Design of a Supplier Obligation System
for the Netherlands from the perspective of Essent

Lijsbeth van den Hurk
SEPAM Master Thesis
Faculty Technology, Policy and Management

May 2011, Delft

A design for a Supplier Obligation System for the Netherlands, from the perspective of Essent

Master thesis

Author	Lijsbeth van den Hurk
Student number	1183141
E-mail address	E.W.G.M.vandenHurk@student.tudelft.nl
University	Delft University of Technology
Faculty	Technology, Policy and Management
Program	System Engineering, Policy Analysis and Management
Graduation section	Economics of Infrastructures
Company	Essent,'s-Hertogenbosch
Graduation committee	
Chairman	Prof. dr. J.P.M. Groenewegen
First supervisor	Dr. R.W. Künneke
Second supervisor	Dr. L.J. de Vries
External supervisor	J. Rookmaaker
Date	May 2011

SUMMARY

Introduction

At the moment, the Netherlands is considering a new support scheme for renewable electricity. The main objective of this support scheme is to achieve the target laid down by European Directive 2009/28/EC on the promotion of the use of energy from renewable sources. Essent, problem-owner of this study, is currently the biggest producer of renewable electricity in the Netherlands and has the ambition to stay a leader in the realization of climate goals. Consequently, Essent wants to contribute to the discussion on the development of a new support scheme. Essent believes that a Supplier Obligation System (SOS) is the preferred support scheme for the Netherlands. In order to further assess the conditions in which a SOS can offer the right incentives for investment, the development of a design of a SOS for the Dutch circumstances was proposed.

The history of support schemes in the Netherlands reveals a trend of regulatory instability. In general regulatory instability is damaging for the long-term effectiveness of any support scheme. In addition regulatory instability will also drastically decrease the short-term effectiveness of a SOS. Therefore, breaking the current trend of regulatory instability was regarded as an essential precondition for the design of a SOS. For this reason, the following knowledge gaps for Essent were identified:

- Insight in how a SOS can provide effective incentives for Essent to invest in renewable energy
- Insight in how a SOS can provide stable incentives for Essent to invest in renewable energy

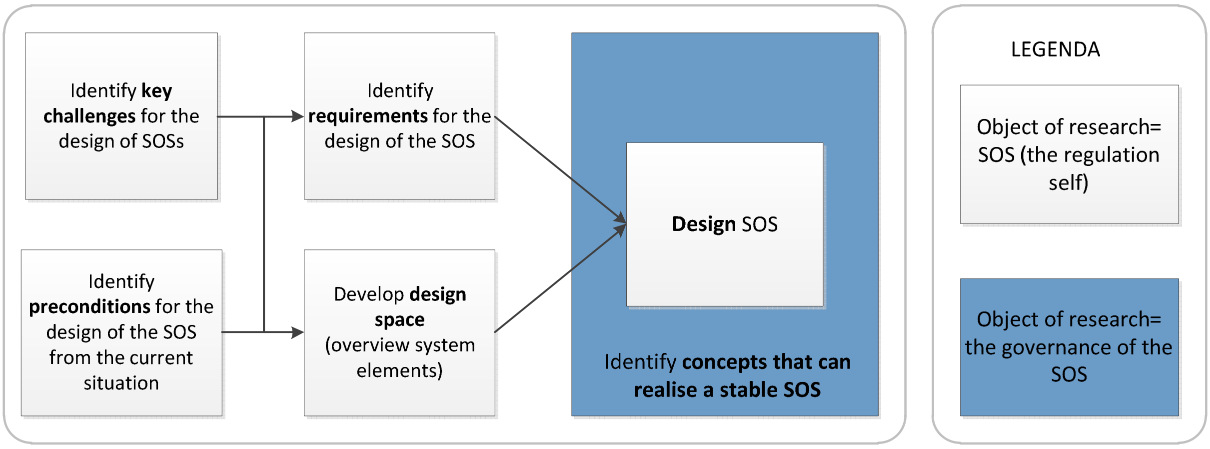
In order to fill in these knowledge gaps a design-oriented research was executed with the objective to answer the following research question:

> **"How can a Supplier Obligation System for the Dutch electricity sector provide effective and stable incentives for Essent to invest in renewable electricity in order to be able to contribute to the European targets on renewable energy?"**

To this research question was remarked that the realisation of effective and stable incentives for investment also needs to incorporate the interests of Essent as an electricity supplier. Furthermore, a SOS designed from the perspective of Essent is only purposeful when this also results in an acceptable situation for the Dutch society and energy sector as a whole. For this reason, the realisation of effective and stable incentives was limited by the realisation of an overall effectiveness, cost-efficiency and equity of the scheme. In order to answer the research question a literature study and interviews were performed.

Design approach

In order to develop a design that can provide both *effective* and *stable* incentives for investment, a framework for design was developed that could clarify this distinction. In order to investigate how a SOS can be *effective,* the detailed specifications of this regulation have to be laid down based on an understanding of the present technical, legal and economic circumstances. However, in order to further investigate how a SOS can provide more *stability* than former support schemes, it is necessary to shift the object of research from the 'SOS itself' to the 'governance of the SOS'. From this realization it became clear that this study had to contain two objects of research in order to be able to develop a design of a SOS that is both effective and stable, namely the 'SOS self' and the 'governance of the SOS'. The division of these objects of research in relation to the different design steps provided the following framework for design, which was applied during the research.



Development of the design

Key challenges for design

In general a SOS exists of three main components: a right for producers of renewable electricity to receive certificates, a quota obligation for suppliers creating a demand for these certificates and a market that brings the renewable generators and suppliers together. Currently, renewable electricity generation is in general not competitive with conventional electricity generation (Jansen and Uyterlinde 2004). Therefore, the main principle on which a SOS operates is that the sales of certificates provides sufficient additional revenue for generators over and above that from the sales of electricity in order to make investments in renewable electricity generation profitable (SEA 2009). In this regard, the following aspects were identified as the key challenges for design, as they can affect the overall effectiveness, cost-efficiency and equity of a SOS:

- market risks for renewable electricity producers
- excessive economic rents for certain renewable electricity producers
- possibility of market power.
- an unequal starting point for different type of electricity companies.

Preconditions for the design

From a description of the current technical, legal and economic situation in the Dutch electricity sector several preconditions for the design were identified. These preconditions have to be incorporated by the design of the SOS and will greatly influence the possibilities for design:

- The Netherlands has a relatively steep supply curve for renewable electricity, which can lead to excessive economic rents for certain producers within a SOS.
- Biomass co-firing and onshore wind power are considered to be relative mature technologies for renewable electricity generation the Netherlands, where stand-alone biomass conversion, offshore wind power, hydro power and solar power are considered to be relatively immature.
- Biomass conversion has relatively low capital expenditures and high operational expenditures, where other technologies have high capital expenditures and low operational expenditures.
- It is not expected that national support schemes will be harmonized on a fully European level before 2020. Regional cooperation is however encouraged and legally possible.
- For legal reasons, the present certificate for renewable electricity (GoO) cannot be applied for the SOS. A separate certificate will have to be created (SOC)

Design space

The design space of a SOS was developed by identifying the elements of a SOS that can contribute to answering the research question. Furthermore, the ways in which these elements can be filled in were identified. An element was defined as a component or constituent of a SOS. The following categories were identified to structure the design space: eligible sources, price mechanisms, certificate allocation, trading mechanisms, quota definition, flexibility mechanisms and governance.

Requirements for design

Requirements for design were identified based on the needs of Essent as a producer and supplier of renewable electricity and as an obliged supplier within a SOS. Additional requirements that secure the overall effectiveness, efficiency and equity of a SOS were added in order to realise a useful design from the perspective of Essent. This resulted in the identification of the following requirements for design:

- A sufficient transition path between the ending of the MEP and the start of the SOS.
- The inclusion of existing biomass conversion plants in the SOS.
- Low market risks.
- Stable market conditions.
- Continuous support for biomass conversion plants.
- Sufficient possibilities for technology diversification and stimulation of immature technologies.
- The inclusion of renewable micro generation.
- Equal starting point for different type of electricity companies.
- Low degree of possibility of market power for certain electricity producers.
- Fair economic rents for renewable electricity producers

Concepts for realising a stable design

In order to identify possible concepts for design that can secure a stable SOS, the object of research was shifted from the SOS self to the governance of the SOS. Based on theories of Spiller and Tomassi (2005) on regulatory governance in the energy sector, the relation of the institutional environment of the Netherlands and stability of regulation in the energy sector was investigated. This showed that regulation in the energy sector can be subjected to governmental opportunism, due to a combination of its specific economic features. Furthermore, was empirically confirmed that the Dutch institutional environment is not able to effectively limit this form of opportunism, which has resulted in support schemes that were often unexpectedly changed, cancelled or replaced. In the search for possible manners to limit governmental opportunism in a SOS was identified that substantial regulatory flexibility is required to be able to respond to the significant dynamics that surround support schemes for renewable electricity. Therefore, the only appropriate manner to structurally constraint governmental opportunism in a SOS is to delegate the responsibility for the governance of the SOS from the central government to parties which are not under direct influence of electoral politics. The main argument for this is that delegation will lead to a more objective and substantive governance of the SOS and therefore a more consistent and predictable policy. This was therefore the main starting point for the identification of the concepts for design and resulted in the identification of the following conceptual design alternatives:

- A1) Connect and adapt design to Swedish SOS
- A2) Connect and adapt design to Belgian SOS
- A3) Connect and adapt design to British SOS
- A4) Connect and adapt design to Polish SOS
- A5) North-west European SOS
- A6) Self-regulated Dutch SOS under control of the energy sector.

Alternative A1 until A5 delegate the responsibility for executing, monitoring and adjusting the SOS from centralized government control influenced by electoral dynamics to a bilateral cooperation of the Dutch and foreign regulator and specialized authorities. Alternative A6 delegates this responsibility to the energy sector self. The alternative that connects the SOS to Sweden was selected from these six alternatives to be further detailed. Firstly, this alternative was selected because it is expected that internationalization is better able to secure the long-term stability of the SOS than self-regulation. Secondly, Sweden has the highest potential regarding feasibility and performance in comparison to the other alternatives based on internationalization.

Conclusions

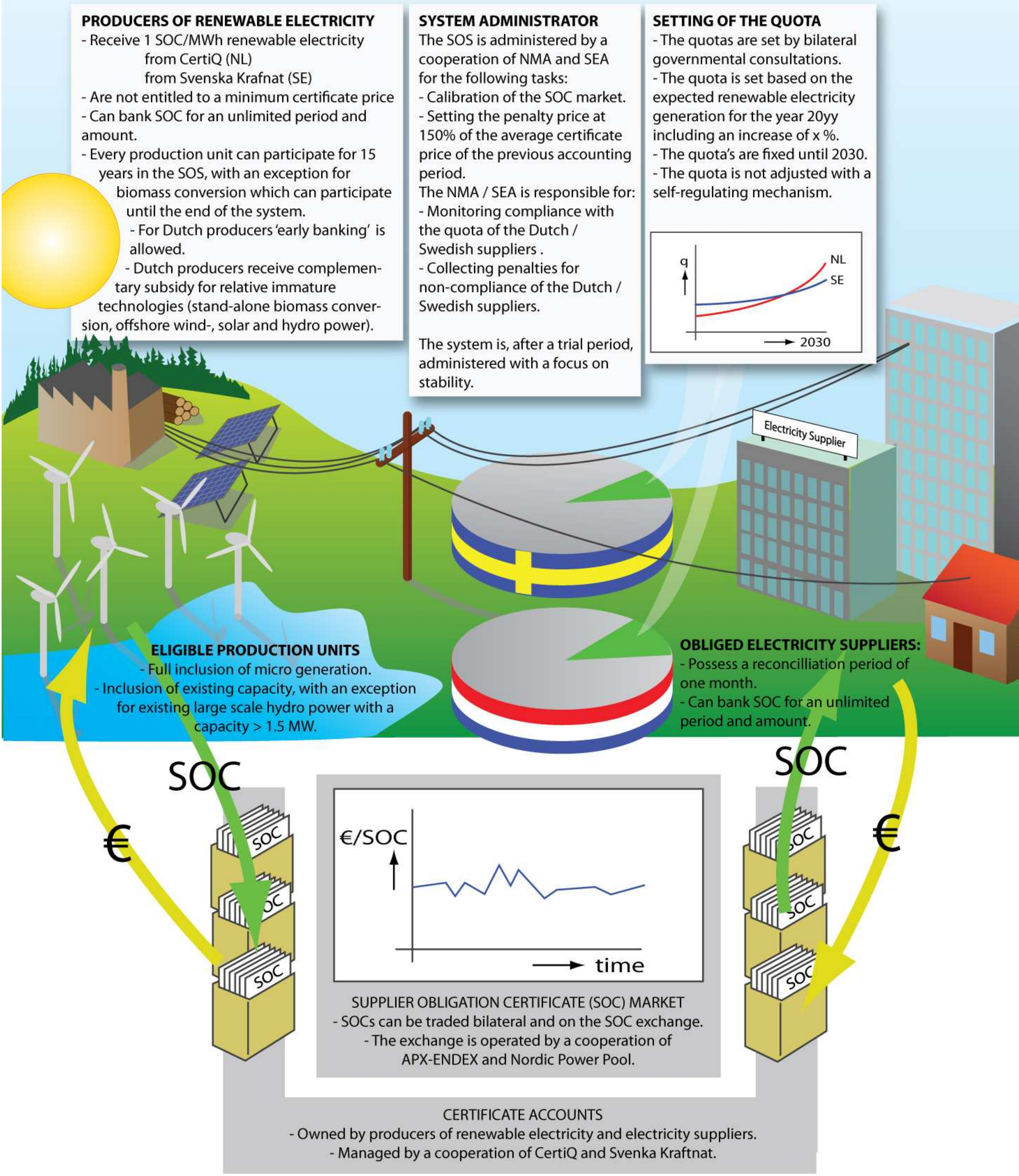
Applying the requirements for design to the design space, with the starting point of a connection to the Swedish SOS resulted in the design that is shown below. This design can provide both effective and stable incentives for investment for the following reasons. Effective incentives were secured by the proposed design by tackling the common issues in SOSs, embracing the current situation in the Dutch renewable electricity sector and incorporating the requirements for design, as much as possible. Stable incentives were secured by delegating the responsibility for the SOS from centralized government control influenced by electoral dynamics to a bilateral cooperation of the Dutch and Swedish government, the Dutch Office of Energy Regulation and Swedish Energy Agency, CertiQ and Svenska Krafnat and APX-ENDEX and Nordic Power Exchange.

Recommendations

Essent is recommended to start a stakeholder dialogue on the possibility of a connection of the Dutch SOS to the Swedish SOS. In this regard, they should advocate for the introduction of the design that was identified during this research as it can provide a predictable and consistent long-term framework for the expansion of their activities in the production of renewable electricity. If the introduction of a SOS connected to Sweden does not appear to be feasible in reality it is advised to further investigate the concept of self-regulation or to advocate for the introduction of the default-option of a SOS that was developed during this research. Lastly, it is recommended to Essent to further investigate how the risk of governmental opportunism can also be restricted on forehand in other type of investment decisions.

Recommendation for further research is to model the effects of the design choices, in order to test whether the assumptions that were made on the mechanisms in a SOS based on findings in literature are correct. Furthermore, further research can also be to reveal the emergent behaviour of a SOS under this design and test the existence of possible unseen interactions among design choices and between design choices and the environment. Lastly, further research can optimize the design on the level of the system elements.

Design of a joint hybrid SOS (NL-SE)



PREFACE

The report which lies before you is the result of the research I performed for my master thesis, which was the final part of my study System Engineering, Policy Analysis and Management. In many ways this research was an interesting journey. Firstly, it was challenging and often confronting to perform a study of this dimension and complexity individualistically. Secondly, as the research was commissioned by Essent, it added very relevant insights to the theoretical knowledge I gained during my specialization in the energy sector. Lastly, performing this research also added real life experience to the core insight I have embraced during my education at the Faculty of Technology Policy and Management, which is the inherent tension and interaction between the different perspectives on reality in realising infrastructural developments.

The transition towards a renewable energy supply will not happen overnight. I had the honour to research how a regulatory framework for the Netherland can contribute to this long-term objective. However, the investigation of this subject made me aware that the realisation of an actual transition still requires many lessons to be learned, both from a technical and an institutional perspective. Most of all I realised that it requires a shift in the valuation of our resources from all of us. Being a part of this larger learning process and development was perhaps the most interesting aspect of the experiences I have gained during my research.

This research would have never been what it is now without the help and support of the following people. I would like to thank Jacob Rookmaaker, who was my supervisor from Essent, firstly for providing the opportunity to perform this research. But most of all I want to thank him for his trust and open-mindedness in guiding me. Secondly, I am grateful for the guidance of Rolf Künneke, who was the first supervisor of my graduation committee. He always encouraged me to see my research from a higher level, which was not always easy but provided valuable lessons. Lastly, I would also like to thank Laurens de Vries, who was the second supervisor of the TUDelft, for his enthusiasm for my research. Next to my supervisors, I want to thank the following persons. I would like to thank my colleagues at Essent for their hospitality, my peers for sharing their experiences in the graduation process and the interviewees for the valuable information they added to my research. Furthermore, I want to thanks Sven for his creative contributions to my report and Claire for her support in editing my report.

Last but not least, as this is the final part of education, many thanks to my family and friends for an inspiring and joyful student life!

Lijsbeth van den Hurk

Delft, May 2011

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Problem exploration

1.1.1 Cause

For more than three decades the relation between our energy supply and climate change has received a rising attention from science and society (Koopmans, Tieben et al. 2010). Nowadays it is clear that the energy sector has to make a transition from a fossil-fuel driven system towards a renewable-driven system. In order to realise this transition the European Union has laid down an Energy and Climate package which sets down mandatory targets for each Member State, with respect to the reduction of greenhouse gasses, the share of renewables in the final energy consumption and energy efficiency improvements (Jansen 2010). The targets regarding the share of renewables in the final energy consumption were laid down in Directive 2009/28/EC on the promotion of the use of energy from renewable sources in 2009. This Directive obliges the Netherlands to realise 14 percent renewables in the final energy consumption in 2020 (EU 2009).

In order to realize the target set by the Directive, Member States are free to choose the policy measures at their preference. Four main types of support schemes for the stimulation of renewable electricity generation can be identified. These are a feed-in-premium, a feed-in-tariff, a supplier obligation system and a generator obligation system. The Dutch government currently has implemented a feed-in-premium to realise the target set down in the Directive. A feed-in-premium guarantees producers of renewable electricity a technology specific exploitation subsidy that compensates for the uneconomic top of renewable electricity production for a pre-defined period (Senternovem 2010). Despite this system, the Netherlands is currently not on track in realising the mandatory targets laid down in the Directive (VME 2010). Furthermore, the Dutch government has the objective to cut down expenses, due to the financial and economic crisis that started in 2008. For these reasons the Dutch government is currently considering a new support scheme for renewable electricity. Consequently, the Dutch government, the energy sector and other stakeholders are discussing on alternative support schemes.

1.1.2 Essent

This research is facilitated by Essent, which is also the problem-owner of the research. Essent is an energy company, located in the Netherlands that produces trades and supplies gas, electricity and heat. About 4400 employees work at Essent, which had a revenue of 5.7 billion Euro in 2009 (Essent 2010). In 2009 Essent became a part of the international energy concern RWE. RWE is one of Europe's leading electricity and gas companies. It is active in the generation, trading, transmission and supply of electricity and gas. More than 70.000 employees supply over 16 million customers with electricity and approximately 8 million customers with gas (RWE 2010).

Essent is currently the biggest renewable electricity producer of the Netherlands and has the ambition to stay a leader in the realization of climate goals. Therefore, as the introduction of a new support system to foster renewables in the Netherlands is discussed at the moment, Essent wants to contribute to this discussion from their interests. With respect to this new support system the main interests of Essent are a guaranteed rate of return on investments in renewable electricity and possibilities for increasing the sustainability of their electricity supply. In order to realise these interests, Essent is advocating for the creation of a market for renewable energy that can realise the climate targets in the most cost-effective way (Essent 2010).

Initial researches which compare the suitability of different alternative support schemes for the Netherlands also point in the direction of a more market-based support scheme, namely a Supplier Obligation System (SOS). A SOS imposes an obligation on electricity suppliers to supply a certain percentage of their total electricity supply from qualifying renewable sources (Jansen 2010). SOSs are backed up with a tradable renewable energy certificate system, which can assist in providing evidence of compliance with the obligation (Jansen 2010). The main advantages of a SOS in comparison to alternative support schemes are that:

- a SOS can create economic efficiency in the transition towards a renewable electricity supply as:
    - the selection of renewable technologies in a SOS is made by market forces rather than government evaluation
    - it maintains continuous incentives for renewable producers to seek cost reduction
- a SOS can be directly linked to government targets
- a SOS does not involve government's budgets (Berry and Jaccard 2001).

