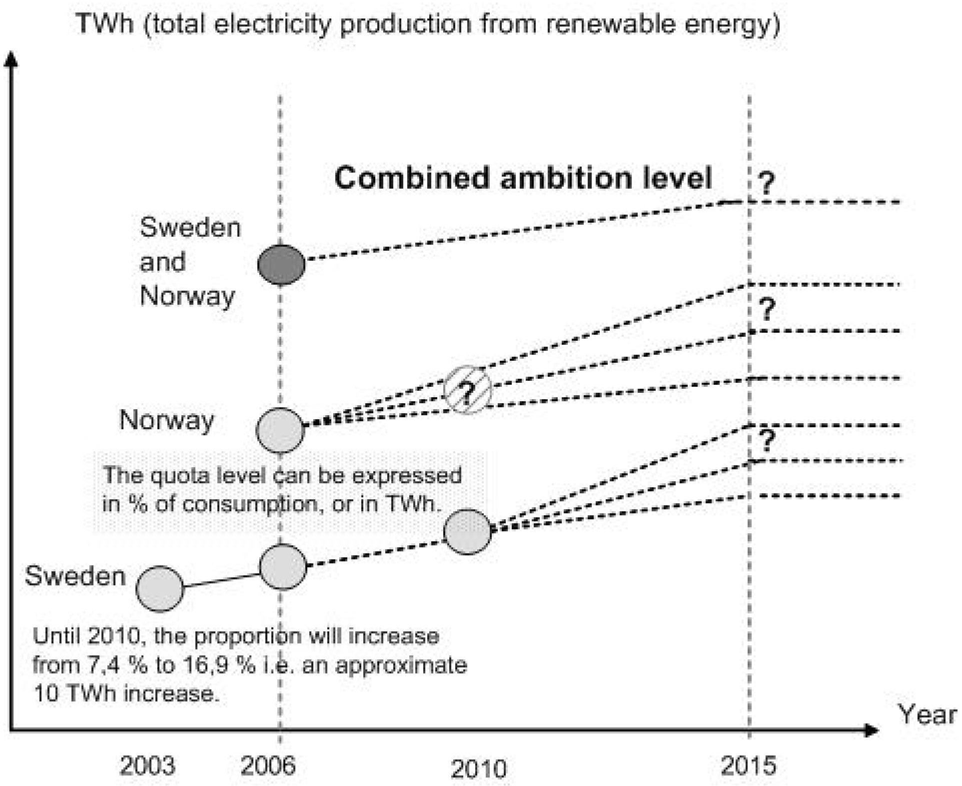

Figure 10: Ambition levels and quota setting on a common Swedish/Norwegian electricity certificate trading market

The first question is what volume of renewable electricity production (i.e. the ambition level) should be added to Sweden's current ambition level up to 2010. This raises the question of how the quota levels up to 2010 should be set. Does Sweden need to alter its present quotas? This should be followed by deciding the ambition level and setting the quotas for coming periods, e.g. to 2015 or 2020. Publishing details of the ambition level and quotas for a relatively long time ahead is important in creating incentives for investments on the market.

Ambition levels as shown in Figure 10 have been proposed/sketched out in the Agency's review of the Swedish electricity certificate system (Stage 2) and in discussions with NVE and Norway. This foresees the quota rising until 2015, thereafter remaining steady or declining, depending on the rules governing the duration of time for which certificates are available to production plants. In the Swedish system, production plants would receive electricity certificates for as long as the system continues. The discussions with Norway have raised the point of changing this, so that the production plants would be given electricity certificates during only a limited period of time, e.g. 10 or 15 years34. If the

[34] However, it is assumed that all investments made up to and including 2015 could count on being allowed to issue certificates for ten years (and also that there would be a demand for certificates on the market). This would mean that the last phase-outs would be made in 2025.

Swedish system is changed, it is likely that it would be necessary to modify the development path of the quota levels. If so, this would mean that future development in Sweden would have a different pattern from that shown in Figure 10. The quota levels would probably decline at some particular time, and then subsequently start to rise again.

In 2006, when it is suggested that the joint Swedish/Norwegian electricity certificate system should start, the Swedish quota level will be 12.6 %. Table 6 shows the planned quota development in the present Swedish certificate system. In the light of the Agency's latest forecasts for quota obligation electricity consumption, the table also shows the expected volume of certificate-entitled electricity production.

Table 6: Quota increases in the present Swedish certificate trading system (to 2010)

Year	2003	2004	2005	2006	2007	2008	2009	2010
Quota	0.074	0.081	0.104	0.126	0.141	0.153	0.160	0.169
Certificate electricity, TWh	7.14	7.90	10.27	12.54	14.18	15.55	16.44	17.54
Additional renewable electricity, TWh	0.64	1.40	3.77	6.04	7.68	9.05	9.94	11.04
Difference from preceding year, TWh	0.64	0.77	2.36	2.27	1.64	1.37	0.88	1.11

In terms of the types of production that are today entitled to certificates, existing Norwegian production amounts only to about 0.5 TWh. If we include new wind power production, as decided from 2004, existing Norwegian certificate-entitled production in 2006 will amount to about 1 TWh.

An important question for the early years of a joint market is how great the rate of increase of Norwegian quotas should be. One starting point could be that the quota would be developed slowly at first, rising more steeply towards the end.

The emphasis of this chapter is on *models* to determine the total ambition level and quota levels. We start from the *time perspective of 2015* (i.e. disregarding necessary development during the introductory years).

7.3 The aggregated ambition level

It is important to emphasise that it is the *aggregated* ambition level that affects the prices on the joint market. How the ambition level is then shared between the respective countries does not affect the price of certificates.

The price of certificates is affected not only by the aggregated ambition level, but also by many other factors. Essentially, it is determined by the price of electricity and the long-term marginal cost curve of new renewable electricity production, which is in turn determined by production conditions. The price of certificates represents the difference between the price of electricity and the total production cost of the technology that sets the price. The certificate price is also affected by the magnitude of the risk premium that the parties include in their budgets, and by their required returns on investment. The risk premium is affected by such factors as political uncertainty relating to the system and its structure, and by the effect of other guide measures and incentives. The required rates of return are individual for each party concerned. All told, it can be seen that price assessments are therefore associated with a wide range of uncertainties.

When deciding the ambition level for the certificate system, the level should be set such that it creates the right conditions for the system to work, i.e. that targets should be achieved, and that the market should operate efficiently (prices as stable as possible, and a market price equivalent to the long-term marginal cost of electricity production from renewable sources).

We have set the following criteria that can be used to determine the aggregated ambition level.

- That the market should operate efficiently,
- …which includes various points, such as the level generating sufficiently high electricity certificate prices as needed to encourage investments, but at the same time not so high that costs for consumers become excessive. Put another way, this means that the frameworks should be sufficiently high for the investors, but at the same time not producing costs that are too high for consumers.
- …that the ambition level, quota levels and the structure of the system should be determined on a long-term basis, so that investors are encouraged to enter the market.
- …that the ambition level should be plausible, and is therefore likely to be widely accepted. This provides plausibility for the whole system.

An efficient market

An electricity certificate system is efficient when the market price is set by marginal costs (P = MC), i.e. so that the system generates market prices that reflect the long-term marginal cost in the supply curve (the production costs) of renewable electricity production. An efficient system will also create the right conditions for leading to target achievement. This means that it is important that prices as determined by the market create a *reasonably stable* price of certificates. Uncertainty of future price levels, regardless of whether they are caused by market risks or political risks, should therefore be restricted as far as possible. The parties on the market must be able to forecast prices with as little uncertainty as possible in order to create the necessary incentives for progressively increasing the capacity of existing production facilities and for building new plants. Expansion of the Swedish market to bring in more countries should improve the price stability of the system. However, this does mean that there should be certain requirements specifying how new countries should set their quota levels, and what forms of production are to be included in the system. In addition, the efficiency of the market can be affected by the planned duration of the system. The likelihood of those on the market acting rationally, so that P = MC, increases if the quota levels in all the countries are published for a sufficiently long period of time ahead.

Sufficiently high prices ...

How do we decide whether prices are *sufficiently* high, but at the same time *not too* high? Sufficiently high prices are those that make it economically attractive to invest in new production. It is also very important that the prices of certificates should remain at a steady, sufficiently high level for a long period of time, as this is very important for investors wanting to work out their returns from the certificate system. If prices should fall drastically in connection with the accession of a new country to the market, there could be problems in financing existing investments.

Certificate prices are intimately linked to the shape of the supply curve for renewable electricity (potentials and costs), and to the ambition level selected depending on the supply curve. Once the ambition level has been decided, the politicians will also largely have determined what the electricity certificate price will be, provided that the supply curve is correct. If the system works, certificate prices will settle at a sufficiently high level to ensure that the necessary production capacity is built.

Prices that are too high will mean that the prices to consumers are also too high. This could occur if the ambition level is set so high that it cannot be met by conventional, economically mature production. It might, for example, force CHP plants to operate in cold condensing mode, or for immature technologies such as solar electricity plants to be built before their costs had fallen.

A joint market will probably produce prices that are relatively lower than those on a sole Swedish market, bearing in mind that production technology as used in Norway has lower costs. When all is said and done, prices will depend on the aggregated ambition level. Chapter 8 describes the model calculations that have been made using MARKAL, which illustrate this.

... but not too high

The cost for the consumer is determined by the established price of electricity certificates, by the renewable target ambition (the number of TWh to which the country will contribute financing) and by the proportion of electricity consumption that does not carry a quota obligation. In addition, any effects on the market price of electricity should also be included, in order to ensure a complete picture. If the market is assumed to operate perfectly, the certificate system will lower the system price for electricity, which will partly compensate the cost increases to consumers in paying for electricity certificates (i.e. for their quota obligation).

The table below shows an overall view of how the cost of consumers' quota obligations vary in response to a number of key parameters. The possible price reduction effects of a lower price of electricity are not included in the table, the purpose of which is to give an idea of the sensitivity of consumers' costs in response to changes in the variables.

- certificate prices
- the volume of quota obligation electricity use
- the quota level.

It should be emphasised that the table is intended to be only illustrative, i.e. it is not based on any calculations of actual certificate prices that could be expected for different levels of the amount of certificate-entitled renewable electricity production in the system.

Table 7 A worked example for the consumer cost of an electricity quota obligation for a specific year.

Increase in renewable electricity quota level (TWh)		12 TWh		16 TWh	
Quota-obligation electricity consumption		**75 TWh**	**100 TWh**	**75 TWh**	**100 TWh**
		Cost of electricity certificate obligation* (öre/kWh)			
Certificate price	**SEK 150 /MWh**	5,1	3,8	6,2	4,6
	SEK 200 MWh	6,8	5,1	8,3	6,2
	SEK 250 MWh	8,5	6,4	10,3	7,7
	SEK 300 MWh	10,2	7,6	12,4	9,3
	SEK 350 MWh	11,9	8,9	14,4	10,8
	SEK 400 MWh	13,6	10,2	16,5	12,4

* Including an assumed transfer charge of 10 % to the distributor plus VAT at 25 %.

In reality, there is a clear relationship between the selected total ambition level in particular and the price of certificates. For example, a situation in which the volume of renewable electricity increases sufficiently will mean that the prices of certificates will almost certainly rise. Consumer prices increase when the total volume of renewable electricity increases, partly because 'more' electricity production must be paid for, and partly because more expensive production is required, i.e. the price of certificates rises.

Within a given volume range (of TWh of new production in the system), the cost will rise only marginally, while with a given volume, the underlying cost can rise in steps to a higher level due to the fact that new production technology is required in order to fulfil the quota. However, this is not reflected in the table.

In preparing this report, we have not performed any sensitivity analyses of the increased costs that result from a given quota level. Attempting to do so is complicated by the fact that it is difficult to judge what proportion of the quota obligation cost can be compensated by a lower price of electricity. It is probably both the quota-carrying consumers and the producers of non-certificate-entitled electricity who pay for the cost of electricity certificates. Consumers pay via their quota obligation, while the producers of 'brown' electricity pay in the form of non-receipt of revenue due to the fact that the certificate system probably results in a lower system price on the Nordic electricity market. The beneficiaries are therefore the non-quota-obligated consumers, together with the producers of renewable electricity.

However, in general, it can be said that, as far as domestic consumers in Sweden are concerned, the rises in the total cost of electricity due to the certificate cost element would further add to the continuous rise in prices in recent years (primarily as a result of increases in taxation). This would strengthen the incentive to reduce electricity consumption, e.g. by replacing electric heating with some other form of heating. The price elasticity of electricity used for equipment etc. is low, and so it is unlikely that there would be any significant effect on each level of use.

The long-term view

Taking a long-term view of setting the final ambition level means primarily deciding the level for a sufficiently long period of time into the future. As investments in renewable electricity production have varying writedown times, there is no single given answer to how far into the future the ambition level should be set. The Agency's review of the electricity certificate system has calculated a number of different sensitivity alternatives for production costs having writedown times of 15, 20 and 30 years respectively. In all cases, hydro power was assumed to have a writedown time of 40 years. The material also points out that a writedown time that has often been used in recent years for the writedown of public sector investments is 10-15 years. This length of writedown is regarded as being closer to a more commercial evaluation of investment projects. A conclusion from this is that the time perspective to be employed when setting ambition levels should be at least 10-15 years35. Stage 2 of the Agency's review of the certificate system considered (in general terms) how potential investors and lenders might be expected to think, as far as suitable time perspectives are concerned when determining ambition levels. This indicated that the various parties felt that a system with quotas set only to 2010 is far too short-term for larger investments having longer writedown times. Some parties felt that an extension of the system by ten years would be sufficient to create incentives for new investments.

Wide acceptance

That the ambition level (the decided quota levels) is important in deciding whether there is a wide acceptance of the system is closely linked to the first point – that stable certificate prices are expected, and that costs should not be too high,

[35] According to the National Tax Board's guidelines for writedown percentages, the life of hydro power plants is given as 50 years (2 % interest), CHP plants as 25 years (5 % interest) and wind power plants as 20 years (5 % interest).

i.e. that both producers and consumers regard the system with favour. In an international certificate market, it is also important that both countries should see the market as fair. In this case, it is the *model* of how the quota levels are set that is decisive. The final result is also affected by the countries' attitude towards the geographical dimension – i.e. where the new production facilities are expected to be built, in relation to how much each country pays.

7.4 Models for determining quota levels

We have been able to identify two main models for deciding the ambition level when a (second) country wishes to join an existing electricity certificate system: see 1 and 2 in Figure 11. We have also identified two types of models for assigning the total volume of renewable electricity production to the consumers with quota obligations, i.e. for calculating the quota levels for each country. See A and B in the figure below.

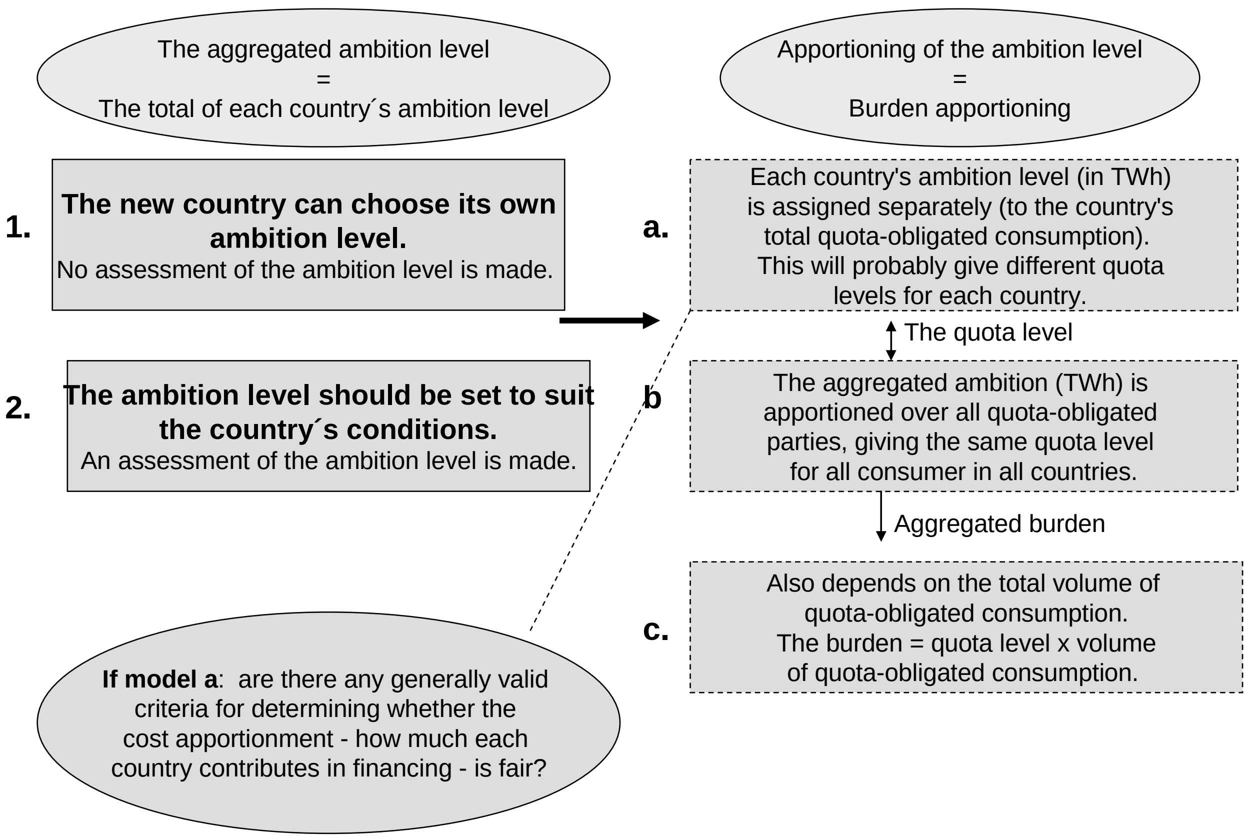

Figure 11 Illustration of different aspects/models for setting ambition levels

7.4.1 How much production should the electricity certificate system aim to create? Main models 1 and 2

It can be worked out from a theoretical point of view that a larger market – in this case, an international market – would result in benefits in the form (primarily) of improved cost efficiency (a larger market provides greater opportunities for new renewable electricity production at lower costs), see Chapter 3. Benefits in terms of the overall national standard of living are achieved as a result of a lower electricity certificate price (for a given quantity of new renewable production).

