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Unwinding the Potential in the European Market for Tradable Guarantees of Origin – Disclosing the Passivity Gap and How to Bridge It

Master of Science Thesis in Management and Economics of Innovation

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Abstract

The liberalization of the European electricity markets together with the European Union's policy stance on increasing the share of renewable energy have set the foundation for a European market for Guarantees of Origin. While Guarantees of Origin were originally constructed for energy disclosure, an opportunistic market for trading those certificates has emerged. As revenues are decreasing for Swedish producers of renewable electricity, additional revenue sources are needed. The purpose with thesis is therefore to examine the potential of tradable Guarantees of Origin as a source of income for producers of renewable electricity. Taking a Swedish perspective, but keeping the European market as a whole in mind, the thesis draws on three types of data - a review of previous literature, semi-structured interviews and a survey addressing Swedish electricity suppliers. The thesis outlines the important linkages between producers of renewable electricity, Guarantees of Origin and end-customers. It also points out the harmonization of a European system as an enabler for the market and the end customers' willingness to purchase environmentally-friendly electricity as the market driver in the long term. The analysis elaborates on the previously known gap between customers' intentions to choose environmentally-friendly electricity and their actual choices. It highlights the importance of this gap for the tradable Guarantees of Origin market and argues for the centrality of eco-labels in bridging this gap. The thesis concludes that in order for the European market for tradable Guarantees of Origin to prosper, the markets actors need to actively push the market, i.e. undertake strategic actions to bridge the gap. The strategic action recommended is building on engagement in the growing market of eco-labelling, as there is a good possibility to influence and steer the Guarantees of Origin market in a desired direction.

Key words: Guarantees of Origin, Eco-Labels, Renewable Electricity, Environmentally-friendly Electricity Delivery Contracts, Renewable Support Schemes, Green Certificates

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This thesis was written as the final part of my master studies at Chalmers University of Technology. It has been a challenge understanding the complex nature of electricity markets and its support mechanisms for renewable electricity, but has led me to new knowledge in the specific area of Guarantees of Origin as well as general knowledge in the electricity markets and support schemes. I am very grateful for the support given to me in gaining this knowledge.

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Best regards,

Jonatan

Table of Contents

1. Introduction

This section includes the background of the thesis, a formulation of the purpose and research questions as well as an outline of the thesis' scope and delimitations. Lastly, it outlines the structure of the thesis.

1.1. Two Reforms that Changed the Game in the European Electricity Markets

Started by the Directive 96/92/EC (later replaced with the Directives 2003/54/EC and 2009/72/EC), a liberalization of European electricity markets took off in the end of the 1990's (Pollitt, 2009). This reform of the electricity markets leaned on the idea of competition and customers' free choice of electricity supplier. The effects of the liberalization is widely discussed and elaborated on in several studies, such as Würstenhagen et al. (2011). Although a completely common view might not be established, for example regarding the effects on price levels, one thing it most certainly has led to is an increase in the number of electricity suppliers. This has, in turn, led to an increased differentiation among the available electricity delivery contracts, as a mean of competition (Würstenhagen et al, 2011). The liberalization of the European electricity markets works as a foundation for the possibility for customers to switch to the source of electricity they prefer, hence influencing the direction of the development of the electricity generation sources in Europe (Köster, 2011).

In a similar timeline, although concentrated in the last decade, another reform took place as several different policy support schemes were introduced in the European electricity market as a consequence of the European Commission's stance on increasing the share of renewable energy (Ragwitz et al, 2011). Some have addressed the producer side, such as additional taxes or emission rights, while other have addressed the customer side, such as support schemes like feed-in laws or green certificates with quota obligations. The overall theme has been an element of obligation on either the producer side or on the consumer side. The diffusion of renewable energy sources due to such policies have been examined in several studies, such as Jacobsson & Lauber (2006), Bergek and Jacobsson (2010), Diaz-Rainey and Tzavara (2011), Meyer (2002), Haas et al. (2010), del Rio (2010) and Ragwitz et al. (2011) among others.

1.2. The Evolution of a System for Disclosure of Electricity Sources

In parallel, a regulatory pan-European system for disclosure of electricity source has evolved, called Guarantees of Origin. The system has emerged from the need to ensure the origin of renewable sources of electricity, thus working as a proof that the specific delivery contracts sold to the end customers actually corresponds to the produced amount of electricity from each different source of electricity. As the system has been implemented, several other attributes have evolved; one being the possibility to trade the Guarantees of Origins and thereby sell the right to the environmental value of the produced unit of electricity. This rather complex system stems

from the issue of physical transportation of electricity; independent of the source of the electricity, all electricity is going into the transmission system and cannot be directed to a specific location or customer.

1.3. The Case of Sweden: Need for Additional Revenue Streams

Lately, looking at the case of Sweden, the established policy scheme with tradable green certificates has displayed steadily decreasing prices since its last peak in mid-2008 (Svenska Kraftnät, 2012). This, together with low electricity prices in general, has decreased the margins for producers of renewable energy leading to a lower profit or even loss in this domain (Lindahl, 2012). As the two streams of revenue, the electricity itself and the support scheme, tend to decrease, there is an interest in a third source of income in order to revert to a state where returns are sufficient for the producers of renewable electricity [1][1].

This is where the road of the tradable Guarantees of Origin crosses the one of the producers of renewable electricity, raising the question if those certificates can become a third leg on which the diffusion of renewable energy technologies will lean on?

1.4. Purpose

The purpose of this thesis is to examine *the potential of tradable Guarantees of Origin as a source of income for producers of renewable electricity*. In order to fully explore the potential, the purpose has been broken down into four research questions;

(1) What are the origin, evolution and role of tradable Guarantees of Origin in the European electricity system?

(2) What are the driving forces in the European market for tradable Guarantees of Origin and where are these heading?

(3) What are the price and volume levels in the European Guarantees of Origin market and what could they be in the future?

(4) What are the strategic options for producers of renewable electricity?

1.5. Scope and Delimitations

Constrained by the time limit, the thesis has put its primary focus on the Swedish market for Guarantees of Origin, but with the hopes of transferability to the European market regarding insights and conclusions. One can say the thesis scrutinizes the Swedish market while gazing out over the European equivalent. A secondary focus has been put on the German market as this is

[1] See interview list for reference – in order to distinguish published sources from interviews, published sources are referred to by last name and year while interviews are referred to with an interview number

considered to have a large market potential due to its "green" focus, high purchasing power and large population [2].

As the electricity market in general, and the Guarantees of Origin market in particular, is surrounded by political issues and agendas to a greater extent than many other markets, the future might heavily depend on such developments. However, since this thesis focuses on the market dynamics rather than the political counterpart, the future of the political game around this will not be taken into account (however the consequences of the political actions up until today will be considered).

1.6 Disposition

The structure of this thesis it built around four main parts, which all have different functions. The four parts and their functions are outlined with a short description below.

(1) **Introduction**

The introduction provides a brief background of the subjects, leading to the purpose and research questions. It also includes the thesis scope and delimitations. The function of the introduction is to frame the subject and give a clear view on what the thesis is examining.

(2) **Methodology**

The methodology section describes what data sources the thesis draws on and how this data was collected. It also contains a description of the analytical framework. The function of the methodology is to give transparency of how the thesis work was conducted.

(3) **Analysis**

The analysis part contains several sections and is the main part of the thesis. It contains the empirical data and the interpretation of this data, i.e. the analysis. The analysis applies the analytical framework and presents the results of the data collection, building a chain of arguments throughout the thesis, which is the function of the analysis section.

(4) **Concluding discussion**

The concluding discussion summarizes the outcome of the analysis and links these conclusions to the research questions stated in the introduction. The function of the concluding discussion is to clearly present to what extent the research questions have been answered.

2. Methodology

This section describes each and every part of the methodology and work process used throughout the thesis. The thesis can be divided into three main parts; the literature review, the interviews and the survey. Hence, the disposition of this section is constructed upon these three parts with an additional part containing methodological reflections.

2.1 Literature Review

The literature reviewed was gathered in mainly two ways. First, the main stream of literature was gathered through a keyword-based search in Google, Chalmers Library as well as the database Elsevier. The objective of using the first sub-source, Google, was to get a comprehensive overview of the most relevant information connected to the keywords selected while Chalmers Library and Elsevier were used to get more narrow results, addressing specifically scientific research connected to the keywords. The overall purpose of the literature review was to get an understanding of what has been done with regards to the subject, what kind of information was available while also getting an initial understanding of the subject, its inherent parts and its complexity.

Second, an additional stream of literature was gathered from suggestions by interviewees. This literature search and review can be described as less structured, as the literature emerged during the interviews on proposal of the interviewee.

It is also important to point out that the literature review did not have a specific time frame nor a completely straight run, i.e. the literature review can be described as an iterative process which the author returned to when necessary. This was partly due to the need for returning and re-considering literature previously studied, but it was also due to the chosen process where additional literature sources were identified throughout the interviews, which in turn were carried out along the whole thesis. However, a more concentrated focus on the literature review, as of the first type, was put in the beginning of the process.

2.2 Interviews

The interviews were carried out throughout the whole process and summarized to 16 in total. 15 of the interviews were conducted via telephone and lasted 30-60 minutes, while one interview was carried out in person and lasted 45 minutes. In case the interviewee accepted, the interview was recorded.

The interviews were initially conducted as *unstructured interviews*, meaning that the interviews were built up around a number of issues to be discussed without any specific order rather than a bucket list to follow strictly (Bryman & Bell, 2011, p. 205). The questions in these interviews were *open-ended*, giving the interviewee an opportunity to set the direction of answer (Bryman &

Bell, 2011, p. 249). The reason for this was to capture as large part of the spectrum of knowledge as possible. Further along the interview process, the interview structure shifted towards more *semi-structured interviews*, implying that somewhat more specific questions were asked in a more predetermined order (Bryman & Bell, 2011, p. 205). The reason for the evolution of the interview structure during the interview process was the increased understanding along the way and, thus, the formation of some concentrated areas of interest, which lead to some initial hypotheses. These hypotheses then led the way in the subsequent interviews, making them more narrow and precise.

The interviewee sampling mainly followed the procedure of *snowball sampling* (Bryman & Bell, 2011, p. 192-193), more specifically letting the current interviewee recommend further interviewees. This builds on the logic of exploiting the inherent knowledge of the interviewee in order to find the most relevant interview objects. In addition, it was deemed important to conduct interviews with several different types of stakeholders in order to get different perspectives. This desire did to some extent align with the outcome of the snowball sampling, although not completely. Hence, some further interviews were conducted specifically addressing the stakeholders not covered by the snowball sampling. To summarize the different perspectives of the individuals interviewed, the below list of groupings was compiled.

(a) ***Policymakers, monitoring authorities and operational bodies*** *(5 interviewees)*

(b) ***Energy brokers and energy traders*** *(3 interviewees)*

(c) ***Energy and environmental consultants*** *(4 interviewees)*

(d) ***Utilities and other energy companies*** *(3 interviewees)*

(e) ***Researchers and other academics*** *(3 interviewees)*

The full list of interviewees can be found in Appendix A together with further details on each interviewee.

2.3 Survey

As the open-ended interviews turned to semi-structured ones, some hypotheses emerged. In order to test these hypotheses, a survey was conducted. The format of the survey was a web-based questionnaire sent out by email to respondents who were pre-contacted via telephone. In total, the survey was sent out to twenty respondents, with 16 finally responding. The respondents consist of representatives of utilities serving the Swedish market. A full list of the responding companies can be found in Appendix B.

The sampling has several aspects that are important to point out to make the thesis as transparent as desired. First, the sampling was made by using a *stratified sample* (Bryman & Bell, 2011, p.