For these reasons, Essent believes that the SOS is the preferred support scheme for the Netherlands. However, several studies show that the degree in which the potential of a SOS can actually be achieved depends to a large extent to the specific design of this system (MacGill, Outhred et al. 2006: Lipp 2007; VME 2010; Jansen 2010; Tilburg, Jansen et al 2006). Currently, it is still unknown what the design of the SOS will look like, taking into account the Dutch circumstances. A relevant next step in the consideration of a new support scheme for the Netherlands is therefore to investigate what the design of the SOS can and needs to look like from the perspective of Essent, based on an understanding of the Dutch circumstances. This will further assess the actual potential of a SOS in the Netherlands and can reveal under what conditions a SOS could actually offer the incentives for investment Essent aims for.

With respect to the conditions under which a SOS can offer effective incentives to invest in renewable electricity generation, it also has to be taken into account that Essent does not only want to be able to invest in new capacity but also wants to remain its current activities in the production of renewable electricity. Furthermore, Essent is not only a renewable electricity producer but also an electricity supplier. In this regard, it is important for Essent to be able to maintain its current activities in the sales of renewable electricity. Secondly, Essent also desires to have considerable insight in how their interests as an obliged supplier in a SOS can be protected. Therefore, the realisation of effective incentives for investment for Essent by a SOS also needs to incorporate these other interests of Essent.

Furthermore, the development of a design of a SOS based on the interests of Essent will be purposeless if this is not related to the overall performance of this scheme. A design that perfectly accommodates the needs of Essent but results in an ineffective, costly or unfair transition towards a renewable electricity supply for the Dutch society will never be implemented. For this reason it is also in the interest of Essent to take into account the general scheme's performance in developing a design for a SOS from their perspective. The overall performance will therefore also need to be incorporated in the design of a SOS from the perspective of Essent.

1.1.3 Context

Before zooming in further on how the needs of Essent identified in the previous section have to be translated into further research, it is necessary to relate the design of a SOS to the history of support schemes in the Netherlands. Over the past 15 years five different support schemes for renewable electricity succeeded each other. These systems were often prematurely stopped for different reasons. Furthermore, unexpected interference within the systems occurred. Lastly, the objectives related to the support schemes changed multiple times. These events resulted in a trend of regulatory instability in the Dutch support schemes for renewable electricity generation.

The renewable electricity sector is characterized by large specific, sunk investments and economies of scale. Furthermore, it is highly dependent on additional financial support as renewable electricity can currently not compete with grey electricity (Jansen and Uyterlinde 2004). For this reason, regulatory instability leads to a highly instable and unpredictable investment environment for the renewable electricity sector. With respect to this, the International Energy Agency (IEA) states that "such stop-start policies drastically undermine the effectiveness of the financial support the government provides and harm the long-term development of renewables"(IEA 2009). Therefore, they recommend the Dutch government to stabilize policies for a sufficient term to underpin a sustainable investment climate (IEA 2009).

Thus, an unstable regulatory framework can heavily undermine the long-term success of a support system for renewable electricity generation. In addition, the expectation of regulatory instability is more damaging for the short-term effectiveness of a SOS than for the short-term effectiveness of the currently implemented feed-in-system. A producer of renewable electricity which is offered subsidy by a feed-in-premium scheme will receive subsidy until the pre-defined term for this subsidy ends. So although the feed-in-premium system is unexpectedly stopped, a generator that is guaranteed subsidy will still receive subsidy until the end of its subsidy term. This means that for a feed-in-system the expectation of regulatory instability will at least guarantee a rate of return on a specific asset, despite insecurity on the availability of subsidies for future investments. This does not apply to a SOS. In a SOS the sales of tradable renewable electricity certificates will provide additional income above the sales of electricity. The expectation of regulatory instability in a SOS will lead to unpredictable market conditions for the sales of the certificates and therefore an unpredictable rate of return on the investment in a specific asset. Examples of the effect of regulatory instability on the effectiveness of a SOS were shown in the UK and Australia. In the UK a lot of revisions in the system were executed which made it difficult for generator to plan and commit themselves to new investments (Lipp 2007). In Australia a review of the domestic energy markets recommended scrapping the SOS, which led to significant concerns amongst generators on the duration of the scheme (Mac Gill, Outhred et al. 2006). Both events resulted in a strong decrease in investments.

From this can be concluded that besides regulatory instability is generally damaging for the long-term effectiveness of any support scheme, regulatory instability will also drastically decrease the short-term effectiveness of a SOS. Therefore, the ability of the design of a SOS for the Netherlands to break the current trend of regulatory instability will be essential for the SOS to be able to improve the performance of the current and former support schemes and to provide Essent the investment climate they demand from a support scheme.

1.2 Problem statement

To summarize, the Dutch government is currently considering a new support scheme to foster renewable electricity generation in the Netherlands, in order to achieve the national targets laid down in Directive 2009/28/EC. Essent, problem-owner of this research, will be heavily affected by the introduction of a new support schemes and believes that the SOS is the preferred option to realise these targets. Essent wants to have further insight in how the SOS has to be designed in order to realise effective incentives for investment in renewable electricity generation. Furthermore, it was identified that the stability of the SOS is an essential precondition for the SOS to actually be able to provide effective incentives for investment. In this regard, it was identified that the former Dutch support schemes were characterised with a high level of regulatory instability. From this can be concluded that Essent requires both an effective SOS, which adequately creates incentives for investment and an effective governance of this system, which effectively guarantees the stability of the SOS. For this reason the following knowledge gaps for Essent can be identified from the problem exploration:

- Insight in how a SOS can provide effective incentives for Essent to invest in renewable energy
- Insight in how a SOS can provide stable incentives for Essent to invest in renewable energy

The problem exploration also reveals that a design-oriented research approach is the required next step in response to the initial more descriptive studies that were done regarding the introduction of a new support scheme in the Netherlands. For this reason a design-oriented research will be executed in order to fill in the knowledge gaps identified in this sector.

1.3 Research questions and sub-questions

1.3.1 Research question

In order to provide answers to the knowledge gaps identified in the problem statement with a design-oriented approach, the following research question needs to be answered during this Master thesis project:

> **"How can a Supplier Obligation System for the Dutch electricity sector provide effective and stable incentives for Essent to invest in renewable electricity to be able to contribute to the European targets on renewable energy?"**

The phrase 'how can' in this research question points out that the research is design-oriented. Furthermore, the term 'Supplier Obligation System' addresses the research object. The term 'Essent' refers to the problem-owner of the research. The phrase ' provide incentives to invest in renewable electricity' refers to the main objective of Essent regarding the design of the SOS, in which the term 'effective' addresses the realisation of an 'effective regulation' and term 'stable' address the realisation of an 'effective governance of this regulation'. To this objective has to be noted that the realisation of effective and stable incentives for Essent for investment by the SOS also incorporates:

- the possibility for Essent to maintain current activities in renewable electricity production and the retail of green electricity
- the interests of Essent as an obliged supplier within a SOS

Furthermore, a SOS designed from the perspective of Essent only is useful if this also leads to an acceptable situation for the Dutch society and energy sector as a whole. Therefore, the realisation of effective and stable market incentives will be limited by the realisation an overall effectiveness, cost-efficiency and equity of the scheme.

1.3.2 Sub-research questions

In order to answer the research question above the following aspects of the design of a SOS have to be studied. Firstly, it is important to develop more understanding of the general functioning and basic principles of a SOS. In this regard, also the key challenges for the design of a SOS from an overall system perspective have to be identified. Secondly, it is necessary to create insight in how the current features of the renewable electricity sector create preconditions for design. Then the next steps are to develop the design space and to define the requirements for design, taking into account the key challenges and preconditions for design. As the problem-owner of this research is Essent, the requirements have to be defined from the perspective of Essent. Before the requirements will be applied to the design space in order to define how the SOS can provide effective incentives for investment, it is required to identify which concepts for design can realise a stable SOS. These concepts will form the starting point and framework for the development of a detailed design for the SOS, which is executed by applying the requirements for design to the design space. Completing these steps will make it possible to create a design for a SOS that both can create effective and stable incentives for Essent to invest in renewable electricity and thus answers the research question. Therefore, the design steps identified here will provide the structure for the sub-research questions of this Master thesis. Consequently, the following sub-research questions need to be answered during this research, in order to answer the research question:

1. What are the basic principles a SOS and possible key challenges for its design?
2. How does de the current technical, legal and economic situation in the Dutch electricity sector affect the design of a SOS?
3. What are important elements of a SOS and how can these elements be filled in?
4. What are the requirements for the design of a SOS from the perspective of Essent?
5. Which concepts for the design of a SOS can provide a stable SOS?
6. Which design for a SOS can provide stable and effective incentives for Essent to invest in renewable electricity?

1.4 Framework for design

This paragraph has the objective to realize a framework for design that can clarify the distinction in realizing *effective* and *stable* incentives for investment during the development of the design for a SOS. In order to investigate how a SOS can be *effective,* the detailed specifications of this regulation have to be laid down based on an understanding of the present technical, legal and economic circumstances and the requirements for design. However, to further investigate how a SOS can provide more *stability* than former support schemes, it is necessary to observe this regulation from a higher level. This requires shifting the object of research from the 'SOS itself' to the 'governance of the SOS', as the governance of the SOS considers how the SOS will be able to uphold stable and well-established (Spiller and Tommassi 2005).

From this, it becomes clear that this report needs to - and will - contain two 'storylines' and 'objects of research' in order to able to develop a design of a SOS that is both effective and stable. The first storyline will elaborate on a detailed level how the design of the 'regulation self' has to be developed in order to be effective. The second storyline will elaborate on a more conceptual level how this detailed design which can enable effective incentive regulation has to be governed. For the first story line the object of research is the 'SOS self', for the second storyline the object of research is the 'governance of the SOS'. The relation of the objective to realise effective and stable incentives for investment and the two objects of research is illustrated in the figure 1.1.

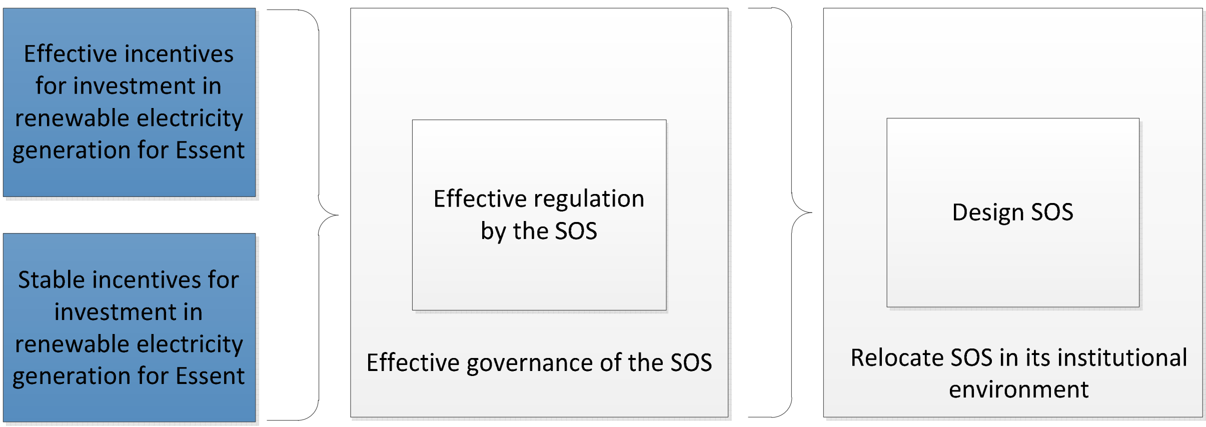


Figure 1.1 The relation between the design objective and objects of research

Now the reader will be provided with more understanding of how these two objects of study relate to each other in the different parts of this research. In order to so we will explain how the sub-research questions relate to the two objects of research. When looking back at how the sub-research questions contribute to answering the research question – which was described in the previous paragraph – it is important to understand that sub-question one until four take the 'SOS self' as the object of research. For this reason, the answers to these sub-questions will mainly contribute to the question how the SOS can realize *effective* incentives for investment for Essent and in the same time enable an overall effective, efficient and fair scheme.

However, before it is possible to answer the research question based on the results of sub-questions 1 until 4 it is required to temporarily shift the object of study from the level of the regulation self to the level of the governance of this regulation. This will be done by answering sub-question five. Sub-question 5 thus still studies the design of a SOS, but with a focus on the governance of the SOS instead of on the regulation by the SOS. This shift makes it possible to step away from the rather narrow and detailed level of the regulation self in order to observe how this regulation is positioned in its institutional environment. By doing so, it will be possible to identify the origin of instability in the support schemes for renewable electricity in the Netherlands. Insight in the origin of instability will again make it possible to understand how and under which conditions the SOS can be relocated in its institutional environment in order realize the required level of stability for a SOS. This will result in the identification of several frameworks for design.

Lastly, sub-question 6 will incorporate the two storylines by combining the findings on both objects of study. This will be done by using the frames for design - which enable to breach with the trend of regulatory instability - as a starting point for applying the requirements for an effective design of the SOS to the design space of the SOS. The division of the 'objects of research' during this research in relation to the sub-research questions is illustrated in figure 1.2 and provide the framework for design that will be applied during the research.

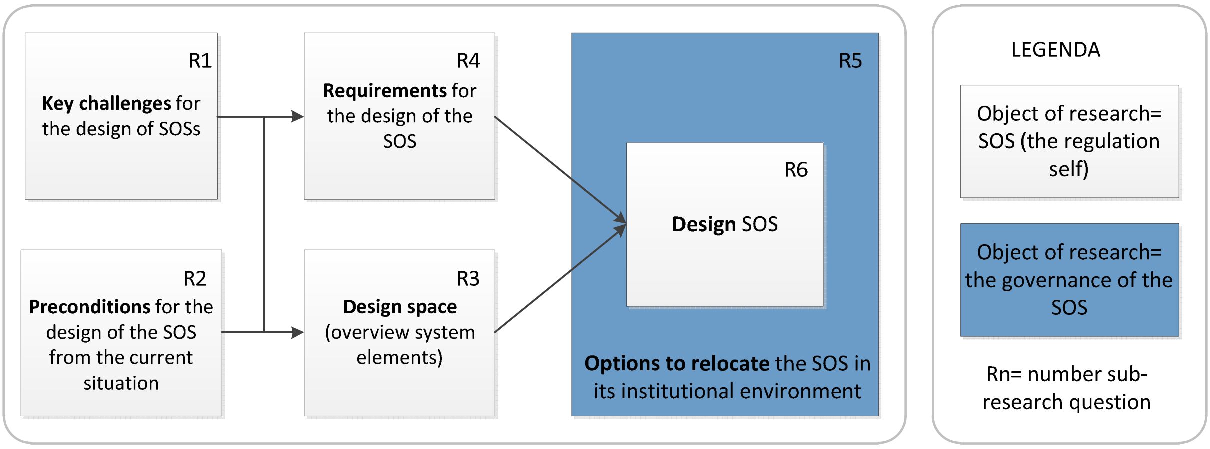


Figure 1.2 Framework for design

With respect to the framework for design it is important to note that the distinction between the SOS self and the governance of the SOS is not as 'black and white' as is indicated here. In reality these two objects of research will often overlap, as the governance of the SOS will demarcate the design space of the SOS and the design of the SOS will also contain elements of governance. In order to also allow the realization of stability within the design of the regulation the requirements for design will incorporate one requirement that considers the stability of the SOS. Furthermore the design space will incorporate elements that can contribute to the stability of the SOS within the regulation self.

1.5 Research method

This research will be done based on a literature study and interviews. Firstly, the literature study has the objective to provide insight in the different aspects of a SOS and its design. Relevant aspects of a SOS are the key issues in designing a SOS, the design space of a SOS, the mechanisms within a SOS and their effect on the production and supply of renewable electricity. Relevant literature is therefore literature that discusses the design of a SOS. Furthermore, literature that describes and surveys the experiences of existing SOSs in other countries can create more understanding of the possible elements and common issues in a SOS. Until now SOSs have been implemented in the UK, Belgium, Sweden, Poland, in several states in the US and Australia. Lastly, literature that compares the SOS with alternative support schemes and which discusses the general advantages and disadvantages can provide more insight in the different aspects of a SOS. The available literature on SOSs is mainly characterized by a descriptive and pragmatic approach. Furthermore, the literature mainly applies an economic or policy perspective on the design of a SOS. From this perspective, the literature review confirms that both the design-oriented approach for and the incorporation of a governance perspective in this research can contribute to the current available literature on SOSs.

Secondly, literature was reviewed that considers the institutions of regulation in the energy sector. This type of literature was applied to create more understanding of the possible origins of and answers to regulatory instability in this sector. Unfortunately this branch of literature is not very extensive. However, the literature that is available appears to be very relevant for this research. An overview of all the literature that is reviewed is in provided in Annex II.

The interviews were mainly exploratory in nature. Firstly, they had the objective to explore the former and current situation in the Dutch renewable electricity sector and the interest and needs of Essent regarding a SOS. These interviews were mostly done with employees of Essent. Furthermore, an interview was held with an expert that has experience with a SOS Belgium in order to add 'real-life' understanding on the functioning of a SOS to the theoretical knowledge that was retrieved from literature. Also, an interview was held with the transmission system operator in the Netherlands in order to provide understanding of the current certification system for renewable electricity. Lastly, an interview was held with the sector organization of the energy sector in order to create more understanding in the specific interests of other energy companies regarding the SOS. The minutes of the interviews can be found in Annex I.

1.6 Scope and delineation of the research

The scope of this research lies on the development of a design for a SOS from the perspective of Essent. Essent has two objectives with respect to the design of a SOS. Firstly, Essent wants to have insight in which design of a SOS sets the right economic and institutional conditions for them to invest in renewable electricity generation. Secondly, Essent wants to have insight in which design of a SOS is politically the most feasible or in order words is the mostly likely to be implemented by the Dutch government, taking into account the current political processes in the Netherlands.

The design SOS will be created during this research without direct involvement of future system administers and key stakeholders. It is however important to realise that in reality a participatory design process will establish the design. The development of the SOS in this research has the objective to offer Essent the necessary knowledge and understanding on the possibilities for design from their perspective, in the actual design process on the establishment of a SOS for the Netherlands. It does not have the objective to predict what the outcomes of the actual design process will be. This research will limit itself to realizing the first objective of Essent, namely to develop a design for a SOS that can set the right economic and institutional conditions for their activities regarding renewable electricity.

1.7 Structure report

The structure of this report is the following. Firstly, chapter 2 will answer the first sub-research question by describing the basic principles and functioning of a SOS and the key challenges for the design of a SOS. Chapter 3 will describe the relevant aspects of the current situation from a technical, legal and economic perspective. Furthermore it will analyse how this affects the possibilities for the design of a SOS. After that chapter 4 will provide an overview of the main elements of a SOS. Chapter 5 will identify the requirements for design from the perspective of Essent. Subsequently chapter 6 will develop conceptual design alternatives for design. These alternatives will be developed with the starting point to structurally breach the present trend of regulatory instability in support scheme for renewable electricity. Chapter 7 will detail a selected number of conceptual alternatives by filling in the relevant system elements (identified in chapter 4) for this concept from the perspective of Essent. Lastly, chapter 8 will present the conclusion and recommendations based on the results of the previous chapters.

2. THE GENERAL FUNCTIONING OF A SOS AND POSSIBLE KEY ISSUES FOR DESIGN

This chapter has the objective to answer the following sub-research question:

> 'What are the basic principles a SOS and possible key challenges for its design?'

This question will be answered by describing the basic principles of a SOS. Furthermore, it will be answered by identifying the possible key challenges for the design of a SOS. This will be done by a literature review on the different aspects of a SOS and its design (Annex II). The design for a SOS from the perspective of Essent is limited by the realisation of an overall effective, efficient and fair SOS. Therefore, the key challenges for design are defined here as the issues that have to be solved by the design of the SOS which can heavily affect the overall effectiveness, efficiency and equity of the SOS. The following definitions of the concepts of effectiveness, efficiency and equity will be applied during this research. Firstly, the effectiveness of the SOS describes the additional renewable electricity volume (in TWh) or generating capacity (in MW) attributable to this scheme (Jansen 2010). Secondly, the term efficiency in this report describes the relative costs for which the Dutch target for renewable electricity is met by the SOS (Bennink, Blom et al 2020). The term efficiency thus refers to the cost-efficiency of this instrument. Lastly, the equity of the SOS describes the degree in which the costs and risks of the SOS are evenly distributed amongst different stakeholders (Bruijne, Steenhuizen et al. 2011; Linden, Uyterlinde et al. 2005). This chapter is structured as follows. The first paragraph will describe the general functioning of a SOS. The second paragraph will identify the key challenges for the design of a SOS.