If the market is expanded to include several countries, it will still lead to cost efficiency and overall national standard of living benefits, even if the new member country has a relatively low ambition level for the volume of renewable electricity production that it intends to finance. With just this as the starting point, it can be determined that the countries can have very different ambition levels, and yet the system will still work and produce cost efficiency gains as a result of internationalisation of the electricity certificate market. This is illustrated in Model 1 in the figure above.

There is, however, an important reservation, which is how the certificate price on the established market might be affected by the accession of a further country. This is affected by the ambition level of the new country in relation to its conditions for producing renewable electricity. As previously described, the price of electricity certificates is affected by a number of factors, including the *total* volume of electricity production from renewable energy sources that is to be generated as a result of the electricity certificate system, in relation to the magnitude of the potential.

An example of this is provided by the situation that would arise if conditions in the new country are favourable for producing renewable electricity, while the country wants to enter the system with a low ambition level (in TWh), so that a relatively low production volume is added to the total volume. This can then result in downward pressure on the price of certificates, creating instability on the established market. The opposite can also apply, with a new country having high ambitions but limited funding and limited potentials for new generation at home, which would have the effect of freezing the prices of certificates on the established market. An uncertainty factor is also introduced by knowing that a new member country with a different ambition level can join the system, thus changing the price patterns and conditions for existing and future investments. The larger the new country is in relation to the existing market, the greater will be the uncertainty. Conversely, if the international market grows, price effects will be dampened when the next country joins the established market.

Consider the illustration below. If the market is operating perfectly, the price of certificates on an existing market consisting of Countries A and B will be P_{A+B}. If a third country, C, joins the system with an ambition level Q_C, there is a clear risk of the price level on the combined market falling. If the market operates perfectly, this new lower price will be P_{A+B+C}. In relation to the country's supply curve, Country C's ambition level results in considerably lower marginal costs for renewable electricity production, which can be expected to have a downward pressure on the price of certificates.

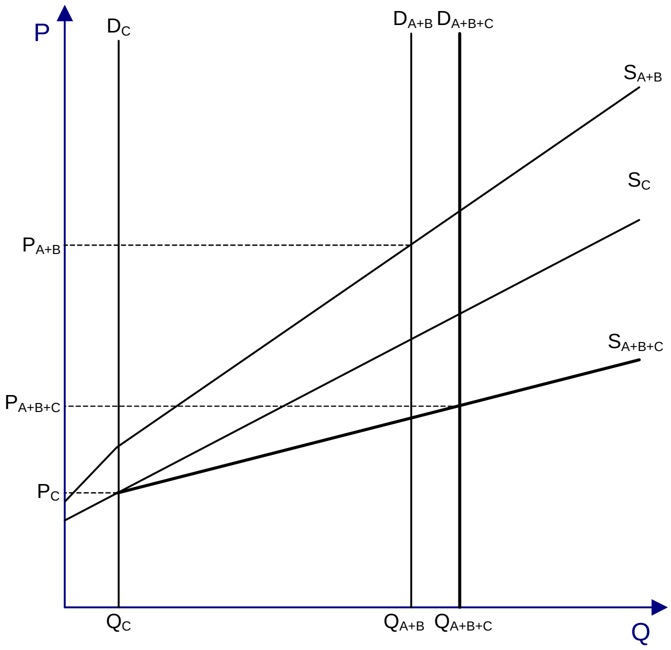

Figure 12 Illustration of supply curves and quota levels for two countries, together with a case where they are joined by a third country with a low ambition level and low production costs.

Figure 13 illustrates the corresponding situation when the new country has a high ambition level, with relatively high costs of renewable electricity production on its home soil. With a given ambition level Q_C, the effect of Country C joining the system will be to increase the price of certificates from P_{A+B} to P_{A+B+C}.

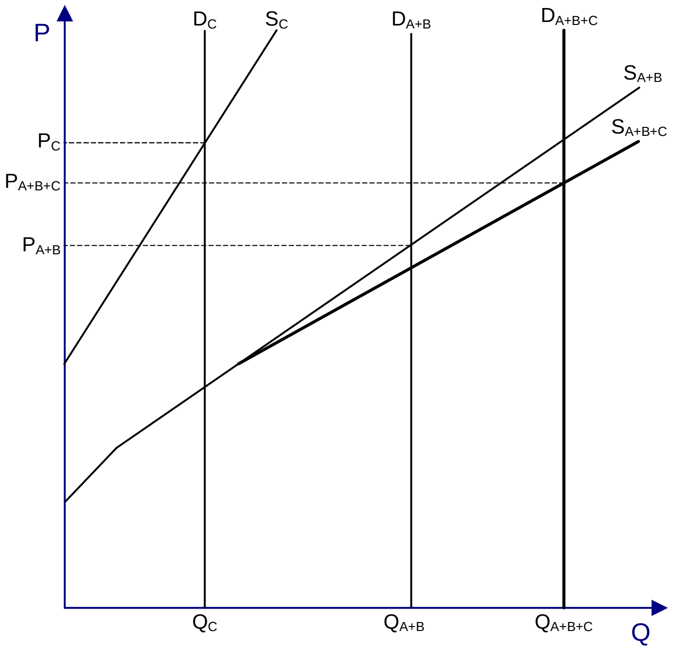

Figure 13 Illustration of supply curves and quota levels for two countries, together with a case where they are joined by a third country with a high ambition level and high production costs.

Table 8 summarises the above reasoning.

Table 8 Possible situations arising when a third country (not having performed any special assessment of its ambition level) joins a relatively small international market.

	High ambition level	Low ambition level
High costs	The certificate price rises. A considerable proportion of production ends up in the original market.	Certificate price will remain unchanged if the ambition level is sufficiently low. Production will probably remain in the original market.
Low costs	Certificate price will remain unchanged if the ambition level is sufficiently high. Production will probably end up in the new country.	The price of certificates falls. Much of the new production ends up in the new country.

Our conclusion is that Model 2 is the most suitable model if excessive certificate price changes are not to occur in the existing market when a further country joins the system. This applies particularly as long as the international market is not particularly large, i.e. as long as the market price can be thought to react strongly as the result of an additional country joining the system. Even in a situation where the initial market is large, it can be advisable to assess the ambition level that the new country wants to finance. If a country having a sufficiently large production potential (at low cost) wants to join the market, it can affect certificate prices on the market even though the initial market is large. The new country's ambition for the volume of renewable electricity production that it is willing to finance should therefore be related to the country's conditions. By analysing the conditions using Model 2, it becomes possible to advise the candidate country whether it should set its ambition level above or below Q_C (as shown in Figures 12 and 13).

The results of a Model 2 analysis make it possible to set countries' ambition levels at a value such that the marginal costs of production within the accession countries, as based on the supply curve, do not differ *too* much between countries. On the other hand, it is important not to arrive at such a value that exactly the same marginal costs are created. In such a situation, and with a perfect market, there would be no need for any trading in certificates, as seen as a total over the year.

In absolute terms, it is likely that TWh ambition levels will differ between countries, as each country has different conditions for its certificate-entitled electricity production.

7.4.2 Assignment of the aggregated ambition level – Models a and b

In order to be able to decide the TWh amount that each country should finance, we should first determine the total TWh volume that should be assigned to quota-obligated consumers via the certificate system, i.e. what the quota levels should be for the participating countries. We can initially see two essentially different models for determining how the quota levels should be apportioned.

a. That *the TWh ambition level determined for each country should be spread over each respective country's consumers having quota obligations.* This would very probably result in the quota levels differing from country to country.

b. That all consumers should have the same quota level, i.e. that *the quota level is the same for all parties having quota obligations in the system,* regardless of in which country they live. The total ambition (i.e. the volume of renewable electricity production to be built within the framework of the system) would be spread over the total number of consumers having quota obligations in all the countries

Table 9 Two models of quota obligation assignment.

	Advantages	Drawbacks
Model A Country-by-Country Assignment of ambition levels (i.e. volume of renewable electricity production). Different quota levels in each country.	It is clear that each country starts from its own ambition level. Each country has greater flexibility for determining its quota level. Allowance for specific conditions is possible in each country.	Represents a departure from the principle that each consumed kWh of electricity shall contribute to the same quantity of new electricity production from renewable energy sources.
Model B Same quota levels for everyone	Transfers the emphasis from each country (makes it clear	Becomes more difficult to distinguish each country's

in the system.	that it is a consumption objective at an overall level that applies to each country). Produces a more cohesive system and reduces political uncertainty.	ambition level. More difficult for a third country to connect to the system. It may be necessary for the joint quota level to be recalculated when an additional country joins.

7.4.3 The aggregated cost for a country also depends on the proportion of its electricity consumption that carries a quota obligation – Frame C

The total cost to a country is also affected by its total quota-liable electricity consumption.

The table below shows the results of calculations including the 'total quota-liable electricity consumption', in order to permit analysis of the total cost of each country's quota-liable electricity consumption. The example has been worked out for three different countries, A, B and C. As the price of certificates is the same across the market, we can compare ambition levels directly without having to calculate the cost in absolute terms, i.e. in SEK[36]. The aim is to see how the two models affect the total cost for the countries.

Table 10 Illustration of the cost for three countries, with two different models of quota obligation assignment.

Quota-liable consumption Country A=100 Country B=80	**Ambition level**	**Assignment of number of TWh, according to Model A.**	**Total cost**	**Assignment of number of TWh, according to Model B.**	**Total cost**
Country A	3	3/100=0,03	3	11/320=0,034	0,034*100=3,4
Country B	5	5/80=0,0625	5	11/320=0,034	0,034*80=2,72
Country C	2	2/140=0,014	2	11/320=0,034	0,034*140=4,76

From this worked example, we can see that, although Model B uses the same quota level for all individual consumers, the total burden (in terms of SEK payments) differs between the countries due to the fact that the quota-liable volumes differ. In this example, Country C will pay the most in total, followed by Country A and Country B. In Model A, on the other hand, in which the number of TWh that each country is willing to finance is assigned separately for each

[36] It is not necessary to include the price in this example, as we are concerned only with relationships between the countries. However, in order to obtain an idea of the cost levels concerned, we can convert the certificate price per MWh to an equivalent price per TWh. An electricity certificate price of SEK 100/MWh is equivalent to a cost of SEK 100 million per TWh of electricity production from renewable energy sources.

country, the cost is identical with the initial assignment, i.e. Country B pays more than Country A, with Country C paying the least in total.

We feel that Model A should be selected, primarily because it allows greater freedom for each country to influence its quota level. In Model B, all the countries have to accept a certain given quota level, which also makes it more difficult for additional countries to connect to the system. It might, in such cases, be necessary to recalculate the entire joint quota level.

In addition, Model A means that the cost relationship between the countries remains, even when the number of TWh is assigned across the quota-liable electricity consumption. This means that the cost relationships between the countries are equivalent to the initial assignment of the ambition levels, expressed in TWh. From this, it is also possible to 'discuss' in TWh when considering the assignment of costs.

7.4.4 Is it possible to reach a fair assignment of the burden?

According to the principle that we have decided (Model A), the total cost for the country's quota-liable electricity consumption is represented by the initial assignment of the ambition level (TWh). One of the arguments for this is that each country should have some freedom in determining its own ambition level – the number of TWh that the country is willing to finance in the system.

The electricity system then 'converts' the ambition level to an electricity certificate *obligation* for the electricity consumers, which it does by setting a quota level for each of the years during the life of the system. The size of these quota levels will be affected by the magnitude of quota-liable electricity consumption, i.e. by whether each country elects to exempt some parts of its electricity consumption from the quota obligation.37

We have previously shown that each new country's ambition level should be assessed on the basis of the country's production conditions for renewable electricity production. This produces a result in the form of a range of 'acceptable ambition levels' that will not cause too great alterations in the price of certificates on the existing market.

The next question is whether the accessing country should be free to determine its own ambition level within the framework of the acceptable interval, or if it is

[37] The system can be designed so that it is determined by the quota level, which is how the present Swedish system is arranged. This means that the exact distribution of costs between the countries will be finally confirmed only when the target year is reached, and that the distribution will be affected by the development of electricity consumption in each country. Alternatively, the system can be designed so that a TWh objective is set for each year. In this case, each country knows exactly how much generation it will be required to finance, in that the TWh objectives will have been defined right up to the target year.

possible to find generally valid criteria that provide a 'fair' distribution of the costs.

Our conclusion is that it is very difficult to arrive at criteria intended to produce a 'fair' distribution of the number of TWh that each country contributes to financing. It is simply difficult to define what is 'fair', which is particularly the case when making comparisons between countries having different economic and/or political conditions. Not only is it difficult to arrive at a 'fair distribution of the burden', but we also feel that there is not, in fact, any overwhelming need to do so. In an international electricity certificate system, each electricity certificate is accompanied by its environmental value which, for one country, is the same as the number of TWh financed by the country and which is expressed in the form of a quota level. This means that the aggregated burden which the country assigns to its quota-liable electricity consumption at the same time corresponds to the environmental benefit that the country may credit itself with. This also applies in accordance with, for example, the RES-E Directive. The lower the burden, the lower the credited environmental benefit.

We describe below some examples which show that it is difficult to find generally valid criteria for comparison of cost assignment, i.e. what each country is financing within the framework of the system.

Approximately equal costs for fulfilling quota obligations

One criterion could be that the costs of fulfilling quota obligations should all be about the same. In order to be able to calculate the cost of fulfilling the quota obligation, we need to know the average consumption of electricity as well as information on the total quota-liable consumption (in order to be able to calculate the quota level from the TWh ambition level). Table 11 is an example of this.

Such a comparison would be fairly relevant in the Norway/Sweden case, as economic development is at approximately the same level in both countries (pay levels being reasonably comparable), and both countries have had policies of attempting to encourage renewable electricity production even before the introduction of the electricity certificate system. However, if another neighbouring country, Poland, wanted to connect to the system, the comparison would not be equally fair. Poland's economy is at a different level of development (with lower pay levels), and its national energy policy has differed from that of the Nordic countries. This example clearly shows that the criterion "*that the costs of consumers' electricity certificate obligations should be approximately the same*" is not applicable in a situation in which a country such as Poland wishes to join the system. According to this criterion, Poland would have to finance extremely high volumes, and set very high quota levels, in order to participate.

There are factors that complicate the picture even in the comparison between Norway and Sweden. The calculations in the table have been made on the basis of average electricity consumption per capita and per household. These values differ considerably, as Norway has an extremely electricity-intensive industrial sector. If this sector is exempted from quota obligations, it is the value of the average electricity consumption per household that becomes more relevant. In other words, allowance needs to be made for which part of a country's electricity consumption is to be exempted from carrying a quota obligation in order to produce a fair comparison.

According to this arrangement, and with a distribution of 21 TWh of renewable electricity production in Sweden and 13.5 TWh in Norway, the quota obligation costs for domestic consumers would be of approximately the same order in each country.

Table 11: Examples of calculated annual quota obligation costs for consumers in Sweden, Norway and Poland.

SEK/MWh for quota-obligated consumers	Sweden	Norway	Poland 1)
On the basis of average electricity consumption per household	**21/96*13,7*200=599** If the quota level is adjusted as plants are phased out, the costs can fall to about SEK 390/MWh. This assumes a phase-out of 7 TWh of plant capacity.	10/80*17,9*200=447 12/80*17,9*200=537 13/80*17,9*200=582 **13,5/80*17,9*200=604** 14/80*17,9*200=626	
On the basis of average electricity consumption per inhabitant	**21/96*16,2 *200=709**	10/980*25,2*200=630 **11/80*25,2*200=693** 12/80*25,2*200=756 13/80*25,2*200=819 14/80*25,2*200=882	10/96*3,3*200= 68 15/96*3,3*200= 103 30/96*3.3*200= 206

1) The assumed quota-obligated electricity consumption has been calculated by excluding the most electricity-intensive sectors (almost 30 TWh – a very rough estimate) from the country's total consumption of over 120 TWh.

NB: The price of electricity certificates has been set at SEK 200/MWh.

Further aspects complicate the picture, as follows. Assume that the Swedish system is changed, so that plants are phased out after a certain number of years (a limited life for plants in the system). In order to prevent this from causing severe price fluctuations on the market, it would be necessary to adjust the quota level downwards. All other things being equal, this would mean that Swedish consumers would see a reduction in their quota obligation costs sometime in the future. However, for Norwegian consumers, the quota cost would not change unless the market price changed. This therefore introduces a further factor that must be considered.

Assignment based on per-capita GNP.

A better basis for comparison would be obtained by including information on per-capita GNP – i.e. a measure of each country's per-capita economic strength.

Table 12 Per-capita GNP

	Sweden	Norway	Poland
Per-capita GNP.	28 100	36 100	11 500
This gives a cost relationship between countries of:	1	1,28	0,4

NB: GNP in USD, converted in accordance with PPP (a measure of purchasing power in each country).

Source: OECD

Table 12 shows that, on the basis of per-capita GNP, a 'comparable' cost for a consumer's quota obligation in Norway would be about 28 % above the corresponding cost for a Swedish consumer. This would mean that the number of TWh to be financed in total by Norway would exceed the 13.5 TWh in the earlier comparison. However, this comparison applies only provided that both countries apply the same exceptions to quota obligations. On the basis of this comparison, Poland would contribute to the system such that the costs to its consumers would be about 60 % less than the corresponding cost in Sweden, if subject to the same rules for quota obligation exemption.

Although we are now approaching a rather more generally applicable basis of comparison, we still feel that it should not be a requirement in an international certificate system that the cost should be apportioned in accordance with criteria intended to produce a fair distribution of the burden. It therefore still remains a fact that it is *extremely* difficult to find a basis for comparison that is generally applicable. The example above does not, for example, consider the effects of, or what has been, political policy in the various countries before joining the joint certificate system. In addition, we feel that each country should have some freedom to set its own ambition levels. A further aspect is introduced by the overall regulatory structure within the European Union. It is therefore uncertain whether excessively severe requirements could be set if a third country wants to join the system.