181), constructed by two groups of population. The first group contained the three main electricity companies in Sweden; the second group the remaining electricity companies. The reasoning behind this grouping was dual, but primarily the fact that since these three players dominate the market it would increase the credibility to include them all in the thesis. At the same time, it would not be possible to include all electricity companies in Sweden within the scope of the thesis. Hence, the solution was to make a stratified sample where the first group has a sample equalling the full population and the second group has a randomly selected sample. The second group's sampling was based on the list of electricity companies presented at elpriskollen.se, the Swedish Energy Market Inspectorate's service for comparing electricity prices. As the aim was for twenty companies in total, seventeen remained to be randomly chosen from the list after the three major ones were deducted. The procedure followed a "blindfold and pick", where all the companies' name were put on separately folded notes which were then selected without any knowledge of the name on each note. Hence, the sampling can be considered randomly conducted.

In order to find a relevant representative in each of the companies in the two sample groups as well as to ensure a high response rate, all the companies were contacted in advance of the survey. The procedure was to,

i. *Call the reception of each company, explain the matter and then get directed to the person who seemed most relevant to the person in the reception.*
ii. *Call the person directed to by the reception, explain the matter in order to find out if the person was informed enough to fill in the survey*
iii. *Iterate until a relevant person was reached who accepted to fill in the survey*

The number of steps until a relevant representative was found varied from being the first person after the receptionist to being up to three more steps away. In all cases, a relevant person was found and the survey was sent out.

In order to assure that the survey questions were understandable and interpreted the way they were supposed to be, a small pre-test was conducted. The pre-test was performed by letting two people, with a similar background as the contemplated respondents, fill in the questionnaire.

2.4 Methodological Reflections

As Bryman and Bell (2011, p. 34) point out, business research is always subject to debate and considerations regarding the different approaches used with respect to its accuracy and relevance. Therefore, some elaborations regarding the choice of methodology in this thesis will be addressed as well as some aspects of its robustness in general.

When it comes to the thesis's reliability and replicability, i.e. the possibility for others to redo the thesis in order to see the consistency in the results or to test them (Bryman & Bell, 2011, p. 157-158), the steps of all procedures were concurrently noted as each step was carried out. According to Bryman and Bell (2011, p. 165) the most accurate way of dealing with this concern is to fully present the procedures of the thesis, which is what has been done in this section. Hence, both the interviews and the survey can be said to meet the requirements of reliability and replicability.

Concerning the validity, i.e. the issue of the thesis's accuracy in its conclusions in relation to the research conducted (Bryman & Bell, 2011, p. 159), there is a need to separately discuss the interviews and the survey since they differ some in their character – the interviews being a straight forward qualitative research while the survey leans towards being a more quantitative type. Bryman and Bell (2011, p. 42-43) point out that the difference between qualitative and quantitative research implies different measures of validity – the former one using the dimensions *credibility*, *transferability*, *dependability* and *confirmability* [2] while the latter's dimensions is *measurement validity*, *internal validity*, *external validity* and *ecological validity*[3].

Starting with the interviews, the most important dimension is the issue of credibility, i.e. the question of how trustworthy the findings are. In this matter, this relates directly to how trustworthy the sources, i.e. the interviewees, are. It is hard to evaluate the credibility of the interviewees; however, two factors can be pointed to which would potentially increase the credibility. First, the fact that personal recommendations (snow ball sampling) were used for selecting interviewees tends to increase the credibility. Second, the fact that several categories of individuals were interviewed decreases the risk of the perspective or opinion of a specific group to colour the thesis. In addition, also all interviewees holds, or have held, positions within the market and most have extensive experience in the field of Guarantees of Origin or in an adjacent field.

Regarding the transferability and dependability, the thesis is limited in those matters since the conclusions are context-constrained as well as time-constrained. This was emphasised by some interviewees who stated that their replies only hold for this specific market and at this point in time. Lastly, the interview's confirmability needs to be addressed. As the author does not have any personal interest or any personal value-based opinions on the matter, it may be considered to be quite high. On the other hand, the thesis is performed on behalf of a producer of wind energy,

[2] *Credibility*: The extent to which the study can be regarded as trustworthy; *Transferability*: The extent to which the results can be applied in other settings; *Dependability:* The extent to which the study's result is consistent over time; *Confirmability:* The extent to which the study can be said to be objective.
[3] *Measurement validity*: The degree to which it measures what it intends to measure; *Internal validity*: The extent to which a causal conclusion is warranted; *External validity:* The extent the study's result can be generalized; *Ecological validity:* The extent to which the settings of the study reflects the real world.

which might have influenced the work. This is, however, clearly stated which makes the potential issue transparent.

Looking at the survey, the foremost issue is the one concerning measurement validity, i.e. if the thesis reflects what is meant to be studied (Bryman & Bell, 2011, p. 42). One important issue is the choice of addressing the electricity companies in the survey when trying to understand the (final) customer. This could definitely lower the measurement validity as it is not sure if the representatives of these companies actually have the required knowledge of their customer base. Regarding the internal validity, the concept of causality has been explored throughout the interviews as well as in the construction of the survey questions, by constantly asking for relationships among the factors. However, the complexity of the thesis field makes this issue hard to settle in a satisfactory way. Regarding the external validity, it can be expected to be low, stemming from the fact that only Swedish electricity companies participated in the survey and national differences can be expected in terms of tradition and values, which constrains the generalizability. Finally, the ecological validity can be suspected to be quite high as the survey questions contain the social setting of the customers.

2.5. Analytical Framework

The analytical framework builds on the concept of scenario planning, although not following it completely. Thus, it will rather use the logic behind scenario planning instead of using its exact processes and methods. The underlying ideas of scenario planning will first be outlined followed by an illustration of the framework used in the thesis.

The concept of scenario planning has been described in different ways, but with similar logic behind it. Wilkinson (1995) describes scenario planning as a way to help setting direction when the future is very uncertain and with the purpose of identify driving forces that push the future in different directions, and making these forces visible for the decision-makers. Ogilvy & Schwartz (2004), in turn, explain that "scenarios describe possible future scenarios that today's decisions may cause. Scenarios are not predictions and they are not strategies. Scenarios should be written as absorbing, convincing stories, in order to give a clear understanding of how the future could play out". In sum, scenarios can be said to explore the future and how an organization can act upon future developments (Bood & Postma, 1997).

Hence, the process of scenario planning starts with identifying the focal issue or decision that is to be addressed (see *phase 1* fig. 1); and when the focal issue is formulated, the factors affecting the future of the focal issue need to be identified (see *phase 2* fig. 1) (Wilkinson, 1995). Among these factors, or uncertainties, those that are key to the focal issue should be sorted out (see *phase 3* fig. 1) (Wilkinson, 1995). These key factors then work as the driving forces which you analyse in order to understand the future of the focal issue.

The evaluation of the factors or uncertainties can entail using various kinds of data. Besides quantitative data, scenarios can handle qualitative input, incorporate results from other forecasting techniques and allow for 'soft' and 'fuzzy' variables (Bood & Postma, 1997).When the scenarios are created, they serve as a background for the evaluation and selection of strategies (Bood & Postma, 1997). They provide a clear and easy-to-understand view which the decision-maker can assess and act upon (Bood & Postma, 1997).

Differing from most scenario planning techniques, which emphasize developing several scenarios, this thesis will focus on building a chain of arguments for one scenario only, the one with highest likelihood (see *phase 2* fig. 1) . The motivation for this rests on the idea of drawing on the interviewees' knowledge to outline not only key factors, uncertainties and drivers but also their ability to process and estimate the future of these factors. Thus, compiling their estimates of the future of the key driving forces, the single scenario presented will capture their estimation of the future. This approach could be addressed as building a baseline scenario, but without developing potential (but unlikely) additional scenarios (Rhydderch, 2009). Chermack (2011) title this type of scenario planning as trend-based scenario planning, as it identifies the most important trends on which the most likely scenario is built.

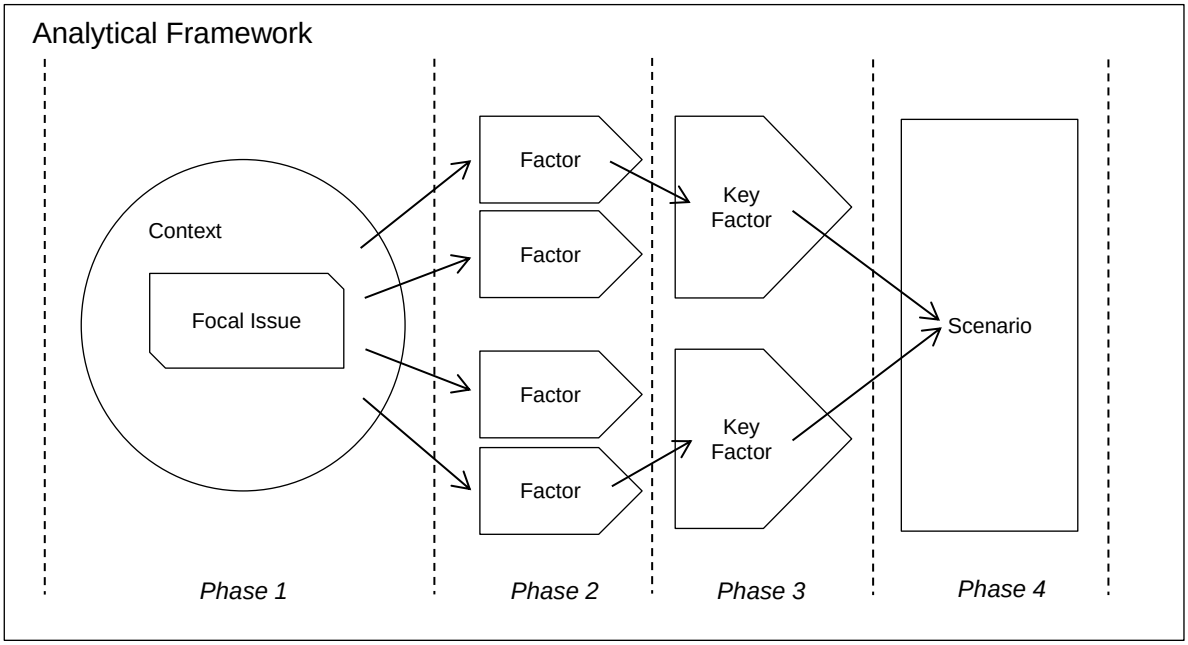


Fig. 1. The analytical framework builds on the concept of the trend-based scenario planning, taking off from the identification of a focal issue, establishing the context of this focal issue, identifying the factors which are then sorted out to key factors.

3. Establishing the Context: The Origin, Evolution and Current Functions of Tradable Guarantees of Origin in Europe

This section aims to explain how the tradable Guarantees of Origin came in place. Starting with its origin, the section describes its evolution leading to its current functions. Finally, the section elaborates on the current volumes and price data available.

The formation of the current functions of Guarantees of Origin in Europe has been led by the guidelines set out in a number of EU Directives, primarily the 2001/77/EG, the 2003/54/EG, with some additions in 2004/8/EG regarding cogeneration heat plants, and later by the now ruling directive 2009/28/EG (Bröckl et al, 2011). However, outside the functions set out by the directives, an additional use of Guarantees of Origin has evolved on a more voluntarily basis (ER 2009:28). Hence, the Guarantees of Origin currently has a broader scope of functions than initially intended (Bröckl et al, 2011). This development of the Guarantees of Origin has led to an uncertainty of what their role and functions actually are (Middlehurst, 2011).

Starting with the directive 2001/77/EG, the interpretation of this was that the original idea of the Guarantees of Origin was to work as a tool for disclosure, in turn to be used as a marketing tool for producers (ER 2007:32). It was not stated in anyway to be a tradable good of some kind [2] [3]. The directive forced the member states to implement a procedure assuring that the producers of renewable electricity would receive a Guarantee of Origin upon request (ER 2007:32). However, the directive did not request member states to recognise Guarantees of Origin issues in other member states. The implementation of this directive was quite sloppy in Sweden, as in the majority of the countries in Europe and different national systems developed [5].

In about 2005, the transformation of the Guarantees of Origin from a disclosure tool to a tradable good started, taking an opportunistic road rather than being led by the directive or its intentions [2] [4]. In 2007-2008, the market was perceived to take off [2] [3] [4], which are confirmed by the increase in issue and trade volumes (see fig. 2).