2.1 The basic principles and functioning of a Supplier Obligation System

In general a SOS exists of three main components: a right for producers of renewable electricity to receive certificates, a quota obligation for suppliers creating a demand for these certificates and a market that brings the renewable producers and suppliers together (Bergek and Jacobsson 2010). Currently, renewable electricity generation is generally not competitive with conventional electricity generation (Jansen and Uyterlinde 2004). Therefore, the main principle on which a SOS operates is that the sales of the certificates provides sufficient additional revenue for renewable electricity producers over and above that from the sales of electricity, in order to make the production of renewable electricity profitable (SEA 2009). In this respect, the price of the certificates has to compensate the uneconomic top of renewable electricity generation, in order to provide an adequate incentive for renewable generators to invest in new renewable generation capacity. This price level is achieved by realising an adequate level of scarcity of certificates on the certificates market, by posing a suitable quota size on the total electricity supply. The quota in this context is the percentage of the total electricity supply of an electricity supplier for which it has to purchase the certificates that are linked to the SOS. These certificates will from now on be referred to as Supplier Obligation Certificates or 'SOCs'. The size of the quota and the type of generation technologies that are eligible for receiving certificates are in general determined by the national government.

The main processes in a SOS are illustrated in figure 2.1 below and will now be further explained. The ovals represent actors in a SOS and the arrows represent the different flows in a SOS. The functioning of a SOS starts with a renewable electricity producer, who generates renewable electricity and receives certificates for this production from the Certificate Authority. In order to receive certificates, the producer has to register itself at the Certificate Authority. The Certificate Authority will then control whether the producer fulfils the criteria for participation in the SOS and will approve its appliance if so. Once the Certificate Authority has approved the participation, it will collect data from the Transmission System Operation (TSO) on the renewable electricity production of this producer on which it bases its certificate allocation to this generator. The renewable electricity producer is then able to receive SOCs and sell them to electricity suppliers via the SOC market. In this respect, a SOS provides two revenue streams to renewable producers, namely the sales of electricity on the electricity market and the sales of SOCs on the SOC market

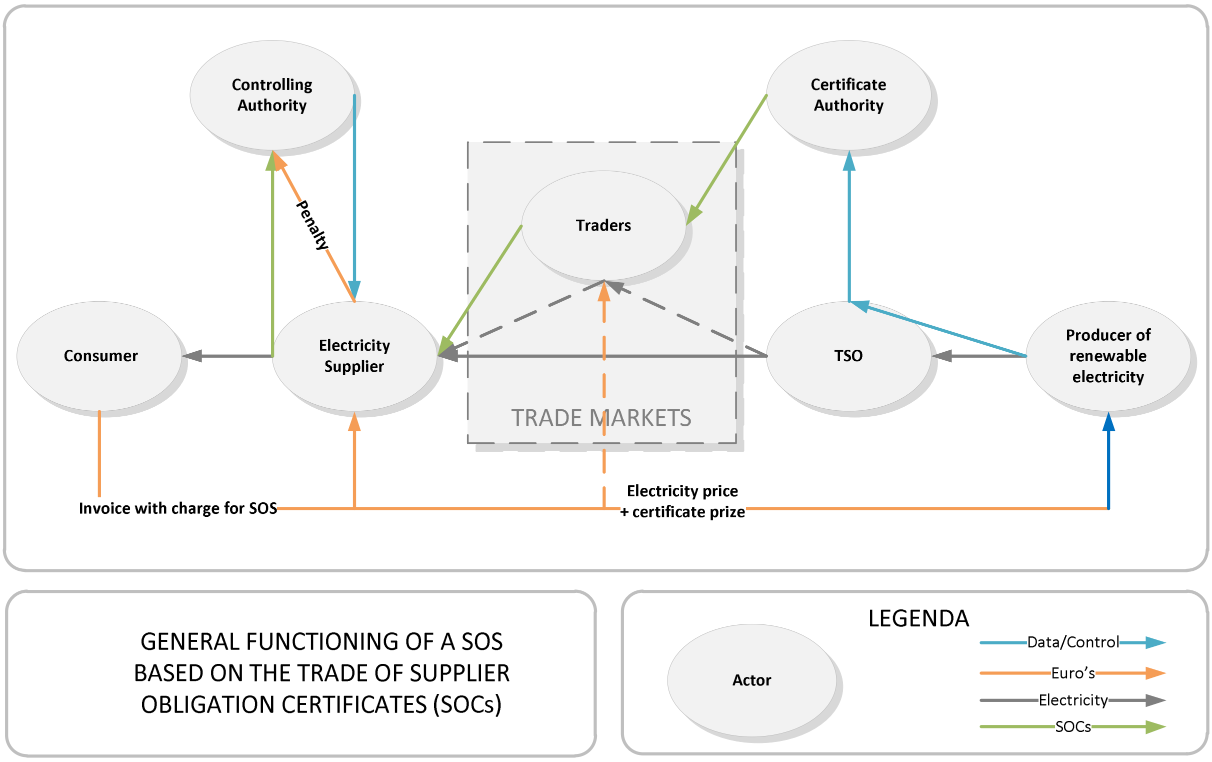


Figure 2.1 General functioning SOS

An electricity supplier sells electricity to its customers. When a SOS is established a supplier is obliged to purchase the quantity of SOCs equal to the quota obligation times its total electricity supply of the previous compliance period. At the end of a compliance period the supplier has to hand in its purchased SOCs to a controlling authority. This authority will control whether the supplier has handed in the satisfying quantity of SOCs. If the supplier has not handed in the satisfying quantity of SOCs and thus has not fully fulfilled its quota obligation, the controlling authority will pose a penalty on this supplier proportional to the degree of unfulfilled SOCs. Suppliers will pass on the cost for complying with the quota obligation to its customers. Every customer will receive an electricity bill that incorporates a contribution for the SOS proportional to the electricity consumption of this consumer. The costs of a SOS will thus directly be financed by the electricity consumers and not through government budgets.

Renewable producers and suppliers meet each other in two markets, namely an electricity market and a SOC market. The processes on the SOC market will largely determine the performance of the SOS, as these processes will set the SOC price. In the height of the SOC a paradox is present. One the one hand the price of SOCs needs to be high enough for generators to invest in new renewable generation capacity. One the other hand the SOC price also determines the affordability of the system for the end consumer. From this perspective the SOC price should be as low as possible.

2.2 Possible key challenges for the design of a SOS

This paragraph will identify the possible key challenges for the design of a SOS that can heavily affect the overall effectiveness, efficiency and equity of a SOS[1]. Based on the knowledge from literature on SOSs (Annex II) can be concluded that the overall effectiveness, efficiency and equity of a SOS is to large extent determined by the degree in which the following matters are realised by the design of a SOS:

- the ability of renewable electricity producers to invests within a SOS
- the ability of suppliers to comply with the quota obligation against a reasonable SOC price
- an equal starting point for all type of energy companies.

For these matters, will be described what aspects in the functioning of a SOS can possible lead to challenges for the design of a SOS.

2.2.1 The ability for renewable electricity producers to invest within a SOS

The effectiveness of a SOS will mainly be determined by the ability of renewable electricity producers to invest in renewable production capacity. The ability of renewable electricity producers to invest is again heavily dependent on the ability of the design of the SOS to reduce the risks for renewable generators that can deteriorate the return on their investments. The following risks for renewable generators within a SOS can be identified that can deteriorate the return on investment. First of all there is a price risk. A price risk is the risk that the market price of certificates is lower than the uneconomic top of renewable electricity generation (Agnolucci 2007). Secondly, a volume risk exists for generators. A volume risk is the risk that the supply of certificates is bigger than the demand and that the generator therefore cannot sell his certificates (Agnolucci 2007).

Price and volume risks for renewable electricity producers will from now on be referred to as market risks. As these market risks can greatly undermine the possibility for a generator to earn back his investment, it will be an important challenge for the design of a SOS to reduce them to an acceptable level in order to prevent underinvestment in a SOS. In this respect, it is important to realise that these risks are increased by regulatory instability. Firstly, regulatory instability makes it difficult for generators to predict the future market conditions and thus the future market risks. Furthermore, it makes the commitment to long-term contracts unattractive, as suppliers and producers cannot predict the future certificate price (Tilburg, Jansen et al 2006). This also enlarges market risks.

2.2.2 Ability of suppliers to comply with the quota obligation against a reasonable certificate price

For the efficiency and equity of the SOS it is very important that suppliers can comply with the quota obligation against a reasonable certificate price. To this respect all the suppliers need to be able to purchase the amount of certificates necessary to fulfil their obligation for a certificate price that closely approaches the difference between the actual costs of renewable electricity generation and the market price for electricity. This sub-paragraph will therefore discuss possible issues that can undermine this ability.

Possibility of market concentration in the SOC market

An aspect that can artificially increase the certificate price is a high degree market concentration in the SOC market. In a SOC market with a limited number of producers or producers with relatively a large share of the total production, a single producer (or a combination of producers) might be able

[1] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme, as was defined in the introduction of this chapter.

to influence the certificate price (del Río 2007). For this reason, market concentration is an indicator for the degree of market power of individual market parties. In a SOS renewable electricity producers with market power might be able to raise prices above the competitive level by strategically reserving certificates from the market and by doing so increasing the scarcity of certificates on the SOC market (del Río 2007). Therefore, the current degree of market concentration in the Dutch renewable electricity supply has to be further assessed in the next chapter. If it indeed would appear that the supply of renewable electricity and thus SOCs will be concentrated at the start of the system it will be an important challenge for the design of the SOS to reduce the possible market power in order to realise an efficient SOS.

Economic rents for certain renewable electricity producers

Furthermore, economic rents for renewable generators in a SOS can undermine the ability of suppliers to comply with the quota against a reasonable certificate price. An economic rent is defined as an excess distribution to any factor in a production process above the amount required to sustain the current use of the factor. A possible cause for economic rents in a SOS is the inclusion of existing capacity. Existing capacity which has received public support through subsidies can already be profitable without extra payments provided by the sales of SOCs (Bergek and Jacobsson 2009). For this reason, the inclusion of existing capacity can lead to economic rents for certain producers (Bergek and Jacobsson 2010).

Furthermore, economics rents can arise due to differences in the production costs due to differences in production technologies for renewable electricity generation. Now the origin of economic rents due to technological differences will be further discussed. In order to do so, it is necessary to first explain the concept ‘merit-order’. A merit-order determines the order in which electrical generation capacity is put into use. Within a SOS the merit-order is a curve that represents the integral production costs of renewable electricity by the eligible production units. This curve consists of different integral costs curves, one for each type of technology. In this respect, the merit-order of production units that are eligible for receiving SOCs will form the supply curve of the SOS, where the quota will form the demand curve of the SOS. The position on the merit-order where the demand curve or quota intersects the merit-order will determine the SOC price, which will be equal to the integral production costs of the marginal production unit. The establishment of the SOC price in the merit-order is illustrated in figure 2.2.

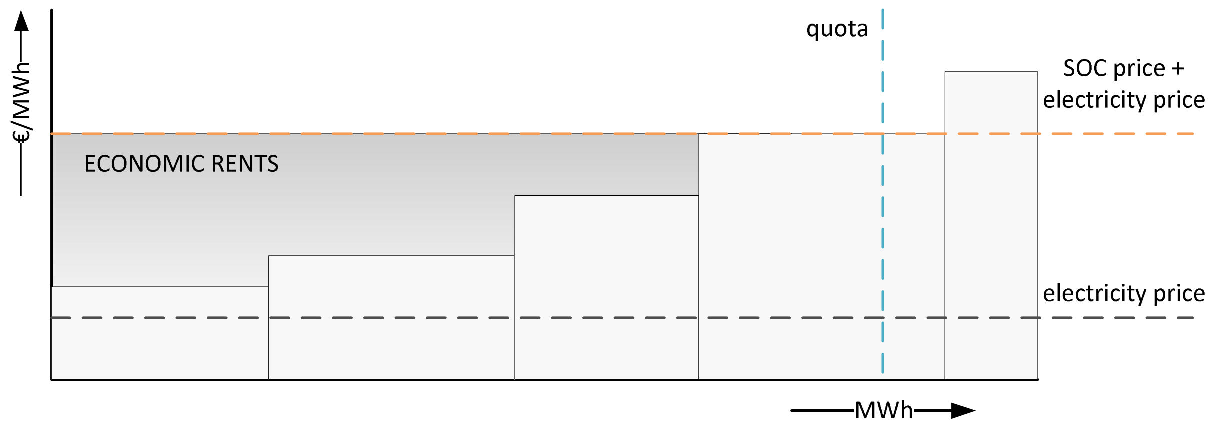


Figure 2.2 Merit-order of production capacity eligible for the SOS

Now the setting of the SOC price will be related to the existence of economic rents for certain renewable electricity producers in a SOS, due to technological differences. As there are differences in integral production costs for different technology classes, the producers that apply a production technology that lies at the left side of the marginal technology will generate economic rents. First of all, the existence of economic rents due to differences in the technology classes creates the core competence of a SOS in comparison with other support schemes for renewable electricity, namely the ability of a technology selection based on market forces instead of government evaluation. Furthermore it creates a continuous incentive for renewable producers to seek cost reduction, which both lead to economic efficiency. However, in a country with a relative steep merit-order the marginal SOC price to achieve the national target laid down in Directive 2009/28/EC can become relatively high. The consequence of a steep merit-order on the degree of economic rents is illustrated in figure 2.2. Figure 2.2 shows that a steep merit-order will result in extensive economic rents for certain producers. This can undermine an even income distribution among the various stakeholders. Furthermore, it can possible reduce the efficiency of a SOS when further use of low-cost technologies to reach the sustainability target is saturated due to physical circumstances. Therefore, in case of a relative steep-merit order it will be necessary to reduce these economic rents to a certain extent by the design of the SOS. For this reason, the projected merit-order for the Netherlands will be further investigated in the next chapter. Lastly, in literature the type of economic rents described here are also often referred as windfall profits (Bergek and Jacobsson 2010; Jansen, Lensink et al. 2011). However, this study will apply the term 'economic rents', as this term provides a more neutral perspective on these type of profits.

2.2.3 Equal starting positions for different type of energy companies

The degree of equity in a SOS will mainly be determined by the equality of starting positions for the different type of energy companies in a SOS. In order to further explore the equality of these starting positions, it important to understand how the different types of electricity companies will relate to each other in a SOS. In the electricity sector there are electricity suppliers and producers. Companies in the electricity sector may act solely as suppliers or producers. These companies will from now on be referred to as supply-only or production-only companies. Furthermore, vertical integrated electricity companies exist. This type of company both produces and supplies electricity. The ratio of production and retail activities is not the same for every integrated company. This diversity has the following impact on the equality of the starting positions of different type of energy companies in a SOS. Firstly, integrated companies will both produce and demand SOCs. Depending on the relative size of their production and supply activities, these companies will have a net demand of supply of SOCs. Furthermore, supply-only companies will only demand SOCs, while production-only companies will only supply SOCs. This division is illustrated in figure 2.3.

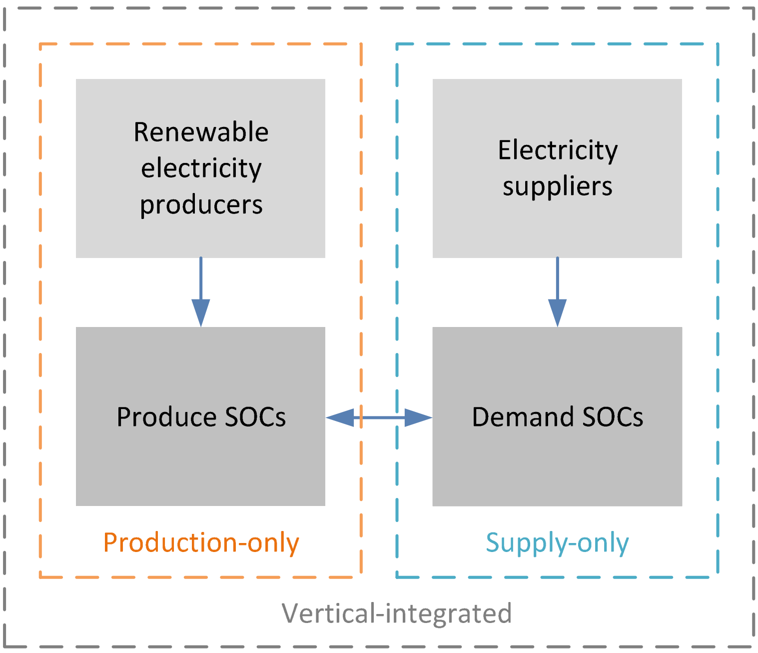


Figure 2.3 Different type of electricity companies connected to their supply and demand of SOCs

From this description can be identified that there are certain competitive advantages for vertical-integrated energy companies in a SOS - depended on the relative size of their supply and production activities - in comparison to production- or supply-only companies. Integrated companies will have the opportunity to internally sell their certificates next to trading them on the SOC market. This creates two advantages for suppliers connected to an integrated company in comparison to supply-only companies. Firstly, integrated suppliers have a guaranteed supply of certificates. Secondly, integrated suppliers can internally purchase SOCs and are therefore less depended on possible price fluctuations on the SOC market, which supply-only companies are. These advantages also exist for producers connected to an integrated company in comparison to production-only companies. Integrated producers have a secured demand for certificates, while production-only companies are fully dependent on the possible sales of SOCs on the SOC market. In order to realise an equal starting point for all type of electricity companies in a SOS, the design of the SOS thus needs to reduce these competitive advantages for integrated companies compared to supply-only and production-only companies. This will therefore be the last key challenge for the design of a SOS.

2.3 Conclusions

This chapter had the objective to answer the following sub-research question:

'What are the basic principles a SOS and possible key challenges for its design?'

Answering this question resulted in a common understanding of the functioning of a SOS and the basic principles in this. Furthermore, it identified the main issues that can affect the overall effectiveness, efficiency and equity of a SOS. Providing answers to these issues will form the key challenges for design. The following key challenges were identified:

- Reduce market risks for renewable electricity producers
- Reduce excessive economic rents for renewable electricity producers due to the inclusion of existing capacity and technological differences in renewable electricity generation
- Reduce the possibility of market power
- Reduce the unequal starting point for different type of electricity companies

With respect to this list of key challenges, the degree in which market power and economic rents from technical differences might be present in a Dutch SOS will be further explored in the next chapter. During the development of the design space in chapter four possible answers to these challenges will be identified. Furthermore, the requirements for design that will be identified in chapter five will have to incorporate these challenges, as the design of a SOS from the perspective of Essent also has to be effective, efficient and fair from a general perspective.

3. ANALYSIS OF THE CURRENT SITUATION

This chapter has the objective to answer the following sub-research question:

> 'How does de the current technical, legal and economic situation in the Dutch electricity sector affect the design of a SOS?'

In order to answer this question a structured understanding is required of how the choices that were made in the past determine the range of choices for the design of a SOS. Therefore, this question will be answered by first describing the relevant aspects of the current technical, legal and economic situation that can influence the design of a SOS. Subsequently, we will analyse how these specific aspects can affect the design of a SOS. This will result in an overview of the preconditions for design, from a technical, legal and economic perspective. Data to answer this research question is mostly retrieved from interviews and supported with findings in literature (Annex I and II).

This chapter is structured in the following way. Paragraph 3.1 will analyse how the technical situation in the renewable electricity sector in the Netherlands affects the design of a SOS. Subsequently paragraph 3.2 and 3.3 will do the same for the respectively the legal and economic situation. In these paragraphs for every aspect of the current situation that can affect the design of a SOS first the current situation will be described followed by an analysis of how this affects the design of a SOS under the heading 'consequences for design'. Paragraph 3.4 will end this chapter by concluding which preconditions for design will affect the design of a SOS.

3.1 Technical environment of a SOS

This paragraph describes the technical aspects of the renewable electricity sector that are relevant for the design of the SOS and will subsequently analyse how these aspects can influence the possibilities for design. Firstly, the current portfolio of renewable electricity generation capacity of the Netherlands will be described and analysed in section 3.1.1. Then, the expected future portfolio and technical developments will be discussed in section 3.1.2, in order to identify the possible technical future that the SOS has to be able to comply with.

