Electricity labelling

Requirements for establishing a reliable well functioning system within the EU

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Content

EXECUTIVE SUMMARY

An electricity labelling system refers to the disclosure of information on specific features related to electricity by suppliers to consumer. The system consists of two main elements:

- The front side; a label directed towards the customer as an integrated part of the retail market.
- The backside; the verification of the origin of the electricity presented on the label. This function is an integrated part of the wholesale market. There are two basic alternatives for structuring the backside of the system: contract-based and certificate-based.

The purpose of this paper is to define the criteria's/requirements, which have to be met in order to establish a reliable, well functioning electricity-labelling system within the EU. The main focus of the analysis is on the backside of the labelling system [1], while the front side is discussed only to the extend it affects the design of the backside. The goal of the analysis is to define the most efficient and effective system design from a European perspective.

1. Objectives and criteria

The introduction of an electricity labelling system should aim at achieving four main objectives: (1) increase market transparency by providing open and easy access to relevant information, (2) comply with the consumers right to information regarding purchased products, (3) enable consumers to make choices based on the quality of the electricity supply and (4) educate consumers and stimulate environmentally friendly electricity generation.

In order for the system to be efficient in realizing the objectives presented above, it has to be seen by the customers as a trustworthy system providing objective information. In other words the system has to have a sufficient level of reliability, accuracy and completeness.[2] Based on the overall perspective, from which the labelling system is

[1] There are a number of reasons why focus should be on the backside of the system: (1) the back side is a "Conditio sine qua non" with respect to the front side of the system; (2) the design of the backside is at least as important for the success or the failure of the labelling system as the front side, but has not been given the required attention and (3) due to the relative independence of the front and the backside, it is possible to structure the front side in accordance with cultural specifics and national requirements while having an uniform verification system on European level.

[2] Reliability refers to the level of consistency and credibility of the presented information. It is affected by the complexity of the system design and the robustness against manipulation. Accuracy refers to the precision of the information. Completeness refers to the level of information detailing.

being introduced and the political ambitions for the future, it is essential that the system is flexible and can be expanded over time both in terms of geographical coverage as well as in terms of width and depth of the information.

A well-designed system has a limited need for further regulation, detailed administrative control and interventions. The incentives imbedded in the system create to a large extent a self-managing and self-regulating structure.

2. Issues on the front side affecting the design of the backside of the labelling system

The design of the backside of the labelling system can be affected by some of the choices made on the front side. The most relevant issues are shortly discussed below.[3] The backside of the system is covered in sections 3 - 8.

The level of information aggregation. There are two levels at which information can be disclosed: company (portfolio) level and product level. A company-based label reflects the quality structure of the total electricity portfolio of the supplier. A product-based label refers to the quality of a specific electricity product. Both types of labels are used in the market. There are also markets where hybrid forms are introduced with a mandatory portfolio based label and a voluntary product based label.

The point of time of the information disclosure. The point of time refers to when the information is presented to the customers. There are two basic alternatives, which are both in use in the market: Ex-post (the information is disclosed after the product has been delivered) and ex-ante (the information is disclosed before product delivery). A product-based label is always ex-ante, while a portfolio-based label can be both ex-post as well as ex-ante.

The content of the disclosed information. The main information that can be presented on the label is: price, fuel mix, country of generation and environmental impact. With respect to the fuel mix the desired amount of details should be determined. In general, the higher the level of details the higher the demand for accuracy on the verification[4] side. Disclosure of very detailed information will moreover lead to higher fragmentation in the wholesale market. One the other hand, once producers are placed within a certain fuel category, they will tend to minimize their production costs using the cheapest and not the most environmentally friendly production technology within the category.

[3] Other issues related to the front side such as the uniformity of the label, the label lay-out, the communication medium and the frequency of communication are not relevant for the design of the backside of the system and will not be covered here.

[4] In this context 'verification' is used for explaining how a label is backed up by real production. 'Verification' is also used to describe the tracking process that will verify the buy/sell balance with the retailer (between both certificates and sold labels) and the balance between production and sales of certificates by producers.

The objectives of the labelling system are to increase market transparency and enable the consumers to make informed choices. Therefore we propose a product based ex-ante information disclosure system based on the following arguments:

- If information (such as quality) is perceived to be important, the consumers will request this information before they purchase the product.[5]
- Consumer research shows preferences for product-based information. [6]
- It allows the suppliers to better position themselves and responds to the needs of the specific client groups.
- From the suppliers' perspective, even a portfolio based ex-post system develops into an ex-ante system the moment the suppliers choose to differentiate based on the quality of their portfolio.

The label is the communication medium between supplier and consumer. Considering the complexity of the issue and the lack of experience of both consumers and suppliers we propose a simple label system presenting for each label the fuel source and the price[7]. Over time, the consumers as well as the other market actors will gain experience and more detailed information can be disclosed on the label.

If a product based ex-ante labelling system is introduced, it is rather easy to present ex-post company based information as well. However, an ex-post company based labelling system has to be fully restructured in order to support ex-ante product based information disclosure.

A product based ex-ante label in the retail market can be backed only by an ex-ante verification in the wholesale market. Ex-ante verification means that e.g. the retailer will know in advance how much of each category he will receive, as opposed to an ex-post system where information of delivered categories can only be revealed after delivery.

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3. Contract-based verification alternative

In the contract-based verification design the identification of the fuel source is permanently tied to the kWh. All electricity contracts for physical delivery include information on electricity origin. The philosophy behind this concept is that if money can

[5] This argument is based on experiences from other markets as well as the limited experience with the labelling system in New York where an ex-post portfolio based label was introduced backed by an ex-post contract-based verification system. Till now the introduction of the label has not resulted in any changes in the behavior of the consumers and the suppliers. The suppliers are simply purchasing the cheapest electricity without any consideration for the quality.

[6] Consumer research on tracking approaches and product vs. supplier labelling, by M. Herrmann & B.Roe, The National Council on competition and the Electricity Industry US, October 1998

[7] The price can refer both to the price of the presented fuel mix as well as the prices of the individual categories. The fuel mix price is then the weighted average of the prices of the individual categories.

find their way from consumers to generators based on the kWh, the fuel source should be able to find its way from generators to consumers also based on the kWh.

This relatively simple concept presents a number of significant practical challenges. The most important are related to the tracking of the information as a result of the bundling and unbundling of contracts within the value chain and the increase of market complexity due to trade on three instead of two dimension (quality next to volume and location)

There are also some practical issues to be solved related to exchanges, import/export and settlement and balancing of the market. Either defining a separate category of “exchange-power” or establishing separate exchanges for each category can solve the exchange issue. Imports (from countries not participating in the common labelling system) raise similar concerns as the exchanges and can be dealt with in a similar manner. The exports create a potential possibility of “washing” electricity. The magnitude of the problem depends on the relative size of the import/exports and tends to decrease with the increase of the geographical region.[8] The issue of settlement and balancing depends on the capacity of the current ISO[9] systems and on the relative volume of imbalance and can vary significantly between electricity categories as well as from country to country.

The introduction of a contract-based verification system will most likely lead to fragmentation of the wholesale electricity market. This will result in reduced market liquidity and increased price volatility. Both have negative effects on the development of the market.

4. Certificate-based verification alternative

With a certificate-based system the generated kWh and the quality identification of the kWh is separated at the point of generation and traded separately. The physical electricity is traded through the existing market structures. The quality identification in the form of certificate is traded through market structures that are presently developing (related to green certificates) or have are yet to be developed. The certificate and the electricity are joined again in the point of supply to the consumers (by the supplier).

The first concern with the certificate model is what the defining factors for the price of electricity (without the certificate) and the price of the certificates will be. It can be expected that the electricity prices in neighbouring regions not participating in the labelling system, will be decisive for the price of basic electricity.

Cross border trade with certificates raises a policy issue about the extent to which imports of certificates should be accepted. The policy issue is related to the balance between local generation versus the economically efficient place of generation as well as creating wind-fall profits for foreign producers. Besides, large import of certificates will

[8] In some cases a small region (for example an island) can have limited import/export possibility.

[9] Independent System Operator

tend to reduce the “quality premium” for the categories imported. The significance of this issue tends to decrease with the increase of the geographical region.[10]

Contrary to the contract-based approach exchanges do not form a problem in the certificate-based approach. The issue of balancing and settlement can be dealt with in a pragmatic and relatively easy manner as well.

However, it is necessary to develop trading rules for certificates e.g. regarding short selling, borrowing, banking, validity, as well as issuing of certificates and settlement between energy and certificates. Generally, experience from the green certificate markets as well as the financial markets such as bearer bonds, equity papers, etc. can help developing the necessary rules.

5. Evaluation of both verification alternatives

The evaluation of both systems is based on the above-described criteria: reliability, accuracy and completeness and non-rigidity as well as the cost perspective. Other relevant findings are also taken into account in the evaluation.

The evaluation presented in Table 0.1 shows that, contrary to general expectations the contract-based alternative is more challenging and sensitive in terms of reliability, accuracy and completeness compared to the certificate-based one.

Criteria	*Contract versus certificate-based alternative*
Reliability	The high complexity of the contract-based alternative as a result of the numerous bundling and unbundling of electricity contracts through the value chain makes it difficult to develop a simple and reliable tracking structure. The large administrative burden will increase the probability of operational errors. In addition, the market fragmentation will make it easier for large companies to dominate a specific market segment, opening up for manipulation and misuse. All this is harmful for the reliability.
Accuracy and completeness	In both systems, imports/exports and settlement and balancing create some challenges with respect to accuracy and completeness. However, meeting these challenges is less complicated in the certificate-based compared to the contract-based alternative. Exchanges form an additional challenge in the contract-based alternative.

[10] For example: Should a windmill park be placed in the country with the highest expected return on investment or in the country with the demand for green (wind) energy?

Flexibility	The issue of geographical expansion is not a problem in any of the alternatives. Though different, there are equally important challenges in both alternatives with respect to increasing the information presented on the label.

Table 0.1: Reliability accuracy and completeness comparison.

There is no information available regarding level of total costs, and it is difficult to estimate the costs without a detailed analysis of the capabilities of the current systems.[11] However, it is expected that the costs will be insignificant compared to the retail electricity prices. From this perspective, the cost analysis should not have significant impact on the final choice of the labelling system design.

In addition, experiences prove that contract-based verification can be introduced in an ex-post portfolio based labelling system, especially in regions with limited import/export.[12] However, it is extremely difficult, if not impossible, to design an ex-ante contract-based verification system. The experience from the New England region supports this conclusion.[13]

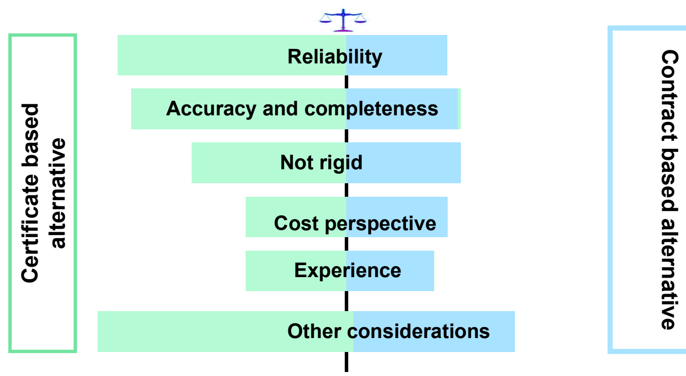
An argument for the certificate-based approach is that this alternative appears to be more suitable to facilitate regions with multiple jurisdictions as well as multi-task purposes. Besides, the higher liquidity and lower price volatility in the certificate-based approach will stimulate the development of secondary (financial) markets. This is essential from a risk management perspective.

[11] This refers for system used by the suppliers, the ISO's, Exchanges etc.

[12] This is the case in Texas and New York

[13] In New England initially a contract-based verification method was selected to support an ex-ante product based labelling system.. However, during the process of designing the system and developing the operational rules and procedures it became evident that the contract-based verification could not work in practice. As a result the contract-based method was abandoned and a certificate-based certification method was developed.

An overview of the evaluation of both systems is presented in Figure 0.1.



. Figure 0.1: Evaluation of the contract-based and the certificate based alternative

Based on this evaluation it can be concluded that the verification on the backside of the labelling system should be certificate-based.

6. Framework design of the certificate-based system

The basic design principles of the certificate-based alternative are presented below:

1) Certificates are traded separately from the electricity.

2) End-use suppliers must prove the purchase of certificates corresponding to the electricity sold.

3) Producers must similarly prove sale of certificates at arms length principles to external buyers – the sale of certificates can be perceived as a license to generate electricity.

4) Balance between sale/purchase of energy and sale/purchase of certificates must be proved for a given period, for example a year.[14]

5) It should be considered to limit import of certificates to the actual import of energy or import capacity for physical energy. Otherwise, the price levels might be lower than intended for several categories. Similar limitations for export of certificates could be considered.

6) Two different systems can hardly coexist as efficiency matters. If one country introduces contract-based verification and the other introduces certificates, it will be difficult to have the two systems working efficiently together.

[14] This refers to both electricity generators as well as suppliers of electricity to end-users.

7. Geographical perspective and system expansion

The geographical aspect is analysed based on four geographical regions: (1) the Netherlands, (2) BeNeLux, (3) BeNeLux and Germany and (4) EU plus Norway and Switzerland.

The evaluation of the effectiveness and efficiency of a possible electricity labelling system in each of the region is based on:

- The relative importance of the imports/exports.[15]
- The relative size of the market.[16]

The four regions are schematically presented in Figure 0.2. An electricity labelling system introduced in the Netherlands alone, or even in the entire BeNeLux region will be very fragile. This is mostly due to the relatively high imports/exports (compared to the size of the market) combined with the small market size. The region is basically too small to implement a consistent labelling system having the required credibility and without too large impact from import and export. Regions like the entire EU, or even BeNeLux and Germany together, could have an effective and efficient labelling system, backed by certificates, which could be reliable, accurate and flexible[17].

Generally, we consider it possible to introduce a certificate-based system in those countries that find labelling attractive, and not necessarily in the whole EU. Other countries could follow when or if they are convinced about the system. Adding more countries to the "labelling region" will not raise issues that are not considered already in a smaller start-up region. From efficiency perspective a large region has major advantages compared to a small one.[18] There is also reason to believe that a larger region will limit the system design problems and minimize the generation costs for the desired categories of electricity. We thus suggest a EU-wide system rather than a smaller region even if the political challenges related to reaching a multilateral agreement on labelling are considerable.

[15] Relative increase in imports/exports erodes the system. High imports allow for oversupply of the desired type of electricity from the outside region decreasing the value of this electricity source. Similarly the exports allow for dumping of the unattractive types of electricity.

[16] The introduction of quality characteristic will result in fragmentation of the electricity market in one form or another. As a result: (1) the liquidity will be effected – the smaller the market the higher the impact on liquidity and (2) the relative power of market players active in the market for a specific generation source will increase – the relative increase in power is higher in smaller markets as there are less generators.

[17] The geographical analysis in chapter 9.2 is related to the recommended certificate solution for the backside. We believe, however, that it will be at least as difficult to implement a labelling system with contract-based backside as it is with certificate-based one.

[18] The production can be better located in the region that maximizes returns. For example it is better to place a windmill park in Denmark compared to central Germany.

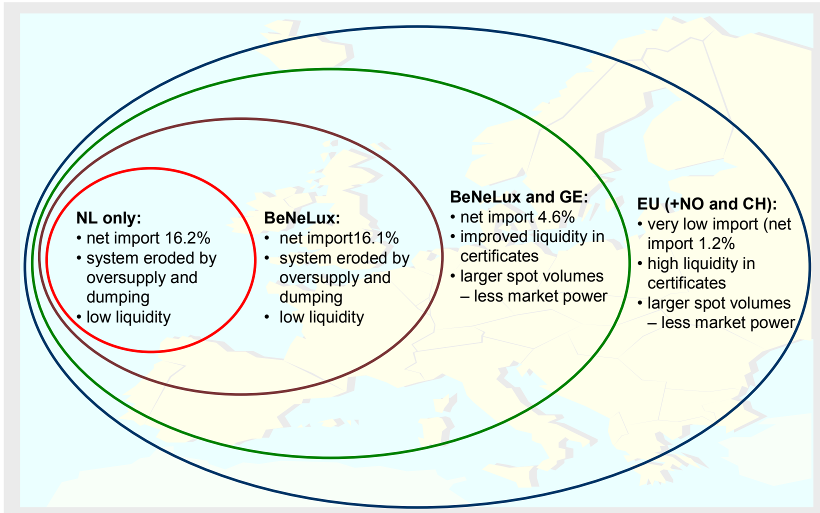


Figure 0.2: Geographical perspective

A stepwise approach could follow the geographical dimension. A stepwise approach in terms of changing the characteristics over time is not equally feasible. An ex-post system is simpler and easier to implement than an ex-ante system. However, changing from ex-post to ex-ante will most likely imply that the efforts taken to develop the ex-post system to a large extent are obsolete. We have concluded that ex-ante contract-based systems are virtually impossible to design completely. Thus we suggest starting with a certificate-based system to avoid double work and the risk of failure to implement an efficient system from the beginning.[19]

8. Criteria to be met for the establishment of a EU labelling system

The main criteria for implementation of an electricity labelling system can be summarized as follows:

1) Regulation set at EU level.[20]

2) Authority to give penalties for not applying with the system.

[19] This also considering the fact that for a EU wide acceptance, the electricity information disclosure should be successful from the beginning.

[20] Experiences from US and Austria show that disclosure laws on national rather than federal level seem to hinder the proper functioning of the system.

3) Acceptance of one basic verification design: certificate. This implies that similar rules are introduced in all countries joining the "labelling region" – different principles for verification can hardly coexist if efficiency matters.

4) Similar principles for issuing certificates, validity of certificates, trading, etc (presented in section 6 of the summary)

5) Agreement on uniform categories of electricity. If category 1 includes e.g. hydro and wind in one country, category 1 cannot be hydro only or coal in another country within the same system.

6) Agreement of a central body or co-operation between regional bodies to monitor issuing of certificates, registry of certificates (as we have national registries of equity papers), cross border trades, etc.

9. Conclusions

To achieve its objectives, the labelling system should be ex-ante and product based. If considered desirable, such system can easily support the presentation of company (portfolio) based ex-post information disclosure. The label should include only few key categories to gain experience, but information could be expanded later.

A product based ex-ante label requires an ex-ante verification system. Our evaluation shows that certificate based system is to be preferred. It is also more suitable for supporting multiple jurisdictions and multi task requirements. Besides, it is extremely difficult, if not impossible, to design a contract-based ex-ante verification system

An electricity labelling system introduced in the Netherlands alone, or even in the entire BeNeLux region will be very fragile. A EU-wide system is the best alternative, but phased introduction is also possible provided some simple conditions are met. The costs will be limited compared to the retail electricity price.