In 2009, the directive 2009/28/EG replaced the previous ones, while also increasing the importance of Guarantees of Origin (ER 2009:28). Several important aspects were strengthened with the new directive; The Guarantees of Origin should be the certificate used as proof for disclosure; all member states should recognise Guarantees of Origin issued in all other member states; all member state should designate authorities for issuing, transferring and cancelation and member state may require electricity suppliers to use Guarantees of Origin as a proof when stating that they are selling electricity from a specific source (Bröckl et al, 2011). This directive, thus, set out a solid foundation for a potential European market for tradable Guarantees of Origin [2] [5] [6].

3.1. A lack of comprehensive historical price data, while volume data is available

In terms of historical prices, there is lack of a comprehensive data (AIB, 2012), which is confirmed by several interviewees [2] [4] [5] [6]. In terms of volumes however, the Association of Issuing Bodies (AIB) has compiled data for the last 10 years, see fig 2. The AIB notes, however, that the data is not completely accurate due to reporting issues in some countries, but all in all, it should give a fair overview of the historical development of volumes. As previously mentioned, the market took off in terms of *issued* Guarantees of Origin in 2007, increasing from a equivalent of about 66 TWh electricity in 2006 to just above 213 TWh in 2008, where it stabilized until 2011. However, looking at the amount of *cancellations* instead, i.e. the Guarantees of Origin ultimately used when electricity has been sold to end customers, the trend is steadily increasing; in 2006 cancellations of 36 TWh of electricity equivalence were reported, increasing to 251 TWh in 2011. This equals a yearly growth of close to 50% on average for the cancellations. This means the cancellations surpassed the issued amount in 2011, which could be explained by that possibility to save issued Guarantees of Origin for 12 months.

However, the cancellations do not directly address the producers, as it represents the trade between the supplier and the end customer. Hence, the demand for Guarantees of Origin can be derived from the cancellations as suppliers only purchase as many Guarantees of Origin as corresponding to their sales to end customers [2] [7] [8]. The cancelation data is therefore more relevant in addressing the market potential and trend, as this reflects the actual market demand.

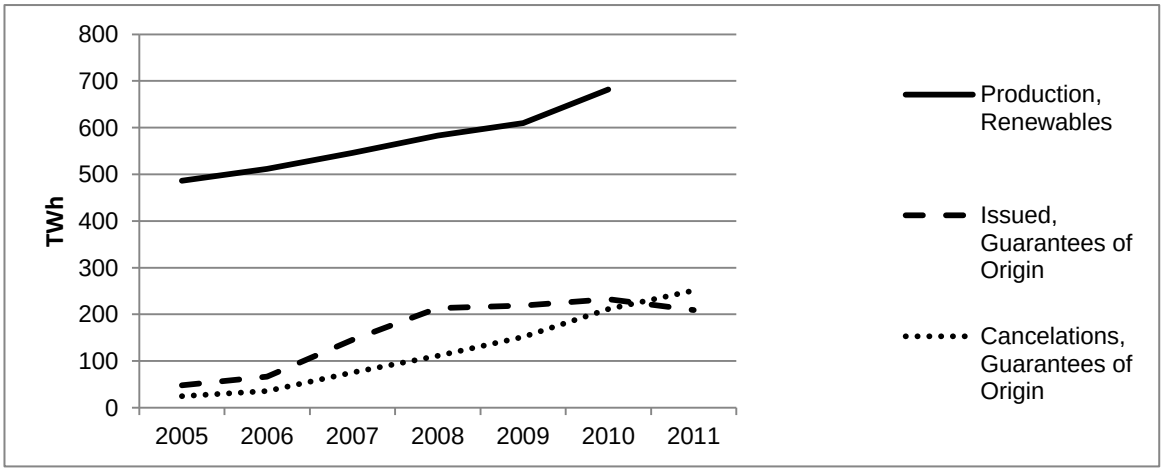


Fig. 2. The quantity electricity produced from renewable sources, the equivalent quantity of issued and cancelled (i.e. the amount sold to end customers) Guarantees of Origin in Europe from 2005 – 2011. **Source:** Eurostat, AIB

Adding the total electricity production coming from renewable sources puts the issuance and cancellations in an interesting perspective, as this reveals the level of maximum supply (table 2). The supply of electricity from renewables has increased steadily over the period; in 2005 it was just below 500 TWh but it increased to almost 700 TWh in 2010 (Eurostat). As a share of the produced renewable electricity, issued Guarantees of Origin increased from 10 % in 2005 to 34 %

in 2010. As a consequence, there is still a latent potential of about 66 %, or the equivalent of about 450 TWh, to increase the supply side in the Guarantees of Origin market.[4] As the production of renewables is expected to grow substantially over the coming years, with the estimation of 31.8 % of the gross electricity consumption coming from renewable electricity source in 2020 (Beurskens et al., 2011, p. 27), the supply side will continue to grow as well.

Regarding price levels, there are no comprehensive data as the central registries do not contain such information [2] [3]. The price data are instead stored by each energy broker or, if the trade is bilateral, by the parties entering a trade [3] [5] [4] [6]. In an attempt to get a rough estimate of historical price levels, data from the two energy brokers STX Services (STX) and Svensk Kraftmäkling (SKM) have been complied in fig. 3. As can be seen in the figure, there is a distinct difference in price between wind power and large-scale hydro power. The price for wind power varies between 4 and 12 SEK per Guarantee of Origin, while that of large-scale hydro varies between 1 to 3 SEK.

However, although the price level for wind power has been substantially higher most of the time during the period, the price gap between the two sources of electricity has narrowed. There might be several reasons for this, but one factor of influence could be the financial crisis [4]. As the economic downturn folds out, the companies are forced to cost-cutting actions; one action would be to drop their vision of purchasing wind power (at least temporary) and either go for the less expensive hydro-power or go back to regular electricity delivery contracts [4].

[4] Germany has decided to not issue tradable Guarantees of Origin to renewable sources that already have received financial support from their policy support scheme, which mean the latent potential might be about 10% lower than stated above.

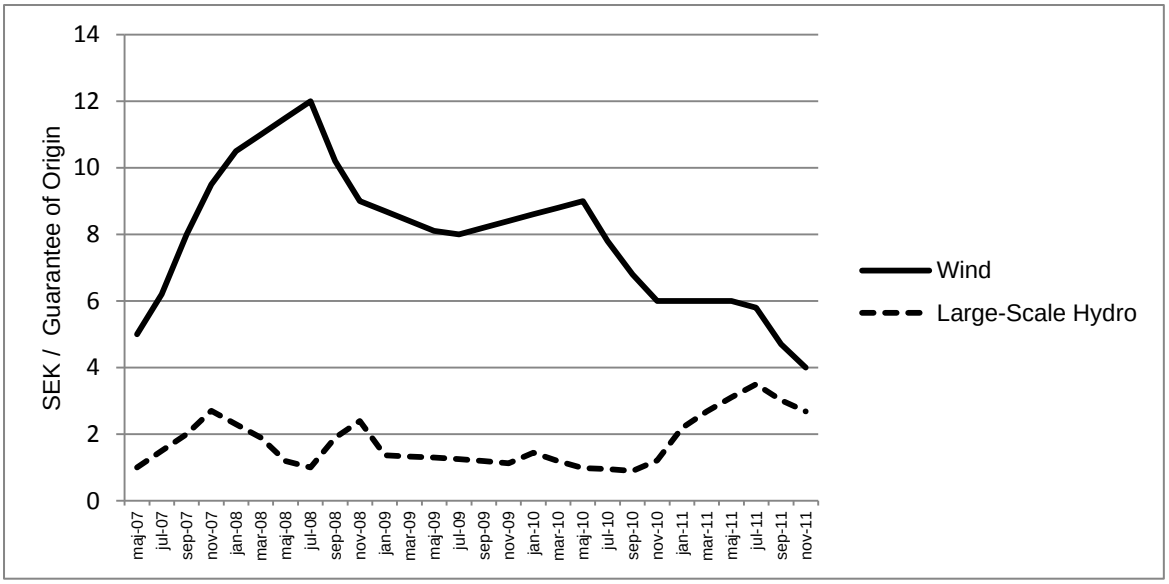


Fig. 3. Price development of Guarantees of Origin for Wind and Large-Scale Hydro between May 2007 and November 2011. **Source:** STX Services, Svensk Kraftmäkling[5]

As a consequence of the lack of comprehensive price data, the total market size is hard to estimate. However, Grexel, the largest data registry for Guarantees of Origin trades, stated they exceeded 1 billion Euros in trade in 2011 for the first time (Grexel, 2012). Out of the total trade volume, about 90 % originated from support certificates and 10% from Guarantees of Origin (Grexel, 2012), leading to a trade volume worth about 100 million Euros for the Guarantees of Origin flowing through the Grexel system. Given a market share of about 42% for Grexel[6] in 2011, the total market in 2011 for the Guarantees of Origin could be worth about 240 million Euros.

As seen from fig 3 and the discussion above, the variations in price due to the production source of the Guarantee of Origin could be large, which is also argued in ER 2009:28. This means using average prices of Guarantees of Origin are almost irrelevant as it could be tenfold higher for one source than for another [2] [9] [6]. Instead, using Guarantee of Origin price levels for the specific source makes more sense and in order to give a fair estimation of the market that is actually relevant for a producer, basing each sub-market (i.e. one market estimation for solar, one for wind power and one for large-scale hydro) on volumes and prices for that specific production source. However, as accurate price levels are only possible to find for large-scale hydro, and to some extent wind power, these estimates could be very misleading.

[5] The data is compiled from two of the largest actors within the brokering/trading of energy certificates; the wind power data comes from one of these sources only while the large-scale hydro data is an unweighted average of the two sources.

[6] Calculated by dividing the cancellation volumes from the Grexel system by the cancellation volumes from AIB (which represents the total number of cancellations).

3.2 Large-scale hydro dominates the market for Guarantees of Origin

The current European market for Guarantees of Origin is heavily dominated by large-scale hydro, as seen in fig. 4. The relative shares stayed quite stable between 2005 and 2011, with between 80 and 90 % for hydropower, between 4 and 14% for solar and biomass (grouped as *Others*) and 4 to 8% for wind power.

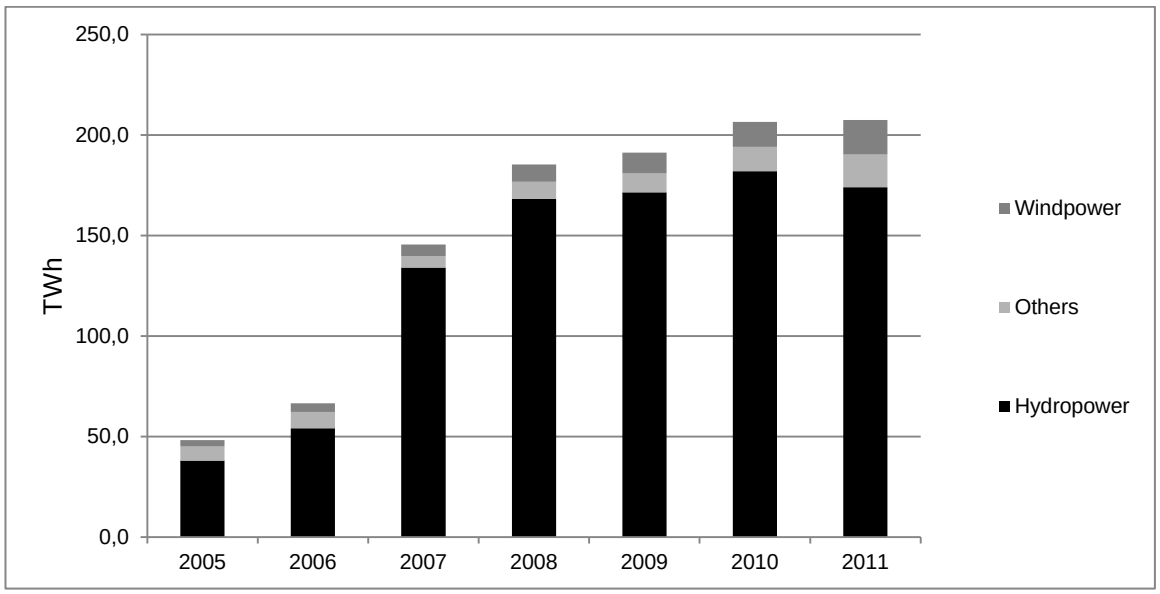


Fig. 4. The total amount of Guarantees of Origin issued for renewables, split up on hydropower, wind power and others (Solar, biomass and non-disclosed) for the period 2005 - 2011. **Source:** AIB

Also in constructing a ratio of the issued Guarantees of Origin per produced electricity, for each renewable energy source, shows how hydropower dominates the market, see fig. 5. While having similar ratios in 2005, the hydropower ratio increased heavily in 2007 and 2008, reaching almost 50 %. Wind has shown a slow trend upwards, increasing from 5 % to above 8 % in 2010. Solar and biomass, once again grouped as *Others*, however stood still during the same period, floating just below the 10 % level. It is important to note though that the amount of wind and solar power more than doubled in the same period while hydropower only increased with less than 15 %.