Our conclusion is therefore that an assessment should be made primarily from the supply curve when a third country enters the system.

7.5 A comparison of quota levels between the countries

This section is an illustrative example, starting from the models described above, and focusing on conditions in Norway and Sweden. The method can be used when a further country wishes to connect to an existing certificate system.

The starting point is Model 2, i.e. that of assessing the ambition level of the new country in relation to its conditions for producing renewable electricity. The objective is that the price of certificates on the established market should not be affected too much, and so two supply curves have been produced for Sweden and Norway in order to do this.

We start from different ambition levels for 2015. We believe that at least this time horizon is required in order to ensure that the system is sufficiently long-term to provide incentives for new investments.

For simplicity, we have selected *one* TWh volume for Sweden, setting the country's ambition level to a total production equivalent to 21 TWh (which includes existing production). Note that, in a case in which existing production facilities are starting to be phased out of the system as they come to the end of their defined life in the system, the Swedish quota level and the described supply curve should be altered in order to prevent excessive price effects arising on the market.

Note also that, if other assessments are made (such as for production costs), the levels in the example will change.

Figure 14 shows the supply curves for the two countries, prepared from input data for the MARKAL model. It should be noted that the curves are not out-and-out supply curves, but should be seen rather as electricity certificate price curves. They show that part of the marginal cost over and above the market price of electricity, i.e. the price of certificates, which is the same as the marginal cost for production of electricity from renewable sources, including any shortfall costs, but minus the market price of electricity. Two curves have been prepared: one for an interest rate of 5 % (Figure 14), and one for an interest rate of 10 % (Figure 15).

The difference between these two curves (5 % and 10 % interest rates) is that the certificate prices are generally higher with a higher interest rate. The slopes of the curves also differ, as capital-intensive production (such as wind power) becomes relatively more expensive with the higher interest rate. This also means that production costs increase relatively more in Norway, as the main certificate-entitled production in Norway - hydro power and wind power - is more investment-intensive. The capital cost therefore accounts for a relatively smaller part of the total cost in Sweden than it does in Norway.

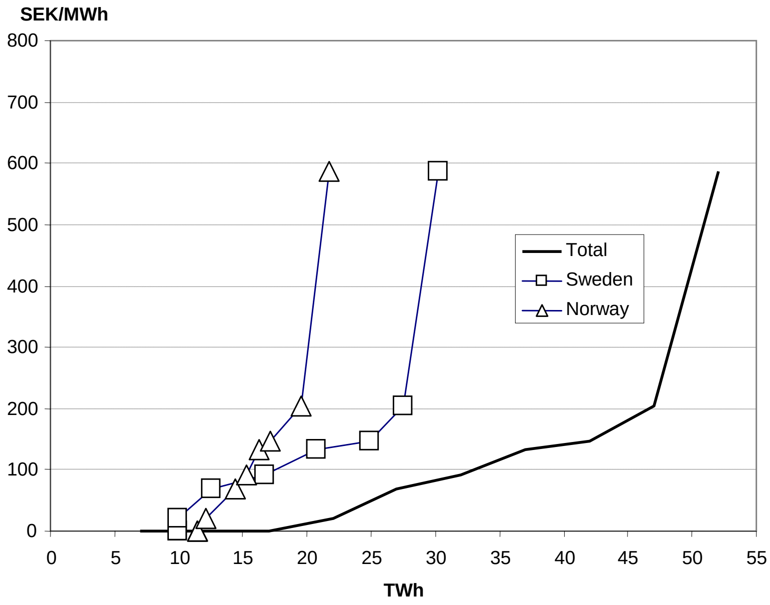

Figure 14: Certificate price (i.e. the marginal cost of generation of renewable electricity *less* the market price of electricity) and qualifying electricity production on a common Swedish/Norwegian certificate trading market for different quota sizes. Real rate of interest: 5 %.

Source: MARKAL calculations, Profu (2004)

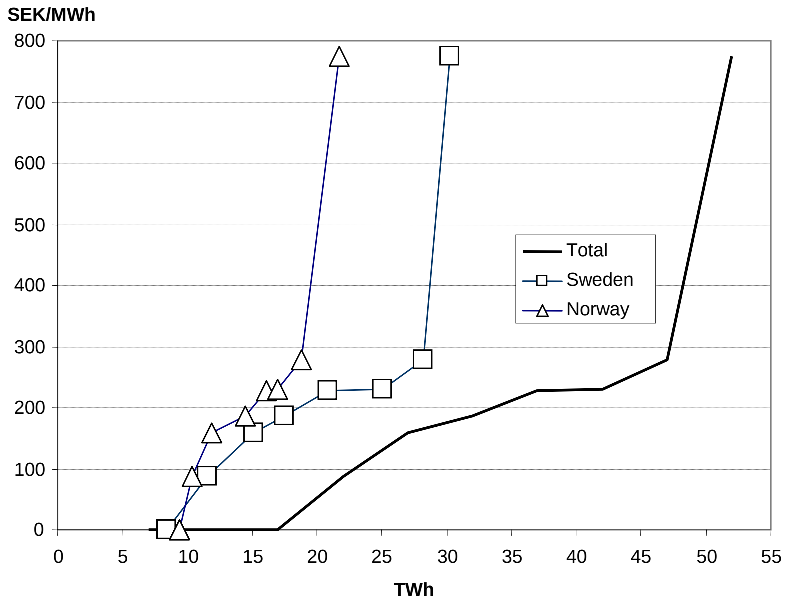

Figure 15 Certificate price (i.e. the marginal cost of generation of renewable electricity *less* the market price of electricity) and qualifying electricity production on a common Swedish/Norwegian certificate trading market for different quota sizes. Real rate of interest: 10 %.

Source: MARKAL calculations, Profu (2004).

It can be seen from the curves (the countries' production conditions) that an ambition level of 21 TWh in Sweden (including existing certificate-entitled production of about 7 TWh) is equivalent to a Norwegian ambition level of about 17 TWh (in 2015). The starting point is then that of equal marginal costs for certificate-entitled production. The ambition level chosen for Sweden represents an increase of 5 TWh over 2010.

However, we are not trying to achieve exactly the same marginal costs in each country: what we have found from the diagram is that the amount of TWh of renewable electricity to be financed by Norway should not differ *too much* from 17 TWh. We can, for example, see from the diagram that if Norway had a considerably lower ambition level, the Swedish objective of 21 TWh would mean that a relatively high proportion of the certificate-obligation electricity in Sweden would have to be supplied by importation from Norway. This would mean that certificate prices in Sweden would almost certainly be lower than if the two national markets were separate.

Conversely, if Norway had a considerably higher ambition level than 17 TWh in 2015, the Swedish objective of 21 TWh would mean that a relatively large quantity of certificates would be exported from Sweden, which would naturally raise the price of certificates relative to the price on two separate markets.

It can be seen from the joint availability 'price' curve that Norwegian ambition levels above 21 TWh (i.e. giving a joint level of over 42 TWh) would result in relatively substantial price increases. In the higher interest rate case, the prices would rise relatively rapidly from SEK 230/MWh to SEK 280 MWh in this case. With a joint ambition level exceeding 47 TWh, the prices would take off vertically.

It is our assessment that, with a Swedish ambition level of 21 TWh, the Norwegian ambition level (TWh to be financed by Norway) should not be less than 12 TWh or more than 21 TWh. The Norwegian ambition level should probably be somewhat above the lower limit, at about 13-14 TWh, in order to avoid undesired price depression. The calculated supply curves (electricity certificate price curves) show that a joint ambition level of 34-35 TWh would be likely to produce a market price of about SEK 115-120/MWh with a 5 % interest rate, or a market price of over SEK 200/MWh with a 10 % interest rate. See also Chapter 8 for a more detailed presentation of the MARKAL calculations.

It should be noted that these are model calculations, which do not allow for institutional or political uncertainty effects. If these risks are regarded as significant, it is probably the higher interest rate case that provides a better indication of where the prices could be expected to end up38.

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[38] The model does not incorporate any element of risk behaviour or a risk premium (instead, it postulates complete knowledge of the future), and nor does it include any administrative costs for certificate management. The effect of this would be to underestimate certificate prices in comparison with a real situation. The higher interest case can give some indication of the effect of this difference. In addition, the model makes no allowance for sanction charges or for floor price levels for certificates, and nor is it capable of allowing for the effects of banking, i.e. the ability to carry certificates forward from one year to the next.

8 Long-term structural effects

This chapter discusses the long-term structural effects on a expanded electricity certificate market, with the emphasis on a possible market between Sweden and Norway.39

The Swedish Energy Agency reaches the following conclusions:

- The effects of a joint Swedish/Norwegian electricity certificate market are not clear-cut, but are considerably dependent on quota sizes, costs and the opportunities for expansion in the market countries.
- In general, it seems to be the case that, for a lower total aggregated ambition level (in TWh), Norway would be a net exporter of certificates, i.e. that it would produce more renewable electricity (hydro power and wind power) than is required by its national quota. In this case, the price of electricity certificates in Sweden would be lower (on a joint market) than on an isolated Swedish market, thus reducing costs for Swedish consumers.
- The reverse would seem to apply in the case of a higher aggregated ambition level, with Sweden producing more renewable electricity than required by its quota. It is primarily biofuelled CHP and wind power that can compete with Norwegian wind power.
- The results of investments are very dependent on the required rates of return. High uncertainty levels, with resulting high required rates of return, put wind power at a disadvantage in relation to biofuelled CHP.
- The new production facilities entering the Nordic electricity system would tend to displace primarily gas-fuelled power generation, which would otherwise have been built. This reduction in natural gas-fired production would be evenly spread across Sweden, Norway and Finland. Some reduction in Danish coal-fired power production could also be expected.
- Expansion of the electricity certificate market brings in more parties and greater volumes, which would probably improve stability and competition on the certificate market.
- There would be significant efficiency gains through establishing a joint electricity certificate market for the two countries, instead of operating two separate markets. It has been estimated that system costs would be about SEK 100-200 million/year lower.

This chapter discusses primarily the following aspects of the work of the report:

In the longer term, looking about ten years ahead, an expanded electricity certificate market can also have structural consequences in addition to short-term and long-term economic effects. The Swedish Energy Agency should analyse the long-term effects on aspects such as pricing, competition, market stability and the consequences for development of investments in production facilities on a joint electricity certificate market.

[39] Chapter 7 describes how investments and pricing are affected by the entry of an additional country to an existing market.

This chapter is largely based on two investigations that the Agency has had performed for this work. Calculations have been made by the consultancy, Profu, using a technical optimisation model of the Nordic energy system (MARKAL-Nordic)40, while Kristina Ek and Patrik Söderholm of the Luleå Technical University, together with Erik S. Amundsen at the University of Bergen, have carried out consequent analyses of long-term structural effects41.

8.1.1 Ambition level assumptions (TWh, 2016)

The analyses described in this chapter look towards 2016, i.e. ten years on if a joint Norwegian/Swedish market starts in 2006 as planned. The magnitude of the aggregated ambition level (i.e. the amount of renewable electricity to be produced, in TWh) on the joint market is decisive for the long-term economic and structural effects that will arise. However, other factors such as the real rate of interest used in the investment budget, also affect development.

The quotas used in the MARKAL model calculations – i.e. the proportion of electricity consumption that is to be entitled to certificates – have been expressed in TWh and not as a percentage. They have then been kept constant from 2016 until 2051 for both Sweden and Norway. It has been assumed, for the second year modelled by the program (2002), that certificates worth 7 TWh were issued in Sweden, and none in Norway.42

The calculations have been made on the basis of various assumed TWh ambition levels, with the levels being expressed either separately for Sweden and Norway or jointly for the two countries. Two different national ambition levels have been calculated for Norway: 10 TWh and 20 TWh. For Sweden, the calculations have been made on the basis of a 21 TWh ambition level (which includes existing production). This means that the results show both how the ambition would be achieved through two separate national markets, and how conditions change when the aggregated ambition level is achieved on a joint certificate market. In addition to the two combinations (21 TWh for Sweden + 10 TWh for Norway and 21 TWh for Sweden + 20 TWh for Norway), two further ambition levels have been calculated for a joint market: (25 TWh for Sweden + 20 TWh for Norway) and (30 TWh for Sweden + 25 TWh for Norway). It is the aggregated ambition level that is interesting as far as the results (i.e. market development) are concerned.

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[40] Profu, 'Analysis of a Swedish/Norwegian electricity certificate market – calculations using the MARKAL model', 2004.

[41] Ek, K., P. Söderholm and E. Amundsen, 'Long-term consequences of an expanded Norwegian/Swedish electricity certificate market', 2004.

[42] Production facilities that are assumed to be entitled to certificates are wind power, all new hydro power, biofuel-based production (peat is included in the model, but assumed not to be entitled to production certificates), solar electricity and wave power. Taxes at the 2004 rate are included. However, the model excludes all subsidies for renewable power in Sweden and Norway, and replaces them instead by a certificate quota. In addition, it is assumed that the European carbon dioxide emissions trading system will start in 2009, with the price of an emissions trading certificate at about USD 10/tonne (equivalent to 9 öre/kg of CO_2). This additional cost will devolve upon the trading sector.

Sensitivity analyses have been carried out to see how the results are affected by changes in a number of important parameters: investment costs for wind power, the real rate of interest, biofuel prices, potentials for new hydro power in Norway and the price of emission rights. The effects of some of these are described in the following section: see Profu, 2004 for a more detailed presentation.

It is very important to remember, when interpreting and applying the results described in this chapter, that they provide only an indication of what could happen in the future, subject to various assumptions.

8.2 Investment conditions in the long term

How investments are made, where electricity is produced, what the effects are on electricity certificate and electricity prices, and how the rest of the electricity system is affected by a joint market, are all determined largely by the production costs and potentials for renewable electricity production in the countries on the market. Another important aspect that affects investment decisions, and not least investment costs, is the degree of future uncertainty. This uncertainty can embrace future energy and climate policies, the degree of public acceptance and, not least, legal aspects of the granting of concessions and physical planning aspects of renewable power projects. This section describes investment conditions in the long term.

8.2.1 Production costs and potentials in the long term

Norway is regarded as having considerably better wind sites than Sweden, together with a substantial potential for new hydro power, all at relatively low costs. However, in the light of uncertainties relating to factors such as the expansion potential for new hydro power, once these resources have been fully utilised any further raising of the aggregated ambition level will tend to become quite expensive. Admittedly, it is assumed that new hydro power production in Sweden will make only marginal contributions, but there is always potential to utilise the relatively large district heating heat sink for biofuelled CHP, which is effectively unavailable in Norway. In addition, Swedish wind power potential should reasonably be much the same as in Norway, although the costs for its expansion are likely to be higher in the former country.

The diagrams below show the future production costs and potentials for the various forms of electricity production that are today entitled to certificates. These costs and potentials have then been used as inputs for the MARKAL-Nordic model, as described later in this chapter43.

[43] See the original report, Profu 2004, for a more detailed description of methods, input data and assumptions as used in the MARKAL calculations.

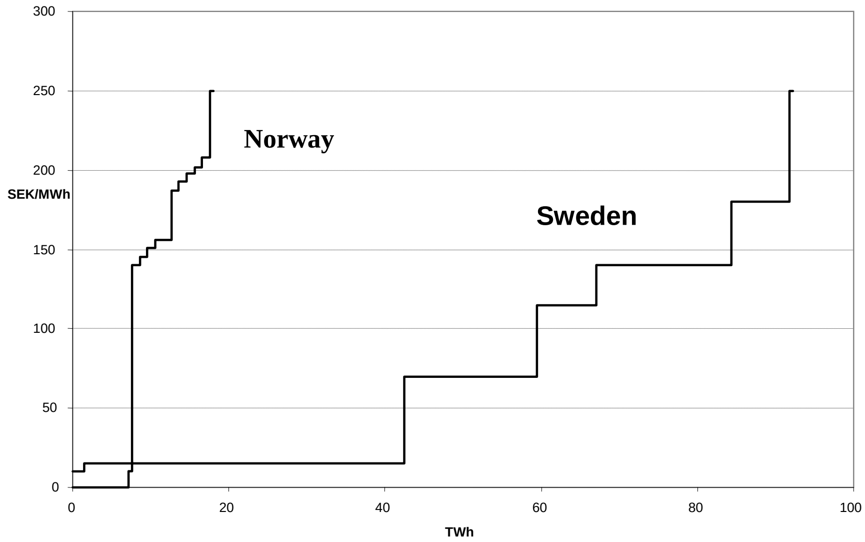

Figure 16: Costs and potentials for <u>biofuels</u> entitled to electricity certificates (2009)

Source: Markal-Nordic, Profu (2004)

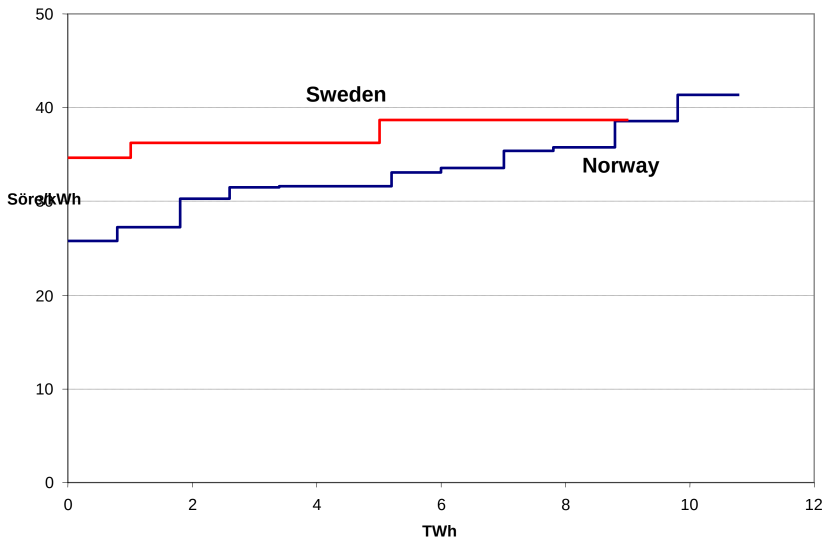

Figure 17: Assumed supply curve for new <u>wind power</u> (2016)

Source: Markal-Nordic, Profu (2004)

Wind power conditions differ considerably between Sweden and Norway. It has been assumed throughout that the total cost of electricity production from wind power is lower in Norway than in Sweden due, to some extent, to better wind conditions. This is despite the fact that the investment cost of onshore wind power plants is generally assumed to be higher in Norway, as a result of greater distances to the grid and higher costs for ancillary works such as access roads (for maintenance). In addition, it has been assumed that all wind power in Norway would be onshore or coast-based, and not offshore, due to the substantial sea depths.