The next step is a study focusing on the following five aspects: (1) define the issues on a country level, (2) quantify the costs, (3) detail the system design, (4) define minimum possible regions within the EU for system introduction and (5) analyse market structure implications.

1 INTRODUCTION

The idea of disclosure of electricity product information is quickly gaining ground. At the moment a number of Member States including the Netherlands are positive towards the introduction of an electricity labelling system on EU level. However, there are a number of important issues that have to be carefully evaluated before such system is introduced.

This study was requested by the Dutch Minister of Economic affairs and focuses on the feasibility and the implications of the introduction of an electricity labelling system within the EU. The key question of the study is:

> What are the requirements / criteria for the establishment of a reliable, well functioning electricity labelling system within the EU?

The study is based on the assumption that an electricity labelling system will be introduced in one form or another and focuses on the framework design of an effective and efficient system. Even though the analysis is executed from a practical rather than theoretical perspective, it aims at identifying the best alternative system design.

1.1 The electricity labelling system

Electricity labelling refers to the disclosure of information on specific feature(s) of the electricity product to the consumers. An electricity labelling system has two main elements: a label and a document of origin to back up the label.

The label forms the front side of the labelling system and is directed towards the customers. It is the guarantee the supplier of the electricity offers to his customers regarding the origin of the electricity supplied. Therefore the label becomes an integrated part of the retail market.

In order to be able to offer the label to his costumers, the supplier has to purchase electricity with the origin reflected on the label. He also has to be in a position to prove the origin of the electricity purchased in the wholesale market. This, verification path forms the backside of the labelling system and is closely linked to the wholesale electricity market. It can be structured in different ways: through certificates, contracts or hybrid forms.

The figure below graphically represents the two aspects of an electricity labelling system.

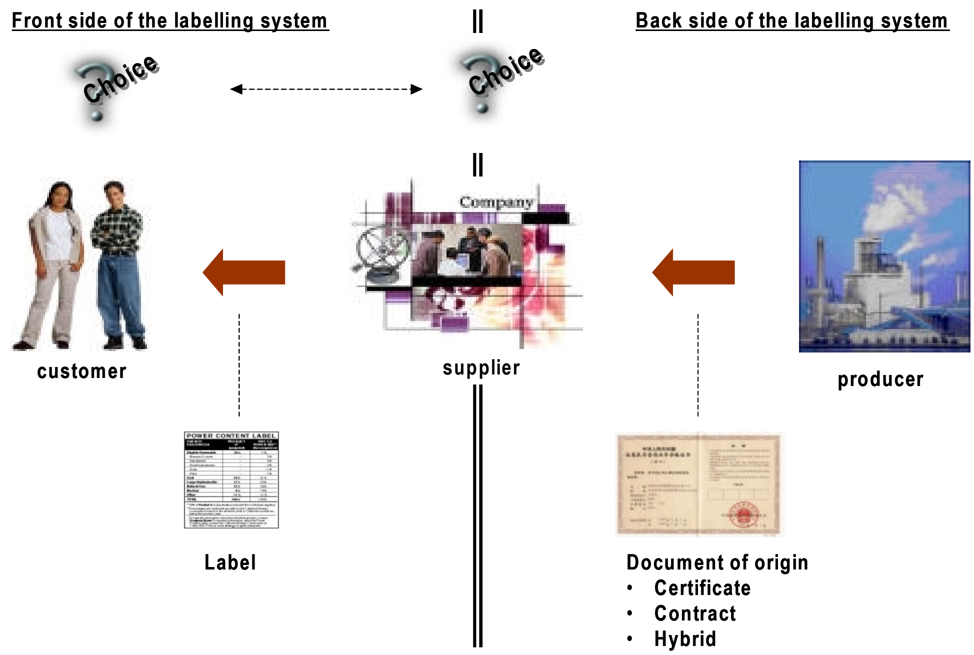


Figure 1.1: General structure of an electricity labelling system.

Many studies[21] focus on the consumer related front side of the labelling system as customer needs are considered of primary importance for the effectiveness of the system. The backside of the system is often considered a technical issue and therefore does not receive much attention.

Without, in any way, underestimating the importance of presenting a good label that meets consumers' expectations, we would like to emphasize that at least an equally important factor for the success or failure of the system, is the design of the backside of the system (wholesale market). Besides, the back side of the labelling system is a 'conditio sine qua non', that is a labelling system without a well functioning backside will not be able to fulfil the minimum requirements of such a system.

As an example of how the system might work, we can assume that there are three categories of production: A, B and C. An individual retailer sells four different labels: 1, 2, 3 and 4. The different labels look like this (total sales in GWh in brackets):

- Label 1: 100% category A (70)

[21] (1) Information Disclosure for Electricity Sales, Alan S. L at al., July 1997, (2) Summary Report, Baseline Survey Consumer Knowledge, Practices and Attitudes, Electricity Utility Deregulation and Consumer Choice, Kenneth Winneg et al., October 1998; (3) Label Testing: Results of Mall Intercept Studies, Kenneth Winneg et al., October 1998;(4) See literature list at the end of the report for further references

- Label 2: 100% category B (50)
- Label 3: 100% category C (30)
- Label 4: 50% category A and 50% category B (60)

His balancing of labels and production categories is illustrated in the table below:

Front side		***Back side – production categories***		
Sales labels	Total sales	A	B	C
Label 1	70	70	0	0
Label 2	50	0	50	0
Label 3	30	0	0	30
Label 4	60	30	30	0
Total sales	210	100	80	30

Table 1.1: Example of portfolio balancing from retailer perspective.

Due to the relative independence of both parts of the system it is very well possible that the front side (the label) may be structured in accordance with cultural specifics and national requirements, and may therefore also differ from one country to another. However, in view of the single European market it is essential that the design on the wholesale side is uniform. It is the electricity categories that are traded across borders, not the labels itself.

Therefore, this study only briefly discusses the main issues of the front side of the system. The focus is on structuring the verification, that is the backside of the labelling system.

1.2 Structure of the report

The purpose of the study is to determine what criteria/requirements have to be met in order to establish a reliable well functioning labelling system within the EU. To be able to do that, we first need to define the framework of the labelling system, which should be introduced. This is done by going through the following steps: (1) define the objectives of the labelling system, (2) define the criteria that should be met by the labelling system, (3) describe the relevant alternatives and (4) evaluate the alternatives against the criteria to determine the best labelling system.

After the fundamental structure of the labelling system has been selected, the framework of this system is further detailed. Only then, the information needed to extrapolate the criteria/requirements for the system introduction is available.

The report is structured as follows: Section 2 of the report presents the objectives of the labelling system as a whole. Section 3 looks at the criteria required to design an effective and efficient system. The lessons learned and best practices from other countries are presented in section 4. The relevant issues with respect to the front side of the system, the retail market are discussed in section 5. The two main alternative designs the contact based and the certificate-based are discussed respectively in section 6 and section 7. The cost aspect of the two systems is discussed in section 8. Finally, the alternative system designs are evaluated in section 9. The framework of the recommended system design is further detailed in this section as well.

In addition a number of annexes are included. The theoretical foundation of the underlying analysis is summarized in annex 1. An overview of the present disclosure systems is presented in annex 2. Annex 3 looks more in-depth on the issue of price formation. Information regarding the author of this report, SKM Energy Consulting, is included in annex 4.

2 OBJECTIVES

Electricity labelling is a tool that provides objective, consumer-oriented information about selected key characteristics of the offered electricity. SKM sees three main objectives related to the introduction of an electricity labelling system. These are:

- Increase market transparency
- Comply with the consumers right to know the characteristics of the purchased product
- Enable consumer choice based on quality of the electricity supplied
- In addition it is desirable that the electricity system contributes towards educating consumers and stimulating environmentally friendly electricity generation.

2.1 Increase market transparency

Market transparency is a precondition for the establishment of an efficient, competitive European electricity market. To realize this, it is essential that all market actors have open and easy access to relevant information. Information with respect to the origin of the provided electricity in one form or another can be considered a significant differentiating factor in a free market environment. Therefore, disclosure of this information is relevant. It will improve market transparency supporting the establishment of a level playing field in the market.

2.2 Comply with the consumers right to know the characteristics of the purchased product

The consumers have a fundamental right to know what exactly they are purchasing. Electricity is a very homogenous product and the consumers are not able to differentiate between the quality characteristics of the different electricity products simply by using the products. Besides, the effect of the origin do not explicitly, but implicitly affect the performance of the product. Therefore, it is important that the relevant characteristics of the electricity are disclosed and communicated to the consumers.

2.3 Enable consumer choice based on the quality of the electricity supplied

Effective consumer choice is also one of the three prerequisites for any liberalized retail market, including the electricity market, to function properly and develop successfully as a fully contestable market.[22] The lack of sufficient and relevant information can therefore distort market outcomes.

Free consumer choice is also one of the main goals of the liberalization of the European electricity market. At present the consumers' choice of a supplier is based on price, service and overall corporate image. In terms of product quality the consumers are, at most, free to choose only between two basic types of electricity: green electricity and not green electricity. In many countries there is no real choice at all.

2.4 Educate consumers and stimulate environmentally friendly electricity generation

Due to the specific physical characteristics of electricity, there is no direct relationship between the actual electricity consumed (coming from the electricity socket) and the electricity purchased. However, the quality of the purchased electricity has direct impact on the source of electricity production and respectively on the environment.

Over the years many efforts have been made to improve conditions for investing in more environmentally-friendly electricity generation. Until recently the main method was different ways of subsidies to selected production technologies, either by direct subsidies on investment, or indirectly by guarantees for higher margins for conventional electricity production. In both cases this has given the investors an acceptable rate of return and consequently increased generation from desired resources.

Information disclosure regarding the quality of the electricity will bring the customers directly into the decision process through the products he chooses to buy from the electricity suppliers. If the customers are willing to pay a premium for environmentally friendly electricity, the funds generated by these premiums will increase the production capacity of such electricity. This method moves the decision from public and governmental bodies to the individual consumers.

The labelling of electricity should therefore educate the consumers by increasing their awareness with respect to the environmental impact of the choices they explicitly or implicitly make. This, combined with increased social awareness on the value of the environment can stimulate demand for environmentally friendly electricity generation.

[22] The three requirements for the functioning any competitive market are: (1) sufficient number of buyers and sellers, (2) free market entry / exit and (3) informed consumer choices steering the value of the products though the demand.

3 SELECTION CRITERIA

A well-designed market system has limited need for further regulation, detailed administrative control and interventions. The incentives imbedded in the system create to a large extent a self-maintaining and self-regulated structure. In the following SKM will highlight three important criteria we believe any labelling system should be measured against.

In order for the labelling system to be effective in realizing the objectives discussed in the previous section it has to be regarded by the customers as a trustworthy system providing objective and fair information. In other words, the system has to have a sufficient level of: (1) reliability and (2) accuracy and completeness.

Based on the overall perspective from which the labelling system is being established and the broader political ambitions for the future it is important that the system is flexible and can be expanded over time.

Even the best system design is worthless unless it can be (and is) properly implemented. It should be practically possible to implement the designed system. Therefore, this study approaches the design issue from a practical rather than a theoretical perspective.

It goes without saying that the system is in compliance with EU regulation and that it is balanced in terms of costs and benefits.

The individual criteria are shortly presented below:

3.1 Reliability of the system

Reliability refers to the level of consistency and credibility of the presented information. The reliability of the system is effected by: (1) the complexity of the system design and (2) the robustness against manipulation.

3.1.1 Complexity of system design

Relatively complex systems tend to be more susceptible to unforeseen changes in their environment compared to more simple ones. This is due to the following reasons:

- Due to the complexity there is a higher possibility and probability of rupture and friction in the system design
- It is much more difficult to oversee in advance all the implications the introduction of the system will have on the market and its participants
- The complexity often presents more opportunities for manipulation and misuse while making the monitoring and control function much more difficult

With the increase in system design complexity, the uncertainty with respect to system reliability also increases. Therefore, everything equal, simple system design is to be preferred.

3.1.2 Robust against manipulation and misuse

A key feature of a reliable system is its robustness towards manipulation and misuse. There are a number of factors determining the level of robustness.

- *The quality of verification system in terms of tracking and issuing*. One of the major difficulties in implementing international trade with emission certificates under the Kyoto protocol is the tracking and issuing systems. Especially in international trading these problems arise, as the tradition for quality and transparency of tracking differs from country to country.

- *Market power.* Manipulation and misuse can be a result of the presence of significant market power of one or few of the players in the market. Therefore the effect of the system on the relative position of the market players should be carefully considered. The market power issue has at least two facets:
  - Impact on the basic electricity market
  - New arenas for market power following introduction of the labelling system

- *Fraud.* Fraud is a potential threat to any system designed for other purposes than basic commodity transactions between two independent parties. The problem arises because the creation of an electricity quality value is not decided upon by normal market forces, but through political decisions. The reason for creating such values for individual participants is to obtain another behaviour from the market participants than would have been the case without these extra values on particular commodities.

3.2 Level of accuracy and completeness

Accuracy refers to the correctness/precision of the information. If accuracy is given a high priority, the suppliers will have additional costs because accounting and reporting must be done more often.

Completeness refers to how comprehensive information the suppliers shall give to the consumers, and is therefore closely related to the detail level of the gathered data. If completeness is given high priority, the suppliers will face additional costs in order to ensure the required level of information, structuring and presentation.

Every system can be designed in a way that ensures a different level of accuracy and completeness. It is clear that there is a direct relationship between costs on one side and system characteristics in terms of accuracy and completeness on the other side. However the relationship between costs and system requirements can differ significantly from one system design to another, both in absolute and relative terms.

Therefore it is important to evaluating the alternative system designs also from a cost-benefits perspective.

3.3 Flexibility

In view of the dynamic European environment and the political ambitions for the future it is important that the labelling system is not a rigid, closed system but an open one that can be adjusted to changes and further developed and expanded both in depth (the detail of the information) as well as the broadness (information variety).

The requirement for flexibility is relevant from two perspectives:

- Regulatory perspective

  A system for labelling of electricity will build on existing regulation. It is unknown in which direction the development of new regulations will go, but we know that it will change. An early introduction of a labelling system will therefore have to be flexible in order to adjust to future regulatory changes while the basic platform remains stable.

- Expansion of the system

  Due to the liberalization of the electricity market the consumers are placed in a totally new situation. They are overloaded with information from old and new suppliers trying to position themselves in the market and gain market shares using aggressive marketing approaches. Consumers, lacking any experience are required to make choices in a new dynamic market.

  Therefore, in view of consumers gaining familiarity with the system, it is desirable that the information presented on the label is simple and limited at the beginning. In time the information will be expanded to meet increasing customer requirements.

Even though the system should be able to expand and adjust to changes in the environment, it is important that the market participants perceive it as a secure system in terms of government commitment and long-term effects on market developments. Investments are based on expected future prices, and the system therefore needs to be considered secure and credible also in the minds of the investors.

In order to gain confidence from the investor's side the system must appear realistic to implement with respect to costs, political framework and simplicity. Many of the same aspects are important for consumers, as it does not make sense to pay a premium for something that will not increase the long-term generation capacity.

3.4 Criteria evaluation

All three criteria described above are important for the evaluation of the alternative system designs. However, the following priority between the individual criteria can be made:

- Reliability of the system. Considering the objectives of the labelling system this criterion should be given the highest priority.

- Level of accuracy and completeness. A minimum requirement for this criterion should be defined. The cost benefit ratio between the alternatives should be considered.

- Flexibility. This criterion should be carefully evaluated, but only in relative terms, which are the best among the alternatives without specified minimum/maximum.

4 DISCLOSURE IN PRACTICE – LESSONS LEARNED AND BEST PRACTICES

In order to make the most effective and efficient system for labelling of electricity an important component is to consider experiences from similar systems and evaluate designs against these experiences. In the following a short presentation is given on current activities regarding labelling systems on a global level, followed by a short summary of the system designs in use. Finally the key findings and lessons learned are listed. A more detailed overview of the disclosure system activities by country is presented in annex 2.

4.1 General observations

In the Western world there is a general support and interest for information disclosure systems on national, state and NGO-level. Electricity disclosure is on the political agenda in almost all countries where governments are engaged in the liberalization of the electricity market.

Full disclosure systems have only been implemented, and then only recently, in Austria and in a few states in the USA. While in Switzerland and in about 20 states in the USA disclosure systems are in an infant-state. Some states are in the implementation phase, some states have designed a system and not yet implemented it, while Switzerland will have a referendum 22. September 2002 on a new electricity law, which also requires disclosure of electricity origin. In a few states in the USA implementation of disclosure systems have been initiated before the electricity market has been liberalized. Disclosure related to green electricity is present in a number of Member States including the Netherlands.

On EU level, the governments of the UK, Sweden, Germany and Austria have recently initiated a study on electricity labelling. The objective of the study is to evaluate different designs for an EU disclosure system. The project runs till 2003 and consist of three components:

- Generator - supplier interface
- Consumer research
- Effect of disclosure on the electricity market

Disclosure of information regarding electricity produced from renewable energy is at a more progressive state than full disclosure. In the Netherlands, Switzerland, Germany, Sweden, Norway and the UK where markets have been liberalized, consumers have the possibility to buy electricity generated from renewable sources.

Despite the fact that there are many activities regarding label design and implementation of information disclosure, there are few experiences to learn from, because the few implemented systems only have been functioning for a short period. However, from the limited experiences, some key lessons, which will be discussed later, can be derived.

4.2 Facts findings on system design

The following is a summary of the designs of disclosure systems in Austria, Switzerland (proposed), Australia (proposed and rejected) and the 26 states in USA, where disclosure systems are (being) implemented.

4.2.1 Front side

From the research regarding disclosure system it is clear that most attention is paid to the front side of the system. Labels seem to be the first components of disclosure projects. Only later attention is given to the backside and the more technical aspect of this, like the verification systems.

All label designs have disclosure of fuel mix. In most states in the USA as well as in Australia disclosure of green-house gas emission is included. Finally a few states disclose price comparisons and information on nuclear waste.

In neither Austria nor the USA there are national laws that can enforce labelling of electricity. Instead the sole authority lies with the individual state. The result is that labels in general are uniform on state level, but not on national level, not even in Austria. This means that about half the states have product-based labels and the other half has a portfolio based labels. Generally, the portfolio based labelling systems are ex-post while the product based labelling systems are ex-ante. Hybrid forms with mandatory ex-post portfolio based system and voluntary ex-ante product based system are also present.

Labels are presented to the costumer in several different ways and with different frequency. In most cases however, states add the label to the bill and send it out on a quarterly or semi-annual basis.