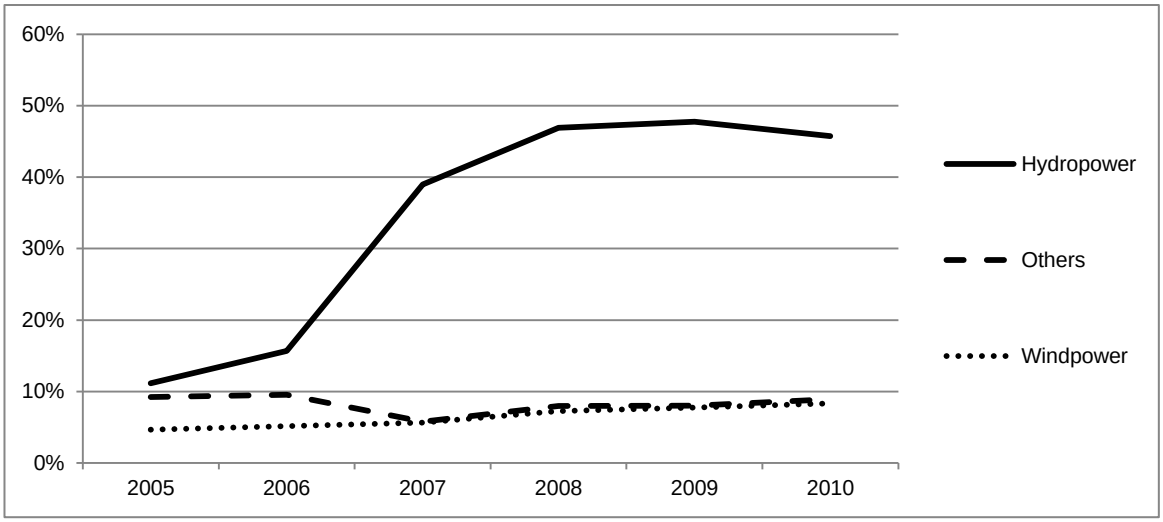


Fig. 5. The ratio between the amount of issued Guarantees of Origin and the corresponding amount of produced electricity from 2005 to 2010 for each type of renewable source. **Source:** AIB, Eurostat

Comparing the historical development for each energy source with the total market development, it is no doubt that hydro power has led the development of European market for tradable Guarantees of Origin. This development could potentially be explained by two factors. One is the policy of Germany, where wind power has had a significant diffusion (Jacobsson & Bergek, 2010), stating that producers who have already received support through the feed-in tariff regulation are not eligible for tradable Guarantees of Origin [3] [6]. The second refers to the focus of lobbying work by wind power producers. Looking at the case of Sweden, these have focused the efforts on the raising of the quota obligations for the current support scheme, as this currently yields more money [10]. This has led to that the Guarantees of Origin has been downplayed [10].

3.3 The Linkages between Electricity Producers, Guarantees of Origin and the End Customers

As stated in the introduction, the electricity market in general, and its surroundings support schemes in particular, create a complex system together. As part of establishing the context, the network of actors influencing the Guarantees of Origin as well as their inherent relationships needs to be mapped in order to understand how the different actors influence the market for tradable Guarantees of Origin.

The different actors involved in the Guarantees of Origin-system can be listed as *Producers of Electricity, Issuing Authority*, *Licencing Authority*, *Energy Certificate Brokers*, *Electricity Suppliers* and *End Customers* (ER 2009:28). All of these affect the system for Guarantees of Origin, but in different ways. Fig. 1 outlines the actors, their relations and the type of activities they are involved in.

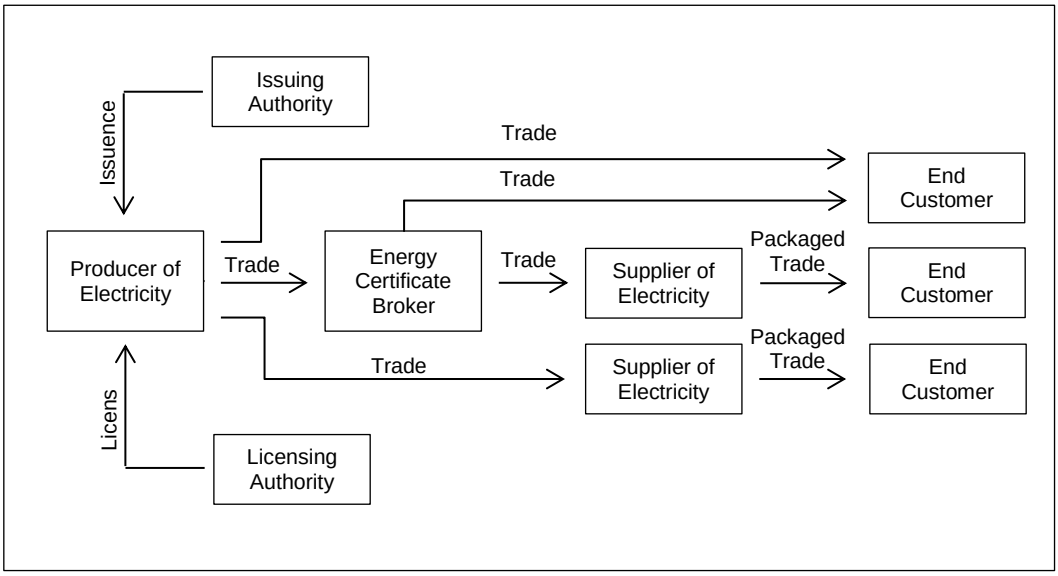


Fig. 6. *Schematic illustration of the actors in the system for Guarantees of Origin and the activities connecting them, with the arrows showing the direction of the Guarantees of Origin.*

Starting from the electricity source, the producer of electricity can apply to the licensing authority for a Guarantees of Origin approval for each production site (ER 2009:28). Once the approval has passed and registration is complete, the producer can request to get Guarantees of Origin issued from the issuing authority; one Guarantee of Origin for each MWh of electricity produced (ER 2009:28). The producer is then free to transfer the ownership of Guarantee of Origin but is required to give notice to the issuing authority when a transfer made [3] [4] [8].

Once registered and operational, the producer can trade their Guarantees of Origin to the actor of their choice, normally based on criteria such as the actor paying the most or offering the most convenient form of trade [5] [6]. As of today, the producer has four options:

i. *directly to the end customer*
ii. *to the end customer through a supplier of electricity*
iii. *through an energy certificate broker who in turn sells it to an end customer*
iv. *through an energy certificate broker who sells it to a supplier of electricity, who in turn sells it to an end customer*

Looking at these trade options, there are two distinct differences from the perspective of the customer. In the first type of trade, both the buyer and the seller are aware of that the trade is a trade of a Guarantee of Origin. This is, for instance, the case of the trade between the producer of electricity and the supplier of electricity. The second type of trade is a *packaged trade* where the end customer may not be aware that they are essentially purchasing Guarantees of Origin, as the supplier is packaging it into different types of products [11]. At a first glance, especially from an end customer perspective, it might look as two separate things, while it from a Guarantees of

Origin market perspective is very similar. This is due to the requirement to back each unit of source-specific electricity sold with a Guarantee of Origin of corresponding source of electricity (ER 2009:28). For instance, if an electricity supplier sells an electricity delivery contract containing solely solar electricity, i.e. a packaging by the supplier, the supplier need to purchase a Guarantee of Origin from a solar source corresponding to the same amount of electricity as the end customer consumes [2].

In the end, the cost of the Guarantees of Origin is ultimately put upon the end customer. If an end customer wants to purchase an environmentally-friendly electricity delivery contract, the cost this brings along as the cost of the Guarantee of Origin, will be handed over to the end customer in both cases. Most importantly, however, is the understanding this linkage between producer of renewable electricity, Guarantees of Origin and end customer since this linkage reveals the whole market dynamics; customers are the ones ultimately steering the market for Guarantees of Origin through their choices of electricity delivery contracts.

4. The Key Factors: A Harmonized System for Tradable Guarantees of Origin and End Customers Willingness to Purchase Environmentally-friendly Electricity

Having created an understanding of the context in the previous section, this section presents two identified key factors for the development of the Guarantees of Origin market and an analysis for the future for these key factors. Categorized as either drivers or enablers their role for the future of the tradable Guarantees of Origin in Europe is examined.

4.1 The trend is towards a harmonized system throughout Europe

As discussed in section 3, the evolution of the Guarantees of Origin has been quite disparate among the different countries throughout Europe. National interpretations have led to different procedures and regulations, i.e. different systems have emerged which are not fully compatible (Draeck et al., 2009).

One important question is if the systems will unite under one standard or not, leading to a state where actors in Europe, independent of which country their Guarantees of Origin are issued, can trade these without any considerable barriers and with low enough transaction costs.

Starting with the interviews as basis for analysis, there seem to be a consensus that Europe is moving towards a harmonized system and this will be the state of the future [2] [3] [6] [12]. Regarding the timeline, there is an uncertainty articulated by most interviewees, as a harmonization relies on political actions and processes. While some believe it to be relatively close, stating a 1-2 year perspective, others are more cautious, predicting 5 years in a best-case scenario.

However, a large effort is now spent in order to standardize the concept of Guarantees of Origin by incorporating it into a CEN standard, with a planned timeline for acceptance in May 2013 [12]. A standardization of the concept will work as a foundation for the harmonization but will still need to be implemented to reach a harmonized system.

Apart from the standardization process, the RE-DISS project was launched in April 2010 with the aim of supporting the European countries to implement the Directive 2009/28/EC with regards to Guarantees of Origin and electricity disclosure (Draeck et al., 2009). The RE-DISS recommendations build upon the E-TRACK project[7] which aimed to provide recommendations and best practice for an electricity tracking system. The outcome of the RE-DISS project, among others, was an assessment of the current implementation status among the European countries, outlined in fig. 6.