The costs of wind power production are in parity with those assumed in Elforsk (2003). Due to major variations, they do not include costs for actual connection to the grid or for any grid reinforcements, but they do include a cable to the shore for offshore wind power.

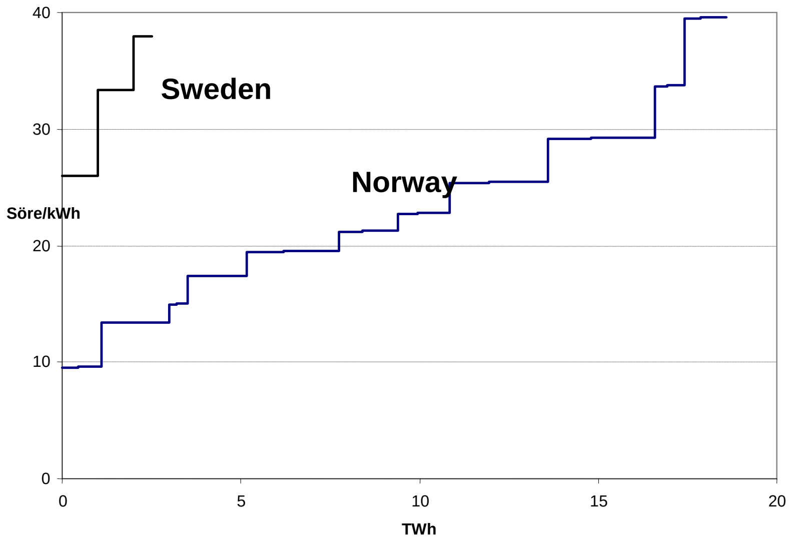

Figure 18: Assumed supply curve for new <u>hydro power</u> (2016)

Source: MARKAL-Nordic, Profu (2004)

It is assumed that Norway has significant potential for new hydro power, although Sweden has considerably less, as shown in Figure 18. However, upper production limits of 3.5 TWh in 2009, 7.5 TWh in 2016 and 10 TWh in 2023 have been assumed for Norway, in accordance with figures given in NVE (2003) and from personal conversations with NVE.

Production costs from other sources

Table 13 shows the production costs of wind and biofuel power as given in six different reports, including the Swedish Energy Agency's own assessment as given in its review of the electricity certificate system (Swedish Energy Agency, 2004b), as a check of the production costs used in the MARKAL calculations.

Table 13 Lifetime costs of new wind power and biofuelled power (öre/kWh)

	Wind power	Biofuelled power
Sweden	38 - 45	40 – 61
Norway	26 – 40	23 – 114

Sources: NVE (2002), NVE (2004), Elforsk (2003), Swedish Energy Agency (2004), IEA (2003), and IEA (2001)

The cost estimates on which the MARKAL-based simulations described in 8.2.1 are based are not included in Table 13. However, they seem generally to be well in line with the costs shown in the table.

8.2.2 Legal aspects

Nothing indicates that the institutional or legal obstacles in the way of wind power would be more demanding in Norway than in Sweden: if anything, it seems as if the present-day concessions process in Norway operates more smoothly than the Swedish process, particularly at local authority level. This preliminary result probably improves the Norwegian competitiveness of wind power. Apart from the fact that wind conditions in Norway are generally better than in Sweden, we can also expect that it is easier in most other respects for Norwegian wind power producers to utilise the best wind conditions than it is for Swedish wind power producers.

However, in a longer time perspective, it is possible that the granting of concessions and physical planning permission for new wind power in Sweden and Norway become more harmonised. Work that is in progress in Sweden on improving the concession process, in the form of a review of the Environment Act and the Planning and Building Act, is of central importance for the development of Swedish wind power. In addition, there are some signs that the Norwegian process is regarded by some parties as *too* fast and efficient, so that there is pressure to introduce something equivalent to the Swedish localisation criteria in Norway as well. In other words, we might be seeing an improvement in the efficiency of the Swedish concession process with time, while the Norwegian process becomes a little more demanding.

8.3 Long-term effects on investments

Given the investment conditions described in Section 8.2, the long-term results of such investments can be simulated using model calculations. The following pages describe and comment on the results of calculations made using MARKAL-Nordic for different ambition levels for a joint Swedish/Norwegian market. It is important to remember that the model has full information on what will happen in the future, and therefore optimises its decisions to suit. Irrational or strategic decisions or behaviour, as occur on the market in reality, are not allowed to ruffle the model's calculations.

8.3.1 Low aggregated ambition level (21 TWh for Sweden, 10 TWh for Norway)

One of the calculation cases for the MARKAL model has started from a total ambition level of 31 TWh of renewable electricity production in 2016 (including existing production). This is made up of 21 TWh for Sweden and 10 TWh for Norway, being the amount of renewable electricity production that each country is prepared to finance on the joint market. This does not define where production or investments might be made, as these depend on the production conditions in each country. In order to illustrate the effects of a joint market, the calculations have been made not only for the joint market, but also on the basis of the two countries operating their own separate markets.

With its own national market, having an ambition level and quotas amounting to 10 TWh in 2016, Norway would not have any shortage of certificate-entitled production. This would mean that its certificates would have zero value each year, and that certificate-entitled production would exceed the quota. The price of electricity alone would therefore be sufficient to expand renewable production to a greater extent than as required by the quota total.

A national market of 21 TWh in 2016 in Sweden would require a production mix of about 2 TWh of hydro power, more than 7 TWh of wind power and almost 12 TWh of biofuelled power in order to fulfil the quotas. Under these conditions, the price of electricity certificates would be about SEK 100/MWh in 2016.

If, instead, we postulate a joint market, we can see the effects that it would have in relation to two separate national markets. Instead of 21 TWh in Sweden and 10 TWh in Norway on separate markets, we now have an aggregated volume of 31 TWh for the two countries together. Sweden is assumed to contribute to this by financing 21 TWh through its quotas, with Norway correspondingly financing 10 TWh via its quotas. Norway would be producing more renewable electricity than its national quota requires, while the reverse would be the case for Sweden, which would mean that cheaper Norwegian production would be used to meet the quotas in Sweden. It is particularly Norwegian wind power production that is more cost-efficient than Swedish wind power production. As a result, 3 TWh of the wind power that would have been produced in Sweden in a separate national market would now be produced in Norway at a lower cost. Instead of 7 TWh of wind power in Sweden on a national market, Sweden would now produce 4 TWh of wind power. In Norway, on the other hand, wind power production would increase to about 6 TWh, as compared with the earlier value of only 3 TWh if the country had been operating its own isolated market. Figures 19 and 20 show the distribution of production.

Certificate prices in Sweden would be noticeably lower on a joint market. Swedish consumers would therefore benefit by the use of cheaper Norwegian wind power to fulfil Sweden’s quotas.

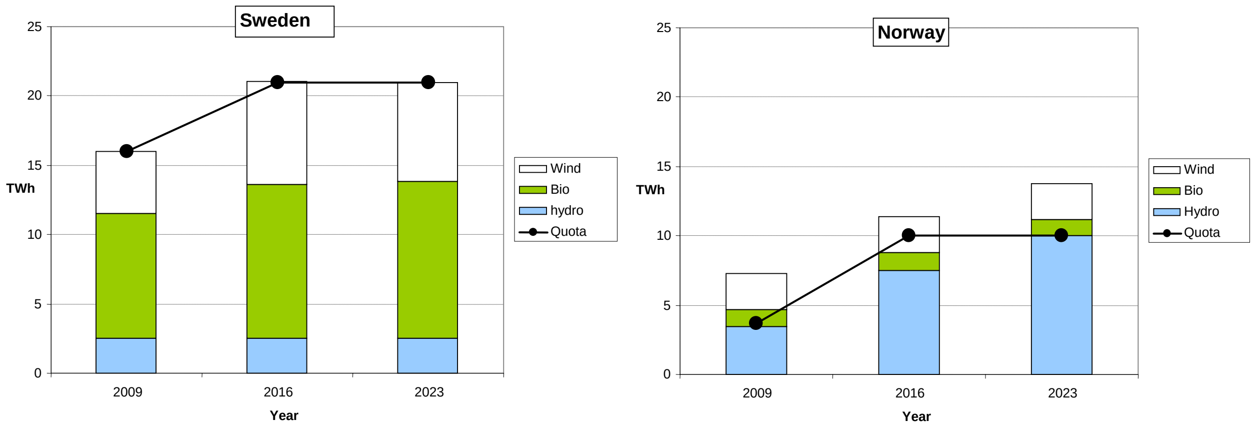

Figure 19: Certificate production in Sweden (left) and Norway (right) in the separate national markets case (Sweden 21 TWh, Norway 10 TWh)

Source: MARKAL-Nordic, Profu (2004)

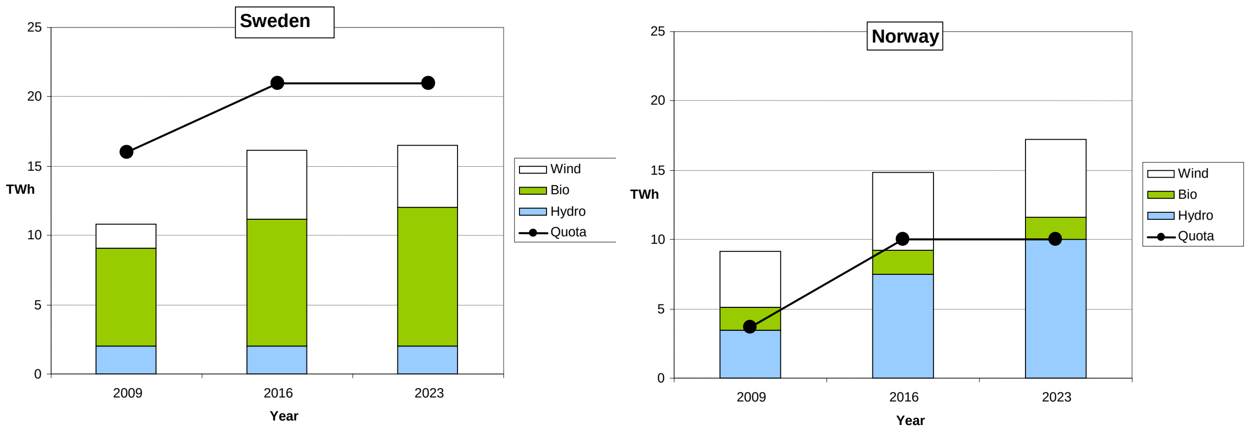

Figure 20: Certificate production in Sweden (left) and Norway (right) in the joint market case (Sweden 21 TWh, Norway 10 TWh)

Source: MARKAL-Nordic, Profu (2004)

8.3.2 High aggregated ambition level (21 TWh for Sweden, 20 TWh for Norway)

A higher aggregated ambition level of 41 TWh for a joint market has also been modelled. In this case, the higher ambition level comes from Norway, increasing its level from 10 TWh to 20 TWh. Sweden's ambition level, on the other hand, is assumed to remain unchanged, i.e. 21 TWh of renewable electricity in 2016. As above, we have prepared calculations for two separate markets, and then compared them with the results of a calculation for a joint market.

Raising the Norwegian ambition level from 10 TWh to 20 TWh could be met by an increase in wind power production. In Sweden, on an isolated market, wind power production would be the same as in the previous example (8.3.1), i.e. almost 12 TWh of biofuelled production, over 7 TWh of wind power and about 2 TWh of hydro power.

On a joint market, with an aggregated ambition level of 41 TWh (21 TWh for Sweden and 20 TWh for Norway), the model results show that Sweden would be a net exporter of certificates in 2016, i.e. that it would be producing more renewable electricity than required by its national quota. The opposite would apply for Norway which, in this case, would be importing certificates. Sweden would be producing more wind power and more biofuelled power on a joint market than would be required in the country on an isolated market. On a joint market, Sweden would produce about 14 TWh of biofuelled power, about 9 TWh of wind power and about 2 TWh of hydro power in 2016, i.e. about 4 TWh more than the country's quota. In Norway, it would be primarily wind power that would suffer a reduction under these conditions. In other words, with the high aggregated ambition level, some Norwegian wind power production would be less competitive than Swedish wind power and biofuelled power.44

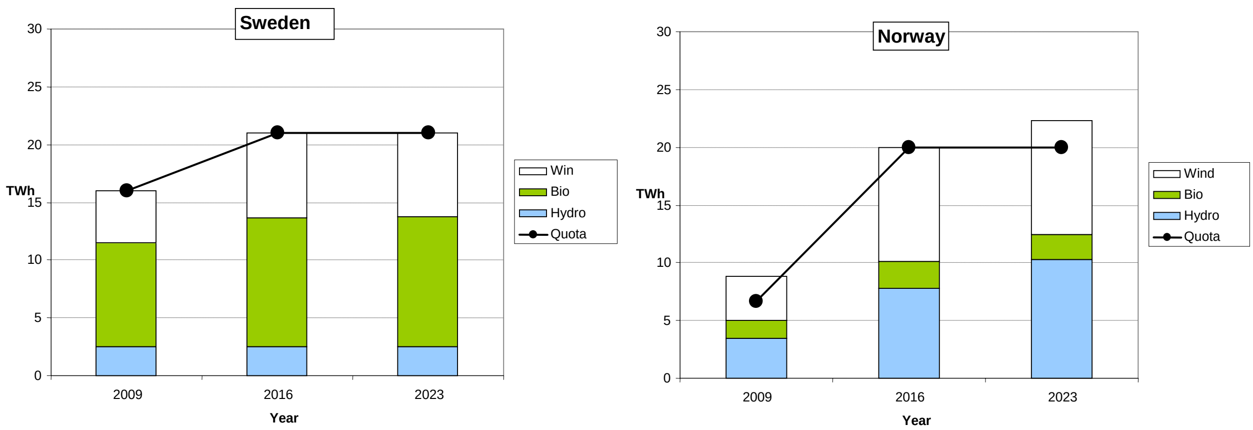

Figure 21: Certificate production in Sweden (left) and Norway (right) in the national markets case (Sweden 21 TWh, Norway 20 TWh)

Source: MARKAL-Nordic, Profu (2004)

[44] A further explanation for Swedish wind power being more competitive than Norwegian wind power in certain cases is due to the fact that the calculations expect the price of electricity to be higher in Sweden than in Norway with effect from 2016, due to the phase-out of nuclear power production and bottlenecks in bulk power transmission. This would produce a difference in the price of bulk power of 2-3 öre/kWh in some model years, which would mean that Swedish wind power would have a correspondingly higher value than Norwegian wind power.

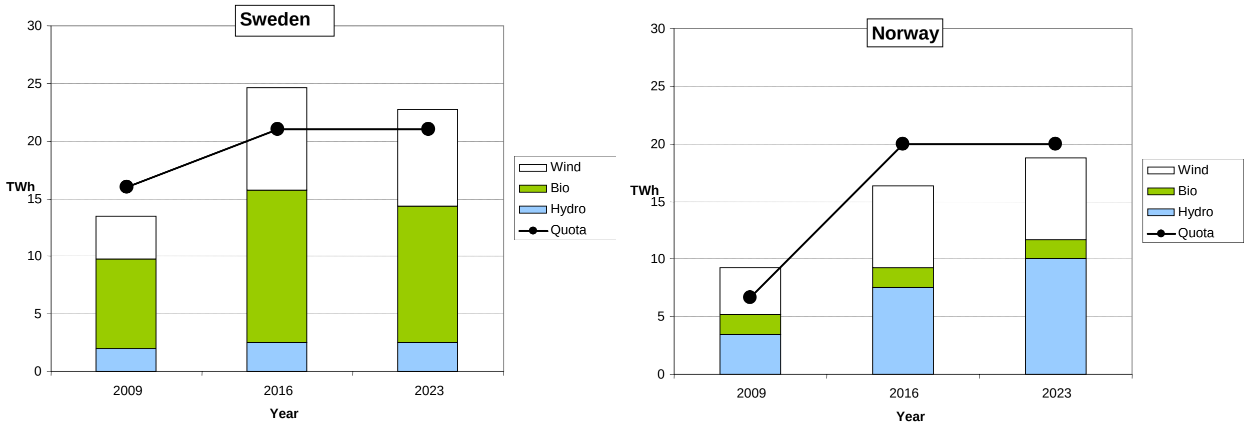

Figure 22: Certificate production in Sweden (left) and Norway (right) in the joint market case (Sweden 21 TWh, Norway 20 TWh)

Source: MARKAL-Nordic, Profu (2004)

8.3.3 Very high and extremely high aggregated ambition levels – 45 TWh and 55 TWh

With an even higher aggregated ambition level, and higher national quotas, much indicates that Sweden would become a net exporter of certificates. Quotas exceeding 21 TWh in Sweden and 20 TWh in Norway in 2016 would be met primarily by biofuelled CHP in Sweden and wind power in Norway. The expansion in biofuelled CHP would occur both in public district heating systems and in industrial back-pressure production through black liquor gasification, the technology for which the model assumes to be available with effect from 2016.

In the case of an even higher ambition level, at a total of 55 TWh in 2016, it would be necessary for about 1 TWh of Norwegian wave power to be added in order to meet the quota demand in the Nordic countries. At this point, the model is on the limit of what it can produce. It is also interesting to note that, at this extreme case, both countries are producing essentially what their quotas require. This is because virtually all potential for expansion in the output of wind power, hydro power and biofuelled power would have to be utilised in each country, with no cheaper production capacity being available in either country. This would also mean that there would not be much certificate trading between the two countries.