4.2.2 Backside

On the backside the situation is somewhat different. Until recently little effort was put into the tracking side of the labelling system. In some states in the US the tracking side of the system is practically non-existing, as a statement from the electricity supplier regarding the generation structure is sufficient as prove of origin. In other states the tracking is contract-based and limited to ad hoc audits by government authorities. The backside has shown to be more complicated to design than the front side and subject to changes as systems was incorporated.

A full contract-based verification system has just recently been introduced in New York. It is managed through the ISO's systems. Each contract includes an attribute for the generation source and is tracked throughout the whole supply chain, with nomination of electricity origin in the wholesale trade market. Imports are treated as the average fuel mix of the import region, unless the specific electricity source can be contractually verified. The balancing market and the exchange are treated as separate categories. The verification is ex-post and supports an ex-post portfolio-based labelling system.

Texas has implemented a hybrid verification system. The system is certificate-based for all renewable generation sources and contract-based for all other generation sources. Contrary to New York, the contract-based verification part in Texas is based on the total portfolio of each generator and not on the specific generation source. That means that a standard fuel mix for each generation company is defined (based on the structure of the generation park) and only bilateral contracts between generators and suppliers are tracked. The rest of the contracts are set against a default (residual) fuel mix. The suppliers are obliged to split their portfolio in sales and trade and nominate each contract to a portfolio.

In Austria the system is also a hybrid, and is certificate-based for small hydro power plants and contract-based for all other electricity generation.

A contract-based verification system[23] was also initially selected in the New England region (six states on the East Coast). Due to difficulties in the system design on operational level, the system was later changed into a certificate-based verification system. At present the New England region has the most developed and comprehensive full information disclosure labelling system with certificate-based verification. It should be operational from July 15 2002.

Certain forms of common verification system based on certificates are also being structured in the Western region (the West Coast of the US comprising of 11 US states and 2 Canadian states) and in PJM (Pennsylvania, Jersey and Maryland). Their level of sophistication is, however, much lower. PJM is in the process of designing a certificate-based verification system.

In Switzerland the people vote over a draft law regarding liberalisation of the electricity market. In this law the government is given the authority to demand that the electricity source and origin is disclosed (Elektrizitätsmarktgesetz der Schweiz from 25 December 2000, Art. 12). A more detailed regulation explains that the source and the country of origin of the electricity must be disclosed in the offers and the bills of the producers, suppliers and traders ("unknown" is also an option). The source of the production should be based on the average values of production and purchase of the prior business year. Details are to be elaborated later by the regulator.

In the Australian state of New South Wales, a detailed proposal was put forth by the local government on a disclosure system. After the proposal had been commented on by the stakeholders, the project was dropped and instead a disclosure program for green house gas emission is currently being designed. In Victoria, another Australian state, a program for green house gas emission disclosure with certificate-based

[23] This verification system has to be used to support a product based ex-ante labelling system.

verification is being designed and it is the intention that a full disclosure program should follow.

In almost all cases information is disclosed based on historic generation information. This has turned out to be problematic for new entities, wanting to enter the market. In Austria new entities make an estimate of the expected fuel mix and a local authority has to verify and approve it.

4.3 Main conclusions – lessons learned

Based on the observations regarding other disclosure systems and experiences drawn from these systems, some preliminary conclusions can be made:

1) Lessons learned from experiences from full disclosure of all electricity sources:

- Basic uniform verification systems should be implemented at least in the regional trading area to avoid problems with import from states with other standards.
- The limited experience suggests that labelling has little impact on the behaviour of the consumers, especially in case of a portfolio based ex-post labelling system.
- Portfolio based ex-post labelling systems seem to give little incentives for retailers to change their fuel source, and will continue purchasing electricity based on the lowest price independent of the fuel source.
- The backside of the disclosure system should be given higher priority compared to the front side, as it appear to be more complicated to design and implement.
- Contract-based verification system seems to be preferred in the initial design face.
- However, the limited experience suggests that a contract-based verification system is difficult to implement in practice for a product-based ex-ante labelling system. This is mostly due to the administrative demands from the bundling and unbundling of electricity and the impact on the functioning of the wholesale electricity market. As result many countries choose the alternative certificate-based verification system.
- The certificate-based verification system is gaining ground and acceptance. It seems to be more suitable for in multiple jurisdiction regions and for multi- task purposes compared to the contract-based system.
- Federal laws on disclosure systems rather than national laws seem to create problems.
- High levels of stakeholder involvement can over through a system due to politics.

2) Lessons learned from experiences with disclosure on renewable energy sources

- For green electricity both contract-based and certificate-based verification system work successfully. This, however, can be due to the fact that green electricity is traded only in small volumes and the problems of bundling and unbundling electricity is manageable.
- Experiences from the Dutch implementation of green certificates suggest that when a completely new system is being developed from scratch, it does not only have a higher level of initial implementation cost it also has a number of child diseases[24].
- The Dutch certificate system, as it is currently structured, does not allow for short position[25]. The wholesale market actors experience this as disruptive, because it is not in line with general accepted electricity trading principles.

[24] For example technical problems such as bugs in the system and not being able to manage multiple accounts from one entry point or other practical issues such as having a small wind mill producer without a computer who has to fill in a form electronically.

[25] Having a short position is a financial term which means selling something which you do not have at that moment (before you purchase it). In other words, sell green electricity to the customers in one period and purchase the green certificates to cover the sale in the next period.

5 THE LABEL AND THE RETAIL MARKET

A competitive market relies on effective consumer choices to determine appropriate market outcomes. In order to achieve this, consumers should be provided with sufficient information to be able to distinguish between the electricity products according to their characteristics.

Electricity market is rather different in nature[26] compared to the other consumer markets. Consumers lack experience in gathering and evaluating relevant information regarding electricity. As a result, consumer preferences are not clearly defined. It can also be expected that due to cultural and other differences, the consumer needs and respectively the label requirements differ significantly from one country to another. As mentioned earlier this should not be a problem as long as there is a common platform on the backside, the wholesale market.

Even though the backside of the system is independent from the front side, there are three issues where choices related to the front side can affect the design of the backside of the system. These are: (1) the level of information aggregation, (2) the point of time of information disclosure and (3) the content of the disclosed information. These issues are discussed in this section of the report. Other issues related to the front side of the labelling system such as the uniformity of the label, label lay out, the communication medium and the frequency of communication are not relevant for the design of the backside of the system and are therefore not covered here.

5.1 Level of information aggregation

There are two levels at which information regarding the electricity quality can be presented: company level and product level.

- *Company level – label related to the total portfolio of the company.* The suppliers present the structure of their total portfolio to the public on a regular basis (monthly/quarterly/yearly). Based on this information (and other relevant information such as price, service quality etc.) the customers can decide

[26] An electricity market is characterised by the following: (1) Electricity is perceived as a very complex field combining technical, economical and environmental aspects and many consumers lack understanding of its functioning and characteristics. (2) Electricity is a homogeneous product . There is no difference in consumption characteristics between the different products. In addition it is not possible to distinguish between different electricity products when delivered into the grid.

whether they want to switch suppliers. In other words, the company can position itself compared to its competitors based on the total structure of its portfolio. There is only one electricity product (label) per supplier.

- *Product level - label related to a specific electricity product.* This alternative allows the suppliers to structure different products and present them to their customers. For example one electricity product (label) can be 50% renewable and 50% nuclear, while another product (label) can be 50% gas and 50% coal. There is large variety of combinations. In that respect a choice has to be made to whether:

  a. The suppliers will be free to structure their own labels

  b. A set of fixed label structures determined by the government can be offered

  c. A combination of a. and b.

  The suppliers can position themselves based on the products they offer. In time these products will be adjusted to fit with the expectations of the customers. The structure of the total portfolio is a weighed average of the different products (labels) of the individual supplier.

The main argument in favour of the company-based label is that some customers are more interested in the total operations of the company. However, there are a number of disadvantages: (1) it is difficult to reinforce, (2) it places vertically integrated companies in disadvantage, (3) it requests a detailed regulation of what should and should not be included (4) there are relatively easy strategies to manipulate the outcomes (for example by setting up partially owned subsidiaries)[27]. Especially the last point is important, If a company wants to have a stronger label profile, it could split its marketing activities in several companies – one company for green, one for the cheapest electricity etc. A company that only offers one label will be in the same position with a product-based label as with a portfolio-based label. Therefore it is possible to have a portfolio-based disclosure within a product-based system. The opposite is not possible.

The argument in favour of the product-based label is that firms should be allowed to sell multiple products, just like in other markets.

In economic theory the consumer's choice is frequently discussed. From a theoretical perspective the consumers should have a full choice of the label mix they want to buy. If an individual customer wants to purchase 50 % green, 10% nuclear, 25 % gas and 15 % coal he should have the possibility to do so. Such very flexible product definitions tend, however, to create complicated decision situations for the consumers, and might also be costly for the supplier.

[27] For more information regarding the disadvantages of the portfolio-based label we refer to the "Synthesis Report: A Summary of Research on Information Disclosure", David Moskovitz at al., The National Council on Competition and the Electric Industry, October 1998

Another aspect is how the labels appear in the market. One conclusion that can be drawn is that an unlimited variety of products increases the transaction costs to such a degree that the consumer in fact does not have any real choice. Some sort of standardisation is therefore needed. Usually the market participants are able to sort this standardisation issue out alone, but it often takes time.

Consumer research[28] shows that when consumers see an electricity label for the first time, they think that the information regarding the fuel mix refers to the individual product and not the company. Also when given the choice, a large part of the respondents express preference for product related label information.

We propose to introduce labels on product rather than company level. By offering different products companies can better position themselves meeting the specific needs of the different client groups. Besides, a product-based ex-ante labelling system can easily support an ex-post portfolio based information disclosure. Presentation of ex-post portfolio based information can be desirable from social and environmental perspective.

Labelling has become a political issue, some sort of standardisation can be introduced. One alternative to consider is therefore to require all suppliers to offer 3-5 standard labels (fuel mixes) to their end users. The standardization will increase market transparency, product comparability and consequently competition. However, some strong arguments can also be raised against standardisation of labels, both from a legal perspective, and from the perspective of increasing competition. New entrants should have the freedom to only sell e.g. green electricity, without being forced to sell the whole fuel mix, including coal and nuclear. Finally the consumer should be informed on what the “default” label consist of, if a supplier is not chosen.

The choice between company versus product level of information disclosure can affect the point of time of the information disclosure. This issue is discussed in 5.2.

5.2 Point of time of information disclosure

The point of time refers to the moment of information disclosure. There are two basic alternatives: ex-post and ex-ante.

- *Ex-post information disclosure.* The information with respect to the origin of electricity is presented after the electricity has been delivered. This alternative is therefore only possible when the suppliers disclose information related to the total structure of their portfolio.
- *Ex-ante information disclosure.* The information with respect to the origin of electricity is presented before the electricity is delivered.

Both alternatives are used in practice. However, the experience from other products shows that if information is perceived to be important, the customers insist on receiving the information ex-ante. If the information is perceived to be of little importance, it can be

[28] Consumer research on tracking approaches and product vs supplier labelling, by M. Herrmann & B.Roe, The National Council on competition and the Electricity Industry, October 1998

provided ex-post. However, if the information is of little importance, it is highly unlikely that the customers will change their behaviour based on the actual information received. Probably the only exception to the latter is the situation where information with extreme values is being presented. [29]

Example: Ex- ante versus ex-post choice

Electricity consumption can be compared with organic food. These are fruits, vegetables and meet produced in an biologically responsible manner (without the use of pesticides or grow hormones). There is not a significant difference between organic food and normal food in terms of taste and nutrition. However, the customers who perceive information about production method as valuable quality characteristic of the product will request the information before they have consummated the food and not after. The customers who do not perceive this to be valuable information will not change their purchase behaviour independent of what information they are given.

With an ex-post system the consumers never know what they are buying as the portfolio structure of a supplier can differ from one period to another. This is especially important when there is a preference for a specific product (quality of electricity). Besides, due to the time lag, the response of the consumers (e.g. to switch supplier or not) to the quality information is also ex-post and does not have the same signalling strength as with an ex-ante system.

Even though it is theoretically possible to have an ex-post product based system, it does not work in practice. Therefore, a product-based system is always ex-ante. But from the suppliers' perspective, even a portfolio based ex-post system develops into an ex-ante system the moment the supplier decides to differentiate based on the quality of the portfolio. In such case, an ex-ante choice of the portfolio structure is made.

Therefore we recommend the ex-ante alternative of the label. In our view this is essential for meeting one of the main objectives of the system – to enable the consumers to make informed choices. Ex-ante is the only alternative, which allows for direct comparison of electricity quality with other characteristics like price and enables the consumers to actually act on the information.

A front side based on an ex-ante information disclosure can be backed only by an ex-ante verification system. A front side based on ex-post information disclosure can be backed by an ex-post as well as an ex-ante verification system. An ex-post verification system is somewhat easier to design compared to an ex-ante system.

[29] The limited experience from the introduction of an portfolio based ex-post system in New York seems to support this statement. Please see annex B for further details on the New York labelling system.

5.3 Contents of the disclosed information

There are a number of possibilities for what could be disclosed. When factors such as requirements on simplicity, consumer research on the importance of the disclosed information, expert views on information priority and the availability of information are considered, the choice is narrowed to:

- Price[30]
- Fuel mix. What type of fuel (technology) is used to produce the electricity, for example nuclear, gas, coal, biomass etc. presented in a fuel mix form.
- Country of production[31]
- Environmental impact, for example emissions such as sulphur oxide, nitrogen oxide and carbon dioxide.

With respect to the fuel mix and respectively the generation technology the desired level of details should be determined. Should it define the fuel source just as coal, or e.g. black coal and brown coal separately? The choice regarding the level of details will have at least three implications:

- The level of detailing of the generation source will affect the required accuracy of the verification side of the system. In general, higher level of accuracy will result in higher system complexity and higher costs.
- Higher level of detailing of the fuel mix will result in a higher fragmentation of the wholesale market. This will affect the basic market structure, market power and price formation[32]. The level of impact will also depend on the type and structure of the verification system.
- A certain level of aggregation implies that different fuels and technologies with different environmental impact fall within the same category. For example, if coal is defined as one category, both black and brown coal will produce the same label rights. The producers with tend to minimize the production costs within each category, which means that the most cost efficient production technology will be used, and not the most environmentally responsible one.

Another relevant question from fuel mix perspective is: 'Can you have electricity with *unknown* source of origin?' In some countries, for example Austria the imports and all electricity with unclear origin are marked as UCTE mix. The main argument for using the unknown label alternative is that it could make verification process simpler and less expensive. The main arguments against using this alternative are: (1) it is inaccurate, (2) it gives the companies the possibility to make unfair representation and (3) expected cost savings are small.

[30] The price can refer to the price of the presented fuel mix as well as the prices of the individual categories. The fuel mix price is then the weighted average of the prices of the individual categories.

[31] The country of electricity production can be considered important from cultural or political perspective.

[32] For detailed information see annex 1: Theoretical Perspective

We feel that the alternative “unknown” should be carefully evaluated and, if possible, eliminated. It forms a fall back alternative and can disrupt the market pricing mechanism. If the consumers consider certain quality electricity undesirable it will lead to a negative pricing premium. In such case the supplier can fall back on the neutral alternative of unknown origin source. It is possible to largely eliminate the latter incentive by artificially setting the price as equal or even worse compared to the one with the most unattractive origin source. This will mean interrupting the general market forces and is, therefore, unadvisable.

Due to the lack of experience by the consumers and the complexity of the issue, the best approach is to start with basic simple information and expand it in time. The advantage of this strategy is that it allows the consumers to get used to the system and gradually increase their knowledge and understanding. Presenting a lot of complex information from the first day after implementing a label system can confuse the consumers.

Therefore we propose to start with labels presenting the following information:

- *The price*. According to consumer research price is considered highly relevant information. It allows for clear and easy price/quality evaluation of the different products and, from this perspective, enables informed choices.
- *The fuel mix*. The fuel mix should be divided in the following generation sources: nuclear, coal, gas, hydroelectricity and bioelectricity in one category with wind and solar.
- Other basic information such as the supplier name / logo and the period to which the label refers.

The system can later be expanded with more detailed information about the generation source, country of origin (if deemed relevant) and the environmentally impacts (emissions and nuclear waste).

5.4 Summery and conclusions

The objectives of the labelling system are to increase market transparency and enable the consumers to make informed choices. Therefore we propose a product based ex-ante information disclosure system. Consumer research shows preference by the consumers for product-based information. It also allows the suppliers to better position themselves and responds to the needs of the specific consumer groups. Based on experience from other markets we can conclude that if information (such as quality) is perceived to be important the consumers request this information before they have purchased the product. If the information is not important it can be provided ex-post but will most probably not lead to change in behaviour. If suppliers choose to position themselves based on the quality of the electricity, an ex-post system is basically developing towards an ex-ante system. A product based ex-ante system in the retail market requires an ex-ante verification system in the wholesale market.

The label is the communication medium with the consumers. Considering the complexity of the issue and the lack of experience by both the consumers and suppliers, we propose to start with a simple label presenting only the fuel mix divided into five main categories and the price. Over time, the consumers as well as the other market actors will gain experience and the label can be expanded.

6 THE CONTRACT-BASED APPROACH

This section describes how a contract-based verification for backing an electricity labelling system may function. First, we explain the general functioning of the system. Then, we develop the design in order to meet important issues as imports, exchanges, etc. properly. Finally, we examine the implications on the electricity market.

6.1 Fundamental design

The idea of a contract-based system is quite simple: When a kWh is produced, it also produces an identification of origin, fuel source, etc. With the contract-based system, the identification is permanently tied to the kWh from which it originates. When a kWh changes hands, the identification changes hands as well. Each and all electricity contracts that entitle the buyer to receive a physical flow of electricity must include information of origin of the electricity. This principle must be applied through the whole supply chain - from generator to end-user. From a generator, the contract will naturally have a single source. The contract with the end-user[33] will naturally be a mixed-source contract, unless the customer (or the supplier) demands a one-source supply. In the wholesale market, single-source contracts can be mixed to multi-source contracts.

The problems with this simple approach are numerous, but not necessarily insurmountable. The various issues call for special attention or arrangements. Examples are import and export of electricity, exchanges and the normal deviations between anticipated and real time measured quantities.

In section 5 we argued, that the label should be an ex-ante. An important question is whether the verification system also must be an ex-ante system, or if it is possible to verify an ex-ante labelling system with an ex-post contract-based approach. There seem to be a simple answer to this question: The verification method for an ex-ante labelling system must also be ex-ante. The explanation is that because electricity generally is bought before delivery, and it is not possible to adjust quality/origin of the delivered electricity after delivery. Then it is really impossible for suppliers to fulfil a contract with an ex-ante guaranteed quality. Any attempt to develop an ex-post system, will turn into an ex-ante system.