[7] A project providing insights for a joint tracking system for electricity in Europe (www.e-track-project.org)

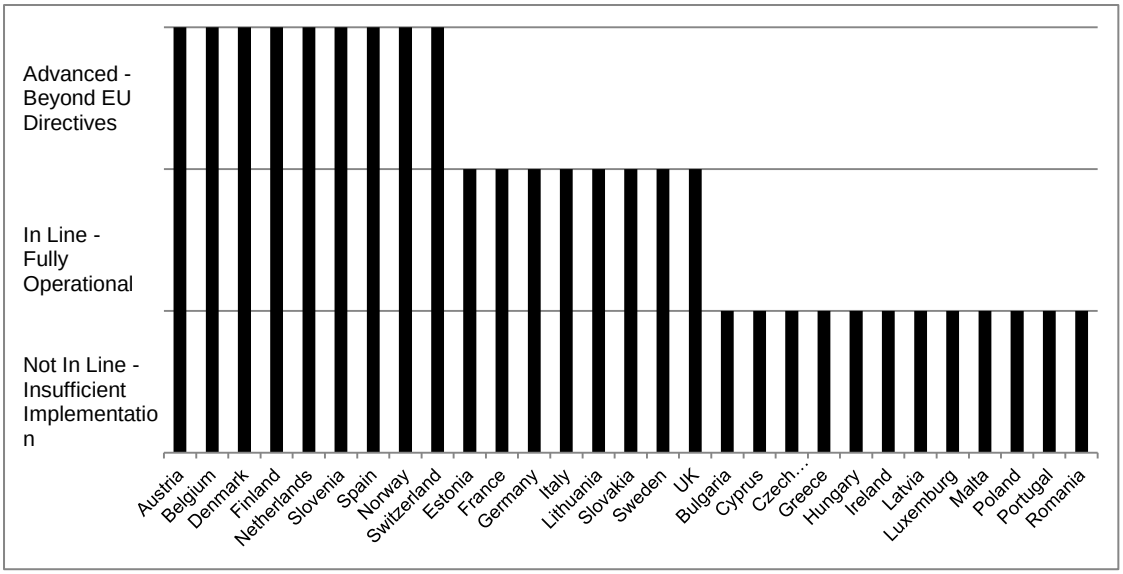


Fig. 7. *The level of implementation for meeting the requirements of the EU Directive 2009/28/EC regarding the Renewable Guarantees of Origin, assessed by the RE-DISS project in late 2010.*

The assessment done by the RE-DISS project reveals the following;

i. 17 out of 29 countries have reached a level meeting the requirements of the directive or beyond
ii. 9 countries are already more advanced than the directive
iii. Among the countries meeting the requirements, most of the expected major markets can be found

Reading out the data in plain language, in terms of meeting the requirements of the Directive 2009/28/EC, the majority was already meeting the requirements in 2009. As important, several large countries, such as Germany, France and UK, who could be expected to account for most of the demand, are included in the group being assessed to be in line with the implementation.

Regarding the Nordic countries, Bröckl et al. (2011) point out that although all Nordic countries had implemented the Directive correctly by 2011, they have not done so in a similar way. Thus, even among the Nordic countries only, the system cannot be considered as fully harmonized. This is also the core of the issue for Europe as a whole; while most countries have implemented a system for Guarantees of Origin, space for interpretation has been provided in how to do it [2] [3].

Middlehurst (2011, p. 15) calls attention to that barriers of harmonization have existed and will continue to exist to some extent. Bröckl et al. (2011) argue, however, that a harmonized system on a European level is now more than ever possible with standards coming up which are reachable for most European countries and expect a full harmonization to be a reality within a few years.

All in all, Bröckl et al. (2011, p. 15) conclude that "in time the goal is that guarantees of origin should be used as the only tracking mechanism for renewable energy in Europe. In practice this means that a natural development will be that in time guarantees of origins will replace the current RECS system and other reliable tracking systems used in Europe, leading to a more harmonized system."

4.2 Doubtful impact on the potential market

While there appears to be a consensus about the forthcoming development of a unified system, opinions vary with respect to the impact created by such a system on the market for the tradable Guarantees of Origin in Europe. The set of opinions range from that it will have a quite limited impact on the market to that it will have a large impact.

The type of impact a harmonization is expected to have can be expressed as a chain of three arguments;

i. **Increased Credibility**
   A harmonized system with standardized regulations will lead to higher trust in the correctness in the issuence of the Guarantees of Origin, leading to an increased will of adopting the system. [5] [6] [9] [13]
ii. **Increased Cross-border Trade**
   As the credibility of the system increases, the trust among actors between the countries will increase, potentially leading to a higher likelihood of purchasing Guarantees of Origin from abroad. [2] [5] [6]
iii. **Increased Market Liquidity** [5] [6] [9]
   As the cross-border trade increases, the supply will better meet the demand. Hence, the liquidity in the market will increase.

The above chain of arguments has been articulated by the majority of the interviewees as the logic that may lead to a successful implementation of a fully harmonized system throughout Europe. As mentioned, to what extent this will in the end impact on the volumes and prices are still uncertain [4] [5]. A harmonization will more likely be an enabler, a necessary foundation, for the tradable Guarantees of Origin market to prosper. It will facilitate the trade stemming from the supply inherent in Europe already today, as cross-border trade will optimise the supply and demand. However, it will not drive volume in itself, as it still needs end customers who are willing to make these choices of renewable electricity specifically in their electricity delivery contracts.

4.3 The Motivation of End Customers to Purchase Environmentally-friendly Electricity

To understand the customer's willingness-to-pay, their underlying motives need to be examined. As pointed out during the interviews, the motivation differs between individuals and companies as end customer [9] [11]. Hence, a separation between these two types of end customers is necessary in order to explore the motivations.

Starting with the individuals, a consensus among the interviewees is the desire of their customers to contribute to a better environment, particularly through the use of renewable electricity sources [9] [10] [13] [14] [15] [16]. This is also consistent with Salmela & Varho (2005, p. 12), stating that the two main reasons among Finnish consumers are "decreasing the ecological burden of one's own consumption; another being is to affect the production capacity of renewable energy". This is, however, a quite broad definition which could mean different things to different people, which suggests that it might be necessary with a further breakdown into more detailed reasons. On the other hand, as the same thesis reveals, people do not consider the issue on a more detailed level, indicating that customers are quite simplistic in their motivations. This is also supported by several interviewees as they believe the majority of the end customers do not care about the type of electricity they choose, as long as it is a good choice from an environmental perspective [10] [13] [16]. This is also well in line with the survey, stating that most end customers are indifferent to the source of their renewable electricity.

Kösters (2011) tried to dig deeper into the motivations in the German market, revealing that rejection of nuclear power and environmental protection were top motivation while consumer impact on society and being a good example were found in the bottom of motivations.

Looking at the second type of customers, the companies, a common view of the motivation among the interviewees summarizes it as a matter of goodwill through green profiling [9] [14] [16]. Showing that they are contributing to a more environmentally-friendly world by purchasing electricity from renewable electricity sources could attract more customers or allow the firms to charge a premium price for their products or services [14] [16]. On the other hand, there are also individuals working at the companies and these might see the need of taking responsibility without any commercial interest as an underlying motive [14].

Hence, in either way, one can derive the motivation to be dependent on the same matter. As the customers' willingness is dependent on their willingness to contribute to a better world, this would influence their willingness to purchase environmentally-friendly electricity as well as any other goods or service. The value of the companies' goodwill is, therefore, a function of the same motivation as for individual customers.

4.4 Increased Willingness to Purchase Environmentally-friendly Electricity among End Customers

Establishing the customers' willingness to purchase environmentally-friendly electricity delivery contracts as the main driver, the future development of this need to be explored, as this would give a suggestion of the future direction of Guarantees of Origin market.

The survey indicated strong support for an increase in the willingness to purchase environmentally-friendly electricity delivery contracts, with 88 % believing in an increase and 12 % believing it to remain unchanged (see fig. 8.)

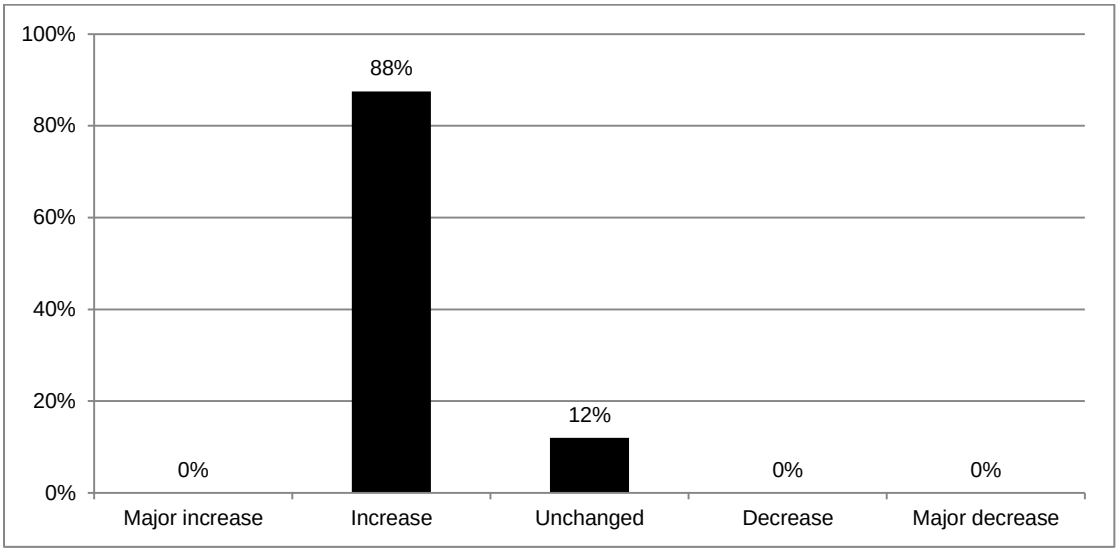


Fig. 8 The outcome of the survey question addressing the future willingness to purchase environmentally-friendly electricity delivery contracts among end customers in Sweden. **Source:** Own survey

Also the interviews pointed in the same direction, believing the customers' engagement in environmental issues is an increasing trend [13] [14] [16].

Looking out into Europe, similar indications can be found. In Italy, Bigerna and Polinori (2011) conclude that there is positive attitude toward a future expansion of renewable sources of electricity which end customers are willing to pay for. In Germany, studies have shown a higher share (60 % to 70 %) of the customers are willing to pay a premium for environmentally-friendly electricity in 2011 (Gratzla, 2011) than previously displayed figures of 50 % for 2005.

4.5 Customers are willing to pay a premium, but no essential increase is expected

Another interesting aspect is the end customers' willingness to pay a premium for the environmental friendly electricity. The survey explored this as a % of the electricity price, revealing an average price of just below 4 % as premium for the Swedish market. Another survey, performed by SOM-institute in 2009, asked the customers in direct monetary terms for premium price levels for environmentally-friendly electricity. The study results showed that 32 %

were not willing to pay any premium for environmentally-friendly electricity, 51 % were willing to (ranging from 1-1000 SEK per year), while 17 % were not sure (Sundström et al, 2011).

The same study also reveals some insights when dividing the answers into demographically sorted groups. For instance, the older the people were, the lower their willingness-to-pay (Sundström et al, 2011). Assuming their willingness-to-pay does not change by age, but rather is something represented by generation, natural demographic changes would push both the share of customers choosing environmentally-friendly electricity but also the willingness-to-pay a premium for that kind of electricity.

In Germany, a study from 2011 reveals that 61 % are willing to pay a premium for environmentally-friendly electricity. The premium price level ranges from 1.88 to 8.44 cents per kilowatt-hour (DIW Wochenbericht, 2011). Another poll in 2011 showed that 71 % of the Germans were willing to pay 20 euros more a month if their money went to an expansion of renewables in Germany (Gratzla, 2011).

A pan-European study from 2008 explored the willingness-to-pay of the customers in the five largest European countries. The results were quite consistent over the continent with average premium pay for environmentally-friendly electricity of 3.9 % (Britain), 4.7 % (France), 5.1 % (Italy), 5.3 % (Spain) and 4.4 % (Germany), averaging a 4.7 % (Renewable World, 2008).

Studies have also explored the attitudes in Eastern Europe; Zoric (2009) surveyed households in Slovenia showing that 77 % of the respondents are prepared to pay a premium for environmentally-friendly electricity with an average premium of 4.2 Euros per month. However, Zoric (2009) concludes that Slovenia is lagging some years behind Western European countries.

In sum, data is indicating that customers are willing to pay a premium for environmentally-friendly electricity all across the Western Europe, in the range of 4-5 % of the electricity price, with indications that Eastern Europe is lagging but on the track to similar numbers. However, there seems to be little support for an increase in these numbers. The total potential would, hence, be expected to increase, but mainly because of an increase in the number of people choosing environmentally-friendly electricity rather than a higher willingness-to-pay among the customers.

5. Revealing the Passivity Gap between the End Customers, Guarantees of Origin and the Producers of Renewable Electricity

This section will further explore the key factor previously outlined as the driver for the market: the customers' willingness to pay a premium for environmentally-friendly electricity. For that purpose, the section introduces the passivity gap model by connecting previously known research on customer behaviour to the market for tradable Guarantees of Origin.