3.1.1 Current situation

Current renewable electricity production in the Netherlands

Figure 3.1 shows the total renewable electricity generation in the Netherlands for 2009. This graph shows that in 2009 9,88 TWh electricity from renewable sources was produced, which is 9 % of the total electricity production of the Netherlands (CBS 2010). In addition, this graph shows that the current renewable electricity portfolio of the Netherlands exists of off-shore and on-shore wind power, biomass co-firing, stand-alone biomass conversion, waste conversion, biogas conversion, solar and hydro plants.

There are six electricity companies that produce renewable electricity on a large scale in the Netherlands, namely Essent, Nuon, Electrabel, Eneco, E.On and Delta. In 2009 they together produced 82 percent of the total electricity production from renewable sources (Essent 2010). Essent produced 23 percent of the total renewable electricity production in 2009, which makes them the biggest producer of renewable electricity in the Netherlands. Furthermore Eneco, Nuon, Electrabel and E.On respectively produced 18, 15, 14, 8 and 4 percent of the total renewable electricity production (Essent 2010). The remaining renewable electricity is produced by consortia, cooperatives (of farmers), businesses and households.

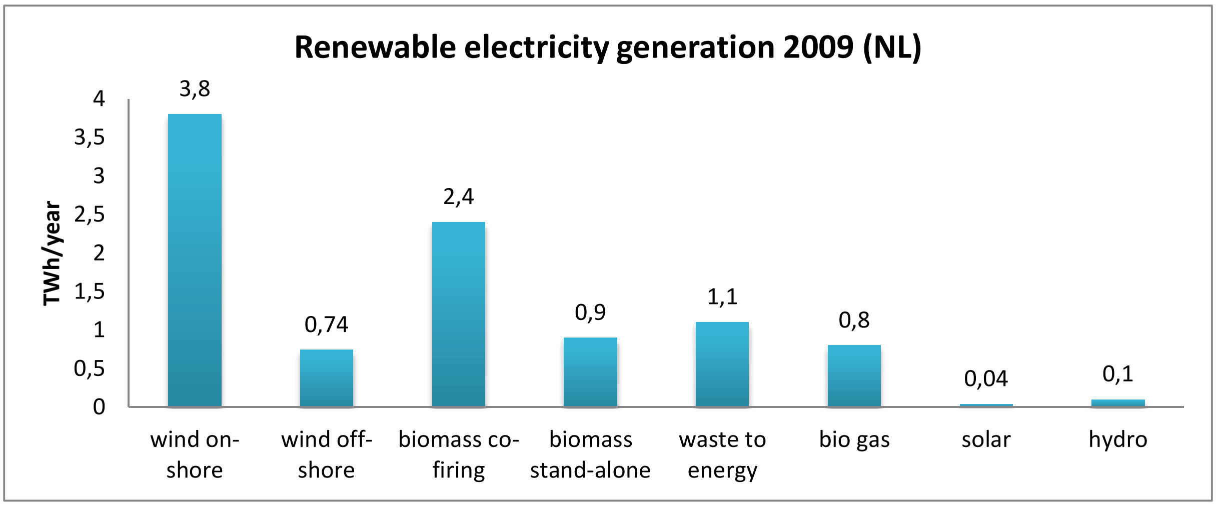


Figure 3.1 Renewable electricity generation in the Netherlands in 2009 (Source: CBS, 2010)

Consequences of design

From the description of the current portfolio the following can be concluded regarding the physical situation at the start of the SOS. Firstly, biomass conversion and wind power will account for the majority of renewable electricity production and therefore will dominate the SOC market at the start of the system. Secondly, it can be concluded that the SOC market will be rather concentrated at the start of the scheme, as currently four market parties possess 70 percent of the total renewable electricity supply. A quantitative study of Koutstaal, Bijlsma et al. (2009) which investigated the degree of market power of producers of renewable electricity in the Netherlands, confirms a moderate degree of market concentration in the current renewable electricity production (Koutstaal, Bijlsma et al. 2009). The challenge for design regarding the reduction of market power identified in the previous chapter thus indeed applies to the Dutch circumstances, at least at the start of the system.

Maturity of technologies for renewable electricity generation

In a SOS different technologies for renewable electricity generation will have to compete with each other on the certificate market. In order to identify how the technologies for renewable electricity production that are currently present in the Netherlands will relate to each other in a competitive market, it is necessary to identify their relative status of maturity. The maturity of a production technology depends on its position in the so-called 'learning curve'. A learning curve represents the average production costs as a function of the accumulated output produced. The principle of a learning curve is thus the reflection of learning-by-doing in lower costs. A learning curve is a self-reinforcing mechanism as a reduction in costs due to learning stimulates further diffusion, which in turn generates opportunities for more learning, which again leads to more possibilities of cost reduction (Bergek and Jacobsson 2010).

Now for each technology that was identified in figure 3.1 its relative position on the learning curve will be described. Before this will proceed, the following remark needs to be made regarding the definition of this position. Junginger (2005) concluded in his research on learning in renewable energy development that in general increase in market share of a renewable energy technology always will lead to further cost reductions. So also for mature technologies it will remain possible to further reduce costs due to learning (Junginger 2005). Based on this notion the descriptions below will apply the following distinction between mature and immature technologies. Mature technologies are technologies that can only realise incremental improvements due to further learning and thus incremental costs reductions. Immature technologies are technologies that can still realise radical improvements due to further learning and therefore also larger cost reductions.

Firstly, the level of maturity regarding all types of bio fuel conversion will be discussed, which are biomass co-firing, stand-alone biomass conversion, biogas conversion and waste conversion. Biomass co-firing is currently applied at a large scale and at a relatively high share in the Netherlands. The experiences that were gained in the realization of this capacity created among other significant insights in the technical consequences of co-firing for the feeding lines and boiler performance (Faaij 2006). This has led to higher conversion efficiencies and lower costs (Mahr 2010). Further improvements regarding biomass co-firing processes will therefore be rather incremental. For this reason it can be concluded that biomass co-firing has realised a relative mature status in the Netherlands (Faaij 2006).

For waste conversion and biogas conversion the same can be concluded as for biomass co-firing. Waste incineration has been proven to be a mature and reliable technology for a complex and heterogeneous feedstock (Faaij 2006; IEA 2006). In the Netherlands newly built installations have an efficiency of 30 % (Faaij 2006). In addition, associated pollutant emissions are effectively controlled with state-of-the-art techniques (IEA 2006). Furthermore, anaerobic digestion is a proven technology for the production of biogas and now used commercially all over the world - especially for waste effluents such as waste water, sewage sludge, and abattoir waste streams, as well as for the biological portion of municipal solid waste (Faaij 2006; IEA 2006). For waste and biogas conversion thus also no further radical improvements are expected. Therefore, these technologies can be considered as relative mature.

The last type of bio fuel conversion is stand-alone biomass conversion. Stand-alone biomass conversion is adopted on a smaller scale than biomass co-firing in the Netherlands. One of the reasons for this it that the complexity of biomass conversion processes described above cannot be balanced by the more stable coal-firing processes, as with co-firing. Therefore, still numerous important lessons have to be learned regarding the handling of the unexpected properties and characteristics that will be experienced during stand-alone biomass conversion (Mahr 2010). From this can be concluded that stand-alone biomass conversion is still a relative immature technology.

Secondly, the level of maturity of both onshore and offshore wind power will be evaluated. Onshore wind power was first implemented as a commercial application in the 1980s. The experiences that were gained since then have extensively reduced the costs for the design and installation of onshore wind mills. Significant improvements in this were the increase in energy output per turbine and the average rated capacity of turbines (Gross, Leach et al. 2003). Furthermore, market growth has brought economies of scale. Due to this onshore wind turbines have become cheaper to produce and install, more efficient and more reliable (Gross, Leach et al. 2003). For this reason onshore wind power can be considered as a relative mature technology for which only incremental cost reductions can be expected in relation to further diffusion of this technology (Gross, Leach et al. 2003). In comparison to onshore wind power, the installed capacity of offshore wind power is relatively low. Therefore, still several lessons can be learned in the offshore wind engineering. Important cost reductions can be realised by gaining economies of scale in the manufacturing of dedicated offshore turbines and the benefits of learning-by-doing regarding the installation, power connection and maintenance of offshore wind turbines (Gross, Leach et al. 2003). Due to these large possibilities of learning offshore wind is still a relatively immature technology.

Lastly, the maturity of solar power or photovoltaic conversion will be discussed. Solar power has already gone through several learning processes, since it first was applied in the 1960s in space engineering applications. Since then conversion efficiencies have risen steadily and production costs have dropped enormously. Currently, two ‘generations’ of PV materials exist. For both ‘generations’ still profound potential for continued improvements in existing module type are expected (Gross, Leach et al. 2003). Furthermore in the long term, a ‘third generation’ of PV materials, currently at the laboratory stage, may be able to deliver even more radical reductions in costs (Gross, Leach et al

2003). This means that solar power can still climb relatively high on the learning curve, which makes it a relatively immature technology.

Consequences for design

From the description above can be concluded that biomass co-firing, biogas conversion, waste conversion and onshore-wind power can be characterized as relative mature technologies which are able to compete with each other on the same level. Furthermore, it was identified offshore wind power, stand-alone biomass conversion and solar power have not reached this level of maturity and therefore cannot compete on the same level. The design of the SOS has to take into account the differences in maturity identified in this section. Furthermore the description above showed that most technologies for renewable electricity production are immature and thus still in development. This technological learning process makes it, at this point in time, uncertain under which costs and efficiencies the different technologies can produce renewable electricity in the future and therefore what their full potential is. Therefore, the design of the SOS has to be able to respond to the changes in the expected potential of technologies for renewable electricity generation.

3.1.2 Technical developments

Future renewable electricity production

The graph in figure 3.2 shows a prognosis of the renewable electricity production in the Netherlands for 2020, divided over the different technologies for renewable electricity generation. This prognosis is made by the Dutch government in the National Action Plan for Renewable Energy of 2010. From this graph can be concluded that the Dutch government expects a large role for biomass conversion and wind power in the Dutch transition towards a renewable electricity production until 2020. The National Action Plan on Renewable Energy 2010 has calculated that 37 percent of the total electricity supply has to come from renewable sources in 2020, in order to realise the target of Directive 2009/28/EC (Rijksoverheid 2009). This leads to a total renewable electricity production of 50,2 TWh in 2020.

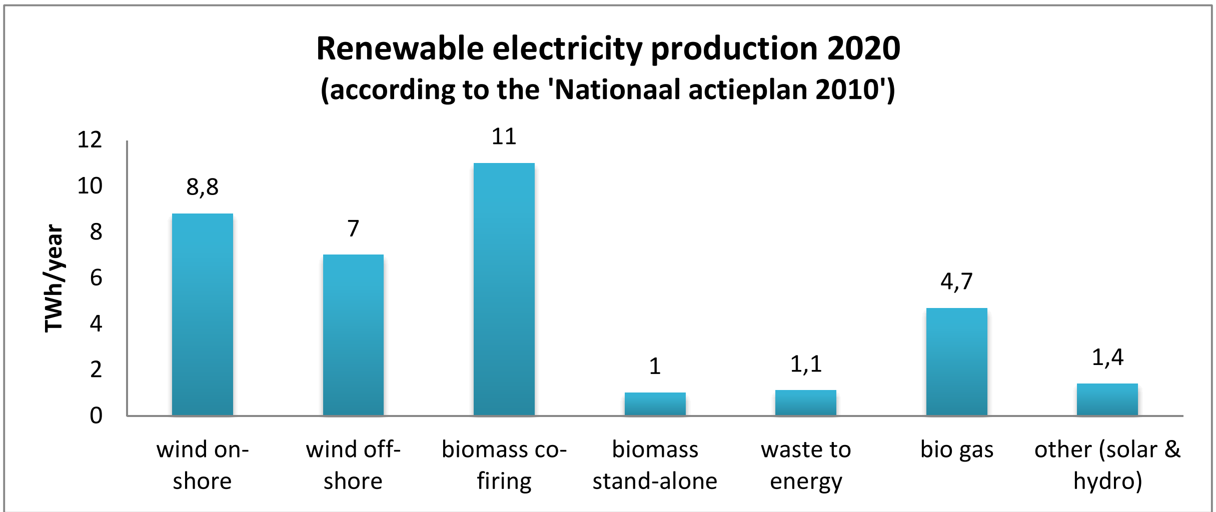


Figure 3.2 Renewable electricity generation portfolio for the Netherlands in 2020 (Rijksoverheid 2010)

After 2020 also other renewable energy technologies can play a role in the renewable electricity supply. These are tidal-, wave- and blue power, which is electricity from the osmoses of salt and sweet water. Tidal energy is currently only implemented on a small scale. Wave and blue energy are still in an experimental phase (Turkenburg 2004). Furthermore, these options are currently still very expensive and do not have a commercially leading design (IEA 2006). In addition, the geographical potential of these technologies is very low in the Netherlands, as there are only a specific number of locations suitable for these technologies. Moreover, the implementation of these technologies will have a big impact on the ecology of the site and possibilities for shipping. Lastly the tides and waves in the Netherlands are not very powerful (Turkenburg 2004). For these reasons it is expected that mainly wind power and biomass conversion will dominate the future transition towards renewable energy in the Netherlands (Jansen and Uyterlinde 2004).

Consequences for design

Wind power and biomass conversion will also dominate the SOC market of the SOS after 2020.

Merit-order of renewable electricity for the Netherlands in 2020

In figure 3.3 the expected merit-order of renewable electricity for the Netherlands in 2020 is shown. This merit-order is based on calculations of Essent regarding the expected production costs of different technologies for renewable electricity generation and the share of the different technologies in the total supply of renewable electricity in 2020. Furthermore, figure 3.4 shows the consequences of combining the target of the government to realise a renewable electricity generation of 50.2 TWh in 2020 - described in the previous section - with the projected merit-order for 2020.

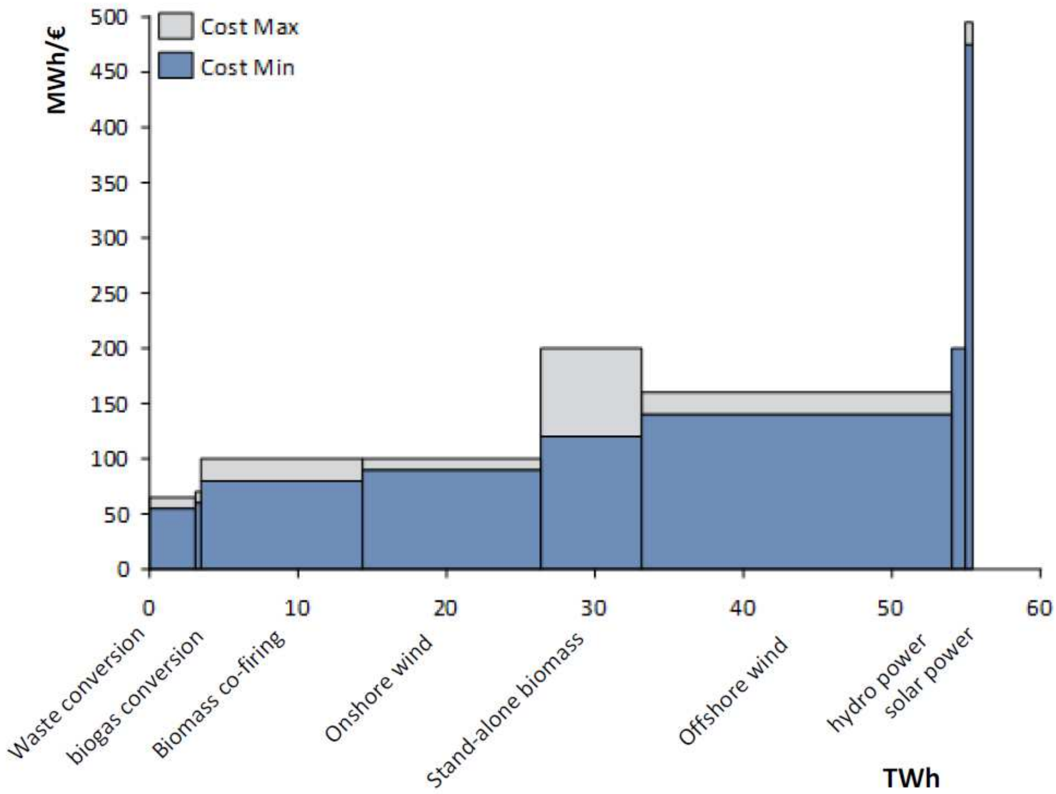


Figure 3.3 Merit-order renewable electricity generation in the Netherlands in 2020 (Essent 2010)

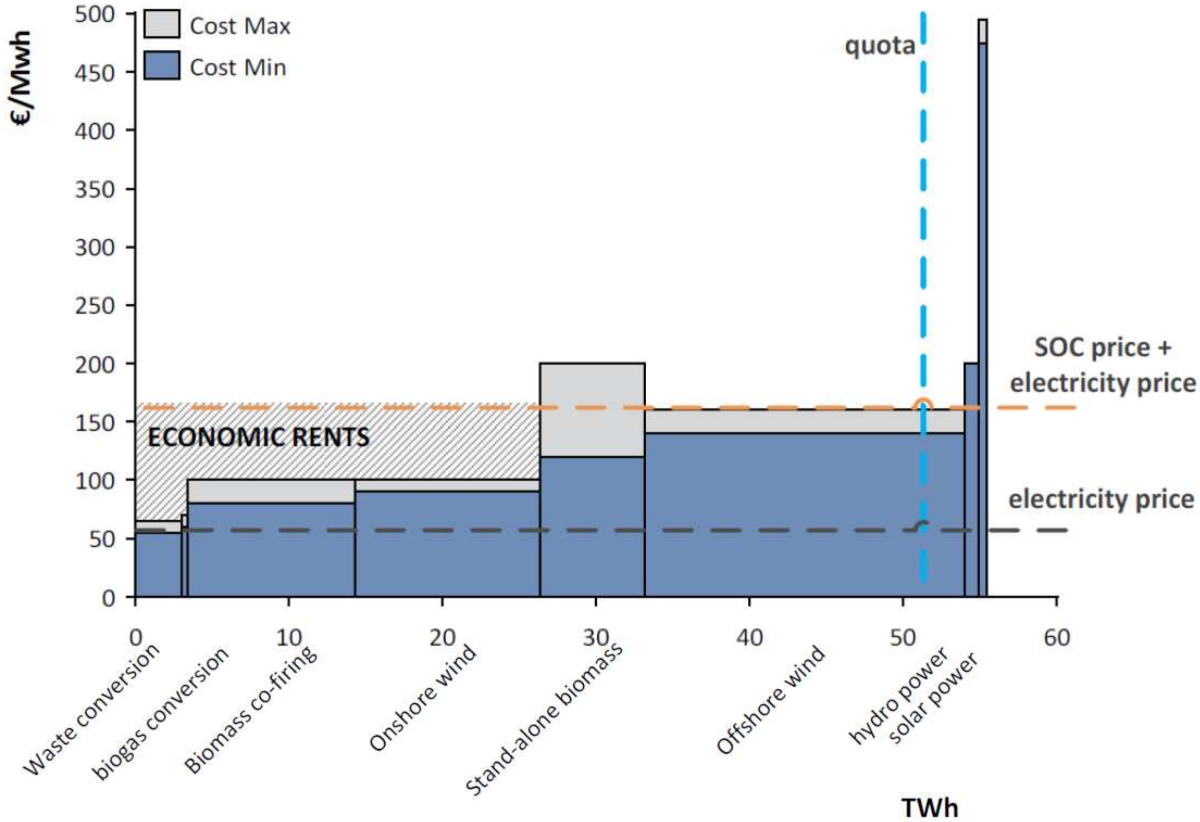


Figure 3.4 Combination of merit-order 2020 and the objective (Essent 2010)

Consequences for design

From figure 3.4 can be concluded that offshore-wind power will likely form the 'marginal technology' in the SOS of the Netherlands in 2020. In this regard it is relevant to observe that producers applying co-firing or onshore wind power might receive a SOC price that is approximately three times higher than the amount required to sustain the current use of their production units. This means that a SOS in the Netherlands will likely create excessive economic rents for certain producers, which can seriously undermine the equity of a SOS in the Netherlands. Furthermore, this can result in a low efficiency of the SOS when further use of low-cost technologies is limited by the physical circumstances[2]. The challenge for design regarding the reduction of excessive economic rents - identified in the previous chapter - will therefore indeed be an important challenge for the design of a SOS, taking into account the Dutch technical circumstances.