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[33] Whether it is a real contract or a standard tariff for the supply of large number of consumers does not matters – tariffs should in this respect be treated as special kind of contracts.

Example: Ex-post and ex-ante

Suppose a retail sales company has a portfolio of customers, who has contracted for 50 % of each of two categories electricity, A and B. In the middle of the period, it turns out that 40 % of the delivered electricity was category A, 25 % was category B and 35 % was category C. There is obviously a risk that a similar mix will be the case also by year-end, and if so, our company will be unable to fulfil the obligations towards the end users. To solve this problem before it materialises, the company could ask in the market if someone is willing to sell a contract where the quality is "predefined", i.e. the company has initiated the ex-ante approach.

Because most of the wholesale trade with electricity is or will be related to risk management and not to selling the production or sourcing the supply, most companies will hold a portfolio of different contracts to match their generation or consumption/retail sale, see also the fact box below on the wholesale electricity market. If the contracts are to be marked with category, referring to quality/origin, the amount of trading activity will most likely be an obstacle, or at least a major challenge for the system. The experience from New England (see section 4.2.2) clearly demonstrates this is a major issue with contract-based verification methods.

The practical challenge of keeping track of quality information would be large in a contract-based system. Currently, traders must consider only two aspects of contracts: price and geographical reference/place of delivery. The trading position is easily measured with the price – together with the volume it creates the value of the contract, and these can easily be summarised for the whole portfolio in one dimension. With location it is more difficult – then contracts must be represented in a matrix and you need two dimensions to explain the value of the portfolio. To minimise the practical challenge associated with this, traders typically focus trade on those locations they have financial interests or obligations. In some regions, trade is typically focused on a "standardised" location. The price risk between this standard location and the location relevant for the trader is normally part of his basis risk, i.e. the risk he cannot hedge. With quality, we would have a third dimension.

Example: The wholesale electricity market

The wholesale electricity market has some important characteristics that must be kept in mind when considering verification methods for a labelling system. One of these is the nature of electricity trading. Electricity trading is important to the wholesale participants as a mean to deal with risks, in particular price risk. Electricity prices tend to be rather volatile, and not having contracts matching the physical/contractual obligations could imply rather high financial risk. In order to efficiently cover this fundamental need for trading, the market participants have developed some standards. Among these are standardised contract specifications in the wholesale market. Not only are conditions etc. standardised, but also quantities are standardised. A standard contract in e.g. Germany is 25 MW, with durations such as one day, one week, one month, one quarter or one year. Contracts are normally base-load (24 hours/day, 7 days/week, etc.) or peak-load (approx. 12 hours/day, 5 days/week).

As consumption or generation is not constant over time, but varies continuously, it is not sufficient to buy or sell only base-load contracts. It is not even sufficient to buy/sell base-load and peak-load contracts – it will be like building a nice round shape with boxes as the only tool. In addition, companies have to involve in some tailor made contracts or transact with an exchange.

Because the purpose of the trade is not to buy/sell sufficient quantities of electricity, but rather to reduce the uncertainty in future cash flows, the amount of electricity traded will normally be far higher than the amount of electricity delivered. In the Nordic region, which is the most mature market with respect to trading, trading volumes are now 7 – 8 times the physical consumption. This implies that for the hour of delivery, there could be somewhere between 15 and 100 contracts covering the underlying obligation, depending on the size and structure of the obligations.

6.2 Important design issues

6.2.1 Exchanges and financial contracts

Generally, one of the purposes of the electricity exchanges and OTC market places is to ensure anonymity between buyer and seller. The mechanics of all electricity exchanges in Europe is to pool all bids and asks and find the clearing price, at least this is the principle in the day-ahead markets.[34] This implies that the exchange is unable to identify the origin and quality of trades via the exchange. With current procedures it would be possible to explain the fuel mix ex-post, but this would potentially differ from hour to hour.

If the retailers only purchase small amounts relative to their total deliveries via the exchanges this problem may be small. But the contract-based system should not imply a mandatory identification for all contracts, only those with physical settlement.[35] In some Member States, i.e. the Nordic ones, physical contracts are rare in the wholesale

[34] Some market places for balancing power or close to real time deliveries are pay as you bid instead of clearing price auctions.

[35] Such a requirement would affect pricing of electricity price risk substantially.

market and common only towards end users or in relatively long term contracts. Such financial contracts are normally derivatives on the spot price in the region, and will not necessarily need a mark for type of generation. In these countries, the exchanges have a substantial market share in the physical supply. It is fair to expect the other European electricity exchanges to become equally important in the future as Nord Pool is today with respect to physical supplies, and thus that the volumes sold over the exchange will be significant.[36]

Consequently, there should be developed a special solution to mitigate the problem of verification of quantities traded via exchanges. Within a contract-based verification, there are two solutions. Both of them address the fact that we are considering an ex-ante system, in which the retailers need to know in advance what quality they can expect delivered from the exchange:

- The electricity physically traded via the exchanges could be identified as a separate category of electricity ("Exchange-power"), in addition to ordinary categories defined by e.g. fuels. Then there is no doubt about which quality the retailer will receive, but on the other hand, it will be difficult to back up a tariff towards end-users with 100 % of one single category. Further, this solution would establish the exchanges as laundries for the least attractive categories. If the volumes traded via market places are high, this model will have obvious disadvantages.
- The alternative is to allow separate exchanges for each category. With this model, there is no uncertainty about the category delivered from the exchanges, as they will be separate or have separate auctions for all traded qualities, i.e. one auction for category A, another auction for category B, etc. The consequences for the bulk electricity market with this model are, however, severe, as liquidity would be reduced in each product category.

It follows from the discussion in section 6.1 that ex-post information from the exchange is useless. Assuming a contract-based method was implemented and the exchange only provides ex-post information, there would immediately develop a need or demand for a market to swap qualities. If someone has received e.g. "too much" of category A, they would ask if someone is willing to swap this with category B, together with a payment of x. In other words, the system would almost "automatically" transform into an ex-ante system, because of the obligations to provide end users with ex-ante information.

Instead of mitigating the identification problem, there is also the option to ignore it. As an example, the verification system could have embedded flexibility, in the sense that end-user contracts with x % of a certain category is deemed fulfilled if it can be verified that the retailer has net purchase contracts for the relevant period and category covering $x \pm \varepsilon$ % of his portfolio.

We consider the potential problems with exchanges to be a major argument against the contract-based approach. Either the information will be inaccurate or incomplete, or the lack of liquidity will prevent efficient and competitive pricing of electricity.

[36] Currently, Nord Pool has an average market share of more than 30 %. The market share is higher in some countries than others.

6.2.2 Imports and exports

Imports from areas outside the geographical area using the verification system are causing the same kind of concerns as the exchanges. Of course, if the potential import is low relative to the total consumption within the area, as it would be if the system covered all Member States, the problem is much smaller than if the system was introduced only in e.g. the Netherlands. There are two basic alternatives to mitigate the problem:

- Imported electricity is defined as a separate category (not very different from the current Austrian system). Such a model raises the same concern as with a separate category for power exchanges: Establishing a laundry mechanism for unattractive categories. (See further explanation below.)
- Imported electricity must have similar identification as internal generation. This raises concerns regarding classification of foreign generation and monitoring/audit of foreign compliance with reporting and other rules. In combination with separate spot auctions for each category of electricity, imported electricity could in this model participate on the exchange on the same terms as domestic production.

The potential problem of imports is relatively smaller if the geographical region covering the system is large, as compared to a small region. The reason is simply that the imports to e.g. the EU as a whole constitutes a far smaller share of the total market than the imports to e.g. the Netherlands represents in the Dutch market. Thus the potential error of ignoring the imports will be smaller the larger region is covered by the system. Ignoring imports implies that it is only possible to verify delivery of $x \pm \varepsilon$ % of the desired categories. In section 9 we return to this point and examine some possible alternative regions.

Exports create the potential problem of washing, i.e. "paper trade" over the borders for the area covered by the system to "wash" or colour electricity. Such washing already takes place with non-green electricity, which is sold to e.g. a hydro-producer who is only selling back the same quantity but now as hydro. With washing there are basically no limits to import capacity for the attractive categories of electricity. As there is no actual flow of electrons when two similar contracts are "crossing the border", the quantities might be as large as there is demand for washing. Thus there is a need to limit the risk of washing. There seem to be at least one possible method: *The "accepted" amount of imports for all qualities is restricted to actual imports. Physical imports thus imply the issuing of an import quota for quality, i.e. we are pretty close to a certificate system for imports, and where there is put a limit on imports of certificate.*

6.2.3 Settlement and balancing

Documents describing contract-based alternatives[37] all emphasise that the system would rely on metering, accounting and settlement mechanisms already in place in

[37] See literature list.

several Member States. Obviously, if there were no deviations between day ahead plans or schedules and real time quantities, this would not have been a problem at all: Assume a nuclear generator selling a contract to end users (via a retailer). For the sake of simplicity of the argument, let us further assume the consumption is constant and 1 unit each hour, 24 hours a day the whole year. The generator is selling a nuclear contract with unit 1 each hour. To the extent the end user or their retailer can rely on the identification in the contract, they know for sure that their purchase is covered 100 % by the contract and is thus 100 % nuclear.

The problem arises when there are likely deviations between plans and real time. Suppose as an example that the output of the nuclear generator unexpectedly drops to zero for an hour. The generator is still supposed to deliver 1 unit, and will have to purchase this on short notice somewhere. Normally, the only seller on really short notice is the ISO or the Transmission System Operator (TSO), who manages a system of balancing services for this and similar purposes. Similarly, if the consumption increases to 2 units, it has to come from somewhere. Against the ISO, the retailer will then be responsible to pay for the incremental unit. In this hour, the end-users receive 50 % nuclear and 50 % something else. If this were the only deviation during the whole year, the share of nuclear electricity in the consumption would be 8760/8761, i.e. very close to 100 %. But to the extent such deviations between plans and real time is normal, the inaccuracy would represent at least some percent of the total delivery to end-users. In Europe today, the electricity delivered to cover such imbalances represents between 1 % and 5 % of total consumption in various countries.

The metering and accounting mechanisms that ISOs have built up are tailored to determine who owes whom for what. If the required accuracy and completeness is exactly 100 %, it is generally possible to extend the current settlement systems to a tracking mechanism also for the balancing power, although some Member States may need to implement more substantial changes, depending on the characteristics of the current settlement system(s) in place. But if a lower degree of completeness requires to leave the quality information out from the settlement system and base the labelling system on anticipated, day-ahead quantities instead of real-time quantities.

Also, if there were substantial incentives to have large *imbalances* embedded in the settlement systems, we might need to extend the current settlement systems even though we accepted some “slack” in the verification. But in most of the current imbalance systems there are rather strong embedded incentives to be in balance all the time. Thus it seems to be a fair conclusion that the verification system could focus on planned quantities and not real time: There is anyway hardly profitable to speculate in “planned increases” between plans revealed to the ISO and the real time values.

6.2.4 Technical and operational issues

Even though the idea of the contract-based system is quite simple, and simple solutions to the concerns discussed briefly above could be worked out and widely accepted, it is not straightforward to introduce a system as described:

Classification of generator: This task is similar for both models, and is a one-time task for each power plant. It must be decided whether a given generator is in category A, B, C, etc. This is typically a task for a verification or classification bureau like Kema, TÜV, Det norske Veritas, Lloyds, etc.

Information systems: In the contract-based system, the generating company will label their contracts with the appropriate quality/origin themselves. The challenge is to create a reliable and trustworthy "information chain" where this information is maintained through all links in the chain. It must be possible to confirm that quantities sold are matched by quantities bought, e.g. by the external audit or by a regulatory body. As there are several information systems in use by traders and wholesale electricity market participants, this is not necessarily an easy task. The purpose of these systems is to keep track of all relevant information about the contracts. With respect to quality and origin, which are new parameters in this respect, the system must prevent attempts to fraud or cheating.

6.3 Expected implications

Introducing a contract-based verification method has implications for the functioning of the electricity trade, e.g. the price formation. Unless demand conditions are extraordinary, prices will not be equal for different categories of electricity – after all such price differences can be considered as part of the purpose of the labelling system. Two consequences are likely:

Reduced liquidity: With e.g. 5 categories of quality/origin, the total trade would be split into 5 sub-markets. These would of course not be completely independent. It is not obvious that this would constitute an overwhelming problem. In the Nordic market, there are 6 geographically separated markets. Most contracts traded do not refer to any of these sub-markets but rather to an artificial price nominated as *the system price*. This could be perceived as the price in the "average location". With qualities it might be similar – that different qualities are priced as deviations from a non-specified or "system" quality. But the locational deviations from the system price are relatively easy to forecast and thus not a major problem for trade. It is not necessarily equally easy to predict price deviations due to quality/origin.

Increased volatility: Currently, the volatility of spot prices is due to aggregated volatility for all generation technologies. With separate prices for various categories, we must expect more volatile spot prices for the most volatile categories like green, and probably less volatile prices for the categories with relatively stable output, e.g. nuclear. This is not obviously a negative effect – it might be argued that prices for e.g. wind power should be more volatile to reflect the fact that output is volatile. However, it is a common argument that volatility is expensive and should be minimised unless there are natural causes for the volatility.

6.4 Summary and conclusions

The contract-based alternative seems at first glance as a simple and natural development of the existing trading system that has developed. But because there is a need for ex-ante verification, it seems as if the contract-based approach breaks down.

This is due to the bundling and unbundling of contracts in the trading portfolios, the complications to deal with exchanges as well as imports and exports and the implications for the price formation (and further consequences for risk management and costs of hedging).

7 THE CERTIFICATE-BASED APPROACH

7.1 Fundamental design

With the certificate-based system, the close tie between the identification and the electricity is broken up. Trade with electricity is separate from certificate trade. A generator will sell his electricity as currently, i.e. he will to the extent possible decide to produce if the day ahead price covers his marginal costs. In order to hedge the price risk, he might sell (partly) on long-term contracts, but the production decision will anyway be based on short-term prices. His decision to sell or store a certificate for later sale could similarly be based on expectations for current and future prices of the certificate.

One of the important design questions with regards to the certificate-based system is whether the generators should be forced to sell their certificates or not. The basic idea with the electricity market is that generators decide for themselves whether to generate and sell electricity or not. It is a voluntary action. But should it be possible for the generator not to sell his certificates? The answer to this question is decisive for the price formation and even more important for the price levels for different certificates. To illustrate the problem, consider the example below.

> ***Example***
>
> *Assume no one is willing to pay for category E certificates – it is simply not attractive to anybody. The only way the generators within the category can reduce the holding of certificates is thus to offer a negative price for the papers, i.e. the buyer receives cash in addition to the certificates. Obviously, this will reduce the real price for category E electricity. But if the generators can decide alone, they would then choose not to sell the certificates. This will, however, have the important consequence that the verification system will not be 100 % complete[1] – if any category E electricity is generated. Thus it cannot be left to the generators to decide whether to sell or not.*

This aspect actually defines the certificates not only as a proof of quality/origin, but also as a right to produce/generate. If the generator is unable to sell/give away his certificates, he cannot be allowed to generate. There is simply not a market for his electricity, and his production is thus not welcomed into the grid anymore. Despite the fact that we started out defining a split between electricity and quality at the place of origin, the final result seems to be a combined price for electricity and quality.

The Nordic electricity market simultaneously defines a basic price for electricity and a price for location. The certificate system (and the contract system) will create a new dimension to the wholesale price. To deal with location specific price risk in the Nordic market, market participants buy or sell CfD – Contracts for (location) Differences. Such contracts will cover the difference between the basic electricity price and the location price. With the labelling system in place, there will potentially be a similar demand for "quality CfD" – contracts that cover the price risk between basic electricity (without any specific location or quality) and a specified quality. One of the really interesting pricing questions is whether a contract-based and a certificate-based system is really different in this respect: Even though the certificates imply a separate market for the quality, there might be a substantial impact on the market for electricity, and this effect might be equally harmful to the forward market for electricity as the contract-based system.

The fundamental issue with the two kinds of market places – electricity and certificates – is the price formation. Initially we can think of a well-established market price for electric energy, as we already have today. Then producers start selling certificates, and it turns out for some of them that the expected value of their certificates is positive, whereas it might be negative for others. How these expectations will affect the offers in the electricity market is not obvious, but it seems likely that it would be rational for the unattractive generators to include the negative price of the certificate in the costs considered when bidding into the spot market or making the production decision for tomorrow/next week.

Example: Production decision

The optimal production decision is in principle similar for all generators. In practice, there is some variation due to quite different cost structures. The following example aims at explaining the principles for thermal generation.

Assume a power plant using e.g. coal as fuel. The station is not running and we consider starting. We know the alternative value of our coal. We also know the efficiency rate when transforming the coal into electrical electricity, e.g. 50 %. Assume this means that the fuel cost for our generation is 15 €/MWh. When starting the plant from a cold status, we need to pre-heat the plant, which costs fuel. We assume the value of this fuel is € 15 000, which is purely a cost. In addition, there is of course maintenance costs etc., but let us ignore all other costs for the moment. If the expected spot price of electricity was exactly 15 €/MWh, we would obviously not start our power plant – we would not be able to cover the starting cost. (Even though we had a sales contract with a higher price, we would not start the power station – it would then be cheaper/more profitable to buy in the spot market.) Thus we would consider whether the expected price could cover the starting cost over a reasonable short period, e.g. 12 hours.

As the starting costs are considerably different for different power plants, the "necessary" period to cover the starting costs vary substantially between plants and fuels, from e.g. 1-2 hours up to several days. Obviously, this will also depend on the prices.

Central to our concern, is the fact that production decisions are based on expected prices. If there is a trade with forward contracts, it is possible to hedge the decision, i.e. make sure the expected prices are realised for the generator, even though they are not realised in the market. If the generator expects a negative value of his certificates, would he not decide to generate only if the expected price covered both his fuel costs (and other relevant costs) plus expected costs for giving away the certificates? If so, what does really define the price for electricity and the price for the certificate?

The answers to the above questions are explored further in Annex 3. It seems clear that the import and export of electricity will define the price for basic electricity. The market price for the various categories will be defined by supply and demand for the various categories.

7.2 Important design issues

7.2.1 Exchanges and financial contracts

It follows from the arguments in section 7.1 that there should be a separate market place or separate price settlement, e.g. an exchange (or several), for certificates. When electricity is (physically) traded via exchanges, it could be done without reference to source of origin etc. and thus leave that part of the market unaffected, at least without direct effects. Those selling on the exchange will simply sell their certificates elsewhere and maybe later. The buyers could also buy certificates when buying electricity, or buy earlier or later. The issue of exchanges is thus not a problem in the certificate system.