5.1 The first gap in the passivity gap refers to the difference of customers' intention and their actions

The electricity market, with its support schemes and disclosure systems, has by many been described as a complex market, hardly understandable even for the most informed customers [9] [10] [15] [17]. This has led to a disparity between what customers would like to choose and what they actually do choose when it comes to environmentally-friendly electricity (Kösters, 2011). Salmela & Varho (2006) entitled this behaviour of the customers' as *consumer passivity*, which is the term the study draws on when naming this disparity to *the passivity gap,* see fig. 9. This is no new, but understanding how this affects the potential of the Guarantees of Origin, is an important piece of insight. As the main driver is the end customers' willingness to choose environmentally-friendly electricity, and a large share of these seems to get lost in the passivity gap, the passivity gap is a major obstacle for the Guarantees of Origin market.

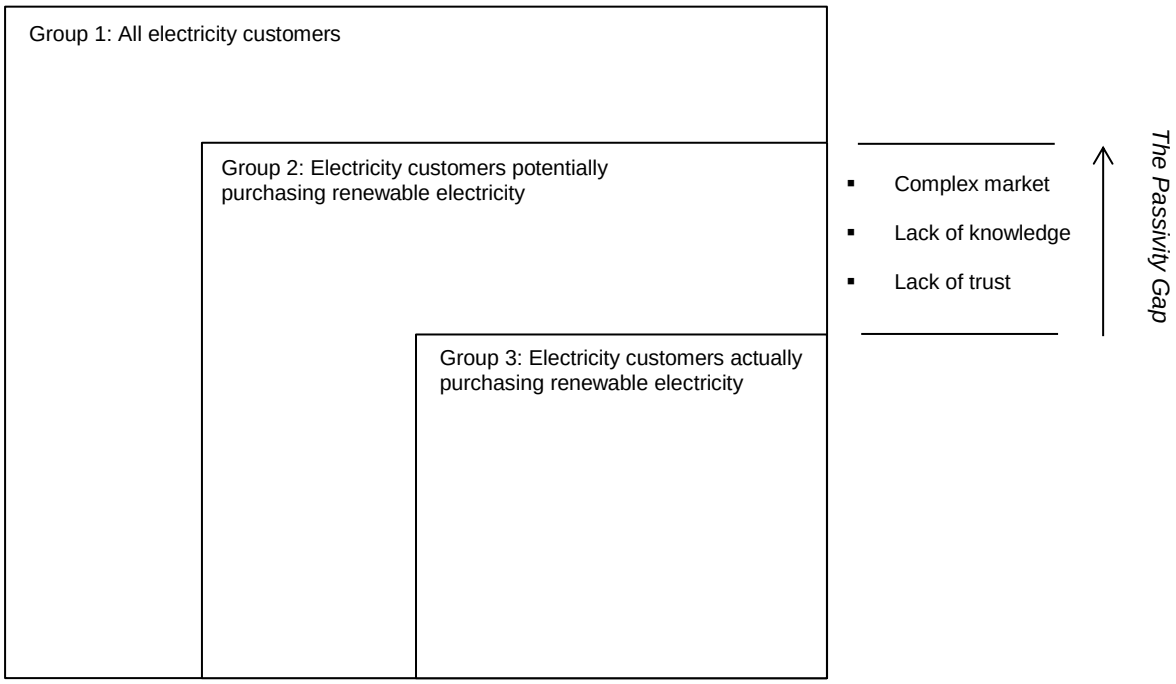


Fig. 9. An illustration of the passivity gap, showing the total mass of electricity customers, the mass of potential renewable electricity customers and actual renewable electricity customers. **Source:** Own elaboration

Using the Swedish market to illustrate the passivity gap model, the latest data found to test it originates from 2009. In that year, the total number of households in Sweden was about

4 470 000 (Sundström et al, 2011). According to Sundström et al. (2011), the SOM-survey in that same year yielded 51% saying they would pay a premium for environmentally-friendly electricity (with an additional 17% saying they were not sure), equalling 2 280 000 households. While there are no comprehensive numbers of the share of electricity delivery contracts available for the Swedish market as a whole, Vattenfall shared some data in 2009 (GP, 2009) revealing that only 5% of their customers had selected to pay a premium in order to get environmentally-friendly electricity. Using the case of Vattenfall as a proxy for the whole Swedish market, the gap would be above 2 000 000, equalling 46 % of the total market.

Several studies explore the reasons behind the passivity gap. Kösters' (2011) study of the customers in the German electricity market identifies the difficulties in understanding the complex electricity market as the most common reason for customers not switching to green electricity. Mistrust of energy product suppliers and their motives for introducing green energy tariffs as well as high search costs are concluded to be additional strong reasons for not buying environmentally-friendly electricity according to Diaz-Rainey & Tzavara (2011). Salmela & Varho (2006) conducted a similar study for the Finnish market, concluding that lack of knowledge is the most important barrier with lack of trust as the second most important reason for Finnish customers not choosing environmentally-friendly electricity delivery contracts.

At the same time, the system for Guarantees of Origin, especially in Sweden, but generic for the whole Europe, is built on the idea of customer power [2] [8] [10]. Customer power, in turn, builds on the vision of customers making active and well-informed choices. One might refer to it as the "rational customer". However, most data collected in this thesis point in the opposite direction; the possibility for the customer to make active and well-informed choices, i.e. being the rational customer, seems quite constrained.

Kösters (2011) also concludes that the share of electricity from renewable energy sources in the overall electricity generation clearly outruns the actual demand for green electricity as long as the disparity remains. Hence, as long the passivity gap is as large as of today, the number of customers constituting the actual demand is holding the Guarantees of Origin market back.

5.2 How Eco-labelling is Bridging the Passivity Gap

Eco-labelling for electricity delivery contracts has been around in the Swedish market since 1996 (Kåberger, 2003). Their function, potential and importance as a mean to increase the share of renewable energy have been examined by several, such as Kåberger (2003), Rex & Baumann (2008) and Berne (2009). Rex & Baumann (2006) concluded already in 2006 that eco-labels had become the most important mean of marketing of environmentally-friendly products. Cederberg-Wodmar & Holmgren (2009) state that Swedish customer in general, about 92 %, would prefer a

well-recognised eco-label if they are to buy an environmentally-friendly product. Although this is not explicitly for electricity, the data further cement the importance of eco-labels.

However, the eco-labels connection to, and influence on, the market for Guarantees of Origins is less obvious. As outlined earlier in the thesis, the driver of demand for the Guarantees of Origin is primarily the end customers' willingness to purchase a specific source of electricity; if an end customer specifically commits to buy electricity from a renewable source, the supplier will need to guarantee this through the ownership of a corresponding Guarantee of Origin [2].

As described in the previous section, there is an indication that customers for different reasons do not make active choices to the extent that is desired; there is a gap between the intention of the actors in the system and the actual functionality of the system. This is where the eco-labelling kicks in, functioning as a bridge for that gap. When customers, who have decided to buy electricity which is environmentally-friendly in some way, are in the position to choose their delivery contract, a large share would be expected to go for a delivery contract packaged in a recognisable and trustworthy way for the customer [16]. The recognition and trustworthiness are in many cases exhibited by an eco-label.

This idea is well in line with the results from the conducted survey as nearly 70 % of the respondents believe eco-labels are "quite important to very important" when customers choose the type of environmental friendly electricity to purchase.

Based on the above data, we can establish the idea of eco-labelling playing a major role in the choice of environmentally-friendly electricity delivery contracts by Swedish customers and thereby also a very essential part of the Guarantees of Origin market. Several interviewees, in line with the above reasoning, also emphasised the importance of eco-labels to increase the willingness to purchase electricity from renewable sources among the general customer [2] [6] [10] [14] [16].

Transferring the conclusions from eco-labelling in the Swedish market, a synthesis can be made for the European counterpart. The perspective taken is to look at Sweden as a forerunner in this matter, which is also argued by the Swedish Environmental Protection Agency (Naturskyddsföreningen, 2012) who issues the leading eco-label in Sweden, Bra Miljöval. As eco-labels for electricity are less diffused and recognised in Europe as of today, it will be a likely future scenario that they will follow the footprints of Sweden [6]. Hence, the insights of the Swedish market, where eco-labels are playing an important role, may also be true for the European market but with some delay.

5.3 The Importance of the Criteria in the Eco-Labels

Establishing the crucial role of eco-labelling in the Guarantees of Origin market, a further examination of its criteria is necessary. If eco-labels bridge the gap, thus increasing the market for environmentally-friendly electricity, the eco-labels' criteria will determine the demand for the Guarantees of Origin coming from different renewable sources. If the eco-label promotes a certain type of renewable source of electricity, the market for this specific renewable source (or the composition of several in that case) will be favoured.

The survey conducted in this thesis reveals important insights; 50 % of the respondents did not believe the customers care about which kind of renewable source of electricity they are purchasing, as long as it is from a renewable source. Including also the respondents who believed the customer do care, but not as much as it being a determining factor when choosing delivery contract, the number adds up to 88 %. Given that customers in general do not care what exact source of renewable electricity they purchase, they may not care of the criteria in the eco-labels in terms of its composition. Hence, the eco-labels capturing the largest market share will also be the ones deciding the relative market shares for the Guarantees of Origin market.

Once again putting our focus on the Swedish market, the eco-label Bra Miljöval has dominated since its inception (Cederberg Wodmar & Holmgren, 2009). In the case of Bra Miljöval, only the secondary purpose is to increase the use of renewable source of electricity; the primary is to decrease environmental impact steaming from the electricity system (Kåberger, 2003). In their criteria, they accept large-scale hydro, wind power, solar power or biomass, with some additional restrictions,[8] but without any specification of the composition (Naturskyddsföreningen, 2011). Hence, it is up to the supplier of electricity delivery contracts to decide what underlying type of renewable energy source they want to apply, as long as the production site is approved.

5.4 A Second Gap of the Between Customers Intentions and Actual Choices Identified

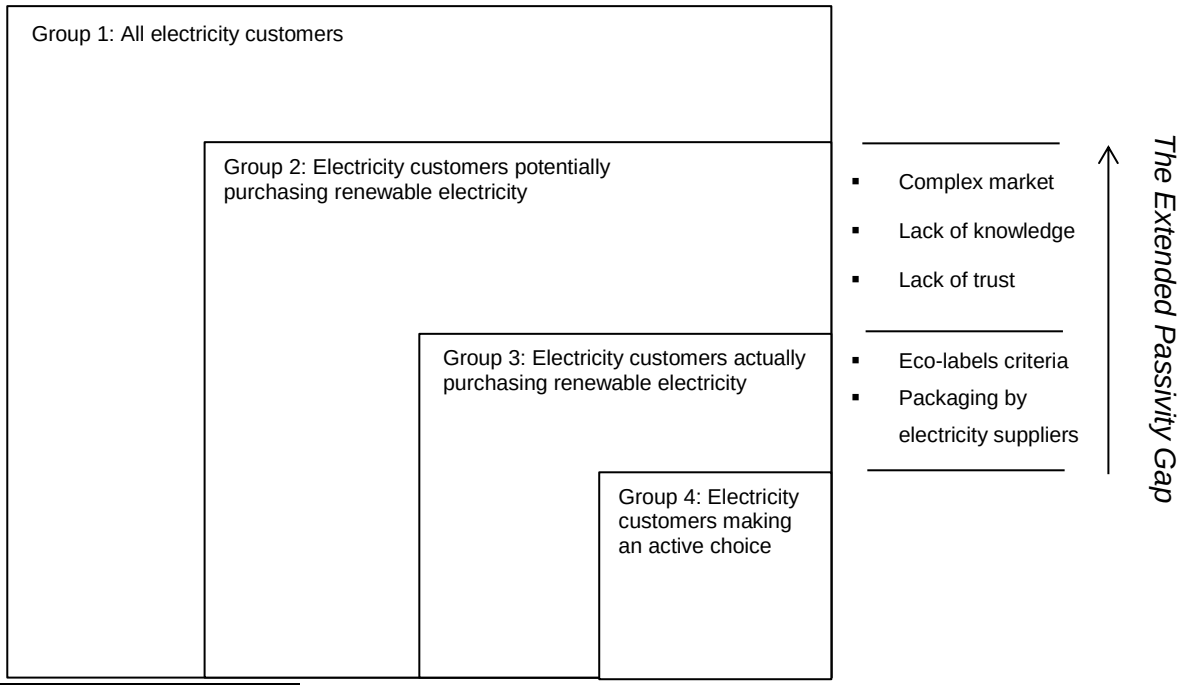
Establishing the importance of eco-labelling of the Guarantees of Origin market, the passivity gap needs to be expanded. As the eco-labelling decreases the need for customers to investigate each type of electricity delivery contracts, one could say they are helping more customers to make environmentally-friendly choices; however at the risk of each of the choice to be less active as they simply trust the eco-label to investigate on their behalf. As the survey indicated, few customers seem to be very knowledgeable of the criteria of the eco-label Bra Miljöval, indicating they do not choose it because the criteria are the most important. Instead, a more likely reason could be the brand recognition as something environmentally-friendly and trustable [16].