The following remark has to be made regarding this conclusion. Firstly, this conclusion is made based on the assumption that national sustainability target will be reached and will not be changed by the Dutch government until 2020. Furthermore, the effect of the introduction of a SOS on development of the renewable electricity production portfolio is not taken into account. However to a certain degree can be concluded that the portfolio will not be totally different, as the possible expansion of biomass conversion is limited by the availability of affordable biomass crops and coal-fired power plants. Furthermore, the possible expansion of onshore wind power is limited by the availability of suitable sites for wind turbines. This means that it is likely that offshore wind power is needed to realise the target of 52 MWh (Lensink 2010). Therefore, for the design of the SOS will be assumed that offshore wind power will likely form the marginal technology in the SOS around 2020.

[2] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme, as was defined in chapter 2.

Intelligent networks and micro generation

Besides technical developments with respect to renewable energy production also technical developments in the electricity networks can have a significant impact on the potential of renewable electricity production in the future. Currently, a new electricity grid design is developed and discussed in the Netherlands and Europe, which integrates automation in the network and accommodates bi-directional power flows (EC 2006). This new grid design is often referred to as an "intelligent network" or "Smart Grid". The transition towards a smarter grid can enable renewable electricity production in the following ways:

- By allowing integration of decentralised production, which make it easier to install solar panels and micro wind turbines on a household level.
- By allowing 'intelligent' charging of electric cars which can function as a decentralised storage system for intermittent renewable energy sources
- By allowing more flexibility in demand as smart meters create more awareness of electricity prices at end-consumers. This results in a better match between generation and load, resulting in a low impact on the electricity network despite a potentially significant level of generation by intermittent sources (Markvart 2006).

Consequences for design

This new grid design will influence the design of a SOS in the following ways. Firstly, Smart Grids will thus enlarge the potential of wind and solar power, as it can provide answers to their intermittent character. Secondly, the development of Smart Grids will enable a bigger share of decentralised renewable electricity production in the total energy production. The SOS can embrace this development by offering micro generators also the opportunity to receive SOCs. Below the implementation of this possibility will be further described.

Prosuming

When households and businesses also become producers of electricity by owning micro generators, the merge of consumers and producers takes place. This is referred to as prosuming (Annex I, interview Romijn). The renewable technologies that are currently used for micro generation by householders and businesses in the Netherlands are solar panels and micro wind turbines (Annex I, interview Eijgelaar). At the moment, prosumers can receive subsidy and renewable electricity certificates for their renewable electricity production. In order to be able to receive this, every household needs to have a special appliance that measures their total electricity production (Annex I, interview Eijgelaar).

Consequences for design

As the infrastructures and procedures to allocate subsidy and certificates to micro generators and smaller decentralized generators are already present, it will organisationally be possible to make relative small renewable generators an eligible source for the SOS. However, as households with a micro generation from solar panels currently on average produce around 850 kWh of electricity per year and the SOC unit will probably start at one MWh, the prosumers have to be bundled in order to participate in a SOS (Annex I, interview Eijgelaar).

3.2 Legal environment of a SOS

This paragraph will describe the former and present European and national laws and regulations that influence the design of a SOS. First the European and national policy measures for the support of renewable electricity will be discussed in section 3.2.1. Subsequently, section 3.2.2 will elaborate on the existing certificate system for renewable electricity.

3.2.1 Policy measures for the support of renewable electricity

European Directive on the promotion of the use of energy from renewable sources

The starting point of the former and present Dutch climate policy and support mechanisms for renewable electricity is Directive 2009/28/EC on the promotion of the use of energy from renewable source and its predecessors Directives 2001/77/EC and 2003/30/EC. In Directive 2009/28/EC mandatory targets regarding the share of renewables in the final gross energy consumption in 2020 for each Member State have been laid down. If implemented, the SOS will have the objective to obtain the target for the Netherlands, which is translated into the target to realise 37 percent of the total electricity supply from renewable sources in 2020. Article 5 of Directive 2009/29/EC states that the gross-consumption of electricity from renewable sources shall be calculated as the quantity of electricity produced in a Member State from renewable energy sources (EU 2009). The purpose of a SOS in the Netherlands is thus to increase the domestic renewable electricity generation, in order to achieve the target set down in the Directive.

Consequences for design

With respect to the design of a SOS, this Directive will have a great impact on the setting of the quota of the SOS, as the quota steers the growth of the gross-consumption of electricity from renewable sources. Furthermore, due to Article 5 of the Directive, the certificates for the SOS can only be allocated to domestic production facilities, as the realisation of the target is measured as the quantity of electricity that is produced in the Netherlands.

Dutch support schemes for renewable electricity production

Based on the Directive described above and its predecessors several support schemes for renewable electricity production were implemented in the Netherlands. For the design of the SOS an important decision will be whether and how to include existing capacity in the system. This possibility will be bounded by the characteristics of the former support schemes, as it is undesired to provide double financial support to renewable generators. At the moment, renewable electricity producers can still receive subsidy from two former feed-in-premium systems, namely the MEP (in Dutch known as Milieu Kwaliteit van de Elektriciteitsproductie) and the SDE (in Dutch known as Stimuleringsregeling Duurzame Energieproductie or SDE). The last MEP subsidy will be remitted in 2016 (Ministerie EZ 2003). The last SDE subsidy will be remitted in 2023 (Ministerie EZ 2007). Furthermore, the SDE will be replaced by a new comparable feed-in-system, namely the SDE plus in 2011 (Ministerie IE&A 2010). Therefore, there are also renewable electricity producers that will receive subsidy from this system at the start of the SOS.

In order to understand whether still subsidized capacity can be included in the SOS without providing two types of support at the same time depends on the ability of the feed-in-system to correct its subsidy tariffs for the SOC price. The MEP is executed with a fixed subsidy tariff for different technology classes (Ministerie EZ 2003). Once the subsidy tariffs of the MEP were set they could not be corrected anymore for fluctuations in electricity and CO_2 prices or other external dynamics during the subsidy term. Therefore, the MEP subsidy tariffs cannot be corrected for the SOC price. The SDE subsidy tariff can however be corrected for the future SOC price, as the SDE subsidy tariffs are yearly corrected for all the elements that can influence the income of renewable energy production, based on Article 14 of the resolution on the SDE (Ministerie EZ 2007).

Consequences for design

As the MEP subsidy tariffs are fixed, it will be problematic to include ‘with MEP subsidized production units’ in a Dutch SOS, because this results in offering double support for these production units. Because the additional income from selling SOCs can be subtracted from the subsidy income within the SDE (Plus) scheme, it will be possible to include ‘with SDE (Plus) subsidized production capacity’,

Harmonisation of European climate policy

At least until 2020, it is not expected that one single European support scheme will be laid down by the European Union (Jansen and Uyterlinde 2004). Instead a more bottom-up approach is currently applied in defining which system is the most appropriate for the stimulation of renewable electricity production on a European level (Jong 2009; Jansen, Lensink et al. 2011). This shift from a top-down approach towards a more bottom-up approach in design of new European legislation is realised by the establishment of regional markets. The general notion behind this is that rules and regulations on several issues have to be developed on a regional basis first before they can be implemented on a European level. In this bottom-up approach new legislation is based on best-practises that arise in Member States or regions. (Annex I, Interview de Jong).

Consequences for design

As on a short-term the harmonisation of support schemes for renewable electricity on a European level is not expected, the design of the SOS must not focus on the possibility of a SOS on a European scale. Regional cooperation between Member States in the realization of the national targets set down in the Directive 2009/28/EC is however encouraged and legally possible. Until a harmonized support scheme will be implemented it is important for Member States to optimize their own support schemes. A well-established and accepted national/regional SOS system can become the basis for a transition towards a European obligation system (Espey 2001).

3.2.2 Certification of renewable electricity

SOSs are executed based on a system of renewable certificates. In the Netherland a system for renewable certificates is already present. This system is applied to prove the supply of renewable electricity to consumers with. These renewable certificates are named Guarantees of Origin (GoO). This paragraph will describe the operation of the GoO system, followed by an analysis of the impact of this system on the possibilities for design. The GoO system origins from Article 5 of the 'European Directive on the stimulation of electricity production of renewable sources' from 2001 (Directive 2001/77/EG) and is translated into national legislation in the 'Electricity Law 1998' and the 'Regulation Guarantees of Origin renewable electricity 2003'. More directions on the issuing of GoOs were laid down in Directive 2009/28/EC. GoOs have the objective and function to prove the renewable origin of electricity. To this regard GoOs only represent the 'sustainability aspect' of the produced electricity and not the physical aspects of the electricity self. This certification of the sustainability aspect of produced electricity is needed for three reasons:

- To serve as a verification of the delivery of renewable electricity to consumers
- To enable trade in renewable electricity
- To serve a means to administer subsidy allocation
- To serve as a means to apply for the exemption of energy tax (Espey 2001; CertiQ 2010)

The GoO system functions as follows. In order to administer for GoOs a renewable electricity producer delivers data on his production to the TSO of the Netherlands, Tennet. This data is send to CertiQ, who is responsible for the issuing of GoOs in the Netherlands. Once CertiQ has certified a kWh of renewable electricity with a GoO, this GoO can be traded on the GoO market. GoOs can be traded on a European level which means that Dutch GoOs can be exported to other Member States and vice versa (CertiQ 2010). A supplier that offers green electricity to its customers, needs to purchase both electricity and GoOs. Once electricity that is coupled to a GoO is consumed by the customer, this GoO is taken out of the market to prevent that it is sold again (CertiQ 2010). A renewable producer thus receives additional income from the sales of GoOs. A GoO is connected to a label, which states the origin of the renewable electricity. The label accompanying the GoO determines the price of a GoO. The prices of GoOs are relatively low because hydro-power is cheap and largely available in Europe and most renewable electricity generation is financially supported by national support schemes.

Consequences for design

Firstly, it is relevant for the design of the SOS to understand that the prices of GoO are relatively low compared to the average uneconomic top of renewable electricity generation in the Netherlands. To this respect the price of GoO will not play a significant role in investment decisions in renewable electricity generation within a SOS. Secondly, as the SOS requires a certification system for renewable electricity, it is relevant to analyse whether the existing GoO infrastructure can be used for the SOS. If the GoOs can also be used in a SOS as a verification of compliance with the quota, depends largely on the framework that is set by the Directive 2009/28/EC. Therefore, this Directive will be further analysed now.

Firstly, paragraphs 1 and 2 of Article 15 can be conflicting with the use of GoOs in a SOS. Paragraph 1 explicitly connects GoOs to the labelling of renewable energy for the purpose of proving renewable sources in the energy mix of the end-consumer (EU 2009). Furthermore, paragraph 2 states that GoOs shall not have a function in terms of a Member State's compliance with the targets laid down in this Directive (EU 2009). When a GoO is applied in a SOS, which has the main objective to achieve compliance with this target, this can thus violate the European law. Another element of the Directive that can restrict the use of GoOs for compliance with the quota set by the SOS is paragraph 9 of Article 15. The SOS is a support scheme with the objective to stimulate the production of renewable electricity within the Netherlands. Therefore the quotas set by the SOS have to be complied with GoOs from a domestic origin. Paragraph 9 states that Member States have to recognise GoOs of other Member States (EU 2009). When Dutch GoOs are used for the verification of compliance with the quota, a Dutch GoO market needs to be established next to the European GoO market. This might be conflicting with paragraph 9 of Article 15. Lastly, paragraph 3 of Article 15 restrains the use of GoOs in a SOS. This paragraph states that the validity of a GoO ends one year after the production of the renewable electricity (EU 2009). This element decreases the possibility of the SOS to allow the banking of certificates. With banking of certificates is meant the possibility to save certificates for another accounting period than the period in which was generated, in order to create more flexibility for producers and suppliers in the certificate market.

From the above can be identified that the use of GoOs for the verification of compliance with the quota can violate the European law. Furthermore it restrains the future flexibility of the certificate market connected to the SOS. Therefore, the option to use GoOs to verify compliance with quota obligation with will not be further taken into account. This means that next to the GoO a new certificate has to be created for the SOS. The certificate that is part of the SOS is referred to a Supplier Obligation Certificate (SOC) in this report. GoOs and SOCs will function in parallel in a SOS. The functioning of the GoO scheme can function as an example of how the certification and issuing of SOCs has to be executed. CertiQ can also have a role in issuing SOCs, as CertiQ already possesses the necessary infrastructures and procedures to issue certificates for renewable energy production (Annex I, interview Lenzen).

In figure 3.5 below the relation of GoOs and SOCs to the total electricity supply of an electricity company is illustrated. GoOs are used to verify the supply of renewable electricity to its consumers. SOCs are used to verify the compliance to a quota obligation with. Furthermore, GoOs are issued on a European level and can be traded on a European level, while SOCs will be issued and traded on a national level. Moreover, the price for a GoO is differentiated per technology, while SOCs have a single price.

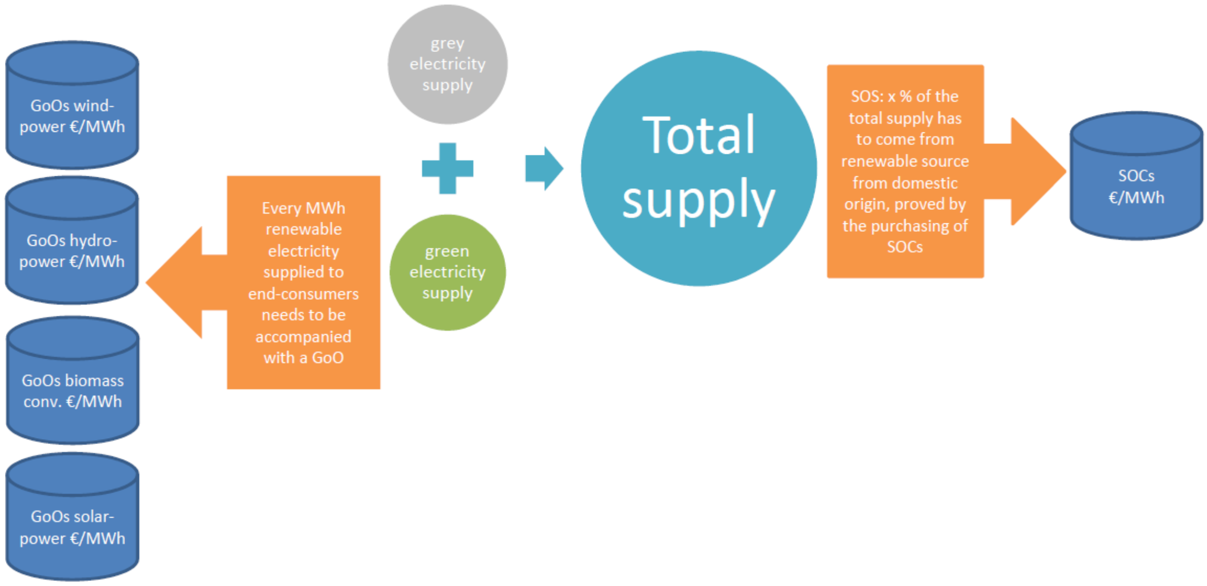


Figure 3.5 Position GoO& SOC in electricity supply

3.2.3 European Emission Trading System

In this section the developments regarding the European Union Greenhouse Gas Emission Trading System (EU-ETS) that can impact the functioning of the SOS will be discussed. EU-ETS has the objective to reduce greenhouse gas emissions. This objective is achieved by certifying the rights on the emission of greenhouse gasses and establishing a limit on the available emissions rights. EU-ETS is laid down in Directive 2003/87/EC and started in 2005 (EC 2010). In 2013 a new trade period will start. In comparison to previous trade periods, the main difference is that the emissions rights will be auctioned at the start of the period instead of given away for free. Furthermore, the limit of emissions rights or 'cap' will be established on a European level instead of determined by the sum of national allocation plans. Both changes can lead to a shift in CO_2 prices from 2013.

Consequences for design

This possible increase in CO_2 prices after 2013 needs to be taken into account in the design of the SOS.

3.3 Economic environment of a SOS

This paragraph will describe the relevant economic aspects of the Dutch renewable electricity sector that can affect the design of a SOS.

3.3.1 Trade in renewable electricity

It became clear from the previous paragraph that trade in renewable electricity exists of trade in electricity and trade in GoOs. In this respect, renewable electricity producers meet customers in a power market and a GoO market. In this paragraph will be described how electricity and GoOs are traded in the Netherlands and how this affects the possibilities for the design of a SOS. In the Dutch electricity market supply and demand meet each other either bilaterally or in voluntary power exchanges. Trade in the electricity sector is dominated by long-term contracting, due to its characterization by large sunk costs and the possibility of price volatility. For this reason about 85% of the electricity is sold in bilateral markets in the Netherlands (Vries, Correlje et al. 2008). The rest of the electricity is sold on a 'day-ahead' power exchange. APX-ENDEX facilitates the power exchange in the Netherlands. In general electricity producers have contracts with customers that demand a certain amount of electricity in the future. This amount is covered party on the bilateral market and with futures and is balanced on the short-term on the spot market APX-POWER NL, in order to divide risks (Annex I, interview Wijnen). The trade in GoOs takes place on a European level and is organized completely bilateral. A bilateral market leads to a non-transparent price. Due to this non-transparency the price of GoOs can fluctuate and be unpredictable. Furthermore, it makes it difficult for new-entrants to determine their trade position (Annex I, interview Wijnen).

Consequences for design

From the above can be concluded that the trade in electricity and GoOs is both dominated by long-term contracting. Short-term trade only takes place to overcome short-term imbalances. This pattern will probably also be seen and required in the SOC market. Furthermore, the current situation in the GoO market shows that a decentralised market design for certificates makes it difficult for new-entrants to determine their trade position. Both need to be taken into account in establishing the market design for the SOC market.

3.3.2 Costs of renewable electricity production

In order to understand how a SOS can contribute to an effective dispatch of all type of technologies for renewable electricity generation, it is necessary to have insight in the different elements of the production costs of renewable electricity generation, which are:

- Capital expenditures (CAPEX): these consist of the investment costs of a new production unit
- Operating expenditures (OPEX): these consist of the costs of raw materials; in this context the OPEX consist of the fuels costs
- Operations and maintenance expenditures (O&M): these consists of the cost made during the operation and maintenance of the production asset

There is a difference in the ratio of these expenditures between wind, solar and hydro power on the one hand and biomass conversion on the other hand. Once installed, wind, solar and hydro power can be collected for free. Therefore, the capital expenditures for wind, solar and hydro plants are relative high, while the operational expenditures are zero. In this regard, the capital expenditures will dominate the resource allocation of wind, solar and hydro power installations (Annex I, interview Romijn). With respect to the resource allocation of these types of plants can thus be concluded that they will aim to operate at the maximum possible load once they are installed in order to earn back their investment. For biomass conversion the operational expenditures are relatively high, as for biomass conversion a continuous supply of biomass crops is required (Jansen 2011). Biomass crops are currently more costly and have a lower energy density than conventional sources. For this reason, biomass conversion cannot compete with fossil fuel conversion at the moment (IEA 2006). Therefore, it can be concluded that also the operational expenditures will significantly dominate the resource allocation of biomass conversion plants

Consequences for design

Due to the CAPEX/OPEX ratio of wind, solar and hydro plants, these types of technologies only require to receive financial support until they have earned back their investment. After this period it will be able to operate the plants based on these technologies without additional financial support, as the OPEX for these technologies is zero and the cost for operations and maintenance can be covered with the market price for electricity. For biomass conversion this is not the case, as biomass conversion requires a continuous supply of relatively costly biomass crops. For this reason, for biomass conversion financial support is required until it is competitive with conventional electricity generation, in order to realise an effective dispatch of biomass production units. These differences in the OPEX/CAPEX ratio have to be taken into account when designing the SOS, in order to be able to realise an effective usage of all type of technologies with a SOS.

3.4 Conclusions on the analysis from the environment

The objective of this chapter was to answer the following sub-research question:

> *'How does de the current technical, legal and economic situation in the Dutch electricity sector affect the design of a SOS?*

This question was answered by describing the relevant aspects of the current situation that can influence the design of a SOS. Subsequently was analysed how these aspects can affect the design of a SOS. This resulted in the identification of the following pre-condition for the design of a SOS from a technical, legal and economic perspective.

Technical pre-conditions

- At least until 2030, biomass conversion and wind power represent the major part of the renewable electricity supply in the Netherlands
- Biomass co-firing and onshore wind power are considered to be relative mature technologies for renewable electricity generation in the Netherlands, while stand-alone biomass conversion, offshore wind power, hydro power and solar power are considered to be relatively immature.
- The supply of renewable electricity is moderately concentrated at the start of the system
- The Netherlands has a relatively steep supply curve for renewable electricity. This can lead to excessive economic rents for certain producers within a SOS.
- There is trend towards more decentralized and micro renewable electricity generation. It is organizationally possible to include renewable micro generation into the SOS, when micro generators are administratively bundled.