Bilateral physical contracts are neither a problem, as the flow of electricity is separated from the flow of certificates. Nor represent financial contracts any problem within this system.

7.2.2 Imports and exports

The issue of imports[38] is different in the certificate-based system as compared to the contract-based system. The physical flow is not really relevant anymore. However, it is obvious that to the extent import of certificates is accepted, it will reduce the value of domestically “produced” certificates. With exports, producers have the opportunity to avoid the problem of negative value of certificates. In total, there is risk that the verification system is not really presenting a true picture of the actual electricity production inside the region operating the system. How we deal with imports and exports in the certificate-based system is to a large extent “only” a policy issue and not so much an economic efficiency issue.

Seen from the point of view of the environmentally concerned end user, it is most likely less important where the windmill he is sponsoring is located, but rather that it has a good and efficient location, that it is actually functioning and that the certificate is not sold more than once from the windmill. Limiting and closing the border for imports of certificates might thus be viewed as a matter of protectionism. The effect will be favouring the local electricity production at the expense of the (potentially) most efficient investments. As long as the certificates imported are based on similar conditions and underlying assumptions, the only concern here is the role of the price level of the certificates. If the certificates are assumed to achieve some goals, the price level itself could be important. Otherwise, if certificates only are tools to verify that the choices

[38] With imports and exports we still mean trades crossing the borders for the region participating in the labelling system, and not trades that only are crossing national borders inside the region.

made by consumers and increase market transparancy, the price level itself is not playing an independent role.

Then it is really a policy issue to which extent imports of certificates should be limited. An important argument in this respect is the risk that end-users will not be convinced about the quality of the verification. To increase confidence, we believe there should be a limit to imports similar to the net import of electricity.

Similarly, export of certificates, unless it is a concern if certificate prices are driven up. But the larger the export, the larger is the risk that the *verification* breaks down. Thus, there might be an important operating goal of the system: To have the amount of certificate trade across the borders for the verification system to reflect the actual power flow across the same border.

7.2.3 Settlement and balancing

Because of the split between electricity and quality at the power station and their reunion at delivery, we do not have to care about what are the sources of the imbalance electricity. Consequently, there is no tight links between the settlement system made for electricity and the system made for quality/origin, except that the actual consumption is calculated via the settlement procedures.

The question is then about duration of settlement periods – how frequently should records of generation be aligned with records of certificate transactions? With the basic electricity, the settlement periods at wholesale level vary from 1 hour to 5 minutes across the Member States. One important reason driving relatively short settlement periods is the physical need to ensure instantaneous balance between generation and consumption. With certificates there is not the similar need to be in balance, and hence it is most likely convenient to have longer settlement periods, e.g. one year. This will provide flexibility in the certificates market and allow for market participants to take advantage of different expectations, financial needs, etc. and to cope with stochastic generation from in particular wind, hydro, some CHP-sources etc.

7.2.4 Technical and operational issues

To keep track of the identifications in the contract-based system, portfolio management tools used by traders etc., which anyway contain detailed information about each contract, had to be relied upon. With the certificate-based system we need one or more central registry. The TSOs keep central registries for the electricity. When production takes place, the generation company is credited with that production, and when electricity is delivered, his account is debited. A similar principle should be applied with the certificates. The account of the generation company is credited according to his production. An efficient solution would be to link the registration of electricity with the TSO and the registration of certificates.

The certificates will be very similar to bearer bonds. When registered in the generators' account, it can be transferred to a trader's or retailer's account according to a transaction in the certificate market. When settlement takes place, we compare the electricity consumption with the holding of certificates (at retail sales company level), and reduce this holding with an "amount" corresponding to the consumption during the settlement period.

One important question seems to be about borrowing or selling short. Short selling means selling something you do not have (yet). Borrowing implies that you can credit your account with certificates not yet "generated". An alternative way to achieve the same is a delayed deadline for settlement of accounts.

- Short selling increases liquidity[39]. Like bearer bonds, shares etc, it is not necessary to be able to have a negative number of certificates on the account. If a generator would like to sell his certificates before production takes place, e.g. because he believes prices are higher now than what they will be in the foreseeable future, he could sell a forward/futures contract. This means that he agrees to transfer the agreed amount of certificates to his counterpart (at times agreed) and normally at a specified price. At the time of delivery, he must either produce certificates (and electricity) or buy identical certificates in the market and have them transferred to the account of his original counterpart. Because it is always possible to buy or sell forward contracts (there is no reason to regulate that), there is basically no need for an ability to sell short "physically". And if it can be avoided, we think it is an advantage. This will contribute to a simple system.
- Because of the stochastic nature of both generation (e.g. hydro, wind) and consumption, there is a need for flexibility. If a company has sold e.g. 100 wind-certificates, but there has only been wind for 90 of them, this could be balanced out by means of borrowing or delayed settlement. With borrowing, he would then ask the register to transfer 10 of his not yet granted certificates to the buyer. The following period, he would have to produce 10 certificates before his account could have a positive status. With delayed settlement, there could be the option to deliver the remaining 10 certificates within 1 or 3 months after 31/12 (assuming a yearly settlement perspective).

In this study, it has not been studied in detail, which alternative (borrowing or delayed balancing) is the most efficient. What seems absolutely clear is that there is a need for at least one of the options to be embedded in the system. We cannot, however, see any reason why more than one of these options should be present.

Another important aspect is validity of certificates. Dutch green certificates are valid for the year they are issued, unless they are being used to balance out the previous year. In a complete certificate-based verification system, we cannot see why issued certificates should have a limitation on validity. If the producer thinks the value is higher in the future, he could either postpone his investment or delay his sales of certificates. However, if the sale of a certificate is perceived as the license to generate, the generator cannot avoid selling the certificates. The rule that validity is limited might provide an incentive that interferes with investment decisions, which we basically would avoid.

[39] Short selling means selling before you own what you are selling. Short selling increases liquidity because it increases the total volume of the market.

As with other bearer bonds and similar, there is an important need for legislation to protect the system against fraud, ensure enforcement of valid contracts, etc. As a starting point, one should rely on the rules for the financial market and eventually adjust them according to special needs in the certificate market.

7.3 Expected implications

There are fair reasons to believe that both a contract-based and a certificate-based system will have impact on the price formation for electricity. This price impact is part of the objectives of the labelling system.

With certificates there is no reason to expect reduced liquidity in the electricity market. The verification system thus offers no opportunities for abuse of market power in the electricity market. Depending on definitions of certificate categories, there might be a risk for market power in some certificate markets.

7.4 Summary and conclusions

The certificate-based approach to verification of a labelling system has fewer complications than the contract-based system. As the electricity and its identification are split at the source of origin, there is not the need to bundle and unbundle as the electricity is traded over and over again. Cross border trades seem to be basically a policy issue with this model, and it seem fair to have a limit on imports of certificates. The price formation is not necessarily any problem, but it is not quite clear how the prices for electricity and the various categories are set in the market. The analysis in Annex 3 suggests that import and export of electricity sets the “domestic” price for basic electricity. The premium for the different categories will then be related to supply and demand for the different categories of certificates.

8 COSTS

The cost issue is discussed from the perspective of introducing the selected electricity labelling system. The costs associated with the decision making process for selecting the system such as advisory and test studies, consultation papers and stakeholders discussion rounds, though significant, are not considered in this analysis. The reason is the fact that these costs will be made independent of the selected system structure, and therefore irrelevant in terms of evaluating the alternatives.

8.1 General cost structure and issues

The cost related to the introduction of a labelling system can be divided along two dimensions: place of the costs within the system (front side vs. backside) and type of costs the (implementation vs. operational running costs). The figure below presents the different costs categories.

	Implementation costs	Operational costs
Label Retail market *(front side of the system)*	*Ex. Adjustment of the billing software*	*Ex. Information disclosure costs*
Contract/ Certificate Wholesale market *(back side of the system)*	*Ex. Adjustment of metering and scheduling systems and procedures*	*Ex. Retailers and regulatory bodies costs of auditing and label verification*

The implementation costs are closely related to the possibility of using present systems and structures. The implementation costs on the front side will be relatively lower compared to the backside and will depend on the label structure and the flexibility of the suppliers administrative systems such as billing, customer care etc. The most critical implementation costs on the backside of the system are:

- *Scheduling, settlement and balancing costs for producers and suppliers.* Similar systems as for basic electricity added for a variety of green, light green, blue, yellow etc electricity will increase administrative costs and thereby necessary premiums from consumers. Therefore one aspect of evaluating the different labelling systems is to see whether it is possible to find simpler and less expensive methods for scheduling the quality side of the electricity. From the producers' perspective it is also important that the scheduling, settlement and balancing costs do not favour large-scale production, and disfavour smaller producers.

- *Tracking system costs.* When introducing a labelling system, the question is whether ISO's current systems will be affected with regard to its operation of the physical electricity, and this will depend on the chosen labelling system. One important element in reducing costs on metering, settlement, and tracking is to see if existing systems by the ISO and others can be used. In this case the extra costs might be reduced to some up-front investments in reporting routines. Solutions that can use existing information will have a major advantage compared to systems that would have to be built from scratch and operated in parallel with existing reporting systems for basic electricity.

The operational costs on the front side are closely related to the frequency and way of information disclosure. The operational costs on the backside are related to the complexity and structure of data gathering as well as the frequency of information auditing, controlling and reporting.

It can be expected that all costs will be passed on to the end-users in one way or the other. Therefore it is essential that the costs of electricity labelling are very small compared to the total costs of electricity. As there are no long-term experiences with electricity labelling it is very difficult to estimate the total costs. However, based on the limited experience it can be expected that the costs for the introduction and management of an electricity labelling system will be very small compared to the electricity retail price. From this perspective the cost discussion should not have a considerable impact on selected labelling system design.

8.2 Front side of the labelling system

The costs of the front side are affected by the choices made on the front side of the labelling system. They are independent from the verification system selected on the backside.

8.2.1 Costs for supplier

The largest part of the implementation costs on the front side of the labelling system is related to the adjustment of the available administrative systems in terms of contact management and billing. These costs will significantly vary from one supplier to another dependent on the flexibility of the systems currently in place. Additional incremental costs for suppliers are associated with gaining familiarity with the system, adjusting internal routines and procedures and the revaluation of strategy and positioning. It can be expected that the costs related to a product based labelling system will be somewhat higher compared to the costs for a portfolio based labelling system.

As mentioned earlier the operational costs for the supplier are related to customer care on an additional dimension (such as switching costs due to fuel mix and answering specific client questions), information presentation (the label) and communication. The expected customer care costs are rather small. The other operational costs are affected by the frequency of information disclosure and the used communication strategy. However, these costs are also rather small compared to the total marketing and sales costs and will be to a certain extent be offset by the benefits of an additional positioning dimension.

8.2.2 Costs for consumers

Two things that are important when a consumer shall decide to change the fuel mix in his electricity consumption: simplicity and costs in the form of out-of-pocket expenses. Both are important for understanding the customer's overall costs of changing supplier (transaction costs).

Simplicity is a key factor to reduce the transaction costs for the end-user. If information is easily available, the time used for searching information can be put to a minimum. What has been observed in Scandinavia is that the number of customers changing supplier of basic electricity is heavily linked to the simplicity of doing the change, i.e. the time used and risk involved in the changing process. Additionally the direct transaction cost, i.e. out-of-pocket-expenses, to be paid to suppliers and others involved in the transaction plays a key role.

8.3 Backside of the labelling system.

It can be assumed that costs on the backside of the labelling system will vary considerably depending on the nature of the selected verification system. This assumption is supported by preliminary studies in US[40][41]. These studies also indicate that the costs, though significant in absolute terms, are likely to have only a minor and declining effect on the retail electricity prices.

There are a number of costs that are relevant to both the contact based and the certificate-based verification system and there is no reason why these costs should differ significantly in both alternatives.

- Costs associated with the registration an qualification of the fuel mix of plans and approving plant eligibility

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[40] (1) Massachusetts Renewable Portfolio Standard, Cost Analysis Report, Massachusetts DOER, December 21, 2000; (2) Electricity labelling, Enhancing competition and consumer choices through information disclosure, SEDA discussion paper, September 1999

[41] The only concrete known costs are the costs for the establishment of an certificate-based verification system in New England region. The costs amount to USD 6 mln and include the costs for software development, system implementation, training as well as maintainance and operational costs for a period of 5 years.

- Costs related to the development of the legal structure of the system
- General costs of presenting the system to and educating the users
- Cost related to monitoring the system operation and evaluating the system performance

From a cost perspective, it is essential to make the right decision regarding the fundamental basis of the verification system from the beginning. Switching from the one verification alternative to another at a later stage will result in significant total cost increaset.

8.3.1 Implementation costs

The implementation costs incur in the start up phase and are related to the detailed design of the system and its introduction.

1) The contract-based approach

In the liberalized electricity markets in Europe new ISOs for the settlement process have been or presently are being created. These entities are responsible for the scheduling, settlement and imbalance costs for basic electricity. Today their systems do not make any distinctions between different fuel sources for electricity generation.

The introduction of a contract-based electricity labelling system results in significant fragmentation of the contract market backing the labelling system. It is questionable whether the current IT systems of the ISOs will be able to manage the already significant increase in number of contract (deals) due to the market opening. It is also questionable whether the technical specifications of the current software allow for high quality origin tracking. Due to the high complexity of the system and the high importance of the operational security (as the system is used also for scheduling and imbalances) the development costs will be significantly higher compared to the development costs of certificate-based software system.

The implementation costs for the electricity suppliers will also be substantial due to the need of adjusting current risk management and portfolio management information systems to cover quality/origin.

2) The certificate-based approach

It is extremely difficult to estimate the cost level as it is closely related to the desired level of system sophistication. The largest costs within the certificate-based approach are implementation costs related to the establishment of a Registry. In the EU perspective, this can be a central Registry or a network of interlinked regional Registries. The costs associated with the establishment of the Registry function are related to the level at which already existing systems such as the green certificates registry system can be used. If a new software system is developed, the costs for such system can easily reach few millions Euro or even more. These costs can substantially decrease if an already developed system can be adjusted to meet the needs of the Registry. From cost perspective, it is very relevant to consider investments already done by RECS.

There is basically a pan European certificate-based verification system that is presently being tested. At present, the investment cost related to the development of the RECS certificate system can be considered sunk costs. From that perspective, it should be relatively cheap to adjust the RECS system to cover all types of electricity and implement it.

The start-up costs for the suppliers are expected to be limited as the certificates can be considered simply as different products or managed in a separate system.

8.3.2 Operational costs

The operational costs consist of administrative and transaction costs.

1) The contract-based approach

The contract-based alternative is expected to have high administrative costs because of the need to track the contracts throughout the whole supply chain. As mentioned earlier, it is very well possible that an electricity contract changes hands more than 10 times before reaching the final user. At each level of the value chain, bundling and unbundling of electricity contracts can take place.

The transaction costs refer to the personnel costs (for example costs for additional traders and back office personnel, risk managers) and costs associated with purchase and sales contracts in the market (brokers fees, exchange fees etc).

2) The certificate-based approach

The operational costs of the Registry will mainly consist of certification of production from generators, management of certificates accounts, information presentation for auditing purposes, and IT system developments and maintenance. These costs depend on the traded volume and, in relative terms, will probably decrease over time.

The transaction costs are very similar to the one in the contract-based system: There is a similar need for traders, for risk management, etc. As the system is most likely easier and simpler to operate, it is most likely also “cheaper in use” than a contract-based alternative.

8.4 Summary and conclusions

There is no information available regarding level of total costs, but we expect that the costs will be insignificant compared to the retail electricity prices. From this perspective, the cost analysis should not have significant impact on the final choice of the labelling system design.

The costs associated with the introduction of a labelling system can be divided into implementation costs and operational costs.

The costs on the front side are closely related to the frequency and the way of information disclosure as well as the possibility to use present CRM[42] and administrative systems and can differ significantly between suppliers.

A number of the costs on the backside are independent on the chosen verification system such as costs related to the development of the legal structure and the general presentation of the system.

The implementation costs are mainly related to the development of software. It is very difficult to determine the level of these costs without a detailed study of the possibilities of the available IT systems. However, there are already substantial investments in the development of a European certificate-based system (RECS) that can be relatively inexpensively adjusted to cover all types of electricity. The implementation costs on the suppliers' side are expected to be higher under the contract-based alternative.

The operational costs consist of administrative and transaction costs. Under the contract-based system, the administrative costs are expected to be higher than with the certificate-based approach. This is mainly a result of the high number of transactions combined with the bundling and unbundling problem. The transaction costs are similar for both system designs.

All things considered, it can be expected that the contract-based verification system will be more expensive compared to the certificate-based.

[42] Customer Relationship Management

9 EVALUATION OF ALTERNATIVE DESIGN SYSTEMS

9.1 Evaluation of the contract and certificate-based alternatives against the criteria in section 3 and 8

In this section the criteria discussed in section 3 and the cost evaluations in section 8 will be used to make a recommendation for the backside of the system. In this overall evaluation we will also refer to experiences from other countries that are described in section 4.

The difference between the two systems is on how labels are verified on the backside, via physical contracts or certificates. The three criteria we emphasized are: (1) reliability, (2) accuracy and completeness and (3) flexibility.

9.1.1 Reliability

The contract system is very complex in administrative terms. This opens up for operational errors that can make the system less reliable. A contract-based system may also distort the operations on the exchange by creating sub spot markets for each category of electricity, something that may open up for abuse of market power if the market categories include only few producers.

We consider the certificate system to comply with most of the reliability criteria discussed in section 3.1. The system is simpler and able to use a lot of verification mechanisms that has been developed in the financial market. Once being issued, the trading and tracking of ownership of certificate has many similarities with trading bonds or stocks in the financial market or derivatives like futures and forward contracts in the electricity market. Therefore the market players will be more familiar with the market mechanisms for certificates than for contracts.

A contract will by definition be physical, and for international trade across TSO borders it should be possible to track the electricity physically, for instance through scheduling and transport documentation. This can potentially have major implications for the underlying electricity market, as can already be seen from the transport of green electricity to the Netherlands from the rest of Europe.

It can be expected that the reliability of the certificate-based verification alternative is higher and easier and relatively more inexpensive compared to the contract-based one.

9.1.2 A minimum level of accuracy and completeness

The contract-based system implies difficulties in tracking the origin of all electricity sold to end customers. With a contract-based system one would have to accept some inaccuracies. In section 6.2.2 discussed an example of how to get around the problem with import/export. The exchanges constitute a problem to the completeness of the system, as the exchanges do not track origin, unless the exchanges are divided into separate sub markets for each category of electricity.

The split of the physical electricity and the source of origin in the certificate-based system allows for higher accuracy. This is also a result of the possibility for a langer settlement period. The exchange will not be influenced, as the certificates are issued to the owner directly, and only the electricity component is sold on the exchange. The buyers on the exchange buy certificates independently of their purchase on the exchange. Import/export is a political issue that do not influence on the physical market.