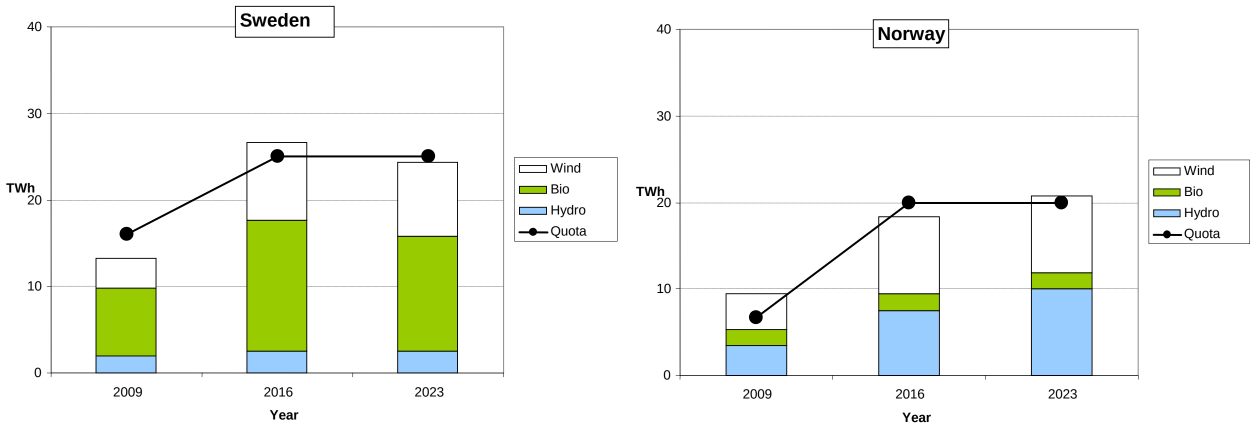

Figure 23: A joint system, with 25 TWh quota in Sweden and 20 TWh quota in Norway (2016)

Source: MARKAL-Nordic, Profu (2004)

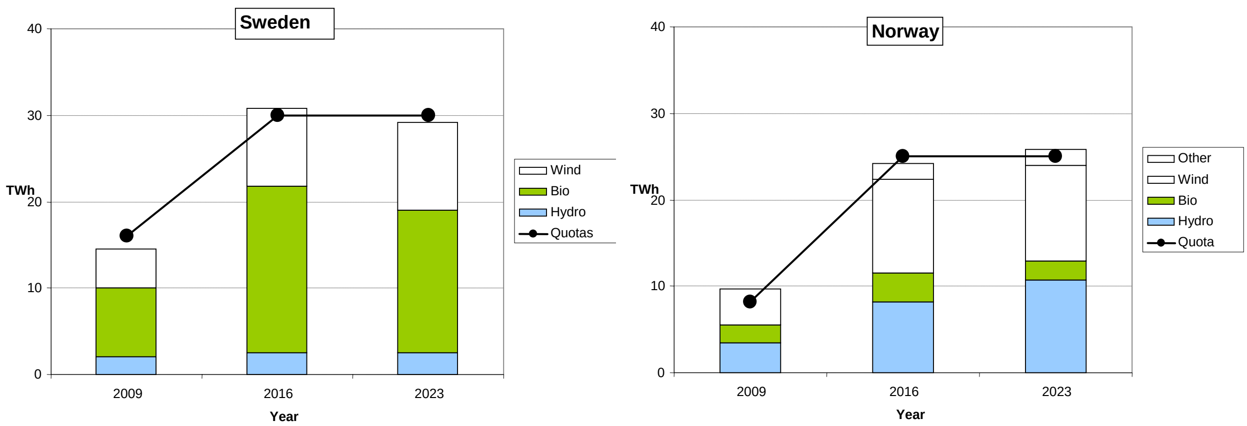

Figure 24: A joint system, with 30 TWh quota in Sweden and 25 TWh quota in Norway (2016)

Source: MARKAL-Nordic, Profu (2004)

8.3.4 Uncertainties that affect the cost picture for investments

In the previous sections, we have described the effects on investments and the types of production technologies that could be assumed to be used, as indicated by MARKAL calculations. Of necessity, these calculations are based on specific assumptions concerning wind conditions, real rates of interest, fuel prices etc., and are very vulnerable to changes in these assumptions. This section describes the effect of sensitivity analyses of certain input variables, in order to show how they change the results. The results also underline what was said at the beginning of this chapter, that the model calculations must be interpreted with care and must be seen only as indications of what could happen in the future in the light of certain assumptions.

Real rate of interest assumptions

The calculations described above have used a real rate of interest of 5 %. This interest reflects the return on investment required by the investors, and includes a certain amount as a risk premium. In the case of relatively new technologies, such as large-scale offshore wind power production, carrying a considerable technical risk, a 5 % rate of return can be regarded as somewhat on the low side. Raising the rate of interest to 10 % affects competitiveness between the different forms of renewable energy. A higher rate of interest improves competitiveness for the fuel-based technologies such as biofuelled CHP, at the expense of fuel-free technologies such as wind power, for which the production cost is dominated by the capital costs. All this is very clear for the Swedish certificate production. However, it looks as if only Swedish wind power would suffer, while the competitiveness of hydro power production, in both Sweden and Norway, would not be affected at all[45]. However, the change would have considerable consequences for the price of certificates, as described below in Section 8.4.2.

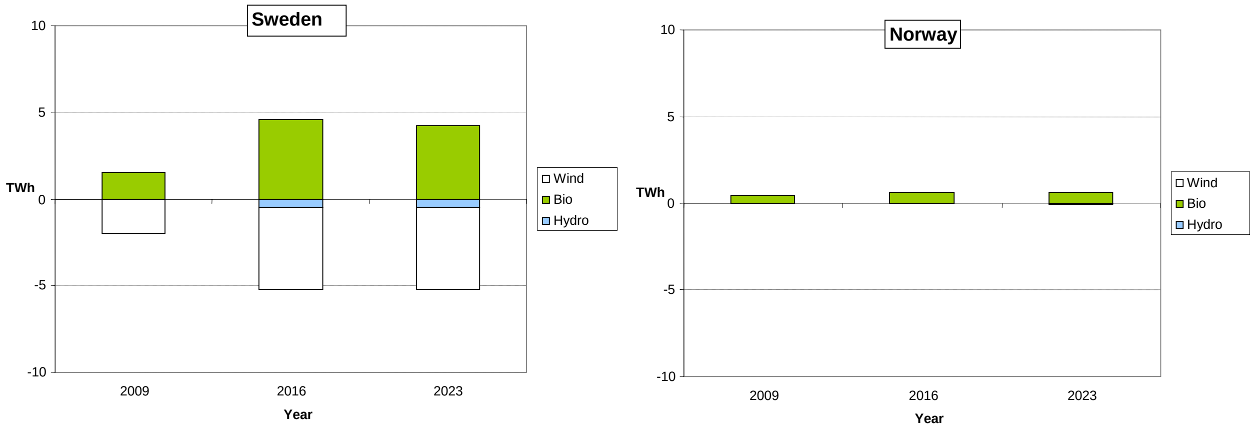

Figure 25: The difference in certificate production between the 5 % and 10 % real rate of interest cases for Sweden (left) and Norway (right).

Source: MARKAL-Nordic, Profu (2004)

Wind power technology development

It has been assumed, in this sensitivity analysis, that the investment costs of wind power plants would fall as the installed capacity grows. In the cases described above, it was assumed that this would not occur. The reduction in investment cost is regarded as occurring in response to learning curves. The assumption made here is that the total world-wide wind power capacity would expand at 15 % per annum until 2010, and then at 10 % per annum thereafter. Together with the assumption that the progress ratio for wind power (i.e. that for each doubling of the global installed capacity, the investment cost falls by 100-92 = 8 %) would be

[45] The higher interest rate calculations have been made for the 41 TWh aggregated ambition case (21 TWh in Sweden, 20 TWh in Norway).

0.92, we obtain a time-dependent investment cost for a standard wind power plant as shown in Table 14.

Table 14: Model assumptions for the investment cost of a standard onshore wind power plant in Sweden for the technical learning curve analysis case (SEK/kW of electricity)

Year	2002	2009	2016	2023	2030
SEK/kW	8000	7220	6702	6250	5830

Source: MARKAL-Nordic, Profu (2004)

The introduction of a technical learning curve for wind power in the model results in an increase of about 2 TWh of wind power production in Norway in 2016, with a corresponding reduction in Swedish biofuelled CHP. The output from Swedish wind power does not increase until 2023, although the cost of the production facilities falls as they are built. The calculations indicate that a technical learning curve for wind power has little influence on the price of certificates. In fact, other investigations using the MARKAL model indicate the opposite, i.e. that technical learning curves for wind power have a considerable effect on the price level of certificates (see, for example, Unger, 2003). Everything depends on the cost range between new wind power, resulting from technical learning, and the type of power generation replaced in the certificate system, i.e. biofuelled CHP in this case. If the cost difference is small, there will be only small changes in the certificate price, or substantial changes if the cost difference is large.

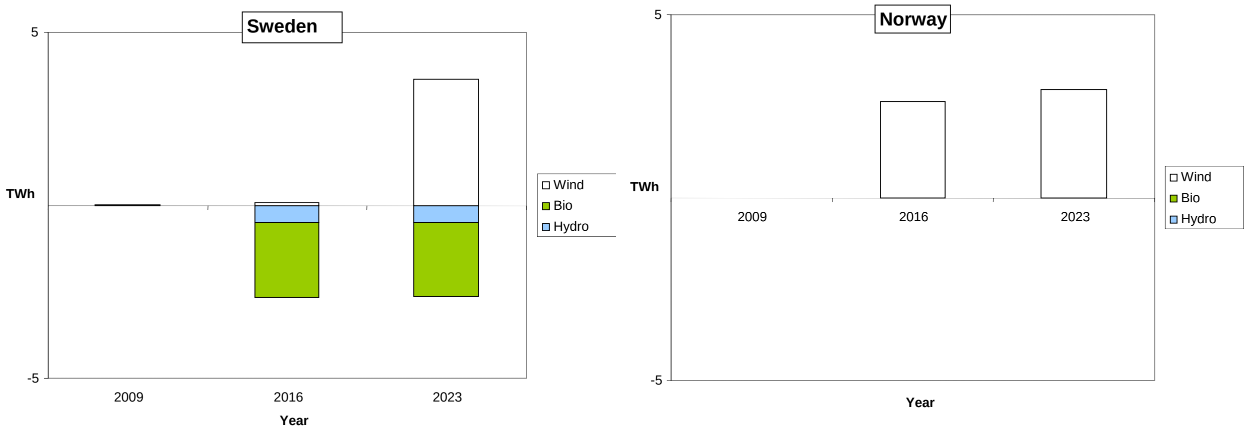

Figure 26: The difference in certificate production between the 41 TWh aggregated ambition case (21 TWh in Sweden, 20 TWh inNorway) and a case with falling investment costs for wind power.

Source: MARKAL-Nordic, Profu (2004)

The international biofuel market

In this part of the sensitivity analysis, it has been assumed that Sweden and Norway have access to unlimited amounts of woodchip biofuel at a price of SEK 150/MWh, e.g. if necessary through imports. As this is well below the biofuel prices assumed in the earlier calculations, the result will naturally be that

the competitiveness of biofuelled CHP on the market is improved relative to the
In this part of the sensitivity analysis, it has been assumed that Sweden and Norway have access to unlimited amounts of woodchip biofuel at a price of SEK 150/MWh, e.g. if necessary through imports. As this is well below the biofuel prices assumed in the earlier calculations, the result will naturally be that the competitiveness of biofuelled CHP on the market is improved relative to the previous cases. However, the model results show that this would be relevant only on the Swedish market, where the district heating load is sufficiently large to permit further expansion of biofuelled generation at the expense of other fuels (mainly natural gas). In the certificate system, it would be exclusively wind power that would lose a corresponding market share, and then also almost only in Sweden (from nearly 9 TWh in 2016 to about 5 TWh).

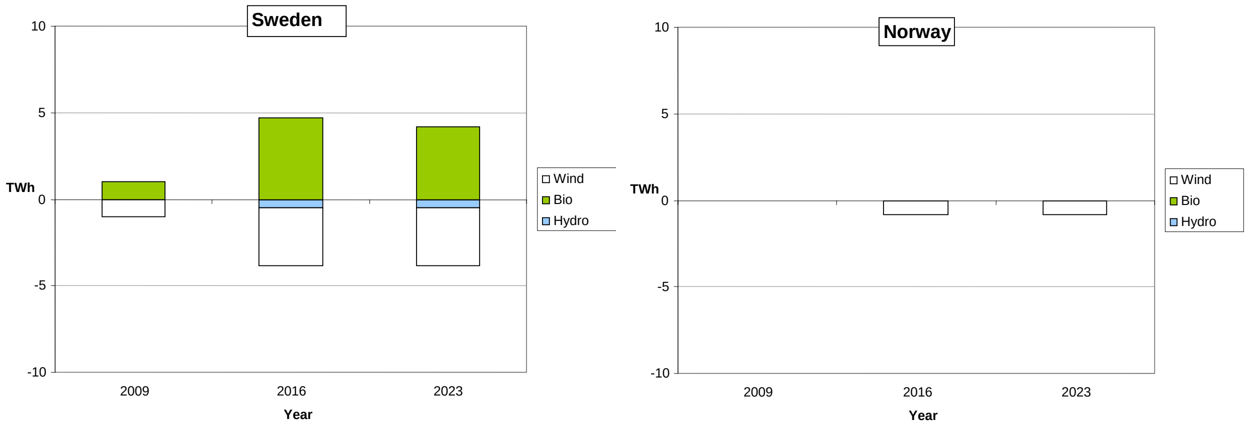

Figure 27: The difference in certificate production between the cases without limitation for biofuels and the case with limitation, for the aggregated ambition level of 41 TWh, for Sweden (left) and Norway (right).

Source: MARKAL-Nordic, Profu (2004)

Severely limited expansion for Norwegian hydro power

The earlier calculations assumed upper production limits for new hydro power in Norway of 3.5 TWh in 2009, 7.5 TWh in 2016 and 10 TWh in 2023. In this case, we have assumed that new Norwegian hydro power would be allowed to contribute only 0.5 TWh in 2009 and 2 TWh in 2016 and 2023. The calculation results show that this reduction in Norwegian hydro power production would be made up primarily by Swedish biofuelled power and by wind power in both Sweden and Norway.

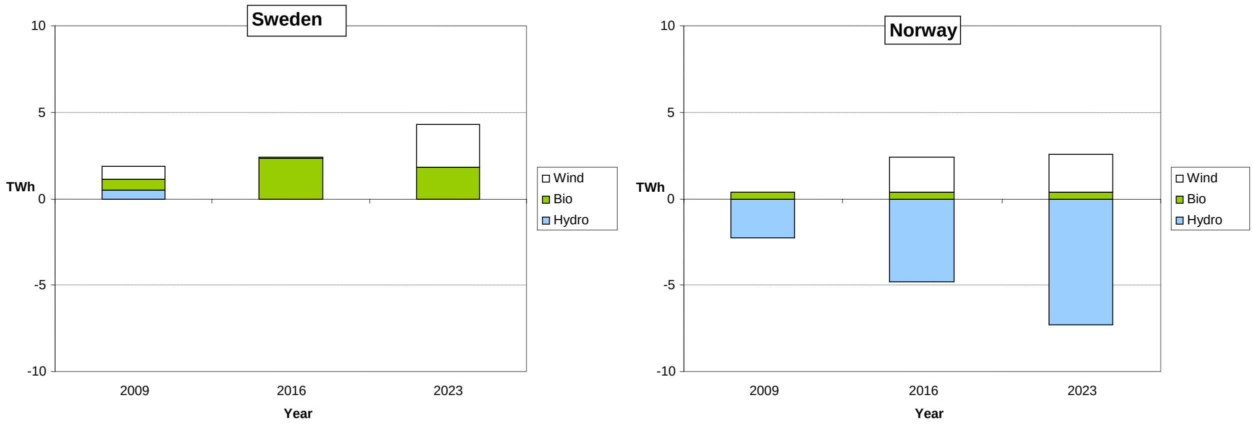

Figure 28: The difference in certificate production when hydro power production in Norway is capped for Sweden (left) and Norway (right).

Source: MARKAL-Nordic, Profu (2004)

8.3.5 What replaces the renewable electricity?

By analysing the results of the calculations made by the MARKAL model, we can get an idea of which form of production that would be displaced through the action of a joint electricity certificate system. Comparing the outcome of the 41 TWh aggregated level with the 31 TWh level, we can see the differences that would arise in terms of Nordic power production.

The difference between the two cases is that a further 10 TWh of certificate-entitled electricity would have to be produced in 2016, either in Norway (where the quota had been raised) or in Sweden. Figure 29 shows the effect on Nordic electricity production.

Increasing the total ambition level by 10 TWh results in an expansion primarily of wind power, with a corresponding reduction in gas-fuelled power production. In this case, these are power production facilities that are not built, but which *would have been* built if the Norwegian quota had remained at 10 TWh. The picture remains the same in distribution terms, although with greater differences in TWh, even if we (for example) compare the cases with an even higher ambition level (45 TWh) with the 31 TWh ambition level, i.e. if the total ambition level is increased by a further 14 TWh. In this case, the ‘replaced’ gas power production is evenly distributed between Norway, Sweden and Finland, with a reduction of about 2 TWh in each country in 2016, in the form of cold condensing power production in Norway and Finland and CHP in Sweden. Existing Danish coal-fired power production would also be reduced. In other words, changes in one country’s ambition level have repercussions on electricity production in its neighbouring countries.