Legal pre-conditions

- Due to Directive 2009/28/EC only renewable electricity from a Dutch origin can be eligible for the SOS
- Existing capacity which is still subsidized by the MEP cannot be included in the SOS
- Existing capacity which is still subsidized by the SDE (Plus) can be included in the SOS
- It is not expected that national support schemes will be harmonized on a European level before 2020. Regional cooperation is however encouraged and legally possible.
- CO_2 prices might rise after 2013, due to changes in the EU-ETS after a restart of the system
- The present certificate for renewable electricity (GoO) cannot be applied for the SOS. A separate certificate will have to create (SOC)

Economic pre-conditions

- Trade in electricity and GoOs is characterized by long-term bilateral trading
- Biomass conversion has relatively low capital expenditures and high operational expenditures, where other technologies have high capital expenditures and very low operational expenditures.

These preconditions have to be incorporated when developing the design space for a SOS in the Netherlands. Furthermore, these preconditions need to be taken into account when identifying the requirements for design.

4. THE ELEMENTS OF A SUPPLIER OBLIGATION SYSTEM

This chapter has the objective to answer the following sub-research question:

> 'What are important elements of a SOS and how can these elements be filled in?'

An element is defined here as a component or constituent of a SOS. In order to answer this question, not every possible system element of a SOS will be discussed in the chapter. Instead only the elements that can have a considerable impact on the degree in which a SOS can realise effective and stable incentives for investment will be elaborated here. Furthermore, the realisation of an overall effective, efficient and fair SOS is also in the interest of Essent, as was stated in the introduction[3]. Therefore, also system elements that can contribute to these aspects will be elaborated in this chapter. The complete overview of the main elements that a SOS exists of and the possible options to fill in these elements forms the 'design space' or 'solution space' of a SOS. Answering the sub-research question will thus result in an overview of the design space. During the development of the detailed design alternatives in chapter seven a selection will be made from this 'design space' based on the requirements for design that will be identified in the next chapter. In this respect, this chapter has the function to provide an overview the options for design.

In order to identify the relevant elements of a SOS and the options to fill in these elements, literature is reviewed that discusses the design of a SOS in general. Furthermore, literature is applied that describes and surveys the experiences of existing SOSs in the UK, Belgium, Sweden, Poland, in several states in the US and Australia. Lastly, literature is studied that discusses the general advantages and disadvantages of SOSs (Annex II). This chapter is structured as follows. Firstly, paragraph 4.1 will identify the structure for the development of the design space. The succeeding paragraphs will describe the important elements of the design of a SOS and the options to fill in these elements based on this structure. Paragraph 4.9 will discuss important interdependencies between the system elements that were found during the development of the design space. Lastly, paragraph 4.10 will provide an overview of the design space for a SOS in the Netherlands.

4.1 Categories for the elements of a SOS

The branch of literature that considers the design of SOSs often uses categories to structure and describe the different elements of a SOS. In table 4.1 below an overview of the categories that were applied in these researches is provided. When comparing these categories for the system elements of a SOS, it appears that they have similar components. Based on this similarity and the starting point for incorporating elements in the design space, now a logical structure for the description of the elements of a SOS will be identified.

Firstly, most of the authors incorporated a category that considers the eligible sources for participation. This category describes all the elements that define which facilities for renewable electricity production are eligible for participation in the SOS and will be referred to as 'eligible sources' in this chapter. Secondly, several studies consider the aspects of a SOS that influence the pricing of SOCs. The category structuring this type of system elements will be referred to as 'pricing mechanisms' in this chapter. Thirdly, several categories in literature considered the certification of SOCs. The elements that consider the certification of SOCs and describe how certificates are allocated to generators will be discussed under the category 'certificate allocation' in this chapter. Fourthly, two authors incorporated market organization in their overview.

[3] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme, as was defined in chapter 2.

Author	Categories	Author	Categories
Bennink, Blom et al. (2010)	• Who is obligated? • Height of the target • Allocation of certificates • Price mechanisms • Flexibility mechanisms	**Linden, Uyterlinde et al. (2005)**	• Start date • Obligated actor • Quantitative obligation • Issuing body • Eligible resource • Banking • Borrowing • Minimum price • Penalty for non-compliance
Berry and Jaccard (2001)	• Selection of the target • Eligible sources • Applicability • Flexibility mechanisms • Administrative responsibilities	**Rader and Hempling (2004)**	• Shape the goal • Select eligible sources • Who has the obligation? • Compliance mechanism • Enforcement provisions • Assignment of administrative duties
Espey (2001)	• Target setting, • eligible Technologies, • parties under obligation • design of certificates • market organization • involved institutions,	**Tilburg, Jansen et al. (2006)**	• Who is obligated? • Height of quota obligation • Penalty • Executing bodies • Banking & Borrowing • Minimum price • Who pays the obligation? • Eligible technologies • Inclusion of existing capacity • Term of participation
Langniss and Wiser (2003)	• Renewable energy purchase obligation • Obliged parties • Eligible renewable energy sources • Tracking and accounting method • Regulatory bodies • Enforcement penalties	**VME (2009)**	• Scope • Pricing • Certificate allocation • Trading mechanisms • Governance

Table 4.1 Overview categories for design elements applied in literature on the design of SOSs

The market design of the SOC market is considered as a very relevant aspect in the design of a SOS, considering its equity. For this reason the system elements that consider the market design will be described under the category 'trading mechanisms' in this chapter. Furthermore, almost every author describes the setting of the quota or target. System elements that relate to the setting of the quota will be discussed under the category 'quota definition' in this research. Then, certain authors consider elements that can create more flexibility in the SOC market for market parties. This category will in this chapter be referred to as 'flexibility mechanisms'. Besides these categories, one category will be added that will describe elements of governance of the SOS on a detailed system level. This is done in order to also be able to realise stability of the SOS on the level of the regulation, as was discussed in the introduction. The category that will consider these elements is called 'governance'. An important element in this category is the allocation of administrative responsibilities to the different executing bodies within a SOS. Table 4.1 shows that several authors have also incorporated this element in their system overview.

Lastly, literature often applied a category concerning the 'obliged parties'. Possible obliged parties for a renewable obligation system are electricity suppliers, producers and consumers. In this chapter this category will not be added for the following reasons. Firstly, this research already delineated the obliged parties to electricity suppliers. With respect to the obligated parties in a SOS, literature often discussed whether electricity that is supplied to the electricity intensive industries also has to be included in a SOS. An answer to this question does not contribute to degree in which incentives for investment or an overall performance of the scheme are realised. For this reason, it is not relevant to further investigate the system elements that consider the obliged parties. In most SOSs other European Member States the electricity-intensive industry is excluded from the obligation in order to maintain their international competitiveness (Bennink, Blom et al. 2010). Therefore, it is assumed here that the obliged parties in this research are electricity suppliers, with an exception for electricity that is supplied to the electricity intensive industry. Furthermore, this means that the following categories remain and will structure the description of the design space of a SOS:

- Eligible sources
- Price mechanisms
- Certificate allocation
- Trading mechanisms
- Quota definition
- Flexibility mechanisms
- Governance

The following paragraphs of this chapter will describe per category the relevant elements that are present here. Berry and Jaccard (2001) state that the different elements of a SOS are interrelated and should not be considered in complete isolation. So although the different elements of a SOS are described separately here, it has to be realised here that choices in certain system elements will limit and influences choices in other system elements.

4.2 Eligible sources

In this paragraph the system elements that define which type of renewable production units are eligible for participation in a SOS will be discussed.

Inclusion of immature technologies

Chapter 2 identified that extensive economic rents for certain producers in a SOS can result in a low equity of the SOS. Furthermore, chapter 2 explained that extensive economic rents can result in a low efficiency of the SOS when further use of low-cost technologies is limited by the physical circumstances. In this regard, chapter 3 revealed that due to the relative steep supply curve of renewable electricity in the Netherlands, certain producers will earn extensive economic rents in a Dutch SOS. Therefore, a key challenge for the design of a Dutch SOS it to reduce economic rents due to technological differences. A manner to do this is by excluding immature technologies from the SOS and implementing a separate system to support the further innovation of these technologies (Berry and Jaccard 2001). Figure 4.1 illustrates the effect of this measure on degree of economic rents. As the production costs of the relative mature technologies lie closer to each other, the exclusion of the immature technologies will reduce the economic rents due to technological differences to a large extent.

Chapter three identified that biomass co-firing, onshore wind power, waste and biogas conversion are relatively mature technologies. Furthermore, stand-alone biomass conversion, offshore wind power and solar power were identified as relative immature technologies. For this reason, the decision to include or exclude immature technologies will extensively affect the size of the certificate market, as stand-alone biomass conversion and offshore wind power are expected to form a large part of the renewable energy supply in 2020. The reduction of the potential size of the certificate market by excluding immature technologies might reduce the liquidity and market efficiency of the certificate market. The liquidity of the certificate market is defined here as the speed with which a buyer or seller of certificates can be found in the market and a transaction can proceed without influencing the certificate price (Tilburg, Jansen et al 2006). Therefore, the effect of excluding immature technologies on the liquidity of the SOC market needs to be taken into account when making this decision. For now the following parameter for the design of a SOS can be identified.

ELEMENT 1: INCLUSION OF IMMATURE TECHNOLOGIES
E1A: separate system for immature technologies
E1B: immature technologies are included in SOS

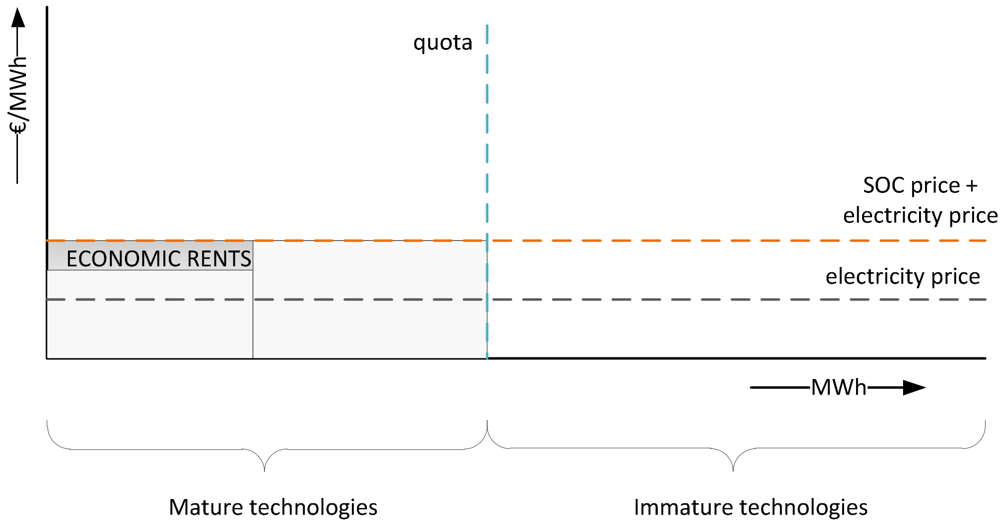


Figure 4.1 Merit-order of SOS that applies a separate system for immature technologies

Level of inclusion of micro/decentralised installation

Some SOSs implemented in other countries have an upper limit with respect to the size of the resources eligible for the SOS (Berry and Jaccard 2001). Such a size limit would prevent renewable micro installations from participating in the SOS. The advantage of a size limit is that it can reduce the transaction costs of the SOS. The disadvantage of size limits is that it reduces the possibilities for small scale distributed renewable electricity generation. Furthermore, a size limit reduces the possibilities to diminish market concentration in the certificate market. Therefore, it needs to be assessed at which scale the transaction costs of participation of micro generation in a SOS can outweigh the benefits of participation, described above.

In paragraph 3.1 became clear that micro-generators need to be administratively bundled, in order to make participation in a SOS possible. Electricity companies can play an important role in this bundling of micro-generators or prosumers. Electricity companies can register new micro-producers at the certificate authority, connect the SOCs of the micro-producers to their trade-account and trade the SOCs on a central level on behalf of these micro-producers. Furthermore, the certification and appraisal of participation in the SOS is operated by the certificate authority and the DSO. In this regard, the inclusion of micro generation in a SOS does not increase the administrative pressure for the central government. Moreover, it will not require a lot of additional investments to include micro generators, as the existing infrastructures and procedures for the allocation of SDE to micro-producers can also be used for the allocation of the SOCs to micro-producers. (Annex I, interview Eijgelaar; interview Lenzen). Lastly, this possibility can provide new commercial opportunities for electricity companies, as it is a manner to attract new customers and make a margin on the sales and installation of micro installations. Therefore, the following elements must be added to the design space of the SOS.

ELEMENT 2: INCLUSION OF MICRO-GENERATION
E2A: full inclusions of micro installation
E2B: exclusions of micro installation < x MW
E2C: full exclusion of micro installations

Level of inclusion of existing renewable capacity

Another design element is to decide whether to include existing facilities in the system. Regarding this element, it is assumed that all existing capacity already received some kind of government support, as without additional support renewable electricity generation is in general not competitive in the Netherlands (Jansen and Uyterlinde 2004). Including existing capacity leads to an enlargement of the market volume for certificates. This is favourable because it creates more liquidity from the start of the system. However, existing facilitates fall or have fallen under support schemes, which can undermine the existence of a level-playing field for new plants. Furthermore, it will also create economic rent for existing plants (Espey 2001; Bergek and Jacobsson 2010; Bennink, Blom et al. 2010).

To this the following needs to be noted. First of all there is a difference between facilities that still receives subsidy or that have passed its subsidy term at the start of the SOS. For the first can be concluded from chapter 3 that the MEP subsidy tariff cannot be corrected for the certificate price, while the SDE (Plus) subsidy tariff can. Therefore, capacity which is still subsidized by the SDE can be included in the system for the term that is still left under the SDE, without conflicting with the existence of a level playing field in the certificate market. Inclusion of capacity of which the subsidy term is passed at the start of the SOS (for both the MEP and SDE) will however lead to economic rents for those generators.

Furthermore, in Australia a baseline principle was introduced that allows inclusion of existing capacity and also reduces economic rents due to double support (Mac Gill, Outhred et al. 2006). This principle can also be applied in a Dutch SOS for plants for which the subsidy term is passed and functions as follows. For existing plants a baseline is established and only the generation beyond this baseline within a compliance period can earn SOCs. The baseline of an existing plant is set at the average production of this plant in the years preceding the SOS. New plants are given a zero-baseline. In this way the baseline ensures that the SOS only rewards ‘additional’ generation beyond that prior to SOS’ introduction (Mac Gill, Outhred et al. 2006).

This leads to the options shown below. In the evaluation of these parameters a trade-off will have to be made between the required liquidity of the certificate market versus the existence of a level playing field and reduction of rents for producers with existing capacity. Furthermore, the differences in the ratio of capital and operational expenditures between biomass conversion and other technologies for renewable electricity generation have to be taken into account when assessing these options. From this perspective can be observed that existing biomass plants cannot continue their operation without inclusion in the SOS, while existing wind- and solar power plants can continue their operation without inclusion in the SOS.

ELEMENT 3: INCLUSION OF EXISTING CAPACITY
E3A: Exclude MEP subsidized capacity and SDE subsidized capacity of which the subsidy term has ended
E3B: Include existing capacity with a baseline principle
E3B: Fully include existing capacity, except for capacity which is still subsidized under the MEP scheme

4.3 Price mechanisms

In this paragraph the elements that affect the price setting of the SOC will be described. Elements that directly affect the SOC price are the introduction of a price floor, a price cap and complementary financial support for immature technologies in a SOS. Price floors and caps are realised by introducing a minimum and maximum price for certificates. Maximum prices are set by the height of the penalty which is posed to suppliers for not complying with the obligation. For every certificate deficit a penalty has to be paid which is set by the penalty price. Thus, once the price of certificates will exceed the penalty price, suppliers will chose to pay the penalty instead of certificates. This makes the penalty price the maximum price. The position of the minimum certificate price and the penalty price is shown in figure 4.2.

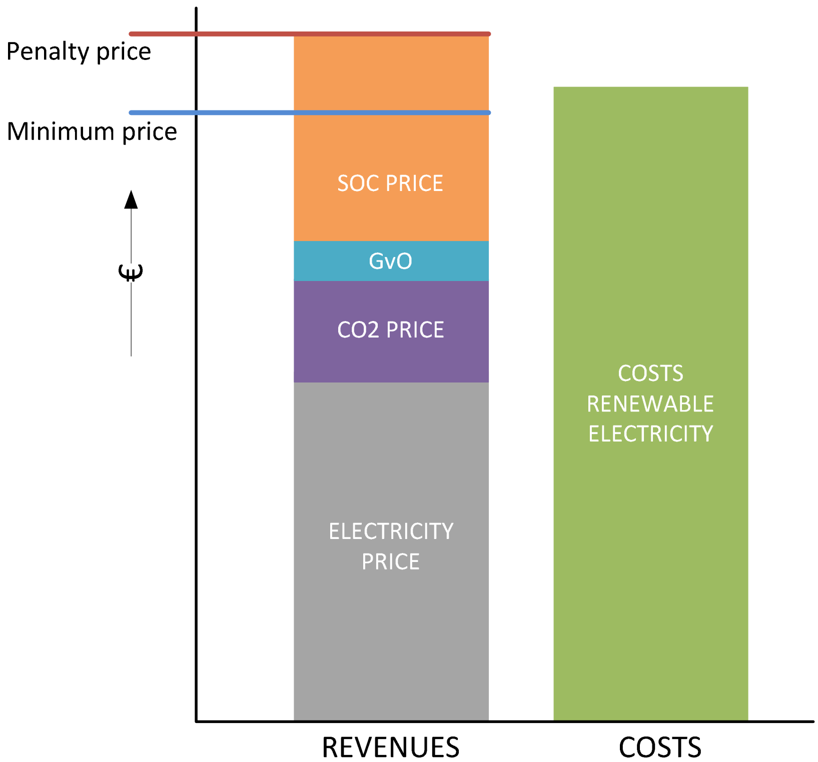


Figure 4.2 Costs and benefits in SOS

Minimum price certificates

In the situation where there is more renewable electricity generated than needed for meeting the quota, the price of the certificates can become lower than what is required to compensate for the costs of production (Espey 2001). For this reason, the establishment of a minimum price for SOCs can secure a return on investment for renewable generators (Bennink, Blom et al. 2010) (Annex I, interview Mortier). The implementation of a minimum certificate price is executed as follows. A generator can choose whether he wants to sell his certificate on the SOC market and receive the market price or offer his certificate to the market-maker and receive the minimum price. This decision will depend on the market price of the SOC. For example, in Belgium the market-maker is the TSO or DSO. The TSO/DSO pays the minimum price to the generator and then offers the certificates to the highest bidder on the certificate market. The costs of being a market-maker are added to the transmission/distribution costs (Annex I, interview Mortier). In this way a minimum price in a SOS effectively functions a fixed feed-in-tariff financed by the consumer (Bennink, Blom et al. 2010). In Belgium the total costs of the minimum price for the consumer lay at five percent of the total transport costs (Annex I, interview Mortier).

In order provide sufficient security by the minimum price, the minimum price needs to be allocated to a specific production unit for a pre-defined term, like in the current subsidy schemes (Annex III). This can be done by establishing the minimum price per production unit on a contract basis with the market-maker. This will oblige the market-maker to offer the minimum price for the pre-defined period despite possible changes in the system. Furthermore, the minimum price will exist of a pre-defined base tariff and a correction tariff which can be yearly adjusted based on the present electricity and CO_2 prices, like in the SDE, in order to provide more adaptability to changes in the environment (Annex III). This also enables to respond to a possible increase in CO_2 prices from 2013, which was defined as a precondition for design.

Furthermore, in the establishment of a minimum price also an option to reduce economic rents due to technological differences can be found, by differentiating the height of the minimum price per technology based on their production costs. Figure 4.3 illustrates how the provision of differentiated minimum prices reduces economic rents. Belgium has implemented differentiated minimum prices in their SOS (Annex I, interview Mortier).