Although we do not consider the lack of completeness and accuracy a breaking point against a contract-based system, we do see that a certificate system is significantly better than a contract-based system. Whether a contract-based system is acceptable or not, depends on whether it is acceptable with some inaccuracies in the system. If the tolerance is large it might be acceptable. This can partly be a political issue, but in the end it is also a question whether an inaccurate system is acceptable for the consumers. If the consumers, when deciding on a label, are sceptical of the whole system due to inaccuracies or incompleteness, they might choose the cheapest label even if they would be prepared to pay more for green electricity with a more reliable system.

9.1.3 Flexibility

The electricity markets in Europe are still in an emerging phase, while the green electricity market has just started in a few countries. The challenge for the contract-based system is that it is relatively complex in itself, and even more complex if it requires documentation of scheduling and transport rights in international trade in addition to the metering data. The more complex the system is, and the more it is tied up to the TSOs operation, the more difficult it will be to change the system.

The advantage with the certificate system is that changes in the electricity market regulations have less influence on the certificate market than what is the case in the contract market. We believe that the change in the certificate and labelling market in itself will be very dynamic in the years to come, and a clear split between a certificate market and the underlying electricity market is therefore an advantage. The certificate system is also simpler due to a less complex system and that fact that certificate trade is not part of the electricity trade.

9.1.4 Costs and other relevant issues

There is no information available regarding level of total costs, and it is difficult to estimate the costs without a detailed analysis of the capabilities of the current systems.[43] However, it is expected that the costs will be insignificant compared to the

[43] This refers for system used by the suppliers, the ISO's, Exchanges etc.

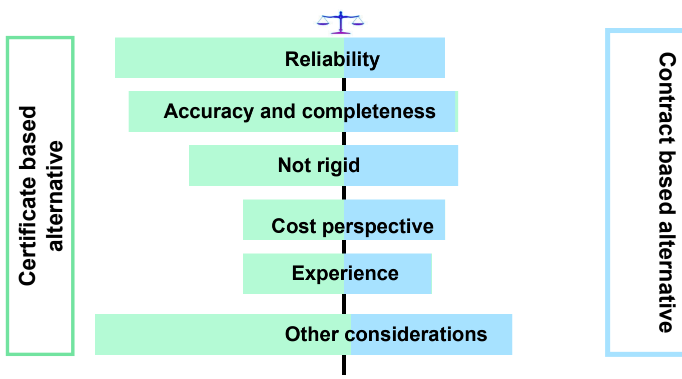
retail electricity prices. From this perspective, the cost analysis should not have significant impact on the final choice of the labelling system design.

In addition, experiences prove that contract-based verification can be introduced in an ex-post portfolio based labelling system, especially in regions with limited import/export.[44] However, it is extremely difficult, if not impossible, to design an ex-ante contract-based verification system. The experience from the New England region supports this conclusion.[45]

An argument for the certificate-based approach is that this alternative appears to be more suitable to facilitate regions with multiple jurisdictions as well as multi-task purposes. Besides, the higher liquidity and lower price volatility in the certificate-based approach will stimulate the development of secondary (financial) markets. This is essential from a risk management perspective.

9.1.5 Recommendation

An overview of the evaluation of both systems is presented in Figure 9.1.



. Figure 9.1: Evaluation of the contract-based and the certificate-based alternative

Based on the above evaluation it can be concluded that the verification on the backside of the labelling system should be certificate-based.

[44] This is the case in Texas and New York

[45] In New England initially a contract-based verification method was selected to support an ex-ante product based labelling system.. However, during the process of designing the system and developing the operational rules and procedures it became evident that the contract-based verification could not work in practice. As a result the contract-based method was abandoned and a certificate-based certification method was developed.

9.2 Framework of the recommended system design

In the previous section we concluded that the verification on the backside of the labelling system should be certificate-based. This model is in briefly presented below.

1) General principle

- The certificates are produced at the same time as the electricity. There are therefore two products produced at the same time, but traded in separate markets.
- All suppliers of electricity to end-users must prove that the sold labels correspond to the purchased certificates.

2) Balancing and settlement

- The labelling/certificate system must be a balanced system. All electric electricity bought, need to be produced, and as all electricity bought needs a certificate, also the produced electricity needs a certificate. Therefore a producer also needs a certificate in order to produce.
- For technical reasons the electricity production needs to be in balance with consumption at any point of time, and the number of certificates produced equals the total number of certificates used at any time. But there does not necessarily have to be a balance in the production portfolio (categories of electricity) compared to the consumption portfolio. The balancing within each certificate category can be made over one year. Each producer must at the end of a longer settlement period (for example one year) to prove that there is a match between certificates sold and actual production, and each retailer has to prove that there is a match between labels sold and the actual purchase of electric energy. If retailers or producers systematically unbalanced, they should be "punished", e.g. loose their licenses to trade labels or certificates.

- Regulating power
- The transport of electricity leads to losses in the grid. The size of the grid losses depends on the transportation distance and the level at which most electricity is consumed (high voltage versus low voltage) Therefore, the size of the grid losses varies from one country to another and is on average between 5% and 8%. In order for the system to be in balance it is required that the ISO/TSO covers the electricity losses with certificates. From the perspective of electricity labelling, the grid operator is also a consumer of electricity (losses).
- Import and export
    - Import/export of certificates with countries outside the "label-region" creates a potential for eroding the certificate system. Certain limits on import and export will therefore have to be considered. One alternative is simply not to accept imported certificates; another alternative is to limit import of certificates to the actual net import of electricity. If such restrictions are not implemented, it can reduce the price of the certificates within the label-region, and thereby the

incentives for investor to invest in new environmentally friendly production capacity. Similarly for export: Should producers be allowed to produce without having sold certificates? This would have only minor impact on the functioning of the system, but it could lead to “dumping” of less environmentally friendly electricity in the neighbouring countries. If dumping is a political concern, some limits for export should also be considered. We have proposed that producers need to show a balance between actual production and sold certificates. A limitation of export could be that producers could buy export certificates if the country/region is net exporters, thus making it possible also to export to “non-labelled” countries.

9.3 The geographical perspective of introducing a certificate-based system

The effectiveness and efficiency of a labelling system are closely related to:

- The relative importance of the imports and exports. Large relative size of the imports and exports erode the labelling system due to: (1) the possibilities of dumping the undesired electricity quality outside the labelling system (through exports) and (2) over supply of the desired electricity quality from outside the labelling system (through imports)

  As a result the value of the certificates will not reflect the true value based on economic supply and demand principles. Large regions will in general reduce the problem with import and export of electricity and certificates
- The relative size of the market. The smaller the market the higher the market fragmentation which will result in: (1) lower market liquidity and (2) higher probability of market power concentration by few market actors

Therefore the smaller the region where an electricity labelling system is introduced, the less robust and more fragile the system is. Besides the efficiency of the system generally decreases with the decrease of the geographical region. At the same time the insecurity of the effectiveness of the labelling system increases.

A basic condition for any common certificate market is that there are common rules of issuing, tracking and trading with certificates. This will include common rules for how to trade with third countries outside the “Label-region”.

To evaluate the magnitude of the potential import/export problem related to certificates, we can estimate the import and export shares of total consumption. We have evaluated four regions: (1) EU (plus Norway and Switzerland), (2) Benelux and Germany, (3) Benelux and (4) The Netherlands only.

The results are presented in Table 9.2. It clearly shows that in the large EU region import and export is very small compared to the overall consumption. If certificates bought from outside the region are limited to the physical import, the system has a very small leakage. The certificate import will probably not influence the internal certificate market, and thus not make any distortion to the investment signals for environmentally friendly electricity.

Region	Total export (TWh/y)	Total import (TWh/y)	Net import (-) /export (+) (TWh/y)	Consumption (TWh/y)	Share in % of consumption		
					Export	Import	Net import
EU (plus Norway and Switzerland)	7.5	34.0	-26.5	2 221.4	0.3	1.5	1.2
Benelux plus Germany	22.5	54.5	-32.0	692.0	3.3	7.9	4.6
Benelux	1.3	33.0	-31.7	196.6	0.7	16.8	16.1
The Netherlands	4.2	21.5	-17.3	107.1	3.9	20.1	16.2

Table 9.2: Import and export in different regions (Sources: UCTE-2001 figures, Nordel-2000 figures)

9.3.1 A Europe-wide system

For a large region like the EU a general ban on import would not create any major problems. The implication would be that the internal production of electricity would have to at least equal the consumption over the certificate settlement period. The reason for this is that all internal consumption requires a certificate, a certificate that in this case only can be bought inside the label-region, and the producers have to produce this volume in order to also produce the necessary certificates. Extra electricity can also be exported out of the region if the balancing requirements for certificates are that sold certificates should not exceed the sold electricity. Alternatively there could be restrictions also on export, either a total ban for net export within the certificate settlement period, or after having bought export certificates. In both cases the day-to-day electricity exchange will not be influenced, but the annual values have to be within the limits, that is either zero or in line with export electricity volume. The market is large and can even support a certain level of market fragmentation due to the introduction of the quality dimension.

9.3.2 A larger region – Germany and Benelux

To some extent the discussion about the EU region is also valid for a region like Benelux and Germany. Here the net import is 4.6 %. The gross figures of import, export and net import are larger in absolute terms than for the entire EU region. France, due to large electricity export, and Switzerland, due to large hydro pumping capacity, are large generators of international electricity trade, and when these two countries are outside the label-region, the gross exchanges increases. The market volume is significant to compensate for large extent for possible market fragmentation.

9.3.3 A smaller region – Benelux

If Germany is not included in the common label-region in North West Europe, the net import to the Benelux in absolute terms is on approximately the same level as with the entire EU region. Therefore the net import as a percentage of consumption increases to 16.1 percent, 10-15 times what the EU region has. The main reason for this is that import of electricity from Germany and France, based on long-term contracts, traditionally has covered a lot of the electricity in the region. The deregulation has not changed the underlying physical production structure, and the import will therefore continue.

Should the import of certificates reach the same level as the physical electricity import, the impact on the certificate market could be significant. We must assume that the imported certificates are the most attractive ones, while the less attractive production inside the region will try to buy export certificates in order to export to the region outside with no penalties for "dirty" fuel sources. The result will be that the price level on environmentally friendly production will be reduced, and the investment incentives for such production capacity will be weaker.

9.3.4 In the Netherlands only

The net import share for the Netherlands alone is on the same level as for the entire Benelux region. The overall market is, however, reduced by half the Benelux level. Market size is in itself important for trade with certificates, as a smaller market will have less liquidity. Liquidity is one of the key factors that investors look for when they take investment decisions.

A certificate market for the Netherlands alone will be a very fragile construction since the country has such a large foreign trade, and there will be an over supply of environmentally friendly certificates from abroad. Some difficult decisions on restricting import from other EU countries have to be made, and can be difficult to implement due to development of the internal electricity market and general competition law. As a permanent solution a Dutch introduction of certificate trade, backing the labelling system, can be unsustainable, but as a mean to having the same system introduced also in other countries it can function as a catalyst to the process.

If the Netherlands goes ahead with a labelling system before other countries in the EU, it will affect the market position for Dutch producers and consumers. A labelling system aims at changing the behaviour of the market participants, but this might at the same time set the producers in the Netherlands in a different competitive position than their competitors in Germany, Belgium, France etc. An important provision for an early introduction of a labelling regime in the Netherlands is that Dutch power producer shall not be negatively affected.

What if other countries choose other systems ?

The advantage of being first mover is that there is a good chance of influencing the systems in other countries. A well known example of this is the spot exchange for electricity developed in Norway in the early seventies, and being introduced in 1992 as an open trading platform for all Norwegian market actors. Today the same principles for day ahead trading are introduced in almost all European countries. The key of this success is most likely that it is so easy to use, robust to regulatory changes, and simple to understand. The spot exchange has also very efficiently been able to solve other issues than just the trade of electricity between market participants, like bottle-necks in the grid.

A well designed labelling system in the Netherlands may therefore also form a reference for other countries. It is even so that the Dutch trading system may be developed as a platform for the internal trade of certificates (or similarly with a contract-based system) in other countries. The concept of international trade with electricity is so well developed today that using a Dutch trading platform outside the Netherlands is not necessarily considered a problem - provided the platform is well designed.

There is, however, always a risk that the Netherlands introduces a labelling system that is not accepted as the optimal one. Then there might be a possibility for major changes in order to adjust to the international standards for labelling. In this case Dutch producers and consumers might have paid a too high price for introducing a label without any significant impact on neither the labelling system as such nor any impact on the production capacity structure.

9.3.5 Recommendation on the size of a labelling region

An electricity labelling system introduced in the Netherlands alone, or even in the entire BeNeLux region will be very fragile. The region is basically too small to implement a consistent labelling system having the required credibility and without too large impact from import and export. Regions like the entire EU, or even BeNeLux and Germany together, could have an effective and efficient labelling system.

Generally, we consider it possible to introduce a certificate-based system in those countries that find labelling attractive, and not necessarily in the whole EU. Adding more countries to the “labelling region” will not raise issues that are not considered already in a small start-up region. To the extent efficiency matters, there is however a major advantage with a large region as compared to a small region.[46] There is also reason to believe that a larger region will limit the system design problems and minimize the generation costs for the desired categories of electricity. We thus suggest an EU-wide system rather than a smaller region, even if the political challenges related to reach a multilateral agreement on labelling can be significant.

[46] For the consumer concerned about fuel choice among generators etc., it can be important whether the desired production takes place in her home country or in a country with similar standards or rules

9.4 Criteria to be met for the establishment of a EU labelling system

The main criteria for implementation of an electricity labelling system in Europe have already been implicitly described throughout the report. However, we would like to make them explicit and summarize below:

1) Regulation set at EU level.[47]

2) Authority to give penalties for not applying with the system.

3) Acceptance of one basic verification design: certificate. This implies that similar rules are introduced in all countries joining the "labelling region" – different principles for verification can hardly coexist if efficiency matters.

4) Similar principles for issuing certificates, validity of certificates, trading, etc (presented in section 6 of the summary)

5) Agreement on uniform categories of electricity. If category 1 includes e.g. hydro and wind in one country, category 1 cannot be hydro only or coal in another country within the same system.

6) Agreement of a central body or co-operation between regional bodies to monitor issuing of certificates, registry of certificates (as we have national registries of equity papers), cross border trades, etc.

[47] Experiences from US and Austria show that disclosure laws on national rather than federal level seem to hinder the proper functioning of the system.

ANNEX 1: THEORETICAL PERSPECTIVE

The principle challenge of designing an economic system is to maximize the likelihood that decision makers have:

- The relevant information to make good decisions
- The incentive to use the information productively

Even though, there are a number of relevant issues to be discussed with respect to the front side of the system (the label in the retail market), the challenge in designing an effective and efficient electricity labelling system is created by the backside of the system (the verification structure in the wholesale market). Therefore, this chapter focuses on the theoretical foundations relevant for the design of the verification part of the labelling system.

There are two basic ways of structuring a verification mechanism: contract-based and certificate-based, hybrid forms are of course also possible. The best choice depends on the:

- Observed market structure
- Expected behavioural implications

However, it can be stated that the best verification mechanism is the one that offers the best trade-off between transaction costs, risks and co-ordination effectiveness. The relevant theories with respect to both models are discussed briefly in this chapter.

1. Observed market structure

Four relevant market characteristics can form the background for the decision making on the backside of the verification system:[48]

- Level of uncertainty
- Frequency of transactions
- Specificity of the assets

[48] Leerboek algemene economie, E.C. van Ierland et.al.,Stenfert Kroese Uitgevers, Leiden/Antwerpen, 1990, ISBN 90-207-1991-2; Beginselen van de techniek van de handel, Drs.A.L.Westers et.al.,DELWEL Uitgeverij, 1993, ISBN 90-6155-539-6

- Numbers of buyers and sellers

The degree of each of these characteristics on the relevant market can indicate which of the two verification systems potentially is most efficient.

1.1 Level of uncertainty

The level of uncertainty represents the expected range and variance related to the future value of the underlying product, in this case the origin of electricity supply. It is reflected in price changes that are considered to be unreasonable by the relevant market actors.

High level of uncertainty can be due to many factors of which the most important are:

- High demand volatility combined with low supply flexibility
- Market structure: number and relative power of the individual buyers/suppliers
- Uncertainty related to fast or extreme technological changes

Higher level of uncertainty generally leads to higher transaction costs for the companies. These costs can be divided into:

- Information collection costs. In case of high uncertainty about the future, the availability, and the complete and speedy information becomes critical for the success or the failure of the company. At the same time, the difficulty of gathering all essential information within a limited time frame raises considerably. This results in drastic increase of information collection costs.
- Transfer costs. The transfer costs include policy and decision-making costs, bargaining costs and enforcement costs.

The ability of a market to function effectively deteriorates as the level of uncertainty about the future increases. Higher transaction costs decrease the efficiency of the market structure and forces the companies to look towards alternative ways of effective co-ordination.

Examples

1) high fixed cost on production side, which makes it uncertain for suppliers if

they i.e. can support a 25% consumer shift from nuclear to green electricity.

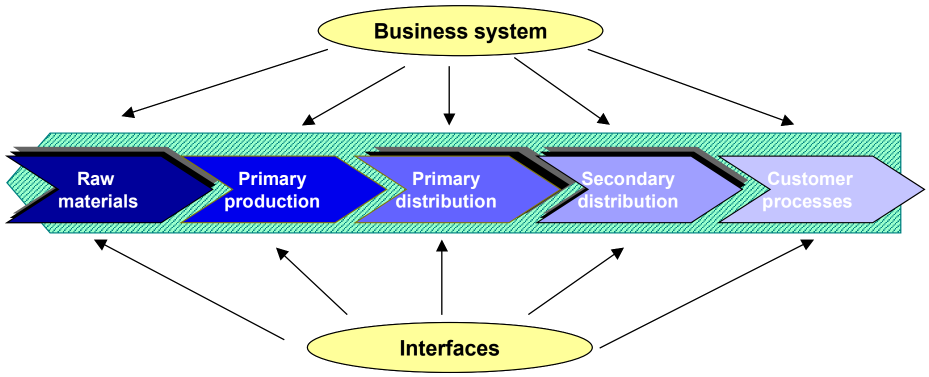
2) Markets are often dominated by few vertically integrated companies, which,

if they have market power, can create uncertainty about prices.

1.2 Frequency of transactions

Frequency of transaction refers to the number and regularity with which vertically adjacent units within the supply chain make (price) deals.

The supply chain looks at the total value chain as part of one whole economic activity. Supply chains are built from different business systems which are linked through interfaces.