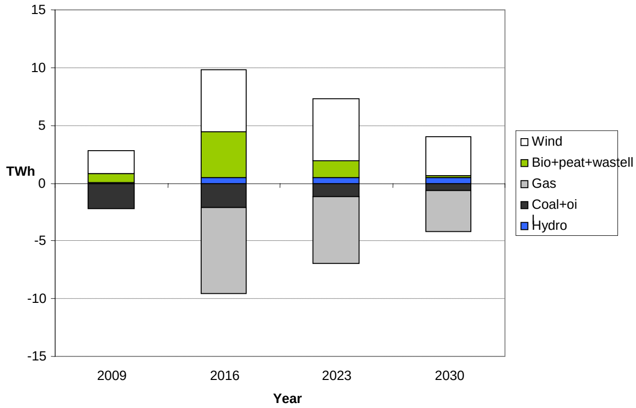

Figure 29: Changes in Nordic electricity production if the Norwegian quota is raised from 10 to 20 TWh on a joint certificate market

Source: MARKAL-Nordic, Profu (2004)

8.4 Long-term effects on certificate and electricity prices

This section describes how prices on the electricity certificate market could be affected by the aggregated ambition level as decided for the joint market, the rate of interest assumed in the calculations and other factors. It also describes the relationship between the system price of electricity and the price of electricity certificates. We also discuss how long-term pricing is affected by various uncertainty factors, again using the MARKAL model calculations as a basis, complemented by the results of other investigations.

8.4.1 The link between the electricity certificate system, the price of electricity and the price of certificates

It is very likely that an electricity certificate system in one country would affect the entire Nordic electricity market, and thus the production of electricity in the various neighbouring countries. This is because, through its quota obligation, renewable electricity production partly replaces other power production; either existing production, or that which would have been built if renewable power production had not been supported by the certificate system. This means that more expensive forms of electricity production in the Nordic electricity system will be marginalised, so that the effect of the certificate system is to apply downward pressure to the price of electricity. However, as far as consumers are concerned, it is the total price that they pay for their electricity that is of interest. Consumers are paying for the certificate system through their quota obligation, which means that the price-restraining effect of the certificate system on the system price of electricity would not necessarily feed through to a reduced price for consumers. Consumers are therefore paying for the certificate system via their quota obligation, although on the other hand they are benefiting by the restraining effect of the system on the price of electricity. If anything, those who are most affected by the effect of the certificate system on the price of electricity are those who produce non-renewable electricity, known as ‘brown electricity’. Introducing an electricity certificate system reduces the system price of electricity, so that the producers of brown electricity have to pay for green electricity via a reduced production surplus.

The price of electricity is naturally affected by many other factors, over and above the amount of new production capacity entering the Nordic electricity market as a result of the certificate system. The price of electricity also has a direct effect on the price of certificates. If the price of electricity rises, producers of renewable electricity receive additional income and have less need of other forms of support, i.e. the price of certificates falls. A higher electricity price therefore gives a lower certificate price, and vice versa.

8.4.2 The effect of differing aggregated ambition levels on the price of certificates

Figures 30-32 show the prices of certificates as arrived at by the MARKAL model calculations, based in all cases on an interest rate of 5 %. Figure 33 shows how a higher rate of interest affects the prices.

The price of certificates on a Norwegian national market with a 10 TWh ambition level would be zero, i.e. there would not be any shortage of certificate-entitled production in Norway. Certificate-entitled production would exceed the country’s quota. On a national Swedish market with an ambition level of 21 TWh, the calculated certificate price would be somewhat over SEK 100/MWh. On a joint market (10+21 TWh), the price would be about SEK 90/MWh. It should be borne in mind that the price of certificates is affected by the market price of electricity. The price per kWh of electricity production received by the producers of renewable electricity is made up of the market price of electricity + the market price of electricity certificates. The system price of electricity in the model calculations is 29 öre/kWh ±2 öre/kWh, depending on the ambition level. With a lower price of electricity, it would be necessary for the certificate price to be higher in order to bring about the same quantity of renewable electricity production.

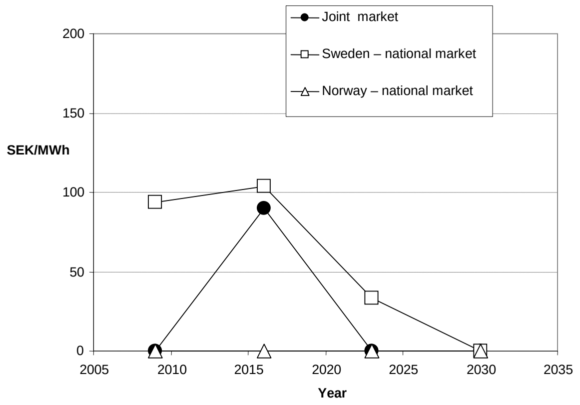

Figure 30: Certificate prices for a joint market ambition level of 31 TWh (21 + 10 TWh) and for individual national markets of 21 TWh in Sweden and 10 TWh in Norway.

Source: MARKAL-Nordic (Profu, 2004)

Increasing the Norwegian ambition level from 10 TWh to 20 TWh in 2016 produces a relatively high certificate price of about SEK 280/MWh in 2016 in Norway, if the country had a national market. This shows that the additional 10 TWh are relatively expensive. However, the price would drop rapidly towards zero in 2023, mainly due to the fact that the potential for relatively cheap new Norwegian hydro power is assumed to increase between 2016 and 2023.

If, instead of separate national markets, we assume a joint market of 14 TWh, we can see a clear price smoothing effect: in this case, the model indicates price levels of around SEK 140/MWh.

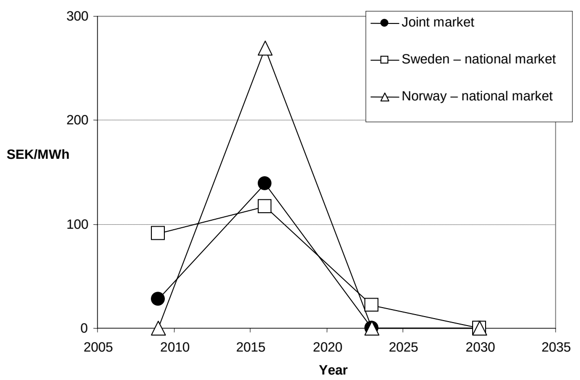

Figure 31: Certificate prices for a joint market ambition level of 41 TWh (21 + 20 TWh) and for individual national markets of 21 TWh in Sweden and 20 TWh in Norway.

Source: MARKAL-Nordic (Profu, 2004)

The 45 TWh[46] case would have relatively little effect on certificate prices on a joint market in comparison with their 41 TWh case. However, raising the ambition level further, to 55 TWh,[47] would raise certificate prices to an extremely high level. It would be necessary to introduce about 1 TWh of wave power in Norway in 2016 in order to meet the country's Nordic quota requirement. At this point, the model is at the limit of what it can calculate during the model year, which is also indicated by the extremely high certificate prices of getting on for SEK 900/MWh. All this is naturally an effect of the model assumptions concerning potentials and rates of expansion of renewable electricity production.

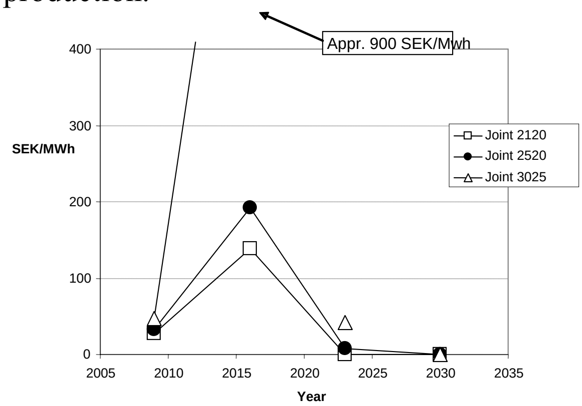

Figure 32: Certificate prices for three joint market cases: (21 + 20), (25 + 20) and (30+ 25).
Source: MARKAL-Nordic (Profu, 2004)

Figure 33 shows the effect on certificate prices of increasing the rate of interest from 5 % to 10 %. It can be seen that a higher rate of interest results in significantly higher certificate prices; increasing, for example, from SEK 140/MWh to SEK 240/MWh in 2016.

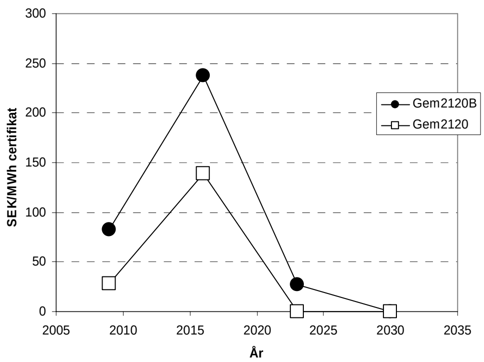

Figure 33: Certificate prices on a joint market (Sweden 21 TWh, Norway 20 TWh) with different interest rates. Gem2120B represents an interest rate of 10 %, and Gem2120 represents a rate of 5 %. Source: MARKAL-Nordic, (Profu 2004)

[46] 25 TWh in Sweden and 20 TWh in Norway in 2016.
[47] 30 TWh in Sweden and 25 TWh in Norway in 2016.

8.4.3 The effects of on the price of electricity

As mentioned in the introduction to Section 8.4.1, the mere presence of an electricity certificate system has a restraining effect on the system price of electricity on the Nordic market. A higher ambition level would increase this restraining potential still more. Expanding the Swedish electricity certificate market to include Norway as well, and thus bring more renewable electricity production onto the Nordic market, should therefore further restrain the price of electricity. However, this has not been quantified by model calculations: on the contrary, the model calculations show that the effects on the price of electricity of changing from two separate markets to a single joint market are negligible.

It is highly probable that the long-term effect of a joint Norwegian/Swedish certificate market on the price of electricity *for consumers* will be very slight. This is confirmed by several investigations: see, for example, Unger and Ahlgren (2004), Nordleden (2002) and Hindsberger *et al*. (2003). The reason for the end user prices of electricity remaining relatively low, even if quota obligations are increased, is that the extra cost of the certificate system is carried mainly by the producers of non-renewable power, in the form of a lower system price for electricity.

8.4.4 Uncertainties that affect prices

It is important to remember that the price analyses described above have been made using a technical optimisation model, MARKAL-Nordic, that assumes long-term stable investment conditions and a perfect insight into the future. It does not take account of any uncertainties or risks, other then those represented by the assumed rate of interest. It assumes that renewable electricity will be produced, that certificates are offered on the market and that quota obligations are fulfilled each year, i.e. that no quota obligation fees are levied. It does not, in other words, take account of any speculation, strategic financial actions or the exercising of market power.

In a real market there are, of course, many parameters that are by no means clear. In a situation where, for example, the future looks too uncertain, investors would hold back from investing in new power production, and it would be likely that, to the extent possible, existing power sources would be more intensively utilised. Improvements in the efficiency of existing hydro power plants (and the resulting production increases) would become more attractive than new building, and we could even expect substantial technical development of such and similar investment alternatives. However, it is also reasonable to assume that there is only a limited potential for better utilisation of existing power sources, and which would be insufficient to meet a relatively ambitious quota obligation. In such a case, there would be a significant risk of very high certificate prices.

8.5 Long-term effects on competition and market stability

Expanding the Swedish market to include (first of all) Norway and, further in the future, perhaps additional countries, would affect the function and stability of the market. Bringing more countries into a joint market would also mean that more parties were involved, which should improve competition. In the same way, an expanded market would mean that greater volumes of certificates were being traded, which could potentially improve the stability and functioning of the market. A market involving several countries also reduces the scope for changing the roles of the market at short notice – at least, if the wishes of other countries are considered.

Concentrating on competition and long-term market stability, this section discusses the importance of taking a long-term view and of forecastability, as well as clarity concerning possible changes in or to the joint market. In addition, if discusses how an expanded market affects market forces, price volatility and the pricing of certificates.

8.5.1 The long-term view, forecastability and clarity

As has been brought out earlier in this report, it is important for the stability of the market that the political plane should take a long-term view of it. An assured long-term demand – i.e. ambition level and quotas – creates the right conditions for problem-free operation of the market and creation of investments. This was also put forward as a recommendation in the Agency's second report on its review of the electricity certificate system (Swedish Energy Agency, 2004b). We have also previously in this report discussed the importance of an expanded market being accepted by society (see Chapters 5 and 7).

Those involved in the market have claimed that one of the biggest benefits of an expanded market would be that it would reduce political risks. According to them, the fact that two or more countries are responsible for the market, and must agree on any changes, reduces the risks of changing the rules governing the market. The larger the market, the greater would confidence and stability be. Against this, it can be said that an expansion of the market would increase the potential for conflicts between different interest groups on the market (see Ek *et al.*, 2004). Such a situation could arise if the results of the joint market did not live up to the group's expectations, which would result in pressure for changes. Ek also says that some aspects would probably be dealt with at national levels, and that neither Sweden nor Norway has a history of a long-term approach to energy policies, which would make the system vulnerable to being abandoned by either of the parties, in favour of some other form of support for renewable electricity production.

Regardless of how the political risks are seen, it is most important that both countries should commit themselves to a long-term sustainable structure of the joint market. It is also important that they should agree on long-term assignment of quotas, and that there should be some type of mechanism that makes it difficult (or expensive) for either countries to depart from the agreement. (This was discussed in more detail in Chapter 6, 'Requirements for effective operation of an electricity certificate market'.)

8.5.2 Exercising of market muscle [48]

There is a significant theoretical potential on a certificate market for a certificate-entitled producer to attempt to manipulate the market. By 'retaining' a certificate (e.g. 1 MWh), a producer could cause significant price rises due to the fact that, in an equilibrium situation, electricity consumption would have to reduce by 10 MWh if the quota obligation was 10 %. However, there are at least two reasons for thinking that, in reality, the opportunities and incentives for manipulating a joint Norwegian/Swedish certificate market would be slight.

The first reason is that many of the most important producers of renewable electricity own both renewable and traditional 'brown' power sources. For them, there would be nothing to gain by restricting the release of certificates, as this would have the effect of reducing the production price of electricity and thus also reducing revenues from 'brown' production. The second reason is simply that, almost by definition, an expanded certificate market represents a reduced risk of misuse of market power, as the number of traders on the market can be assumed significantly to increase.

8.5.3 Price volatility

The availability of renewable electricity can vary widely from one time period to another, not least as a result of changed wind conditions (see, for example, Lemming, 2003). In combination with a price-insensitive demand for certificates, this can give rise to substantial market price fluctuations. Such a situation would also create a substantial economic risk for new investments, thus inviting a relatively high risk premium.

In this case, too, an expanded certificate market should bring important benefits. There is little to indicate that wind conditions in Norway and Sweden should be closely linked, which should ensure that price fluctuations on an expanded market should be less marked than they would be on two national markets.

[48] See Amundsen and Nese (2004) for a more in-depth discussion of market forces on an electricity certificate market.

8.5.4 International certificate markets with several countries

Expansion of the Swedish certificate market to include Norway can be seen as a first step towards an even larger market, bringing together many countries. Although such an expansion means that the cost differences between countries for renewable power can be utilised to an even greater extent, and thus give substantial efficiency gains, there are also aspects of such an expansion that can be regarded as problematical. On a market with many countries, an individual country is not going to be able to affect the price of certificates, and this also means that countries will not be able to utilise either their quota obligations or price controls to encourage the expansion of green electricity production at home. Instead, this will require a coordinated increase in the joint ambition level. Even on a Norwegian/Swedish market, there will be tendencies towards limited self-determination, but the more countries that are involved, the less will be the influence of national decisions on overall expansion of renewable power production. This has been discussed in more detail in Chapter 7, ‘Models for determining ambition levels and quotas’.

8.6 Long-term efficiency benefits on a joint market

As pointed out earlier in several places in this report, efficiency benefits increase with the size of the market. These benefits arise as a result of differences in production costs and conditions between countries, which means that it becomes cheaper to achieve an objective by cross-border trading than by attempting to do so on separate national markets. An expanded market can also be expected to show long-term benefits in the way in which the market operates in respect of such aspects as greater liquidity, reduced price volatility, improved competition, lower political risk etc. What is the magnitude of these gains in efficiency? Can they be measured?

A simple evaluation of the effects of market expansion has been carried out using the MARKAL-Nordic model by looking at the difference in total system costs between a Nordic energy system having separate markets for electricity certificates in Sweden and Norway, and a Nordic energy system with a combined Swedish/Norwegian certificate market. The results indicate a cost difference of between SEK 1000 and SEK 2000 million, expressed as discounted present value over the next 20 years, which is equivalent to about SEK 100-200 million per year. In other words, with the quota sizes analysed in this investigation, a joint market is about SEK 100-200 million cheaper per year than two separate markets creating the same quantity of certifiable electricity production. These savings are made up of those resulting from the actual trading of certificates, by certificates being produced wherever is cheapest, and of cost changes arising in other changes to the system outside the certificate system itself.

We can also note that, in this context, SEK 100-200 million is a small amount. However, in addition to this amount, there should be efficiency gains as a result of factors such as greater competition (due to a greater number of parties), increased liquidity (due to a larger market) and reduced annual price variations resulting from precipitation, wind conditions or the size of the district heating heat sink. However, it has not been possible to quantify these changes that would be likely to occur on a real market.

9 Short-term consequences on the Swedish market

9.1 Introduction

This chapter discusses the short-term consequences that could arise on the Swedish market and for those active in it.

The Swedish Energy Agency has reached the following conclusions:

In the short-term, the most significant consequence of an expansion of the market is that it will result in a greater price risk. Norway's entrance to the market could result in speculations concerning expected future prices, thus creating fluctuating and impossible-to-forecast prices.
Expectations of lower certificate prices would bring forward price reductions. In the same way, expectations of higher certificate prices would result in the prices rising even before the market was expanded. Forecasts could turn out to be self-fulfilling, in that the actual expectations affect the price in the short term. If the forecasts are actually wrong or exaggerated, the effect could be fluctuating certificate prices until the prices have adjusted themselves to the real conditions.

The most important consequence of the increased price risk is that it could cause a vacuum in which investors hang back, so that no new production capacity is actually built. It is important to realise that quite a lot of the uncertainty arises because the detailed rules governing operation of the market have not yet been worked out. The uncertainty will be considerably reduced when all the legislation proposals have been published and all the details have been decided.

Practical problems that need to be resolved in connection with the expanded market are the creation of a working infrastructure to provide each country with access to the other's systems, the setting up of a working market place and ensuring that all parties have access to the same market information, regardless of in which country they are working.