[8] The full list of criteria to be eligible for the Bra Miljöval-label can be found at http://www.naturskyddsforeningen.se/sites/default/files/dokument-media/bra-miljoval/bmv-el-kriterier.pdf

This shows some further complexity of the issue, as it implies there are two different groups (and thereby underlying reasons) as to why there is a passivity gap. The first gap is, as previously explained, due to the complexity of the energy markets, lack of trust and knowledge. This gap also separates customers who are choosing environmentally-friendly electricity (group 3 in fig. 10) from whose who are not (group 2 in fig. 10). A second gap can, however, be identified by separating those who very consciously choose their electricity delivery contract (group 4 in fig. 10) from those who are choosing due to other attributes such as brand recognition (group 3 in fig. 10).[9]

Cederberg Wodmar and Holmgren (2009) grouped different customer types into groups, named *climate profiles*. Except pointing out a relatively large share as passive customers (23 %), they also differentiate between those who currently buy environmentally-friendly products. They divide these customers into *newly awakened* (25 %), *moderate* (26 %), *engaged* (18 %) and *elite* (4 %). This analogy could be further used to explain and confirm the difference – the active customer group (group 4 in fig. 10) would correspond to the two last groups (summarized to 22 %), while the groups being directed by eco-labels (group 3 in fig. 10) corresponds to the first two (summarized to 51 %).

The passivity gap model can, therefore, be expanded by adding a second gap between the ones actually making an active choice and those purchasing environmentally-friendly contracts but without making a very active choice, see fig. 10. This splits the customers purchasing environmentally-friendly electricity up between two groups, creating the expanded passivity gap.



[9] However, there is still a share of the informed and knowledgeable customers making an active choice when choosing eco-labels such as Bra Miljöval.

Fig. 10. An extension of the passivity gap, adding the gap between customers who make an active choice and those making a non-active choice. **Source:** Own elaboration

The two gaps create the extended passivity gap, differing only in their reasons why the gap has emerged. The consequences of the gap are still the same, which is why they both are included in the passivity gap. The different underlying causes between the groups are, however, important at they imply different strategic action taken on how to meet the gap challenge. As the second gap refers to the passive customers among those who nevertheless purchase environmentally-friendly electricity, this gap primarily affects the relative shares of the different sources of environmentally-friendly electricity. Thus, the link to the dominant position of large-scale hydro is primarily the second gap, the extension of the passivity gap, which has paved the way for this development. Hence, the forthcoming section on strategic options elaborates on how to bridge this gap.

6. Bridging the Passivity Gap – How to Use Eco-labelling as a Strategic Tool

As outlined in the previous section, eco-labelling is ruling a large chunk of the market of Guarantees of Origin through its criteria, particularly in Sweden. There are also indications that the European market will follow in the footsteps of Sweden (Naturskyddsföreningen, 2012). Taking control, or at least steering the direction, of the eco-labelling market would therefore be the strategic path to take. This section will, thus, provide three strategic options in connection to eco-labelling, an assessment of these options and, building on that assessment, an outline how to build a successful eco-labelling strategy.

6.1. Assessment of Three Strategic Options on Eco-Labelling

Building on the strategic path of eco-labelling, three strategic options have been identified;

i. *Creating a trustworthy eco-label with criteria aligned with the desired direction*
ii. *Joining an existing eco-label inheriting already existing criteria*
iii. *Pushing market-leading eco-labels to be more in line with the desired direction*

The assessment of each strategic option will build upon two dimensions;

i. *The potential of alignment between the criteria of the eco-label and the actor's objectives*
ii. *The potential of the eco-label to become adopted by a larger market*

Starting with the first option, the immediate benefit would be the possibility to tailor-make the criteria of the eco-label in order to align them with an actor's own objectives. If you were a wind power producer, you could initiate an eco-label with a high share of electricity coming from wind power as this would drive a higher demand for wind power-specific Guarantees of Origins. Thus, this would drive both larger volumes as well as push prices on the specific wind power Guarantees of Origin.

However, the cost, efforts and knowledge needed to initiate an eco-label would be high [14] [16]. Also the risk of failing would be high as an actor, such as a producer, or a set of producers formed as a trade or lobby organization, may not be credible according to the conducted survey (fig. 11), leading to a low adoption of the label. Figure 11 reveals a belief that environmental organisations are the entities with highest trust (71 % ranks it as the top entity when it comes to trust in issuing an eco-label), with governmental organisations as the second most credible (25

%), electricity suppliers as number three (6%) and trade or lobby organisations as fourth, and least, trustworthy (0%).

Continuing with the second option, the benefit would be, similar to the first option, a set of criteria which are fairly aligned with the objective of the company. However, an eco-label with a suitable alignment will most likely be issued with someone with similar objectives, such as a trade or lobby organization. Hence, finding an eco-label that aligns with your objectives while still being credible might be difficult. However, if successful in the quest, the option could be very fruitful.

Considering the last option, the trade-off would be the opposite of the first two. Finding a market-leading eco-label implies high credibility, but a high level of alignment will be a hard to find. This implies a need to push for adjustments of the criteria in order for higher alignment. Unfortunately, the incentives for a well-established eco-label to adjust their criteria according to lobbying forces seem to be low.

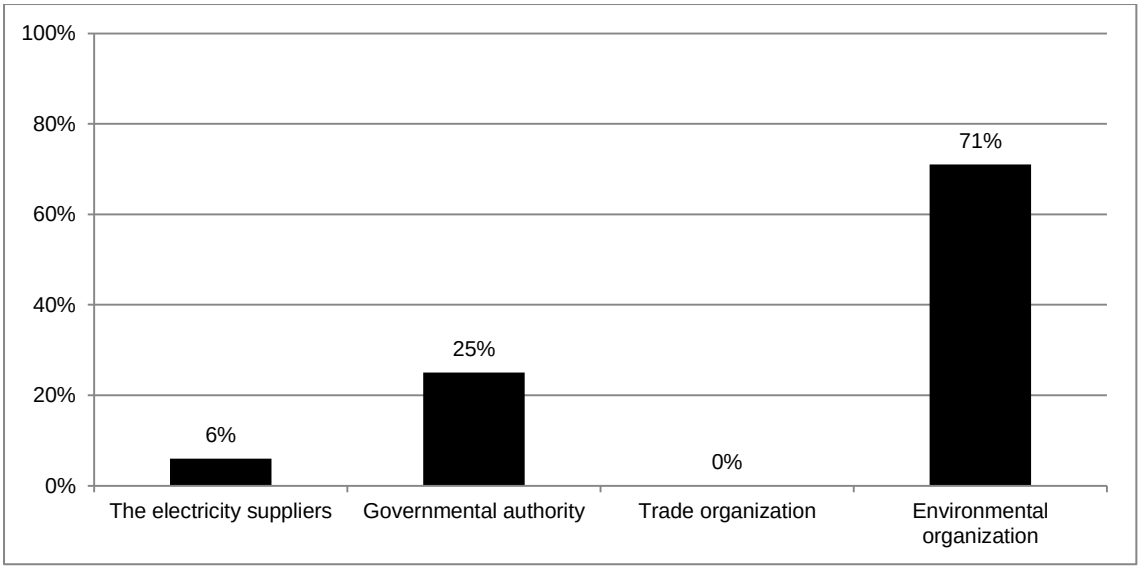


Fig. 11. The survey respondents' beliefs concerning in whom their end customers put the highest trust as an issuer of an eco-label **Source:** Own survey

6.2. Considerations for Disparate Markets and its Strategic Implications

In addition to the assessment of these three strategic options, the issue of different strategies for different markets need to be addressed. As pointed out, the diffusion and adoption of eco-labels are quite disparate among the countries in Europe. This implies a different approach for the different markets. The basic idea behind this would be that in a market where eco-labelling is already widespread, there may be one or a very few dominating the market, which implies high entry barriers. In that case, it might lean towards the third strategic option. In the case of the opposite, a market where eco-labelling is less or not at all established, the playing field could be

considered as open and "up for grabs". For that kind of market, a strategy like the first or the second may therefore be more suitable.

Touching on the recently discussed geographical segmentation strategies, the possibility to create a global eco-label which could address several or all markets seems intriguing. The disadvantage would be a less optimized choice for each market, but the benefit would be a possibility to find support of stronger partners. The cross-recognition between different markets, i.e. the success of the eco-label in one country could establish its credibility in others, would not be unlikely in the global world of today.

6.3. Building a Successful Eco-Labelling Strategy

Building on the above assessment of the strategic options and the data from the survey, an execution of the second strategic option would seem to be a good choice of strategy. However, the risk is to find an eco-label aligned with the objectives of your firm while not being very successful in terms of adoption, due to its lack of credibility. Or in contrast, find an eco-label which is well adopted but not very aligned with your company's objectives. As the survey heavily suggests that the issuer should be an environmental organization, or possibly a governmental authority, in terms of trustworthiness by the end customer, a way of solving this issue would be to invite or partnering with environmental organisation, hence leveraging their credibility. One way would be to make the organisation responsible for controlling and monitoring, in return for a fee or share of the revenues.

As an example, for a wind power producer, this strategic option would involve joining an eco-label such as Windmade,[10] created as a joint venture with the wind turbine manufacturer Vestas Wind System as a lead sponsor, to be a globally recognized label for wind power. To increase credibility of the label, United Nations Global Compact and WWF were invited as founding partners.

An alternative strategy would be to go for strategy 3 but try to push for an alignment of the criteria of the eco-label and the company's objective. As an example, a firm could join the eco-label Bra Miljöval, but persuade them to introduce some variations of their label – such as Bra Miljöval Wind or Bra Miljöval Solar. In these cases, there would be an obligation that the electricity provided does not only fulfil the general criteria of Bra Miljöval but also has a certain share of wind power or solar power.

As the thesis also has showed, an important motive for the customers to pay a premium price for electricity is that it actually leads to an expansion of renewable energy supply. As outlined

[10] Windmade has so far only introduced a company label, event label and consumer label, no label addressing electricity delivery contracts directly.

previously, data shows that the majority of the Guarantees of Origin market is captured by suppliers of large-scale hydro. As recently revealed by Orre & Ahlbom (2012), suppliers such as Vattenfall, who own a very large share of large-scale hydro capacity, also owns a broad portfolio of electricity sources, portioning only a smaller share of their investments into renewables. Their article shows that of the total investments made by Vattenfall in 2011, only just above 18 % went to investment in renewables (Orre & Ahlbom, 2012). It is not unreasonable to expect that the current division would be sustained if the revenues increased, meaning that only about 18 % of the additional revenues coming from Guarantees of Origin would lead to expansion in renewable energy. In the Swedish case, it would actually be very unlikely since the expansion of large scale hydro is more or less prohibited in the north of Sweden. Building on this mismatch between large-scale hydro suppliers and customers' actual preferences, by including in the eco-labels criteria that the majority (or even 100%) of the investments must go to renewable sources, the supply side could be decreased while attracting a larger share of the customers. This criterion could be applied to both recommended strategies.