The complexity of the supply system increases with the increase of the number of players within the supply chain as well as the variety and the complexity of the products.[49] This issue have to be carefully considered in view of the nature of the electricity market and the large number of intermediaries within the supply chain.

In a well developed deregulated market it is common that an electricity contract changes hand more than 20 times before reaching the final consumer, resulting in a high number of transactions. The regularity of transactions is also high, due to:

- the large variety of products in the market that are simultaneously homogeneous in nature, for example base load and peak load products for year ahead, quarter ahead month ahead week ahead and day ahead
- the use of these products for managing price and volume risks as well as speculative trading

Within the supply chain, the proprietary rights are transferred from one element to another in a consequential order. This is a demand managed, push based system with large information gaps. Collaboration based on transactional and information sharing relationship is challenging to develop. Therefore, the result is often (vertical) integration.

With arm's-length markets, it is possible to eliminate/ pass over elements of the supply chain. Elements from the supply chain are included only when they are in position to demonstrate their added value. As a result companies are pushed out of the supply

[49] Designing and managing the supply chain, Concepts, strategies and case stuidies, D. Simchi-Levi et. al., McGraw-Hill, 1999, ISBN 0-256-26168-7

chain and forced to operate directly in the market increasing the pressure to improve performance.

> ***Example***
>
> From an electricity perspective contract-based verification system have higher frequency of transaction than certificate-based. In contract-based verification systems, the "verification" is attached to the contract traded between producer and supplier, unlike in a certificate-based verifications system, where the "verification" is traded on a secondary market.

1.3 Specificity of the assets

Specificity of the assets refers to the characteristics of the underlying asset/ product, where this is the specificity of the origin guarantee (certificate or contract).

A high degree of asset specificity deteriorates the effectiveness of the market structure. Assets specificity, durability and intensity raises the barriers to exit and entry, decreases price transparency and makes the companies more vulnerable to opportunistic bargaining. This is especially the case when transactions occur infrequently. In case of frequent transactions occurrence, the specificity of the assets leads to high transaction costs with all negative consequences described earlier.

In addition, a high degree of asset specificity leads to decreased market liquidity and depth. The low liquidity is reflected in a high spread (the difference between the bid and the ask price) in the market. The depth represents the slope of the bid and the ask curves. Due to the limited depth of the market, small changes in demand result in disproportional high price changes, consequently increasing the level of uncertainty.

Concerns about potential vulnerability to suppliers/customers combined with the higher degree of uncertainty causes firms to desert the market or move towards more (vertically) integrated co-ordination structure, thereby further decreasing the size of the market.

> ***Example***
>
> The problem of specificity is related to the number and complexity of the products traded on the backside of the labelling system. If more products are designed than there is a demand for, the liquidity of the market will decrease and thereby the efficiency of the market.

1.4 Number of buyers and sellers

The number of buyers and sellers and their relative power, is relevant when looking at the market structure. Based on the number of the buyers and sellers three types of market structures can be defined:

1) *Infant or generic markets*. Markets characterized by a very limited and even non existence buyers or sellers are called 'infant or generic markets". This situation occurs when a product is completely new and no demand for this product has been developed yet or when one of the stages of the supply chain is insufficiently attractive for single stage suppliers. In both cases vertical integration is required, which can be downstream as well as upstream oriented.

2) *Market power asymmetry.* Market power asymmetry arises when there is unbalance between the number and/or the power of the suppliers on the supply side and the number and/or power of the buyers from the demand side. In such cases tendency towards the lower levels of market co-ordination mechanisms (contract-based mechanisms) can be observed, as this benefits both the weak side as well as the strong side firms.

3) *Market competition.* Market competition occurs when there are sufficient number of buyers and sellers with no extreme market dominance. Based on research and past experience, it can be assumed that the presence of five more or less equal players can lead to reasonably competitive market formation. This provided that the environment in which companies operate stimulates competition and not co-operation. The market competitiveness increases with the increase of number of market players.

In order for a market to work there should be clearly assigned property rights that can be exchanged.[50] Provided that the above condition is met and the transaction costs are sufficiently low a free market exchange is powerful and efficient mechanism which ultimately results in Pareto efficient[51] resource allocation regardless of the initial assignment of the property rights.

Furthermore, property rights provide a strong incentive to for the different market parties to act on their specific information and are therefore critical for designing a successful labelling system.

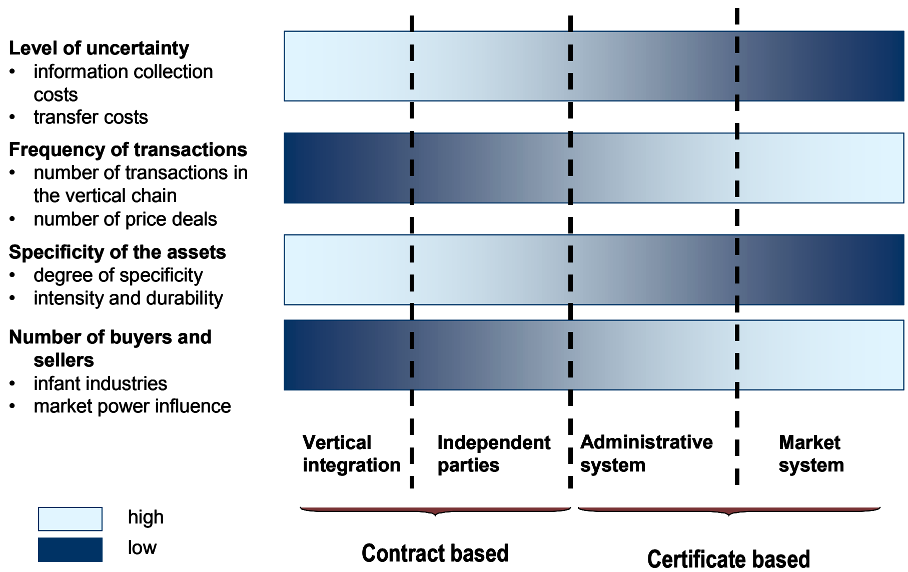
[50] Coase theorem, Nobel price winner Ronald Coase, 1960, Managerial Economics, Berkley et.al., 1997, ISBN 0-256-15825-8

[51] Pareto efficiency (Vilfredo Paroto 1848 – 1923), A distribution of resources is said to be Pareto efficient if there is no alternative allocation that keeps all individuals at least as well off but makes at least one person better off.

> ***Example***
>
> The number of buyers and sellers are determined by the size of the market, if the market is cost-effective (there can be many players in a small market, but they are unlikely to be cost-effective). A successful labelling system is based on a market of a sufficient size, where no actor has market power.

1.5 Market characteristics and verification systems

Different levels of the four market characteristics apply to certificate-based and contract-based verification system. The figure below summarizes those.



2. Expected behavioural implications[52]

Every economic system is set in place with specific objectives. Once the system is in place, it can be expected that it will affect the behaviour of all market parties – from the small consumers, through the suppliers and traders to the producers.

Most models attempting to explain and predict human behaviour are based on one or both of the following assumptions:

[52] Among others: Organizational behavior, J.E.Champoux, Western Publishing Company, 1996, ISBN 0-314-06242-4; Prinsiples, Agents and Ethics, G.J. Dees, 1992, Oxford University Press; Stakeholders agency theory, C.W.L. Hill, 1992, Jurnal of management Studies, vol. 29, p.131-154; The psychology of judgement and decision making, S. Plous, 1993, McGraw-Hill; Prinsiples and agents – the structure of business, J.W. Platt et.al., 1985, Harvard Business School Press.

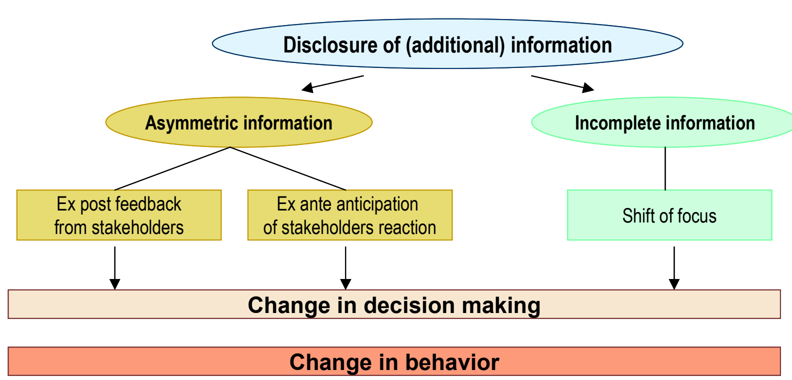
- Humans are rational, though our rationality is bounded by capabilities, knowledge and time.
- Humans are opportunistic creatures, and when given the chance they will behave illegally if they perceive that it is in their long term interests to do so.
- Humans are social in nature and therefore often show socially desirable conduct.

The impact of information disclosure or the lack thereof on the actions of a person/ organization is explicitly or implicitly covered by a number of different models. Many of them such as the utility maximization theory, the prisoner's dilemma model, the administrative man model, the cognitive dissonance theory and the confirmation bias theory are rather fundamental and therefore will not be explain in detail in this study.

In line with the stakeholders-agency theory, disclosure of additional information, although coming at some cost, will help to realign the actions of the firm with the interests of the principles (stakeholders). The disclosure of the information will affect the behaviour of the companies along three dimensions:

- The stakeholders can asses ex-post the behaviour / performance of the company and take corrective actions. For example, in liberalized electricity market information regarding the origin of the electricity portfolio of the supplier can push consumers to switch suppliers.
- The social costs of the managers' economic decisions will be incorporated ex-ante in the corporate decision process when the managers know that the result will be disclosed. This argument assumes that the managers hold relevant information that was not asked previously to disclose. Here, it is clearly the origin structure of the supplied electricity.
- The obligation to disclose information forces managers to collect structure an evaluate information which for variety of reasons they might have not done before. Examples of such reasons are: not aware of the relevance of the information, information is considered low priority or unconscious attempt to avoid contradictions with own views. It is logical to assume that when the managers gain a good insight in the origin structure of their own portfolio as well as the portfolio of their competitors and in the needs and desires of their clients, they will re-evaluate the current policy. If seemed required the policy will be adjusted to optimise the position of the firm.

A schematic overview of the three dimensions affecting the behaviour of the agent (the electricity supplier) is presented in the figure below.



3. Summary

There are two basic ways to organize the verification part of an electricity labelling system: contract-based and certificate-based. Vertical integration and certificate market are the two extreme alternatives.

Which alternative is the best depends primarily on the market structure and the expected implications on the human behaviour.

In order for a market structure to be an effective and efficient verification system it is essential that the following conditions are met:

- Low level of uncertainty reflected in the rapid dissemination of accurate information at low costs and low transaction costs
- High frequency and number of transactions
- Low specificity of the asset to ensure easy market entry and exit
- A significant number of more or less equally powerful market actors (buyers and sellers) to ensure environment of competitiveness

The other extreme is a vertically integrated verification system which can be effective in markets with characteristics opposite to the ones described above.

The disclosure of additional information can influence human behaviour along three dimensions:

- The stakeholders can take ex-post corrective actions resulting in changed behaviour by the companies
- The companies can change ex-ante their behaviour knowing that the information will be disclosed
- The companies can change their behaviour due new insights created by the collection of the information that will be disclosed.

ANNEX 2: PRACTICES OF ELECTRICITY LABELLING

1. USA

Disclosure of electricity products has been or is being implemented in 26 states in the US. Only in a few states like Texas and New York disclosure system is fully in place and than only recently, while most other states are in the implementation face.

No federal law has the authority to prescribe disclosure of information regarding electricity quality, which leaves the states with the sole authority to regulate the terms and conditions of disclosure. As a result, there is no homogeneity among the states as each state has adopted different approaches to information disclosure and are presently at different levels of introducing electricity disclosure systems. The National Association of Regulatory Utility Commissioners, however, passed a resolution, which urges the states to implement a disclosure system.

On the front side there is no general system. Each state has developed its own guidelines. The main characteristics of the front side of the system are:

- In most states fuel mix and gas emission are disclosed on the label and in some states prices and nuclear waste is indicated as well.
- About half the states have portfolio based ex-post labels (ex. New York) and the other half have ex-ante products based (ex. New England region). In few states there is a combination of both, where portfolio disclosure is mandatory and product disclosure is voluntary.
- There is no uniform label on national level, but most states have a uniform label on the state level.
- In the states where disclosure systems have been implemented consumers have shown little tendency to change supplier.

On the backside the situation is somewhat different. Until recently little effort was put into the tracking side of the labelling system. In some states the tracking side of the system is practically non-existing, as statement form the electricity supplier regarding the generation structure is sufficient to as prove of origin. In other states the tracking is contract-based and limited to ad hoc audits by government authorities. The New England region has the most developed and comprehensive system of verification. Certain forms of common verification system are also being structured in the Western region and in PJM, however their level of sophistication is much lower.

1.1 The New England region

New England started with the designing of the verification of the labelling system in the 1999. First analyses resulted in a contract-based verification system. The basic design principles were:

- At the moment of production, each kilowatt hour was coupled with the source
- The generator source becomes an integrated part of the kilowatt-hour and follows it through the whole supply change.
- The New England ISO routinely balances the hourly load of each retail seller with its various sources of supply in addition to the general balancing of the electricity system.
- The electricity purchase falls into one of two category: a unit purchase with a specified generation source or ANI (Adjusted Net Interchange), which is basically a system purchase (if the suppliers are short the difference is balanced by buying ANI).
- Electricity imported from states outside the New England was labelled as the average fuel mix of the area it was imported from.
- Import and export are treated separately without netting possibilities.

During the process of detailing of the contract-based system design, and developing the operational rules and procedures it became clear that the contract-based verification system will not work in practice. The design became very complex and a large number of assumptions had to be introduce decreasing the accuracy of the system. The administrative chaos due to the bundling and unbundling of electricity contracts made it extremely difficult to verify the electricity origin decreasing the system reliability. It also became clear that a contract-based system will decrease market liquidity and prevent the development of professional financial markets. Based on this, it was concluded that the contract-based verification system was not functional and was abandoned.

As a result further studies were initiated and. A certificate-based verification system GIS (General Information System), which will be operational after July 15 2002 was chosen. The basic principles of the new system design are:

- The GIS administrator produces certificates based on the hourly generation information from the settlement database. The certificates are produced quarterly and deposited into the appropriate account holders account. Each certificate will denote the month in which the associated electricity was generated.
- The settlement period for the certificates is one quarter. At the end of each trading period all trading of certificates for the quarter will cease and the GIS administrator will issue a final report. Unused certificates are withdrawn at the end of the trading period.
- The aggregated characteristics of the remaining unsettled certificates that trading period form the residual mix certificate. Sales by supplier not covered by certificates are automatically assumed to have the residual mix quality.
- For suppliers selling multiple products there will be sub accounts for each products specifying also the corresponding MWh.
- Exporting companies may export certificates equivalent to MWh of electricity exported or may export electricity without associated certificates.
- Companies importing electricity to New England from areas outside New England may sell certificates provided that
- there are transmission rights for importing the electricity into New England

- the generator of the electricity is accepted by the GRS administrator and complies with the operating rules of the GIS.

The costs for the certificate-based system are estimated at USD 6 mill. This includes the development and implementation of the software, the training of the relevant personnel in the market and the operational and maintenance costs of the Registry for 5 years.

1.2 Western region

The Western area comprises of 11 states and two Canadian states, with California as the absolute frontrunner.

In the Western area the initial model of information disclosure on the wholesale side was a hybrid between certificate-based tracking for generation of electricity with renewable sources and contract-based tracking for all other sources of electricity generation. The reason for not implementing a certificate-based system for non-renewable generation was a concern that consumers would not accept the tag as a reliable verification format.

Since 2001 the Commission is developing a tradable certificate program for verification purposes as well as new registration procedures, which are being implemented. However due to the significant difficulties and urgent issues arising from the California crises the issue of electricity disclosed has temporarily been given a lower priority.

The most relevant aspects of the verification system in California are.

- Disclosure of electricity is on a voluntary basis.

- If electricity is sold without a specific label, the disclosed fuel mix is identified as the “net system power”, which is the estimated mix of fuel types in California.

- The original system for verification was contract-based where retailers were obliged to submit an independent third-party audit. This has been changed to a certificate-based verification system.

- The Electricity Commission has developed a software program called “Electricity Commission Certificate Program”, which is distributed to all generators. The software creates certificates of the electricity produced at each generation facility with information on amount, fuel type etc. Retailers then buy these certificates to support a claim of specific purchases. In an annual report the Electricity Commission verifies that the amount of electricity sold by a retailer with a specific claim of purchase match the certificates bought by the retailer.

- There are both positive and negative aspects of this. On the registration side, which is a prerequisite for a successful disclosure program, most cost were related to the development of the software program, which was distributed freely. On the other hand it did reduce the administrative load for the retailers.

For the retailers there should be savings connected to the tradable certificate programme, because they are able to diversify their product base. For generators issuing of certificates are voluntary, which means that those using it find it is cost-effective. It will typically be producers, who produce electricity with an environmental profile.

1.3 PJM region (Pennsylvania, Maryland, Jersey)

This region is just presently drafting the conceptual design of the electricity labelling system. The basic principles of the design of the verification system are:

- Certificate-based tracking system with spot trading of certificates and electricity.
- Certificates only count if electricity is generated within, or delivered to i.e from New York to PJM.
- Each retail MWh supplied must be matched with a MWh of attribute at the end of each reporting/ settlement period.
- Certificate settlement period is set to two months.

1.4 Texas

Texas implemented full disclosure on information regarding electricity origin in January 2001. There is a full unbundling between generation and supply.

The verification system is a hybrid form of contract-based and certificate-based system.

- For electricity generated from renewable sources a certificate-based system is used.
- For all other generation sources a contract-based approach is applied.

The contract-based system is on generator and not on plant production level. For each generator (there are approximately 30 generators in Texas) a fuel mix structure is defined based on the total generation park and past information of capacity utilization. The suppliers are obliged to have a split portfolio for supply and trade. Contracts are nominated to a portfolio and only contracts nominated to the supply portfolio are tracked. The bilateral contracts between generators and suppliers are set against the standard generator mix. All other contracts with exchanges and traders are set against default fuel mix. Import and export is not an issue as Texas is practically a closed region. The implementation and operational costs are rather low.

1.5 New York

New York has introduced a contract-based verification system in January 2002. The system is managed by the ISO and structured as follows:

- Every contract contains an extra attribute (code) presenting the fuel used to generate the electricity and follows the contract throughout the total value chain.
- The imports are treated as the average fuel mix of the importing region, unless in the importing state there is a comparable contract-based system or the specific origin source can be contractually verified.

- Electricity purchased from the spot market and the balancing market is based on the residual mix.
- The ISO manages the system and informs ex-post each supplier about the fuel structure of their portfolio.