Certain short-term consequences affecting the Swedish electricity certificate market can arise in connection with expansion of the market, and these points will be identified and analysed in this chapter. For this purpose, 'short-term' consequences are regarded as being those that can arise from the time of starting discussions with Norway until about six months after the expanded market has come into operation. We intend to describe which uncertainty factors are likely to be introduced in connection with expansion, and how they will affect those involved. In addition, the chapter discusses possible price effects, together with a number of practical problems that must be dealt with in the short term.

That part of the work described in this chapter is:

Certain short-term consequences for the Swedish market and for those involved in it can arise in connection with expansion of the market. The Agency should identify and analyse these consequences.

9.2 Uncertainty factors introduced in connection with expansion

An important conclusion from Stage 2 of the Electricity Certificate Review was that the system is regarded by many of those involved in or with it as uncertain. This applies particularly to uncertainty as to what can or will happen after 2010, although most of those involved also had reservations concerning future price levels and the lack of market information. One of the effects of this perceived uncertainty could be that those involved, or who should be involved, decide to postpone possible investment decisions. Further uncertainties are also introduced by the possibility of expanding the market still further, to become an international certificate market. These uncertainty factors can be divided up into two sub-categories: uncertainties that arise due to the system expanding from being a national system to becoming an international system, and uncertainties that arise as a result of changes to the Swedish electricity certificate system, as shown in Table 15. Changes in the Swedish electricity certificate system can result from the fact that Norway would have views on the design of the system, rather than as a direct result of expansion of the market. If anything, these changes should be seen as a natural consequence of the review of the certificate system.

Uncertainty as to what ambition level Norway might choose belongs to the first category of uncertainty factors. Its ambition level will naturally have a direct effect on the price of certificates, and so it is important – if potential investors are to dare to make investments – for the certificate price to be sufficiently high, even with an expanded market.

In addition to its ambition level, Norway's production potential also affects the price of certificates. If the expanded market results in large amounts of Norwegian production capacity being brought into the system, it can cause a temporary glut of renewable electricity, causing the price of certificates to fall.

Uncertainty as to Norwegian production costs is also closely linked to production capacity. Major differences in production costs between the two countries can result in physical construction of new production facilities tending to occur primarily in one country or the other. In the short term, Swedish investors could hesitate to make investments in Sweden, preferring instead to invest where production costs are lowest, even if this means that the investments will be made in Norway, as support from the certificates is not dependent on where the production capacity is built.

A further uncertainty factor that changes in the short term in the event of an expanded market is that the Swedish parties on the market will find it more difficult to forecast future political actions than would be the case for a single national certificate system. This uncertainty is greatest until the joint market has finally started up and its operating rules have been determined. This uncertainty will be relatively large when expanding the market from one country to two countries. However, the greater the number of countries on the market – i.e. the larger the market for certificates – the less will be the effect of bringing in one additional country to join the market.

Uncertainty as to what type of production will be entitled to certificates in future belongs to the second category of uncertainty factors. A number of suggestions for changes have been put forward in connection with the discussions with Norway. If these changes are realised, they will involve both an expansion of certificate-entitled production (refuse incineration) and a reduction (peat) in comparison with energy sources that are today entitled to certificates. The question of how long a production plant should be entitled to receive certificates has also been raised, and any such change would naturally have a considerable effect on investment decisions

The fact that the quotas have been set only up to 2010 must be seen as the single biggest uncertainty factor in the Swedish electricity certificate system. When the system was started, there were no clearly expressed guidelines to indicate what would happen after this date, and so this lack of a long-term view has therefore been cited as an important reason for investors declining to invest in new production capacity. Norway joining the system will therefore force attention to what the quotas will look like after 2010. The uncertainty factor for those involved on the Swedish side of the market is not the fact that the certificate system will have to be extended, but rather the uncertainty relating to the actual transition period until the quotas have been decided. Once the parties have picked up signals concerning possible changes to the Swedish system, there will be a period of uncertainty until final decisions are made. It is therefore important that definitive decisions on the structure of the joint market should be made at as early a stage as possible.

Table 15 Uncertainty factors introduced in connection with expansion of the market. The left-hand column shows the uncertainty factors that are a direct result of the expanded market, while the right-hand column shows the uncertainty factors that should be regarded more as an indirect result of discussion held with Norway.

Uncertainty factors introduced by an expanded market	Uncertainty factors introduced as a result of changes to the system (e.g. as a result of the discussions with Norway)
• Norway's ambition level, and its effect on the certificate price • The Norwegian production potential and its effect on the certificate price • Production costs in Norway and their effect on where production capacity would be built • Norwegian political considerations	• Changed definition of what constitutes certificate-entitled production • Limited qualification period • Changing from old to new quotas

A simple way of classifying risk in more general terms is to consider *volume risk, price risk, other party risk and political risk*. Volume risks that could be encountered in connection with an expanded market include, for example, changes in the amount of electricity used and price risks in the form of a rapidly changed electricity certificate price. Other party risks consist of the second party failing to fulfil its obligations. Political risk lies in the politicians changing the rules concerning such aspects as which fuels are entitled to certificates, or changing quota levels, without giving sufficient notice of their intentions.

- An expanded market involves a greater *volume risk* as a result of the uncertainty concerning how much weather-dependent production would be added to the system. If an expanded market would mean that more wind power or hydro power came onto the system than would be the case for a national Swedish market on its own, it would mean that there would be a more fluctuating availability of certificate-entitled production, as wind power and hydro power are more weather-dependent than, for example, CHP or industrial back pressure generation.

- An expanded market would also involve a greater short-term *price risk*, as a result of an expected effect on pricing. These expectations could arise as a result of views on how the quota levels would be set, or of how much new production capacity would enter the system.

- The *other party risk* is not particularly large in the Swedish system, and is unlikely to increase in connection with an expanded market.

- Whether the *political risk* decreases or not in the long term is worth discussing. However, in the short term, the political risk could be said to increase, mainly in connection with failing to announce changes in time.

As far as discussion of short-term uncertainty factors is concerned, it is important to bear in mind that much of the uncertainty is due to the fact that the operating rules have not yet been decided. This uncertainty will be considerably reduced once all the legislative proposals have been put forward and all details have been decided. In the short term, the uncertainty for the Swedish parties lies in the fact that it is still not clear how an expanded market would be constructed. Once all the details have been settled, the uncertainty will shift primarily to the fact that prices can fluctuate until they have settled down to reflect real conditions. This means that, if the operating rules are decided in detail before or after the market has been expanded, there will be consequences in terms of the degree of uncertainty experienced by the parties concerned in connection with an expanded market.

The sector representatives on the reference group linked to this investigation have been given the opportunity to put forward their views on the short-term consequences. On the whole, these views are very similar to the points described above, and can be summarised as follows:

- Uncertainties associated with the expansion can risk causing a postponement or abandonment of investment. Good information on the expected availability and demand from the Norwegian side is essential in order to prevent this.
- Certificate prices are entirely dependent on factors in the Norwegian system such as quota levels, type of production entitled to certificates etc.
- There are many points on which Sweden and Norway must reach agreement over a relatively short period of time, which in itself is unsettling the market.

o How the parties are affected by uncertainties

The short-term uncertainties arising from expansion of the market affect different parties in different ways, as shown in Table 16. The uncertainty introduced by the discussions on an expanded electricity certificate market directly affect potential *investors* in renewable electricity production capacity, in so far as they may choose to wait and see as far as planned investments are concerned. The most important consequence of this is that a vacuum could arise, with investors waiting until all the political decisions have been made, and with the overall result that no new production capacity is built. However, this particular uncertainty has only a limited effect, in that there are several other factors that decide whether an investment is made or not. In addition to factors relating to the electricity certificate system or an expanded market, investment decisions are also affected by whether they are part of the company’s long-term expansion plans or its environmental policy, and by more specific factors such as the size of the heat sink available.

Producers of renewable electricity, who today receive support from the certificate system, have only limited room for manoeuvre, although they can try to avoid making production changes or new investments that would further restrict their freedom of action. Those who may have made investments shortly before expansion of the market could be hard hit if expansion results in a severe drop in certificate prices.

Consumers are naturally affected in economic terms if the expanded market results in changed certificate prices. If the expansion results in no new investments being made in the short term until all questions have been sorted out, the result can be temporarily very high certificate prices. This is because the high level of uncertainty means that the investors require high risk premiums, which in turn means that very high certificate prices are needed if investments are to be made.

Traders in electricity certificates, whether as electricity suppliers or as market intermediaries, play an important part in the changeover period as a joint market starts. This is because they are expected to deal with speculations and trade in certificates on the basis of expected effects on pricing.

Table 16 Short-term effects of uncertainty introduced by expansion of the market.

Investors	Producers	Consumers	Traders
May prefer to wait and see.	Try to avoid making production changes that restrict their freedom of action during a transition period.	Cannot do anything, but can suffer from temporarily high certificate prices.	Play a more important part.

9.3 Autumn 2005 prices?

An expanded market will increase the availability of certificates which, taken on its own, would depress the equilibrium price. At the same time, however, demand increases as a result of the Norwegian quota obligation being added to the Swedish quota obligation, which would have the opposite effect in tending to increase the equilibrium price. The resulting net effect on the equilibrium price therefore depends on by how much availability increases – i.e. on how much certificate-entitled production is added to the system from Norway – and on how much demand increases, i.e. on the level of the Norwegian quota. Figure 34 shows an example of how the equilibrium price could change. In the example, the equilibrium price falls due to the supply curve moving outwards in parallel when the Norwegian production comes in. If, in addition, the Norwegian supply curve is flatter – i.e. the system does not require as high certificate prices in order to produce a certain quantity of renewable electricity – the equilibrium price will be further depressed. This means that the final equilibrium price depends not only on by how much the supply curve moves outwards, but also on the shape or slope of the supply curve on an expanded market. It also depends on the demand curve, i.e. on the aggregated Swedish and Norwegian quotas. If, instead, Norway chooses a high quota level from the start, the effect instead can be that the equilibrium price increases.

The model calculations that have been run for the Agency have assumed that Norway has cost advantages over Sweden, or at least up to relatively high production volumes. In addition, according to the production cost assumptions made in the model, the Norwegian supply curve is flatter, which means that Figure 34 probably gives a relatively good picture of what pricing will look like in the short term. The supply curve will move outwards, as shown in the diagram, while the equilibrium price will probably fall further due to the fact that the combined supply curve will probably not move outwards in parallel as shown in the diagram, but will tend to be flatter.

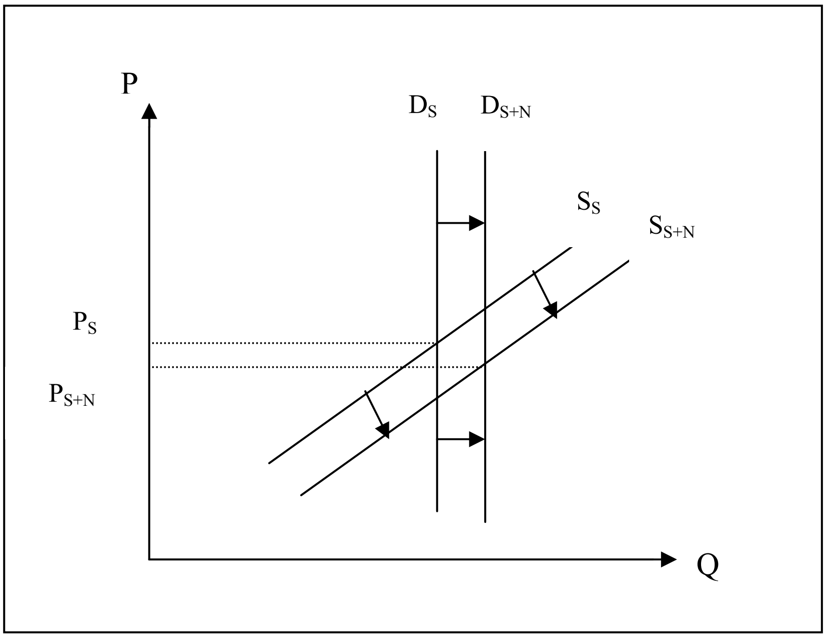

Figure 34 An example of how the equilibrium price can change on an expanded market.

If the general expectation is that the price will fall after expansion, then the demand side will try to postpone buying certificates, while the supply side will want to sell them. Expectations of lower certificate prices would bring forward price reductions. In the same way, expectations of higher certificate prices would result in the prices rising even before the market was expanded.

Expectations would be driven by a number of factors, including the forecast issued by the authorities. Forecasts could turn out to be self-fulfilling, in that the actual expectations affect the price in the short term. If the forecasts are actually wrong or exaggerated, the effect could be fluctuating certificate prices until the prices have adjusted themselves to the real conditions.

Norway's entry to the market will result in speculations on expected price developments. This, in combination with the price ceiling changing to a varying quota obligation fee, will result in substantial price variations and fluctuating and unpredictable pricing.

The expectations that the parties have today – before everything is in place and while important factors are still under discussion – are that the expansion will result in lower certificate prices. It is expected that Norway will enter the system with low quota levels that do not compensate for the surplus of Swedish production availability. Regardless of the quota level that Norway actually chooses, it is certain that the Norwegian quota levels will have a significant effect on pricing. It is therefore important that the market should know the Norwegian quota levels in good time, in order to avoid too severe a price shock when they are finally announced.

9.4 Practical problems

One practical problem, a solution to which is unconditionally required if a joint market is to be established at all, is whether Norway can set up an operating IT system that is compatible with the Swedish system. *Working infrastructures, providing each country with access to the other's systems*, are so important that there cannot be any question as to whether such a system is in place when the expanded market opens on 1st January 2006. Any suspicions that the system will not be ready will create unnecessary worries on the market. In order to ensure that such a scenario - which, in practical terms, would render trade between the two systems impossible - does not occur, it is important that the Norwegian authorities should learn from and apply the experience and know-how that the Swedish authorities have obtained.

The present position is that the public authorities in the two countries will not be responsible for setting up an operational trading market for certificates: instead, it is expected that the market parties arrange this themselves. However, the expansion means that *the need for a working trading market* increases, and a working market will therefore probably emerge. The question is simply when such a market will be ready and able to operate to its full extent. In the short term, the lack of a working market may be a problem, in so far as it makes it difficult for smaller parties to trade on the expanded market.

In order to avoid duplication of information, it is important that all parties receive the same information from the authorities, regardless of in which country they are. The lack of *market information* has been put forward as a weakness of the Swedish system. The importance of a market information function increases when the market expands. Without it, there is a greater risk of the spread of incorrect information, with more serious consequences as a result not only of providing different information to different parties, but now also to different countries. Reliable market information is also a countermeasure against the short-term uncertainty associated with expansion.

One practical solution is to set up a joint web site with market information, to which those involved in the market in both countries have access, and from which information is equally available, regardless of the destination country. It would naturally be necessary to provide the required resources for operating such a web site. It is desirable that the quality of the information should be improved in comparison with its present quality in the Swedish system. In addition to information on the trading prices of certificates, it would also be helpful to have information on planned production expansions in the form of information from the authorities on the number of power production applications that they are processing. If plants are going to be granted certificates for only a limited time, this in itself means that more information would be required. How this information might suitably be provided is not further considered here, although it would be helpful if, perhaps, five years before a plant is due to be phased out, the market could be provided with statistics on the amount of renewable electricity that it had produced during the last few years. Market traders could then draw their own conclusions on what the effect might be in terms of reduced system production capacity. However, the most important element is that the information is the same in both countries.

Realisation of a joint market must be preceded by a political decision-making process that can be quite extensive. Perhaps the most serious short-term consequence of this is the risk that the parties on the market respond by doing nothing until all the legislative aspects have been put forward. This would create a vacuum in the market, during which time nothing happens and no new production capacity is built. One possible practical solution to this short-term problem would be to construct some form of *transition arrangement*, the main aim of which would be to calm speculation induced by the expansion. An example of such a transition arrangement might be to restrict trading in the other country's certificates for a certain time. However, how such a restriction should be designed, and what effect it would have, would depend entirely on the state of the market at the time concerned. It could, for example, be decided that Sweden could not use Norwegian certificates due for cancellation in April 2006. On the other hand, if Sweden holds a surplus of certificates (which is very likely), this limitation would not be particularly serious in practice. It is important to bear in mind, when discussing different types of transition arrangements, that any exception or regulation will result in new responses from those on the market, in turn resulting in new speculations and further complication of the market. Each and every exception creates its own ripples in the market, with the result that transition arrangements could tend to aggravate the uncertainty rather than reduce it. In the light of this, the Agency does not recommend any transition arrangement.

10 EU legislative aspects of an expanded market

This chapter presents an analysis of an expanded electricity certificate market in the light of Sweden's EU undertakings, and particularly as affected by EU legislation. The entire chapter has been written by the Swedish Board of Trade, and the conclusions and recommendations in it are those of the Board of Trade. The Swedish Energy Agency has not evaluated the conclusions or recommendations in it.

The National Board of Trade reaches the following conclusions:

- An open system of trading in electricity certificates between several countries would further the benefits of a certificate system.
- The fact that only two countries would be involved initially is not seen as a problem, although this arrangement should be checked with the European Commission at a suitable time. The proposal also needs to be reviewed against the requirements of Directive 98/34/EC.
- It must be possible to justify any departures from the requirements of Directive 2001/77/EC.

That part of the Swedish Energy Agency's commission that is mainly dealt with in this chapter is:

> The Agency should also analyse the consequences of an expanded electricity certificate market in the light of Sweden's obligations in connection with its EU membership, and particularly in connection with EU legislative aspects.

Introduction

The National Board of Trade is the central authority having jurisdiction for foreign trade and trade policy, and is the contact point for dealing with barriers to trade and other problems arising in connection with the free movement of goods on the single market (Sweden's SOLVIT centre)49. We have been instructed by the Swedish Government to work for an efficient single market. This means that we are responsible for safeguarding the 'four freedoms' on the single market, and so we evaluate proposals primarily against this starting point. In line with this, it is also our duty to examine authorities' proposals for new national regulations, and to act as the Swedish contact point within the EEA in information procedures in accordance with Directive 98/34/EC. It is important that new or amended legislation or regulations that could result in acting as barriers to trade on the

[49] The National Board of Trade is Sweden's official SOLVIT centre. SOLVIT is an electronic network within the EU/EEA (run by the European Commission), with the purpose of trying to find informal solutions to concrete problems arising on the EU single market. Each member country has a SOLVIT centre, which receives notifications of barriers to trade.

single market are not introduced. In order to avoid barriers to trade or distortion of competition, we feel that it is a principle that agreed solutions to problems should be striven for at European and international levels.