6.4. The Risk with Increased Understanding, Transparency and the Emerging Market Opportunity

When analysing the drivers and assessing the different strategic options, a risk analysis is also necessary. This section will hence discuss two main risks identified in relation to the development of the Guarantees of Origin market.

As several interviewees have pointed out, the system for tradable Guarantees of Origin and the support scheme for Green Certificates in Sweden have completely different purposes [2] [8] [9] [18]. The Green Certificates' purpose is to support the diffusion of renewables while the Guarantees of Origin is to increase customer power. Nevertheless, the designs of both systems are very alike, potentially creating confusion among end customers [2] [8] [9] [18]. Since the designs are so similar, and the fact each unit of renewable electricity may get support through certificate system as well as get issued a Guarantee of Origin, a mistrust of the system is a large risk. As customers learn that they are already paying for the expansion of renewables through the certificate system, they might see it as redundant to pay once again for the same unit of electricity by making an active choice of renewable electricity through the Guarantees of Origin.

However, to scrutinize the topic even more, a return to the context of eco-labelling is necessary. Addressing the first risk, bridging the gap by eco-labelling, will prevent the need for end customers to engage in understanding the whole electricity market complexity. Leaving the responsibility of investigation to the organisations behind the eco-labels, the end customers will not be exposed to the issue of double issuing.

Also addressing the potential effects of an increasing market for Guarantees of Origin, a second risk can be identified: As revealed earlier in section 3, yet a minority of the producers in Sweden

use their right of getting Guarantees of Origin issued. If the market takes off, increasing the demand side substantially, there is a large potential on the supply side in those producers who today do not exercise their right to get issued and sell Guarantees of Origin. With an expansion of the market, we must expect that these actors will step in. With increasing volumes, the price might remain in a today's range. It will only be when the latent potential on the supply side is exhausted that a substantial increase in prices may be expected to occur.

Addressing the second risk, there is also a large potential in differentiation among the different sources of electricity. Such a differentiation, with a much stronger demand for specific sources such as wind or solar, could prevent the down-ward pressure on price since much of the latent buffer might be in a different, still renewable, energy source. Even more, a differentiation, constructed by successfully segmented eco-labels, could shift customers from one source of electricity to another. As an example, only some percentages of the demand for the market for large-scale hydro need to switched over to the solar market to make the prices increase.

7. Concluding Discussion

The purpose with thesis was to examine the potential of tradable Guarantees of Origin as a source of income for producers of renewable electricity. The purpose was broken down into four research questions in order to frame the issue in detail. This concluding section will use the research questions as its structure and present the conclusions to each research question respectively.

7.1 Conclusions

The first research question - *what are the origin, evolution and current functions of tradable Guarantees of Origin in the European electricity system* - is answered by conclusions 1-3.

1. The evolution of the Guarantees of Origin as of today has been led EU directives – however, the trade function of the certificates has emerged outside the boundaries of the directives.

2. The Guarantees of Origin market in Europe is dominated by large-scale hydro, accounting for about 84 % of the total Guarantees of Origin issued in 2011. Also relative the total generation from each source of renewable electricity, hydropower is utilizing the market well above other sources.

3. Due to the current structure of the Guarantees of Origin markets, large scale hydro dominates. In turn, large scale hydro owners capture most of the revenue streams of the market. As these owners invest only a minor part in expansion of renewable sources, there is a risk that only a minority of the premium payments of the end customers through the Guarantees of Origin system support expansion of renewables.

The second research question - *what are the driving forces for the European market for tradable Guarantees of Origin and where are these heading* - is answered by the conclusions 4-8.

4. In the near to mid-term horizon, a harmonized European system is likely to come in place – this will further enable the market, increase credibility of the system, lead to larger cross-border trade and thereby increase market liquidity. However, the magnitude of these effects is uncertain and hard to predict.

5. The market for Guarantees of Origin is driven by customers' willingness to purchase electricity from renewable sources – this is due to the linkage between producers of renewable electricity, Guarantees of Origin and end-customers and constituted by the requirement to back electricity delivery from specific production sources with corresponding Guarantees of Origin.

6. There is large potential market, displayed by several studies on customers' willingness to choose environmentally-friendly electricity delivery contracts. However, there is a gap between customers' willingness to purchase renewable electricity and their actual purchases. This is described as *the passivity gap*, referring to the passive customer. The complexity and mistrust of the electricity market are the main reasons behind the gap.

7. The key matter for the future development is to bridge this gap as this would drive the market for the Guarantees of Origin. Hence, the market is not developing by itself – active actions to steer the direction of the market is determining for the exploiting the market potential.

8. Eco-labels function as a bridge for this gap – hence, the criteria of the leading eco-labels are ruling much of market for Guarantees of Origin in Europe. As the customers trust the credible and recognisable eco-labels, they do not scrutinize their criteria.

9. The importance of eco-labels splits the customers purchasing environmentally-friendly electricity into two groups – the ones choosing eco-labelled electricity delivery contracts on brand recognition rather than on detailed knowledge and those who to the opposite. Hence, the passivity gap is extended to also include the group that make choices on brand recognition rather than detailed knowledge.

The third research question - *what are the price and volume levels for the European Guarantees of Origin market and what could they be in the future* - is answered by conclusions 10-12.

10. The cancellation volumes, used as a measure to estimate the trades to end customers, for the European market for tradable Guarantees of Origin has been growing steadily by a CAGR of 50% over the last 7 years, equalling 251 TWh in 2011.

11. There is no comprehensive price data available for the Guarantees of Origin market on a European level. Indications also point to a large price disparity between different types of Guarantees of Origin, depending on the source of production. Some data points for large-scale hydro however indicate price levels in the range of 1-3 SEK on average while for wind power prices are ranging from 4-12 SEK.

12. There is a large latent potential on the supply side of the Guarantees of Origin – this could hold back price levels as the demand has to triple until the existing supply is exhausted. Also exogenous factors such as economic downturns seems to push back demand and, thus, also prices.

The fourth research question - *what are the strategic options for producers of renewable electricity* - is answered by conclusion 13-17.

13. The eco-labels' also create a possibility for actors to steer the market in a desired way. By undertaking an eco-label strategy, an actor could potentially increase the market for a specific type of Guarantee of Origin or the market as a whole.

14. Utilizing eco-labelling is partly a trade-off between two dimensions – finding an eco-label which is well aligned with the company's objectives while still being perceived as trustworthy among the customers. Results indicate that involving an independent environmental organisation is essential to fulfil the latter.

15. Three strategic options were identified in connection to eco-labelling – creating an own eco-label, joining an existing eco-label with aligned criteria or joining a leading eco-label with high credibility. Assessing the choice from the two above mentioned dimensions, a strategy joining an existing eco-label with high alignment but still some affiliation with an independent environmental organisation is proposed. An alternative strategy would be to join a brand such as Bra Miljöval, but jointly develop sub-labels such as Bra Miljöval Wind.

16. There are some risks inherent with increasing awareness of the customer, such as double-paying for renewables. This risk might not, however, be an issue when if focusing on eco-labels as these only operate in the interaction of the end customer and the electricity supplier.

17. If a customer would like to support the expansion of renewables, (s)he does not only need to purchase electricity from a renewable source, but also consider the owner of that specific renewable source the electricity origins from as this determines the share of re-investing in renewables. This fact could be used as criteria in a successful eco-label strategy and promoted to customers by the eco-label.

7.2 Discussion and Further Research

This thesis has examined the potential in the Guarantees of Origin market from the perspective of a renewable electricity producer, in order to find out if it could become a substantial third stream of revenue. However, a change in perspective would most likely highlight some other issues and would reveal other insights and understandings. This work only examines one part of the spectrum of important aspects of the Guarantees of Origin.

Therefore, I would like to elaborate on one issue touched upon previously in the study; the next step following the revenue stream scrutinized previously in the thesis. As a matter of fact, and as mentioned in sections 3.2 and 6.3, the revenues in the Swedish Guarantees of Origin market mainly end up in the large-scale hydro power producers. This issue was addressed in the discussion of building a Guarantees of Origin strategy; however this could also be a focal point for a further discussion from a policy perspective. Restraining the revenues stemming from Guarantees of Origin to only be used for expansion of that specific source it originates from or

restrict the type of source that can get issued tradable Guarantees of Origin are two interesting thoughts in the scenario where eco-labelling (or other strategies) do not work as a bridge of the passivity gap. If the customers do not make that active choice the system intended them to make, policy makers might need to address the issue from a different angle, for instance by helping the market to some extent or re-make the system in some ways making it work as it intended to.

This means, if (and this is as concluded in the thesis, a quite large if) the Guarantees of Origin market grows, but with the current structure, a substantial part of the additional money paid by the end customer in the belief it supports the renewable energy expansion, just a smaller share minority of it would.

Therefore, looking at the Guarantees of Origin from a policy perspective, with the conclusions of the passivity gap revealed in this thesis, there might be reasons to revise the policies around Guarantees of Origin in order to steer the potential investments it could lead to into investments in renewables instead of fossil-based or nuclear power plants.

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[12] Pierre, Inge, *Head of Foreign Affairs, Svensk Energi.* [Telephone Interview]. 23 October 2012.

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Appendix A – List of Interviewees

Andersson, Nils

Current Position: Independent Consultant Energy Markets

Interview type: Telephone

Date: 2012-10-02

Bergek, Anna

Current Position: Associate Professor, Linköping Institute of Technology

Interview type: Telephone

Date: 2012-08-24

Björklund, Ulrika

Current Position: Portfolio Management, Telge Energy

Interview type: Telephone

Date: 2012-10-29

Blomqvist, Peter

Current Position: Head of Production, Arise Windpower

Interview type: Telephone

Date: 2012-09-21

Cederberg Wodmar, Jessica

Current Position: Energy and Environmental Communication Consultant, JCW

Interview type: Telephone

Date: 2012-11-07

Chudi, Peter

Current Position: Vice President, Svenk Kraftmäkling (SKM)

Interview type: Telephone

Date: 2012-10-10

Damsgaard, Niclas

Current Position: Head of Energy Consulting, Sweco

Interview type: Telephone

Date: 2012-09-26

Ebenå, Gustav

Current Position: Head of Operations Green Certificates, Energimyndigheten

Interview type: Telephone

Date: 2012-09-28

Ericson, Gary, Arise Windpower

Current Position: Head of Marketing, Svenska Kraftnät

Interview type: Telephone

Date: 2012-09-21

Fredriksson, Gunnar

Current Position: Deputy CEO, Svensk Vindenergi

Interview type: Telephone

Date: 2012-10-31

Henryson, Jessica

Current Position: Energy and Environmental Communication Consultant, Westander

Interview type: Telephone

Date: 2012-10-26

Johannessen, Carl

Current Position: Energy Certificate Trader, STX Services

Interview type: Telephone

Date: 2012-11-01

Kåberger, Tomas

Current Position: Professor Physical Resource Theory, Chalmers University of Technology

Interview type: In person

Date: 2012-10-24

Larsson, Mats

Current Position: Energy Certificate Trader, ATC

Interview type: Telephone

Date: 2012-10-30

Lehtovaara, Marko

Current Position: CEO, Grexel

Interview type: Telephone

Date: 2012-10-11

Mustafic, Mirela

Current Position: Analyst, Svenska Kraftnät

Interview type: Telephone

Date: 2012-10-12

Pierre, Inge

Current Position: Head of European Affairs, Svensk Energi

Interview type: Telephone

Date: 2012-10-23

Söderholm, Patrik

Current Position: Professor, Luleå Institute of Technology

Interview type: Telephone

Date: 2012-10-23

Appendix B – List of Survey Respondents[11]

Group 1

E.ON

Fortum

Vattenfall

Group 2

Bixia

Borås Elhandel

Dalakraft

DinEl

Falkenberg Energi

Göta Energi

GodEl

Halmstad Energi

Jämtkraft

Jönköping Energi

Kundkraft

Lund Energi

Mälarenergi

Mölndal Energi

Telge Energi

Umeå Energi

Öresundskraft

[11] 16 of the 20 companies listed ultimately responded to the survey