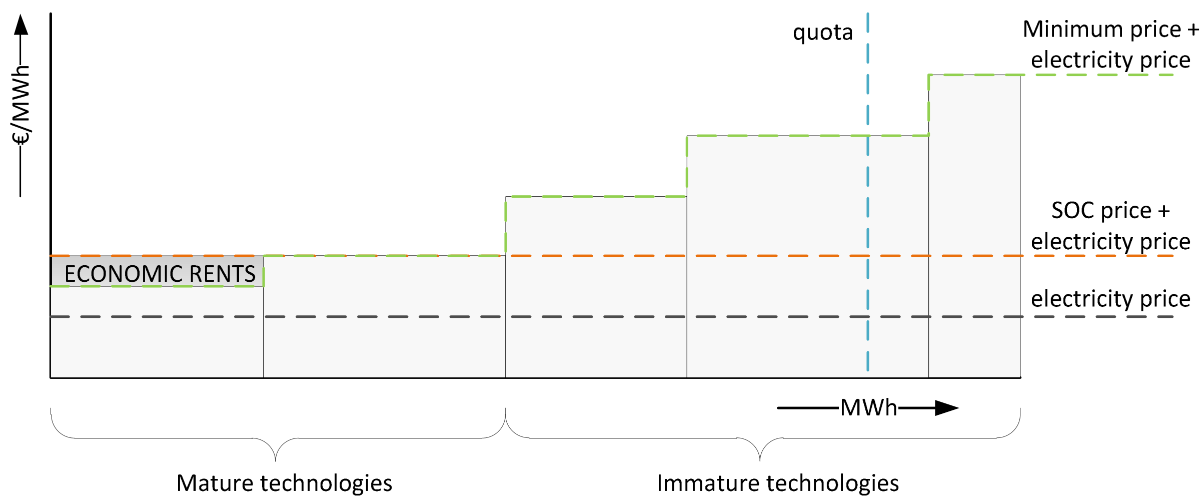


Figure 4.3 Effect of the establishment of a differentiated minimum price on the degree of economic rents

ELEMENT 4: MINIMUM PRICE
E4A: No minimum certificate price
E4B: A single minimum certificate price for all technologies, which is yearly corrected for the CO_2 and electricity prices.
E4C: A per technology differentiated minimum certificate price, which is yearly corrected for the CO_2 and electricity prices and production costs of the technologies

Penalty price

A penalty has two functions. Firstly, it provides a maximum value for the certificate price. Secondly, it stimulates the compliance with the quota set by the SOS (Agnolucci 2007). Therefore, a paradox is present in setting the height of the penalty. On the one hand it is important that the penalty price creates sufficient incentive for suppliers to comply with the obligation. On the other hand the penalty price also needs to be able to constrain price volatility, in order to secure the affordability of electricity (Espey 2001). To realise a balance between these two functions of a penalty several options are possible. Firstly, it is possible to set a fixed penalty price. Secondly, it is an option to set the penalty price as a percentage of the average certificate price. For the fixed penalty price it will also be important to yearly correct it for the average certificate-, electricity- and CO_2 price. This leads to the following options to fill in the parameter.

ELEMENT 5: PENALTY PRICE PER UNPAID CERTIFICATE
E5A: A penalty price based on a percentage of the average certificate price of the previous compliance period
E5B: Fixed penalty price, which is yearly corrected by the average certificate-, electricity- and CO_2 price

Complementary financial support for immature technologies

Chapter 2 identified that the existence of extensive economic rents for generators due to technology differences can be damaging for the equity and efficiency of a Dutch SOS. In this chapter it became clear that these economic rents can be reduced by excluding immature technologies from the SOS and implementing a separate system to support the further innovation of these technologies. However, when immature technologies are excluded from the SOS, the liquidity of the future certificate market might be insufficient. Therefore, it is another option to include immature technologies in the SOS, but to add complementary financial support for immature technologies. Figure 4.4 illustrates how additional support for immature technologies within a SOS can reduce economic rents. The additional support ensures that the certificate price will not be set by production costs of immature technologies but by the production costs of mature technologies, while the certificates of the immature technologies will still be added to the market size.

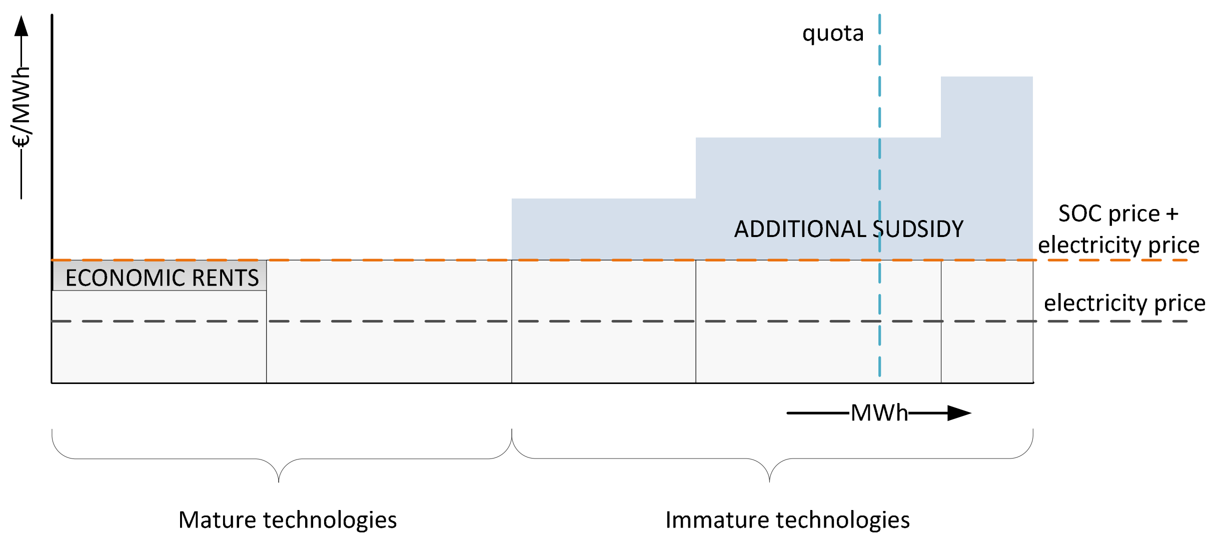


Figure 4.4 Effect of additional support for immature technologies within a SOS on the degree of economic rents

When financial support for immature technologies is added to a SOS, this SOS is defined as a 'hybrid SOS'. A hybrid SOS will function as follows. In the SOS resolution will be laid down which technologies are eligible to receive additional subsidy. In chapter 3 was identified that currently offshore wind power, stand-alone biomass conversion, solar power and hydro power are relatively immature technologies in the Netherlands. A hybrid system in the Netherlands will thus lead to a SOS in which additional financial support will be available for these technologies until they can also compete with the mature technologies. The subsidy tariffs will be equal to the production costs minus the electricity, CO_2 and SOC price. For the additional subsidy has to be determined whether it will be paid by the end-consumer or the government. Furthermore, the allocation of the subsidies has to be defined. The main objective of the additional support is to realise innovation of immature technologies. Therefore, the subsidies need to be capped. This can be done by tendering new renewable electricity capacity by the government or to create a cap on the available budget for the subsidies. Furthermore, the complementarily support be executed under SDE Plus scheme or by a new subsidy scheme. This leads to the following options to fill in this parameter.

ELEMENT 6: COMPLEMENATRY SUPPORT MEASURES FOR IMMATURE TECHNOLOGIES
E6A: Hybrid SOS with SDE Plus support
E6B: Hybrid SOS with new subsidy system, which is financed by end consumer and capped by a tender system
E6C: Hybrid SOS with new subsidy system, which is financed by the government and capped by a tender system
E6D: Hybrid SOS with new subsidy system, which is financed by the end consumer and capped by a fixed budget
E6E: Hybrid SOS with new subsidy system, which is financed by the government and capped by a fixed budget
E6F: SOS without complementary support measure for immature technologies

4.4 Certificate allocation

This paragraph will discuss the system elements that consider the certification of SOCs and describes how certificates can be allocated to generators. Firstly, the possible options to define the unit base of certificates will be elaborated. Then the possibility of differentiating the certificate allocation for different technology classes will be considers. Lastly, the term on which certificates will be allocated to a specific production unit will be discussed.

Unit base certificates

Certificates can be denominated in MWh or in avoided CO_2 emission. For the last option the establishment of an appropriate method for defining the CO_2 abatement for each technology is very important (Espey 2001). The actual CO_2 abatement per technology might be difficult to define, as the different renewable technologies replace different fossil fuels. Furthermore, the calculation of the CO_2 emissions that origin from the production of the assets self can be ambiguous (Espey 2001). These difficulties need to be balanced with the advantages of the use of CO_2 as unit base for certificates. For the now the following options for this element can be identified.

ELEMENT 7: UNIT BASE CERTIFICATE
E7A: 1 certificate per MWh renewable electricity generation
E7B: 1 certificate per metric ton avoided CO_2 emission

Differentiation in certificate allocation for the level of maturity of technologies

In the UK the certificate allocation is differentiated by the level of maturity of the technology and the associated production costs for electricity generation with this technology (Bennink, Blom et al. 2006). The further the renewable technology is derived from market introduction, the higher the amount of SOCs is that can be received per MWh of renewable electricity (Bennink, Blom et al. 2006). Figure 4.5 illustrates how a differentiated certificate allocation can reduce economic rents.

> ELEMENT 8: DIFFERENTIATION IN CERTIFICATE ALLOCATION
> E8A: undifferentiated certificate allocation
> E8B: certificate allocation based on the maturity of the technology

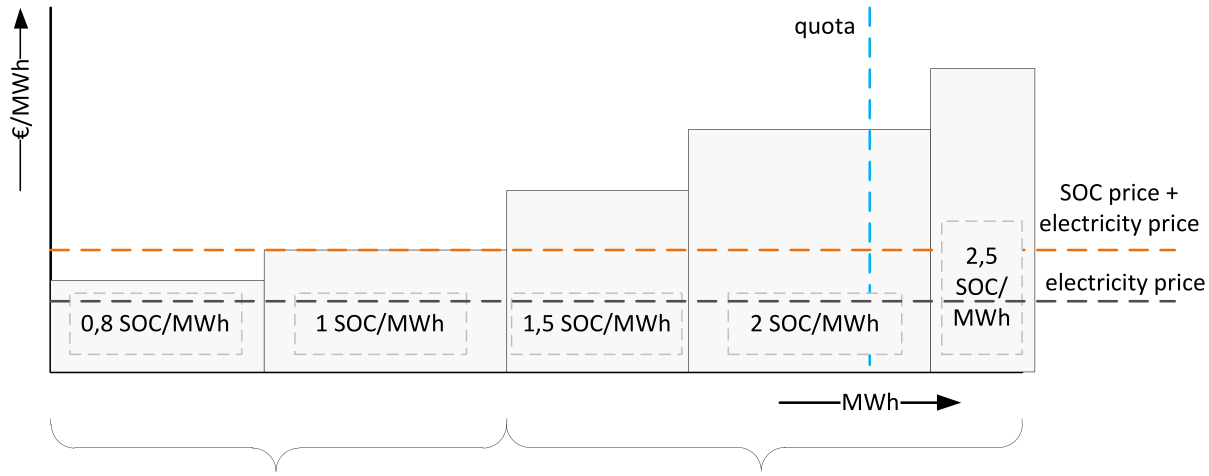


Figure 4.5 The effect of differentiated certificate allocation on the degree of economic rents

Term of certificate allocation per production unit in a SOS

In most SOSs applied in other countries the duration of participation of a production unit is limited by a period of 10 to 15 years (Bergek and Jacobsson 2010). The disadvantage of limited participation is that it can drive up the certificate price (Tilburg, Jansen et al. 2006). However, an unlimited participation can also lead to support of renewable electricity production that is already profitable. From this perspective a limited certification allocation is preferred. Furthermore, the difference in the ratio of capital and operational expenditures of biomass conversion in comparison to this ratio of other technologies for renewable electricity generation has to be taken into account here. Biomass conversion needs to be able participate in the SOS until it is competitive with fossil fuel conversion due to its relative high operational expenditures, while wind- and solar power need to be able participate until their investment is earned back due to their low operational expenditures. From this can be concluded that if the participation of an asset in the SOS will be limited, biomass conversion plants must be allowed to participate multiple terms, if an effective stimulation of biomass conversion within a SOS is desired. From this perspective is might be required to differentiate the duration of participation in the SOS per technology.

> ELEMENT 9 TERM OF CERTIFICATE ALLOCATION PER PRODUCTION UNITS
> E9A: ‘x’ years of participation per asset
> E9B: duration of participation per assets is differentiated per technology
> E9C: Unlimited duration participation

4.5 Trading mechanisms

This paragraph will discuss the possibilities for the market design of the SOC market.

Market design

There are different types of market designs possible to organize the trade of SOCs. The trade of SOCs can take place through exchanges, auctions, tenders and bilateral. In chapter two several challenges for design were identified that can be tackled by the right market design for the SOC market. These are:

- The reduction of an unequal starting position for different type of electricity companies in a SOS; competitive advantages for integrated power companies
- The reduction of market risks for renewable generators
- The reduction of the possibility of market power

Furthermore in chapter three different preconditions for design from the current situation were identified that have to be embrace by the market design. These are:

- pattern of long-term trade in electricity and GoO market
- relative small size of the SOC market at the start of the system

Now per aspect will be described how the market design can approach this.

Competitive advantages for integrated power companies

Firstly, it is important to determine whether the trade of SOCs needs to take place on a central platform or that it is also allowed to trade SOCs bilaterally (Agnolucci 2007; VME 2010). For the last option there are competitive advantages for vertical integrated companies, as they can better secure the sales and acquisition of SOCs than respectively production-only and supply-only companies. An obliged central trade platform will make it impossible for integrated companies to internally transfer certificates and therefore diminish the advantages described for above.

Market risks renewable generators

Furthermore, choices in the market design can affect the degree of market risks for producers of renewable electricity and therefore determine the attractiveness of the investment climate within a SOS. A market design that can reduce market risks is a mandatory tender structure, in which supplier are obliged to enter into long-term contracts (Agnolucci 2007; del Río 2007). The framework for this tender system can be partly copied from the European Directive on public procurement (Directive 2004/17/EC). In the tender system a producer who has an investment plan for a new renewable electricity production unit is obliged to give notice of this. Based on pre-defined rules, suppliers can respond to this with a specified offer. Subsequently, the producer has to select the best offer, based on pre-defined and public criteria for selection. In this respect, an obliged tender structure for long-term contract leads to a kind of feed-in-system in which the market will pay the tariffs. It is important to realise that the possibility of this option is restrained by the stability of the scheme, as the SOS has to be stable enough for market parties have to be willing to close long term contracts. In the UK frequent changes in the SOS lead to medium- and long-term uncertainty in the price of renewable electricity. For this reason, most contracts are negotiated for a relative short-term in the UK (Lipp 2007).

Reduction of possible market power

Furthermore, obliging to tender long-term contracts will also reduce the possibility of market power, as all SOCs are allocated on beforehand and cannot be strategically reserved (Agnolucci 2007).

Pattern of long-term and bilateral trade in electricity and GoO market

From chapter three can be concluded that long-term trade dominates the electricity sector due to its characterization by sunk costs and price volatility. Short-term trade in the electricity sector only takes place to overcome short-term imbalances. This pattern will probably also been seen in the SOC market. This notion is confirmed by experiences in Belgium in which 95 percent of the certificates is traded on a long-term basis (Annex I, interview Mortier). In order to embrace this pattern in the market design of the SOS, the market design has to provide the possibility of long-term trade. Furthermore, a short term spot market might still be needed to solve short term imbalances.

Size of the market

The possibilities in the selection of a market design are constrained by the number and behaviour of market parties (Espey 2001). Trade through auctions and tenders will be appropriate in a market with a small number of participants. When the trade volume is large enough, SOCs can also be traded on exchange platforms. From this can be concluded that different options could be optimal for the SOS depending on the age of the SOS, as the certificate market will grow during its existence.

The possibilities to tackle the key challenges for design and embrace the pre-conditions for design by the market design described in this sector have to be taken into account when selecting the most suitable option to organize trade in SOCs, in chapter 7. For now the following options to fill in the organization of trade can be identified.

ELEMENT 10: ORGANISATION OF TRADE
E10A: Bilateral trade
E10B: Voluntary auction moments
E10C: Mandatory auction moments
E10D: Mandatory tenders for long-term contracts
E10E: Voluntary exchange market
E10F: Mandatory exchange market
P11G: Combination of two of the above

4.6 Quota definition

This paragraph will describe all the elements that consider the term and method in which the quota size is set and calibrated.

Size of the quota

The size of the obligation, often referred to as target, goal or quota, is expressed as a share of the total electricity supply of a supplier (Bennink, Blom et al.2010). Theoretically the quota has to balance the Dutch target of Directive 2009/28/EC and the actual supply curve of renewable energy in the Netherlands (Berry and Jaccard 2001; Espey 2001). Berry and Jaccard (2001) define the optimal balance in the following way: “the quota should be large enough to move the industry towards the environmental objective, but no so large that it results in significant increases in electricity prices”. This leads to the following option to fill in the quota size.

ELEMENT 11: QUOTA SIZE
E11A: the size of the quota is set based on the expected renewable electricity generation for year 20yy including an increase of ‘x’ percent

Two possible imbalances can be identified regarding the size of quota. Firstly, the total renewable electricity production can be smaller than the quota. In this case the market price for SOCs will lie at the penalty price and producers can demand a certificate price close to the penalty price. Thus as long as existing capacity is smaller than the quota, a SOS will function as a feed-in system with a tariff equally to the penalty price (Agnolucci 2007). An oversized quota will therefore lead to a very low cost-efficiency of the SOS. Another imbalance exists when the quota lies below the total renewable electricity generation and its potential growth. In this situation the certificate price will be too low for investors to earn back their investment or to dispatch their renewable generation assets. A too small quota can thus result in a low effectiveness of the SOS.

As imbalances in the quota size either lead to a very costly transition or underinvestment, a very realistic and pragmatic approach is required in setting the quota. In order to realise this realistic approach, the 'x' in element 11 has to be set at the actual potential of growth in capacity at the start of the system, as generators need time to anticipate to the new system and the set quota. Further along the system 'x' can lie at the desired growth in capacity with respect to the sustainability objectives, as generators had more time to anticipate to the quota. This development of 'x' is only possible if the quota is fixed for a longer term. This is described in the next two sections.

Duration of SOS

In order to able to fix the quota for a long term, first the duration of the SOS has to be defined. The government has to commit itself at least 15-20 years to the SOS in order to realise their long-term sustainability objective (Tilburg, Jansen et al. 2006). This term is required because the SOS has to offer incentives for investment at least until 2020, in order to achieve the national target of 37% renewables in the Dutch energy supply by 2020 (EU 2009). Experiences with the MEP and SDE showed that 10-15 years of financial support (dependent on the technology choice) is required per production unit in order to offer producers a sufficient rate of return and also realise affordable support (Annex III). Therefore, as the SOS is planned to start around 2015, a duration of at least 15-20 years is required to realise incentives for investment at least until 2020 with the SOS. This leads to the following options to fill in this parameter.

ELEMENT 12: DURATION OF SOS
E12A: The SOS will exist between 15-20 years

Term on which the quotas are set

In order to realize the proposed development of 'x' in system element 11, the quota needs to be set for a long-term. On the other hand some flexibility with respect to the setting of the quota is required in order to be able to react to unexpected outcomes of the SOS or dynamics in the technical, legal and economic environment of the SOS (Tilburg, Jansen et al. 2006). Imbalances between the quota and the actual generation can be caused by a wrong estimation of the total renewable electricity generation, its potential growth and the total electricity consumption. In order to realise both security for investors and flexibility for adjustments, both fixed quotas for the short-term and proposals for the quotas for the long-term have to be defined and published before the start of the system. The proposed long term quotas can only be corrected based on pre-defined rules, in order to further enhance the long-term predictability of the SOS (Tilburg, Jansen et al. 2006). For the same reason, the long-term and short-term quota together with the rules that will be applied to calculate the correction of long-term projections have to be laid down in the future resolution on the SOS.

The fixed short-term quota will be laid down for the next five years, while the estimations of the long-term quotas are laid down for the remaining of the system duration (Tilburg, Jansen et al. 2006). Three years after the start of the short-term period the short-term quotas have to be evaluated. The results of this evaluation can provide market parties understanding of the possible adjustment of the proposed long-term quotas. In the year the next period of five years enters the final quota for the new period will be defined, based on the rules for correcting the quota laid down in the resolution on the SOS. Another option is be to fix the quota for the year 'n+5' after year 'n' and so on. The quota of for year 'n+5' will be based on the proposed quota for this year and a possible required adjustment of this target, based on the rules for correction laid down in the resolution. This leads to the following options to fill in this element.