Background

The Swedish Government has decided that the benefits of the electricity certificate system will be most clearly felt when international trading of such certificates is brought about, and that Sweden should actively work towards establishment of a larger market for electricity certificates, starting with the Nordic countries.

The Government has commissioned the Swedish Energy Agency to investigate the consequences of an expanded electricity certificate market. This work includes analysis of the consequences of such expansion, in the light of Sweden's EU undertakings and particularly in respect of EU legislative aspects.

As part of this work, the National Board of Trade has been asked by the Swedish Energy Agency to analyse the EU legislative aspects. We have therefore identified a number of points that we feel need to be further considered in EU and WTO perspectives.

10.1 General and formal conditions

10.1.1 A single system, open to all parties

The legal aspects of establishing a system for trading electricity certificates between Sweden and Norway can be discussed only in general terms. As far as we know, there are no discussions in progress in other countries concerning establishment of a common international market for trading in electricity certificates. The subject has not, in other words, been subjected to legal scrutiny. We do not see any problems in principle with a system that is open to all parties on the EU single market, but in which only two countries participate at first. It is the design of the system that will be decisive for whether it, in practice, meets the requirements in respects of openness. The system must be predictable and robust, and its requirements must not be such that they can, in practice, be fulfilled only by Sweden and Norway. In the longer term, it should be aiming to become a joint international system. A proposal for a solution in which only two countries participate from the start should be submitted to the European Commission for confirmation at some time when the Ministry for Foreign Affairs deems it appropriate to do so.

10.1.2 Notification in accordance with Directive 98/34/EC

Before any new proposals for legislation or regulations are adopted, they must be examined in accordance with the requirements of Directive 98/34/EC, laying down a procedure for the provision of information in the field of technical standards and regulations.

As defined in the directive, *a product* is any industrially manufactured product and all agricultural products, including fisheries products. Electricity is a product in the meaning of the directive. A *technical specification* is a specification in a document, setting out the required properties and characteristics of a product, such as quality levels, performance, safety or dimensions, and including requirements in respect of the product that relate to the name of the type of product, terminology, symbols, testing and test methods, packaging, marking or labelling and procedures for conformity assessment. An *other requirement* is a requirement which is not a technical specification, and which is applied to a product with the prime purpose of protecting consumers or the environment, and which affects its life cycle after it has been released to the market, e.g. conditions of/for use, recovery, recycling or disposal, it these instructions can significantly affect the composition, nature or sale of the product.

We are of the opinion (preliminarily, before the text is available) that a proposal for a new or modified law concerning trading in electricity certificates would be liable for notification in accordance with the requirements of Directive 98/34/EC. In our opinion, certificates can be regarded as a requirement which is not a technical specification, but which has been expressed in order to protect consumers or the environment, and which can significantly affect the sale of electricity.

Proposals that are regarded as being notifiable under the terms of the directive, and which are sent to the European Commission, are considered by the Commission in respect of a number of aspects. The resulting views, which can also include submissions from other member states, are put together into comments or what are known as detailed statements. The commonest comments relate to a lack of a mutual recognition clause and incorrect incorporation of secondary rights. If the material has not been submitted, and if a court subsequently decides that the material should have been submitted under the terms of the directive, the result is that those parts of the national law or regulation that constitute technical regulations have no legal authority, and cannot therefore be cited against individuals in national courts50.

10.2 Possible problems

10.2.1 Departures from Directive 2001/77/EC

One of the matters that can be considered by the Commission is how the proposal relates to Directive 2001/77/EC on the promotion of electricity produced from renewable sources in the internal electricity market. This directive is based on Article 175 of the Treaty of Rome. Article 176 states that the protective measures adopted in accordance with Article 175 shall not prevent any member state from retaining or introducing stricter protective measures, although such measures must be compatible with the Treaty, and must be notified to the Commission.

This means that, in other words, it must be possible to justify the measures if any departures from the directive are to be acceptable. We cannot judge whether departures from the definitions given in Directive 2001/77/EC can be justified as

[50] Judgement of the European Court in its case C-194/94, CIA Security International, REG 1996, p. 2201.

necessary and proportional, but we see a risk in the fact that the positive effects of the system can be reduced if different definitions of what constitute renewable energy sources are applied in different countries. There would be a risk that the harmonising effects of the directive would disappear, as would the conditions for all parties to participate in the system.
The fact that the present Swedish system has not been reviewed by the Commission in accordance with Directive 98/34/EC introduces an element of uncertainty concerning the status of the system. A review of the system from a competition point of view – i.e. the Commission's opinion of any state subsidies – does not replace submission for examination of the technical regulations. This uncertainty also makes it impossible to assess the ability of each country in the system to decide what form of electricity production to enter in the system. Changing the subsidy measures for renewable energy seems to be less uncertain, bearing in mind the fact that the Swedish subsidy measures have been approved. Even if the Swedish limitation of what constitutes renewable energy sources is approved in a review, it is not necessarily clear that certificates based on electricity produced in a manner that Sweden does not regard as being entitled to a subsidy, but which complies with Directive 2001/77/EC, can be refused by the system. A starting point here would probably be how the limited Swedish definition has been justified.

10.2.2 Criteria

As far as the criteria that can be applied are concerned, the requirement for a competitive electricity market should be thoroughly discussed. If the conditions for a country's participation in the system are that it must have a competitive market for electricity, then this requirement should be applied, but be clearly defined, transparent and neutral. The question of any parallel support measures by the state should be included in the assessment of deciding whether the market is sufficiently open to competition. Public support measures must always be approved by the Commission, or must comply with defined guidelines. If the conditions for support are altered by participation in a certificate system that provides a guarantee price to producers, it would be necessary to review the question of support again.

10.2.3 Other criteria

Other criteria that may arise, but on which we have no views other than the general requirement for openness, are:

- Possible limitation of the support period
- Requirements in respect of the quota-based system
- Quota level and its development
- The length of the quota period
- Sanction charge for failing to fulfil quota obligations
- Legal status – financial instruments
- The validity time of certificates

- Crediting of environmental value
- Matters relating to the registry
- Cancellation
- Functions for certificate management, the issuing of certificates, surveillance, inspection, transfer between countries.

10.2.4 What measures need to be applied?

The measures and notification procedures that we feel should be observed in order to establish an expanded system can be summarised by the three following points:

- In order to obtain legitimacy at an early stage for expanding a certificate system in which only two countries initially participate, the proposal should be *referred to the Commission* as soon as regarded as suitable by the Ministry of Foreign Affairs.
- When a proposal text is available, *a decision should be made as to whether it constitutes a technical regulation in accordance with Directive 98/34/EC.* We are preliminarily of the opinion that such material would be liable for submission to the Commission, but a new review and decision should be made when the text is available.
- If the conditions for *state support* have been changed, a new notification to the Commission should be considered.

10.3 WTO

In addition to the legal considerations from the EU point of view, we have also analysed expansion of the electricity certificate system in the light of the WTO agreement.
From a WTO perspective, parallels can be drawn with emission trading rights, although electricity certificates also document the proportion of electricity produced in a renewable manner, which the emission rights do not do.

10.3.1 Inadmissible subsidies?

As in the trade in emission rights, there can be a subsidy aspect to electricity certificate trading. Is the issue of certificates by the state to be regarded as an inadmissible export subsidy or as an assessible subsidy as defined in the Agreement on Subsidies and Countervailing Measures (ASCM)? Production of renewable energy is more expensive than production of non-renewable energy, and therefore involves an economic commitment. Issuing certificates with the aim of compensating electricity producers for their additional costs in producing electricity from renewable sources can therefore probably be regarded as a subsidy in the meaning of the ASCM. Certificates can be regarded as a form of price support, and thus become a subsidy in accordance with Article 1.1(a)(2) of the agreement. The higher the quota obligation and the quota obligation fee, the more likely it is that producers of renewable energy will be over-compensated, and can thus be regarded as receiving a more than merely insignificant benefit. The system should therefore be designed so that unnecessary over-compensation is avoided. It is worth mentioning that the present level of support provided by the electricity certificate system is regarded as considerably exceeding the existing costs of producing electricity. Overcompensation for new renewable electricity production is also regarded as occurring, as stated by the Swedish Energy Agency to which reference is made in an ongoing public investigation. This risk for a non-insignificant benefit being regarded as present means that it is probably even more important that the system should be as general and objective as possible, so that it does not particularly favour certain producers of renewable energy. We are of the opinion that there is no liability for notification of the certificates to WTO in accordance with Article 25.2 of the agreement, provided that they are made available to all producers on the same terms.

10.3.2 How will electricity certificates from other countries be handled?

Trading in electricity certificates should probably be regarded as trading in a new service, for which commitments have not been made51. This means that the Most Favoured Nation principle applies, but not the rules governing access to markets or national treatment. From this, it follows that if electricity certificates from a country outside the EU/EEA area were permitted in the system, other countries outside the community could not be treated less advantageously. On the other hand, different definitions of renewable energy sources in different countries might affect the extent to which certificates could be traded.

10.3.3 Other renewable energy

Our final question concerns how renewable energy from non-EU/EEA countries not having electricity certificates, or having electricity certificates that are not approved, is treated. It could be claimed in a WTO perspective that such imported renewable energy should also be granted certificates, in addition to the fact that this would be desirable in a global environmental perspective. If not, this could be regarded as discrimination against like products – other renewable energy – or as a quantitative restriction. There is, admittedly, an exception rule (GATT Art. XX g) that could be applied, but it is our preliminary view that this rule would probably not apply in this case, which would mean that discrimination of imported renewable energy is dubious. One aspect is that competing imported renewable energy could assist restructuring of the energy system and fulfilment of Kyoto Protocol commitments.

[51] In order to decide which agreement is applicable, we need to consider the further question of whether certificates as defined in WTO Agreement are to be regarded as goods in accordance with the General Agreement on Tariffs and Trade (GATT 1994), or as services under the General Agreement on Trade in Services (GATS, 1994). This is not clear. However, we feel that it is somewhat more likely that trading in certificates will be regarded as trading in a service.

11 Necessary legislative changes

This chapter describes legislative changes that are required as a result of the analysis described in this report.

The Swedish Energy Agency reaches the following conclusions:

- The Agency is of the opinion that several changes are required to:
- The Act (2003:113) concerning Electricity Certificates
- The Ordinance (2003:120) concerning Electricity Certificates

- The Agency is of the opinion that it is very likely that changes will also be required to:
- The Act (2003:437) concerning Guarantees of Origin of Renewable Electricity

- As a result of its analysis, the Agency does not feel that the following statutes require any changes:
- Debt Enforcement Act (1981:774) 4 Chapter 30 § and 6 Chapter 2 §,
- The Rights of Priority Act (1970:979) 4 §,
- The Act on Secrecy (1980:100) 8 Chapter 29 §,
- The Bankruptcy Ordinance (1987:916) 12 § 16 p,
- The Ordinance (1995:1301) concerning Handling of Compensation Claims against the State 4 §,
- The Ordinance (1999:716) concerning Metering, Calculation and Reporting of Transmitted Electricity 9 §,
- The Act (2001:1227) concerning Self-declarations and Statements of Income 11 Chapter 12, 13 §§,
- The Income Tax Act (1999:1229) 17 Chapter 4, 22 a §§

11.1 Introduction

This chapter describes legislative changes that may be required as a result of the Agency's analysis of the consequences of an expanded electricity certificate market.

The main statutes relating to electricity certificates are the Act (2003:113) concerning Electricity Certificates and the Ordinance (2003:120) concerning Electricity Certificates. In addition to changes in these two statutes, it is likely that changes will also be needed to the Act (2003:437) concerning Guarantees of Origin of Renewable Electricity.

In addition to these statutes, electricity certificates are also affected by legislation concerning financial instruments. In practice, this means that trading in electricity certificates would be covered by the regulations that apply to trading in securities. Our analysis indicates that it would be desirable for the legal status of the certificates in the countries connected to the system to be coordinated. The analysis does not indicate that any change in this respect is necessary.

The analysis shows that most types of parallel support system distort competition between different forms of energy, which means that such support systems should be harmonised. The environmental bonus for wind power is at present being phased out, and no other parallel support systems that could be regarded as affecting competition exist at present.

Other statutes for which changes are not indicated by the analysis are as follows:

- Debt Enforcement Act (1981:774) 4 Chapter 30 § and 6 Chapter 2 §,
- The Rights of Priority Act (1970:979) 4 §,
- The Act on Secrecy (1980:100) 8 Chapter 29 §,
- The Bankruptcy Ordinance (1987:916) 12 § 16 p,
- The Ordinance (1995:1301) concerning Handling of Compensation Claims against the State 4 §,
- The Ordinance (1999:716) concerning Metering, Calculation and Reporting of Transmitted Electricity 9 §,
- The Act (2001:1227) concerning Self-declarations and Statements of Income 11 Chapter 12, 13 §§ and
- The Income Tax Act (1999:1229) 17 Chapter 4, 22 a §§.

Changes that are indicated by the analysis as being required are described on the basis of the structure of each item.

11.2 Changes to the Act (2003:113) concerning Electricity Certificates

11.2.1 1 Chapter. Purpose and definitions etc.

It will be necessary to change the definition of an electricity certificate in the event of an expanded market system, as certificates will then be issued by public authorities in other countries.

Participating countries need to have some form of registry for production plants and those having quota obligations. In Sweden, the National Energy Agency has an IT system that permits those having quota obligations to register for management of their obligations, and which permits plant operators to apply for approval of their plants. There will need to be legislation that specifies to which authority (to which country) notifications or applications must be submitted.

It should be legislated that applications for approval should be submitted to the authority having jurisdiction in the country in which the plant is situated. This is important, in making it possible to monitor national production objectives and for the acquisition and processing of other statistics. It will also mean that, provided that certificates are issued by the respective national systems, certificates will indicate their correct nationality of origin. If there is a joint system for issuing certificates, they must be marked for identification purposes within the framework of the system.

As far as quota obligation management is concerned, electricity consumption in each country must be declared in the country of consumption. In this respect, it will be necessary to clarify the definition of management of quota obligations.

11.2.2 2 Chapter. Conditions for the receipt of certificates

Electricity production entitled to certificates

The Agency's analysis emphasises that, in the interest of legitimacy, significant differences between the types of production that are entitled to certificates should be avoided. It will be necessary to make changes to the law if changes are made to definitions of the types of energy sources that are entitled to electricity certificates. These changes may relate both to energy sources and also possibly to the types of plant that can be approved for the receipt of certificates.

The life of plants

As far as international trading in electricity certificates is concerned, the length of life of plants in the various countries' systems will probably not be anything that must be coordinated between national systems in order to allow certificates to be traded between them. If, in the end, an alternative is chosen in which plants are eventually phased out of the system, the intended lengths of lives of the plants must be stated.

11.2.3 3 Chapter. Electricity certificates - accounting

Register function for electricity certificates

There are two possibilities: either a register in each country, or a joint register function.

If separate registers are chosen, it must be possible for the register-operating agencies in each country to communicate with each other if it is to be possible to transfer certificates within the joint market. There will also need to be rules governing how transactions between the register systems are to be made.

With a common register, it will probably be easier to transfer certificates, regardless of their origin. In addition, a joint register will probably facilitate subsequent entry of third and fourth countries.

Certificate accounts must be held in the country in which the certificate-entitled production has arisen, and this should be stated in the legal text.

Electricity certificates

It is important that information on the number of certificates that have been issued should be available to the parties on the market. This information must also be available at the same time for all parties. In the case of a common register, this is no problem: if there are separate national registers, there must be a common information point on the internet.

11.2.4 4 Chapter. Quota obligations etc.

Long-term quota setting

The analysis indicates that it is important that quotas should be set in a long-term perspective. The legislation should specify this, together with instructions on how the quota levels are to be determined. In addition, the legislation needs to state that the system has a limited length of life.

Management of quota obligations

Assuming that end user consumers will no longer have to manage their quota obligations themselves, the rule applying to users who have notified that they wish to do so needs to be clarified. Other changes concerning quota obligation categories may also require changes to the legislation. These include specification of the types of companies that may be exempted from quota obligation management of electricity used in industrial manufacturing processes.

The quota period and declaration and cancellation dates

It is suggested that the quota period should continue to be the calendar year, which means that no change in the legislation is required. The analysis has not suggested any changes to the present declaration or cancellation dates.

11.2.5 5 Chapter. Quota obligation non-cancellation penalty

Quota obligation non-cancellation penalty

Any change in the amount of this penalty, or any new way of determining it, would require changes in the law.

11.2.6 6 Chapter. Surveillance etc.

It should be clarified that, within the framework of participation in the electricity certificate system, the surveillance authorities should be able (on request) to assist each other with information and in other ways. Surveillance should be restricted to parties in each country's own national register, although coupled with a requirement to provide information to surveillance authorities in other countries connected to the system if irregularities linked to that country should be found.

11.2.7 7 Chapter. Penalties and damages

There must be congruence between participating states as far as the factors that lead to penalties in connection with the transfer of certificates are concerned, as it is most important that there should not be any possibility of manipulating the market values of certificates.

11.2.8 8 Chapter. Appeals

As far as regulation of the appeals procedure is concerned, there are no indications of the need for any changes.

11.2.9 Transition regulations

Any phasing-out of plants that, at the time of establishing a joint certificate market were entitled to certificates, must be regulated. This also applies as far as categories of those having quota obligations are concerned if they, after establishment of a joint market, are no longer required to manage their quota obligations.

11.3 Changes to the Ordinance (2003:120) concerning Electricity Certificates

If the definition of biofuels is changed, there will need to be a corresponding change in the Ordinance.

11.4 Changes to The Act (2003:437) concerning Guarantees of Origin of Renewable Electricity

Provided that the concept of 'plants that can be approved for the receipt of electricity certificates' is changed, it will not be necessary to change the regulations in 4 § of the Act (2003:437) concerning Guarantees of Origin of Renewable Electricity. The regulations here apply to the plant concept.

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