It is used to verify an ex-post portfolio based labelling system and seems to work well according to the New York government. Till now, it has not have had any significant implications on the functioning of the wholesale electricity market. The most important reason for this, is the fact that the suppliers still purchase the cheapest electricity without concern about the fuel used. In other words, the introduction of the labelling system has not resulted in differentiation of the electricity based on the origin source. The fact that the suppliers are not very interested in the origin structure of the portfolio can be explained by the fact that the system is ex-post and portfolio-based. The consumers do not show significant preference for specific fuel mix and it is difficult for the supplier to position themselves based only one label (total portfolio).

2. Australia

Like in The US there is no national law, which can enforce electricity laws on federal level. This means that the federal states have the sole authority to decide on a disclosure system for electricity. However both Victoria and New South Wales have taken actions to implement such a disclosure system.

2.1 Victoria

In Victoria a bill on disclosure of green house gas emission was passed in April 2002 and a system for full disclosure of electricity information is being discussed. The green house gas emission information shall be disclosed on the consumer bills, but the details of the system is still under discussion. On the backside the green house gas emission information will be based on the Victorian state-based greenhouse gas co-efficient, which is derived form the National Greenhouse Gas Inventory data. The co-efficient will reflect Victoria's sources of electricity supply and will be based on electricity generated in the proceeding calendar year.

2.2 NSW

In 1999 SEDA (Sustainable Energy Development Authority) presented a comprehensive discussion paper on electricity labelling. The paper discussed how an effective disclosure system should be designed and how it could be implemented in NSW. It included experiences from the US and consumer responses. The result of the discussion paper was a consultation paper "Implementing Electricity Labelling in NSW" presented by SEDA in June 2001. The objective of the paper was inform stakeholders and to get comments on the proposed system.

Status is that the project was dismissed due mainly to political issues regarding cost and complication of implementation. Instead a system similar to the one in Victoria with disclosure of green house gas emission has been implemented.

The system suggested in the consulting paper was based on the following principals:

- Fuel mix and green house gas emission should be disclosed,
- It should be an ex-post portfolio based system with voluntary disclosure of product information.
- The information to be supplied in the electricity label should be standardized across the market with minor possibilities for deviations.
- The tracking system was not presented in detail but should have been a contract tracking system based on the current tracking and accounting methodology used in NSW.
- Labelling should be implemented on state basis initially.

3. Austria

In Austria the electricity market has been liberalized since October 2001. At the same time a disclosure program was introduced. Prior to this date the Austrian consumer have had the possibility to bye eco-power, electricity from renewable sources.

An important driver in the implementation of the disclosure system has been the desire to give the Austrians the possibility to buy “nuclear free” power. Austria is declared “nuclear free”, but import electricity produced at nuclear plants outside Austria. This makes the export/import a special issue for Austria, which would be solved by a disclosure system on European level.

The national electricity market control authority (E-control) has developed guidelines for information disclosure, but the nine federal states of Austria are responsible for the implementation details. After the system has been implemented for eight months and the experience is that it is impractical to have the law on disclosure on the federal level. The federal states do have the administrative capacity to enforce the system and it is not possible to compare labels across states. Currently the discussion whether the law on disclosure of electricity level should be elevated to the national level is taking place before addressed in the parliament.

In Austria many supplier does not disclose information as required and the local authority does not have administrative capacity to enforce the law. In response to this, E-control, the national electricity market control authority has developed a database where consumers can compare prices and view fuel mix. The database is not only developed with the purpose of informing the consumers and enable them to make better choices, it also supposed to give the supplier a positive incentive to supply information. It is the policy of E-control, that positive incentives are effective than punishment in obtaining better results in the disclosure program

3.1 Front side

The label is uniform on federal level and contains data only on fuel mix. Some states have a portfolio based system and some states have a products based system. The disclosure is ex-ante, which has turned out to be problematic for new entries to the market, which has no history. In those cases ex-ante information is disclosed, but it needs to be verified by the local authorities. If no information on the source is available the UCTE mix is indicated, which is the average composition of electricity production sources for each federal state. Consumer choice is limited to the local federal state and each supplier can only offer one label.

3.2 Backside

On the backside both certificate-based as well as contract-based verification systems are in place. Certificates are used for small hydro power plants. For all suppliers 7 % of the total electricity sold must derive form small hydro plants. In addition all power from renewable (large hydro does add to this category) must be bought by the grid at market prices. All other electricity production has contract-based verification system. Electricity, which is imported or bought on the exchange is sold as the UCTE-mix.

4. Switzerland

In December 2000 the Swiss parliament approved the Electricity Market law, which prescribed the liberalization of the Swiss electricity market. In the law there was made the possibility of making a system for disclosure of electricity information to the consumers. The Swiss people will vote on the acceptance of the law in a referendum in September.

The label should be uniform for whole Switzerland and contain data on fuel mix, nuclear waste, country of origin, where, if data is not available, it will be labelled “unknown”. The label will be product related and provided once a year on the request of the consumer. Information should be disclosed on an ex-ante basis.

Because of the problems with import/ export a contract-based system is suggested. However, currently EU standards for disclosure of renewable are in progress and if, as the Electricity Association suggest, the system in Switzerland will only be regarding renewable, a certificate-based system will be more effective.

5. Experiences from Eco labelling in Europe

5.1 Netherlands

The Netherlands have a well functioning certificate system, which in short is structured as follows[53];

Subject to certain conditions, the owners of plants where electricity is generated using solar energy, wind, hydropower or biomass can register with Groencertificatenbeheer bv (Greencertificate body/GCB) as a generator, as well as registering their plant with the regional electricity grid administrator to which the plant is (to be) connected.

The grid administrator in question checks the plant and the connection, and provides for a measuring installation to be able to measure the quantity of electricity fed into the

[53] For detailed information: www.groencertificatenbeheer.nl/UK/method/methodUK.html

electricity grid informally. The measuring company performs a reference measurement of the registered locations. Subsequent measurements by the same measuring company will be used in calculating and reporting to the GCB of the quantities that have been generated.

The GCB issues an electronically certificate for each MWh supplied, which is coded on the basis of the plant's connection number. Via this procedure the source of the electricity can always be traced. Certificates are issued in 1, 10, 100 and 1,000MWh. The splitting to smaller quantities is free of charge and the original code is preserved. The certificate will be credited on the account of the trader the producer chooses. The GCB's system exclusively caters for certificate transfers (i.e. not for financial transactions).

The Certificate is available in electronic format only. Generating companies, traders and suppliers of renewable energy are allowed to register with the GCB as traders; a "current account" for the certificates will then be opened for them.
The GCB records the ownership of the certificates and their transfers to another registered party. The parties can access their own account using a secured login connection, to be able to request information and complete transactions.

Any trader which supplies renewable electricity to an end user instantly becomes a supplier. It reports the green certificates registered in its name to the Tax authorities. In so far as a matching quantity of power has effectively been supplied, the Tax authorities may decide to apply the Regulatory Energy Tax zero rate for renewable electricity.

When the trader redeems a certificate, the certificate is cancelled. All other certificates are automatically cancelled on expiry of a one-year period of the date of issue. This ensures the reconciliation of the quantities of renewable electricity having been generated and used up on an annual basis.

If the electricity is generated outside the Netherlands the importing Trader has to take care of physically importing of the electricity over the border. Only when the certificates can be issued over this quantity of electricity.

5.2 UK

In the UK there are no plans of introducing a disclosure system, despite the fact that the UK is the most developed country in the EU in terms of electricity liberalization. Nevertheless a system for certification of green electricity was established in 1999. The system called "Future Energy" is a voluntary program for producers of renewable energy. The system shall insure that correspondingly to the green electricity consumers may choose to buy, the same amount of electricity is actually produced from a renewable source.

The system is solely based on "clear contractual links" between the supplier and the producer, which means that there is no trade of certificates.

5.3 Scandinavia

In Scandinavia (including Norway) there is no disclosure system, neither is one on its way. The Scandinavian market is highly integrated, which means that it would be complicated and even meaning less to have a disclosure system, which would not cover Sweden, Norway, Finland and Denmark.

Several eco-labels, however, is in place. One eco-label “Bra miljoevalg” covers Sweden, Finland and Norway. It was initiated in Sweden in 1996. In 1999 42% of all suppliers in Sweden offered this label and 5% of the electricity consumption is of this label. The label does not yet have a deceleration but is just a logo. Most suppliers, however, disclose which renewable sources the electricity has been produced from. This means that the system is contract-based and relies completely on suppliers own production or long-term bilateral contracts.

5.4 Germany

In Germany disclosure of electricity information is not in place, but green electricity is available. Three different certificate concepts are in place, which like in Sweden are based on logos. If the consumers want further information it should be obtained from the supplier. The three systems all relies on bilateral contracts and yearly balances, which are supplied by the designated authorities.

5.5 EU

RECS is the European system for trading of renewable certificates. All procedures, bodies and IT platforms are in place. Currently the system is in test face with participation of Germany, Italy, Norway, the Netherlands and Belgium participates, while UK and Denmark will join in later. The Goal of RECS is to implement an international uniform system for trade with renewable energy and in that way use resources in the most cost effective way. The certificates are traded independently of the contract and can be traded up to 5 years before they retire.

The RECS certificates exist mainly in electronic forms and are “produces” by regional or national bodies and kept in a central database administered by the “ Central Monitoring Office”.

ANNEX 3: CONTRACTS AND CERTIFICATES MARKETS – THEORETICAL FRAMEWORK

The following note explains the principles for price formation in an electricity market with a) no restrictions except supply and demand limitations, b) limited transmission capacities between regions, c) two categories of electricity traded as contracts and finally d) two categories of electricity certificates traded in addition to traditional electricity trade. The purpose is to provide a framework for understanding the price formation and how different models for verification can work. It could perfectly be the scope for another project to investigate the equilibrium conditions in the different models.

To keep the presentation simple we have not considered exports and imports, except slightly in the last model.

1. Basic model – no restrictions

Assume a single region with demand and supply for electricity. Graphically we could illustrate this with the following picture:

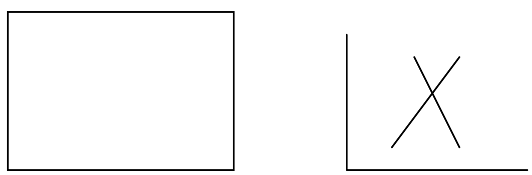


Figure 1 Market without restrictions; Market shape and equilibrium formation

The equilibrium can be found when solving the following set of equations:

$$\max\ (p_t - c_t) \bullet q_t$$
$$q_t = q_t(p_t, \ldots)$$
$$c_t = c_t(p_t, \ldots)$$

q(p, …) is the demand function; Demand is a function of price and other factors not relevant here. c(p, …) is the supply function; Supply is a function costs, which in turn is a function of quantity and other factor not relevant in our context. By definition, the electricity market must be in equilibrium all the time. We have therefore added a subscript t for time

With reasonable conditions on the supply and demand curves[54], we can be sure there is one and only one equilibrium solution to this problem.

2. Extended model – two regions with limited transmission capacity

Now consider a situation where the market is separated in two regions. Between the two regions, there is a limited transmission capacity. The maximisation problem is now complicated with a constraint; Actual flow between the regions must at any time be within the capacity limit.

In the graphic presentation of the model there are now two equilibrium prices – one for each region, but still there is a unique equilibrium solution to the maximisation problem. For simplicity, we have here removed the subscript for time, except in the constraint.

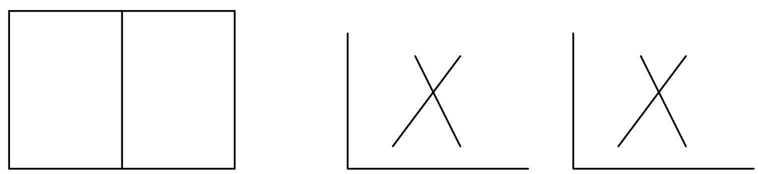


Figure 2 Limited transmission capacity between two regions; Two different prices

The equilibrium can now be found when solving the following set of equations:

$$\max \sum_i (p_i - c_i) \bullet q_i$$

$$\text{s.t.}\, f_t \leq F_t \quad \forall t$$

f is the actual flow between the two regions and F is the available transmission capacity. The supply and demand functions are defined as above. With similar conditions on the supply and demand functions as in the previous section, there will be one and only one unique equilibrium solution to this problem. The market splitting in the Nordic electricity market follows this principle.

3. Two categories (qualities) traded as contracts

We now consider a model without bottlenecks in the transmission grid, but with two distinct different categories traded as contracts as described in the report. Instead of flow f between two regions, we here consider swap s between categories. We will highlight two different conditions for swapping: Swapping must equal zero at all times and aggregated swapping during a longer period (e.g. one year) must be zero.

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[54] Examples of such conditions are continuity and constant signs of the derivative of the functions.

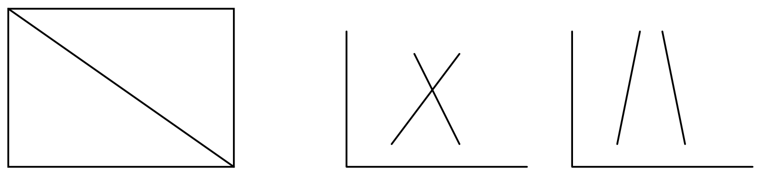

Figure 3 Market with two qualities

The graphical view suggests there is a mismatch between demand and supply in quality 2 (to the right). Whether there exists an equilibrium or not depends on the swap conditions. Suppose the curves represent supply and demand for one hour. Unless it is possible to swap between categories, there is no equilibrium in this hour. If swapping is accepted, category 2 must "borrow" from category 1 and returned the "borrowed" electricity at a later stage. Unless there is a limit on such borrowing, e.g. aggregated borrowing must equal zero in one year, the above model could be perceived as a washing vehicle.

It follows directly from this picture that defining the categories too narrow and with too little options for "borrowing" should be avoided, as it might be difficult to find equilibrium solutions in such cases.

The equations to describe the problem are similar to the previous model, except the subscript is turned to k to represent different categories. For simplicity, we have not included a subscript for time, except in the two alternative conditions.

$$\max \sum_{k} \left(p_k - c_k\right) \bullet q_k$$

$$\text{s.t. } s_t = 0 \quad \text{OR} \quad \text{s.t.} \sum_{t} s_t = 0, \quad \forall t$$

s is the swap of electricity between categories. Assume category 1 is wind and category 2 is everything else. If first constraint is applied, the buyers of category 1 unless the wind is blowing and windmills can produce electricity. With the alternative condition the windmills will "borrow" from category two when it is not windy, and deliver back in periods with more wind than normal. Over the settlement period the quantities borrowed must equal the quantities delivered back.

We could expand this problem also to cover two regions. This will simply increase the problem of non-existing equilibriums, or, in other words, put even more emphasize to the need for both broadly defined categories and flexibility in terms of swapping rules.

4. Two categories traded as certificates

Finally we consider a model where the categories are traded in a separate certificate market, i.e. separate in the sense the trading electricity can be done without simultaneously trading category certificates. We include the option that there also is congestion between regions. The graphic picture is then a little bit more complex – there will be two regional prices and two certificate prices.

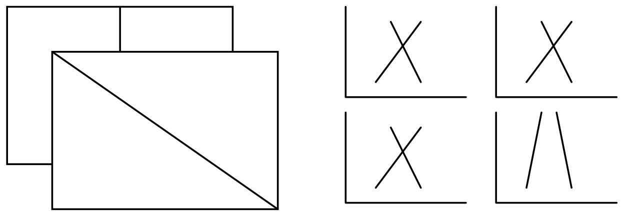

Figure 4 Certificate and electricity markets - two regions and two categories

We assume that both producers and consumers are concerned about the total price of electricity, i.e. demand is function of the total of the price for electricity and the price for the certificates, and similar for supply. This must hold at least in the long run, if not on a day ahead basis. This implies that the price for a certain category in a certain region, which is to be used in our equations can be written like this:

$$p_{k,i} = p_k^c + p_i^e$$

p_{ki} is the price for electricity delivered in region i. p^c_k is the price for the certificate, and can be assumed to be equal in both (all) regions. p^e_i is the price for the physical delivery in region i, taking care of the congestion between region i and the other region(s).

Then, combining the equations used in the above sections, we can demonstrate that with reasonable conditions on supply and demand curves and definitions of categories there exists a unique equilibrium (a set of prices and quantities).

$$\max \sum_{k,i} (p_{k,i} \bullet q_i) = \max \sum_{k,i} ([p_k^c + p_i^e] \bullet q_i)$$

$$\text{s.t. } f_t \leq F_t$$

$$\sum_t s_t = 0$$

However, there does not seem to be enough equations to determine the price of certificates and the price of electricity. Without having studied this in depth, it seems as if only the total or the sum of the two is settled in our set of equations. This is not necessarily a problem. If there is import and export of physical electricity, there must be an exogenous price settling the price pe in the equations above. However, this also may imply that even if the total price can be assumed to be not more volatile than the current electricity prices, there is a risk that the two factors in the price have a higher volatility.

As a conclusion it seems to be fair to call for further analysis of the price formation of both electricity and certificates in a certificate based verification system.

ANNEX 4 : SKM ENERGY CONSULTING

SKM Energy Consulting (hereafter SKM) possesses the required expertise to deliver high value advise to its clients on issues related to i.a. designing contestable electricity markets and trading functions within companies. Expertise within SKM is gained through more than 10 years operating in deregulated electricity markets. We have assisted more than 100 European electricity companies in building their trading functions, including issues as organization, risk management, training and skills improvement, etc. SKM has 30 employees, of which 20 works with consulting and 10 works with price forecasting. Our offices are in Norway, Denmark and the Netherlands.

SKM was established at the beginning of the liberalization of the Norwegian electricity market in 1992 and has become a leading energy consulting firm with long-term involvement and extensive experience in deregulated energy markets in Europe, specializing on electricity issues and increasingly on natural gas and green certificates. Our team has proven experience in understanding energy markets in transition from legislative, regulatory and competitive perspectives. Through active participation in the development of the deregulated Nordic power market SKM combines state-of-the-art energy consulting skills with an in-depth knowledge of the market place.

Market design is one of our core competences. Our focus is on the objectives to be achieved by a new market structure, and aim to design the main market principles as simply as possible. We recognize that in order for a transition from one system to another to be successful, it should not be unnecessary complicated.

Building trading organisations is another core competence of SKM. The services vary from education and training of traders and risk managers, development of risk policies, trading and hedging strategies, and to the establishment of trading companies. Several of the major European electricity companies have had personnel as trainees within SKM, on assignments from a few weeks up to several months. Companies in the Nordic region, Germany, the Netherlands, Belgium, Switzerland and Italy, have used our advice.

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