ELEMENT 13: TERM ON WHICH THE QUOTAS ARE SET
E13A: The quotas are fixed on the short-term for 5 years and proposed for remaining duration of the system, for which after 5 years the proposed targets can be adjusted based on a legally established framework
E13B: The quota are fixed on the short-term for 5 years and proposed for the remaining of the system, for which in year 'n' the quota of year 'n+5' is fixed based on the proposed quota on the long term and adjustments based on a legally established framework.

Self-regulation mechanism for the quota size

This paragraph has already explained and emphasised the critical impact of an accurate quota size on the functioning of the certificate market and thus the SOS. Furthermore, was argued that the fixation of the quotas for a certain term is necessary in order to create enough security and adaptability for investors. In order to balance these two needs, a self-regulating mechanism for the quota size can be added to the SOS. In Belgium de quota is automatically adjusted in year 'n' for the percentage of surplus or deficit of certificates in the year 'n-1'. The trade-off with the implementation of this option is that it can lead to over- or under stimulation with respect to the sustainability objective (Annex I, interview Mortier). Over- or under stimulation occurs when respectively more or less renewable electricity is produced than necessary to achieve the national targets laid down in Directive 2009/28.EC. For this reason, the possibility of over- or under stimulation with a self-regulating quota results from the fact that the quota size is not determined by government objectives but by a surplus or deficit of certificates in the market.

ELEMENT 14: SELF-REGULATION MECHANISM FOR THE TARGET SIZE
E14A: The quota is automatically adjusted in year 'n' with the percentage of certificate surplus/deficit of year 'n-1', if this is required.
E14B: No self-regulating mechanism

Differentiated quota sizes per technology

The SOS can define one quota for all renewable technologies or it can define separate quotas for different technological classes (Berry and Jaccard 2001). The use of one target will lead to the selection of the least-cost options to meet the targets and therefore minimize the total costs of the SOS (Berry and Jaccard 2001). Furthermore, the selection of multiple targets leads to relatively small certificate markets. The liquidity of these markets might be not large enough to create effective sub-certificate markets. On the other hand multiple targets can be a manner to reduce economic rents for renewable generators due to technology differences. Multiple targets can for instance separate the support of mature and immature technologies. In chapter three several relative mature and relative immature technologies were identified. This distinction could be the starting point for the definition of two different targets.

However competition between immature technologies is not very relevant, as the position of immature technologies on the learning curve is different and the costs of these technologies currently cannot be compared. To this regard figure 4.6 illustrates that in the technology class for immature technologies still extensive economic rents for certain producers exist. For this reason, this option will not be further taken into account. Another option is to define separate targets for every immature technology. For this option has to be realised that is might not be possible to realise the required degree of liquidity in the immature sub-markets.

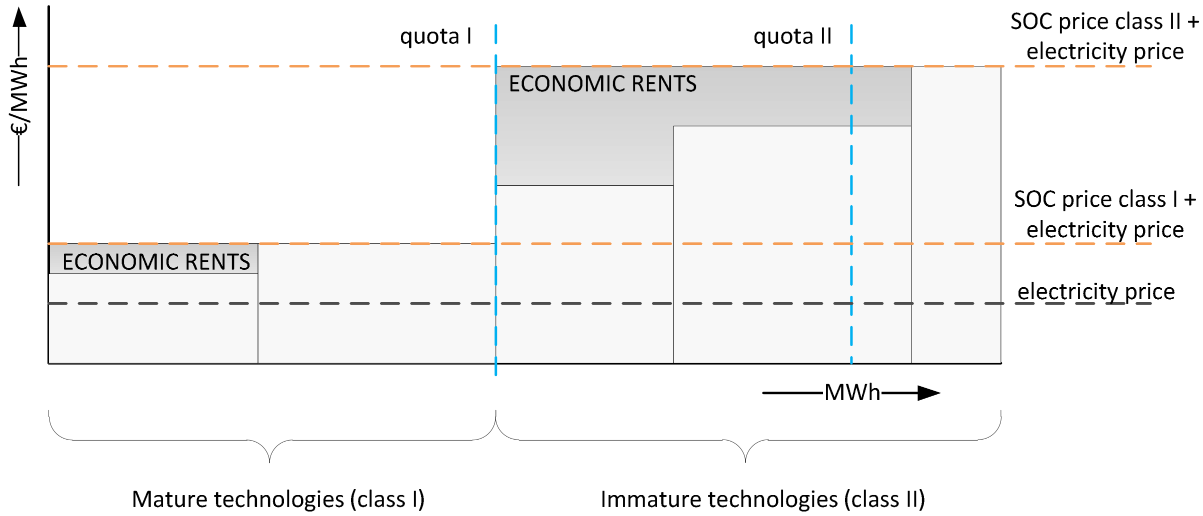


Figure 4.6 The effect of differentiated quotas on the degree of economic rents in a SOS

Based on the options identified above the element 'differentiation quota size per technology' can be filled in as follows:

ELEMENT 15: DIFFERENTIATION OF THE QUOTA SIZE PER TECHNOLOGY CLASS
E15A: One target for all technologies
E15B: One target for relatively mature and separate targets for immature technologies

4.7 Flexibility mechanisms

The previous paragraph showed how quotas for the next year(s) can be adjusted by the controlling government authority when they do not lead to an accurate certificate price. However, also market parties can have options to adjust to imbalances between the quota and the actual renewable electricity generation. These options are referred to as flexibility mechanisms. Flexibility mechanisms mainly provide options to adjust to incidental short-term imbalances on the SOC market. Reasons for incidental short-term imbalances on the certificate market can be the following. Firstly, the intermittent character of wind and solar energy creates inherent uncertainty in the availability of SOCs (Berry and Jaccard 2001; Bennink, Blom et al. 2010). Furthermore, a supplier can experience deviations in the anticipated total sales (Rader and Hempling 2001). Lastly, a renewable electricity facility can experience unexpected deviation in the output, due to unexpected trips of facilities (Rader and Hempling 2001). Flexibility mechanisms will contribute to the cost-efficiency of the SOS, as they provide suppliers with the option to reduce their risk of non-compliance. Furthermore, flexibility will contribute to the effectiveness of the SOS, as it enables renewable producers to reduce market risks in the certificate market, which makes the investment climate more attractive. Therefore, this paragraph will describe the possible flexibility mechanisms.

Banking of certificates

With the banking of certificates is meant that producers and suppliers can use certificates in another accounting period then the accounting period in which the certificates were generated. (Espey 2001; Rader and Hempling 2001). In this respect, banking provides producers the opportunity to hold on to their on to their certificates until the market price is high enough. Furthermore, it provides suppliers the opportunity to hold on to their certificates in case of over-compliance, in order to comply with the quota in subsequent years. Furthermore, banking leads to a more liquid market and more possibilities for capturing economies of scale in the size of renewable energy facilities in combination with the increasing quotas (Rader and Hempling 2001). Lastly, the possibility of banking also decreases the transparency of the certificate market, which will undermine the possibility of market power (Tilburg, Jansen et al. 2006).

In certain foreign SOSs limitations were laid down for the amount of certificates that can be banked (Rader and Hempling 2001). For instance, in Belgium certificates can be banked for 5 years (Bennink, Blom et al. 2010). Another option is to limit the amount of certificates that can be banked per accounting period. In the UK the amount of certificates that can be banked in one period is limited to 25 percent of the quota (Bennink, Blom et al. 2010). Under the condition that all market parties in a SOS possess a single certificate account and that the certificates are labelled with the date of origin, it is organisationally possible to enforce these limitations on banking. In Sweden both the term and the amount of banking is unlimited (Tilburg, Jansen et al. 2006). Combining the options presented above leads to the following options to fill in this parameter:

ELEMENT 16: BANKING OF CERTIFICATES
E16A: certificates cannot be banked
E16B: a certificate can be banked for ‘x’ years for an unlimited amount
E16C: a certificate can be banked for an unlimited period for an unlimited amount
E16D: ‘y’ percent of the quota can be banked for an unlimited period
E16E: ‘y’ percent of the quota can be banked for ‘x’ years

Early banking

In order to realise a smooth phase-in of the SOS ‘early banking’ can be allowed. Early banking means that SOCs can be allocated to and banked by renewable producers before the actual start of the SOS. Rader and Hempling (2001) argue that “early banking may foster a more functional renewable certificate market at the beginning of the program” as “early banking encourages expedited development by providing a market for early output”. This leads to the following options for design:

ELEMENT 17: EARLY BANKING
E17A: Early banking is allowed
E17B: Early banking is not allowed

Borrowing certificates

The opposite of banking certificates in case of a surplus is to borrow certificates in case of a shortage. The borrowing of certificates prevents suppliers from purchasing certificates in period with a deficit on the certificate market and therefore increases price stability and thus the cost-efficiency of the SOS (Tilburg, Jansen et al. 2006). The borrowing of certificates is executed as an account balancing mechanism in which the supplier is allowed some shortfall in its compliance in a specific accounting period, as long as the quota is achieved on average over a period of years (Berry and Jaccard 2001). In order to ensure that demand for certificates remains sufficient, the possibilities for borrowing have to be limited. This leads to the following options to fill in this element.

ELEMENT 18: BORROWING OF CERTIFCATES
E18A: borrowing of certificates is not allowed
E18B: 'x' percent of the quota may be borrowed

Reconciliation period

An alternative to the borrowing of certificates is a reconciliation period. Berry and Jaccard (2001) and Radar and Hempling (2001) suggest adding a reconciliation period to the SOS in order to create more flexibility for suppliers. The reconciliation period starts after the due date of the accounting period. During this period the controlling government authority informs the supplier on the status of his compliance. If the supplier lacks certificates to meet his obligation he can purchase the missing certificates during the reconciliation period (Langniss and Wiser 2003). Radar and Hempling (2001) argue that a reconciliation period of three months provides suppliers sufficient flexibility without compromising the functioning of the certificate market.

ELEMENT 19: RECONCILLIATION PERIOD
E19A: Provide a reconciliation period of 3 months to suppliers to comply with the quota
E19B: Do not provide reconciliation to suppliers to comply with the quota

4.8 Governance

The previous paragraphs described the elements of the SOS which determine the technical scope of and mechanisms in a SOS. This paragraph identifies the elements that determine the governing of the SOS on a detailed system level. With respect to the governing of the SOS, the allocation of responsibilities to possible executing bodies of the SOS and the focus of these bodies in the execution and monitoring of the SOS are relevant.

Governing bodies

There are several administrative functions that have to be executed in a SOS. The following administrative functions for a SOS can be identified:

- Setting and correcting of the quota sizes
- Issuing of certificates
- Managing of certificate accounts
- Certificate exchange operator
- Monitoring of compliance with the quota
- Setting and collection of penalties for non-compliance
- Calibration of the certificate market
- Market-maker: administration of minimum certificate price (Berry and Jaccard 2010; Espey 2001)

These functions can be the responsibility of executive bodies that are already present in the energy sector or new specialized authorities. In table 4.2 an overview is provided of the present executive bodies and their current administrative tasks, in order to identify whether the described responsibilities in a SOS align with their current responsibilities.

Governing body	Responsibilities
Ministry of Economic Affairs	Responsible for the definition of legal framework of the Dutch energy sector
Office of Energy Regulation (EnergieKamer)	Responsible for energy market surveillance and

	regulation of monopoly functions
Agentschap NL	Execution of policy of EZ; handling of subsidies request and subsidy payments
Tennet	System operator & transmission network manager
CertiQ (part of Tennet)	Responsible for the issuing of GoOs
APX-ENDEX	Responsible for operating the spot and futures markets for electricity and natural gas in the Netherlands, the United Kingdom and Belgium

Table 4.2 Overview governing bodies in the energy sector

Per task the most suitable governing body has to be selected from the table above or a new authority needs to be created. Regarding this selection needs to be realised that for the tasks that require certain degrees of freedom and therefore more regulatory discretion an independent governing body is preferable, as this will contribute to the consistency and predictability of the execution of the SOS.

ELEMENT 20: GOVERNING BODIES
E20A: Ministry of Economic Affairs
E20B: Agentschap NL
E20C: Office of Energy Regulation (Energie Kamer)
E20D: Tennet
E20E: CertiQ
E20F: APX-ENDEX
E20G: New specialized independent administrative body

Focus of government intervention

Changes in the design of the SOS while the system is in use heavily jeopardize the credibility and predictability of the system, which can have serious consequences for the attractiveness of the investment climate under a SOS (Berry and Jaccard 2001; Langniss and Wiser 2003). However, this chapter also revealed that some flexibility in the design is required to be able to adapt to unexpected changes in the environment or the outcomes of the scheme. With respect to changes in the scheme can be thought of small interventions for calibration of the certificate market or structural interventions in the scheme's design.

For structural interventions in the design of the SOS, two perspectives can be identified: a focus on stability versus a focus on adaptability (Berry and Jaccard 2001; McKinsey 2010). When the focus lies on stability, this means that no structural interventions can be made in the system once it is implemented, except on clearly defined evaluation moments laid down in the future resolution on the SOS. This focus can only be implemented if the design of the SOS possesses sufficient self-regulating and flexibility mechanisms with respect to the quota size and pricing mechanisms. The focus on adaptability will lead to the ability to quickly adapt the design to unexpected outcomes or external developments. This can improve the short-term performance of the system, but in the same can undermine the attractiveness of the long-term investment climate. Lastly, with respect to the phase-in of the system, the government can also choose to start the system with a focus on adaptability until the system has solved all its teething problems and then move over to a focus on stability to secure down an a stable investment climate. Condition for the success of this approach is that this shift in focus is clearly communicated to the market parties and investors. Otherwise the damage for the investment climate cannot be able to be restored anymore.

ELEMENT 21: FOCUS OF GOVERNMENT INTERVENTION.
E21A: government focus on stability
E21B: government focus on adaptability

4.9 Interdependencies between the system elements

This paragraph will identify the consequences of possible interactions between the elements described in this chapter.

4.9.1 The effects of market risks for generators in a SOS

In chapter two was identified that the existence of market risks for renewable producers can result in underinvestment. However, the description of the system elements showed that underinvestment - and thus a low effectiveness of the scheme - again can result in a low cost-efficiency of the system. Due to underinvestment the actual renewable electricity supply will be lower than the expected or desired investment rate of the scheme. This again can lead to a quota which is bigger than the total electricity generation, which again will lead to the SOC price being set by the penalty price as was described above. The result of these interrelated mechanisms in a SOS is that the electricity consumer is going to pay a high price for investments in renewable electricity, without them being realised. This form of system behaviour in a SOS is therefore very damaging for the overall performance of a SOS. To summarize, the reduction of market risks for renewable electricity producers, which was identified as a key challenge for design does not only lead to a higher effectiveness of the SOS but also to a higher cost-efficiency of the SOS. In this respect, it will be essential that the design of the SOS takes away the uncertainties for investors described above to a reasonable degree.

4.9.2 Complexity and uncertainty in price setting of SOCs

Also, the height SOC price will be very important for the performance of the system. In the height of the SOC price a paradox is present. On the one hand the SOC price should be high enough in order to provide sufficient incentive for renewable generators to invest in new capacity. On the other hand the SOC price should be low enough in order to maintain affordable electricity for the end consumer. From the description of the elements the following balances in a SOS can be identified that will determine the SOC price in a SOS:

- The quota size in relation to the total renewable electricity generation.
- The quota size in relation to the total electricity supply
- The quota size in relation to the merit-order of renewable electricity production
- The merit-order in relation to the additional income for generators by support mechanisms for immature technologies

From these balances can be concluded that the price setting of the SOC will be a very interrelated and therefore complex process. Furthermore, these balances are heavily influenced by external events, like the total electricity consumption, the wind conditions and the price of biomass crops, conventional fuels and CO_2. Also unexpected internal events can disturb these balances, like trips of renewable production units or delays in construction projects of new renewable production units. These balances are thus heavily dependent on both external and unexpected internal events, which make them inherently uncertain. When combining these uncertainties and complexities in the setting of the SOC price with the consequences of high market risks for producers described in the previous section, it can be concluded that the main solution in reducing the market risks lies in offering producers flexibility to respond to these dynamics, a self-regulating quota or providing a minimum price.

4.10 Conclusions

This chapter had the objective to answer the following sub research-question:

'What are the main elements of a SOS and what are the options to fill in these elements?

This question was answered by performing a literature review of literature on the design of SOSs, literature that describes and evaluates existing SOSs in other countries and literature that describes the general strengths and weaknesses of SOSs. This literature review made it possible to identify the main elements of a SOS, the different options to fill in these elements and the trade-offs that exist in choosing between these options. Furthermore, literature provided a framework to structure the description of the different element. Based on a comparison of the structures that were used in literature, seven categories were identified for a structured description of the elements, namely: eligible sources, price mechanisms, certificate allocation, trading mechanisms, quota definition, trading mechanisms and governance. In total 21 elements were identified which are structured by these categories. Below in figure 4.7 an overview of these elements is provided. In chapter 7 these elements will be logically structured into detailed alternatives for the design of a SOS.

Furthermore, different interactions between elements were identified. From these interactions can be observed that several negative feedback loops and interrelated balances exist in the mechanisms of a SOS. When these feedback loops or balances are not adequately approached by the design of the SOS they can result in a low performance of the SOS. This chapter provided several options to cope with this behaviour, which need to be taken into account when developing the detailed design alternatives of the SOS. Furthermore, it will be important to design a robust and adaptive introduction of the SOS in order to cope with possible teething problems in finding the optimal balances between the different mechanisms in a SOS. Therefore, the phase-in of a SOS needs to be carefully designed so that a return on investments can be guaranteed during this period (Espey 2001). The following options were identified during this chapter that can contribute to a smooth phase-in of the SOS:

- Allow the 'early banking' of certificates
- Start the SOS with a intervention focus on adaptability which switches to a focus to stability when teething problems of SOS are solved

DESIGN SPACE: ELEMENTS OF A SUPPLIER OBLIGATION SYSTEM

ELIGIBLE SOURCES

ELEMENT 1: INCLUSION OF IMMATURE TECHNOLOGIES
E1A: separate system for immature technologies
E1B: immature technologies are included in SOS

ELEMENT 2: INCLUSION OF MICRO-GENERATION
E2A: full inclusions of micro installation
E2B: exclusions of micro installation < x MW
E2C: full exclusion of micro installations

ELEMENT 3: INCLUSION OF EXISTING CAPACITY
E3A: Exclude MEP subsidized capacity and SDE subsidized capacity of which the subsidy term has ended
E3B: Include existing capacity with a baseline principle
E3B: Fully include existing capacity, except for capacity which is still subsidized under the MEP scheme

PRICE MECHANISMS

ELEMENT 4: MINIMUM PRICE
E4A: No minimum certificate price
E4B: A single minimum certificate price for all technologies, which is yearly corrected for the CO_2 and electricity prices.
E4C: Per technology differentiated minimum certificate prices, which are yearly corrected for the CO_2 and electricity prices and production costs of the technologies

ELEMENT 5: PENALTY PRICE PER UNPAID CERTIFICATE
E5A: Penalty price based on a percentage of the average certificate price of the last year
E5B: Fixed penalty price, which is yearly corrected by the average certificate-, electricity- and CO_2 price

ELEMENT 6: COMPLEMENATRY SUPPORT MEASURES FOR IMMATURE TECHNOLOGIES
E6A: Hybrid SOS with SDE Plus support
E6B: Hybrid SOS with new subsidy system, which is financed by end consumer and capped by a tender system
E6C: Hybrid SOS with new subsidy system, which is financed by the government and capped by a tender
E6D: Hybrid SOS with new subsidy system, which is financed by the end consumer and capped by a fixed budget
E6E: Hybrid SOS with new subsidy system, which is financed by the government and capped by a fixed budget
E6F: SOS without complementary support measure for immature technologies

CERTIFICATE ALLOCATION

ELEMENT 7: UNIT BASE CERTIFICATE
E7A: 1 certificate per MWh renewable electricity generation
E7B: 1 certificate per metric ton avoided CO_2 emission

ELEMENT 8: DIFFERENTIATION IN CERTIFICATE ALLOCATION
E8A: undifferentiated certificate allocation
E8B: certificate allocation based on the maturity of the technology used for the renewable electricity generation

ELEMENT 9 TERM OF CERTIFICATE ALLOCATION PER PRODUCTION UNITS
E9A: ‘x’ years of participation per asset
E9B: duration of participation per assets is differentiated per technology
E9C: Unlimited duration participation

TRADING MECHANISMS

ELEMENT 10: ORGANISATION OF TRADE
E10A: Bilateral trade
E10B: Voluntary auction moments
E10C: Mandatory auction moments
E10D: Mandatory tenders for long-term contracts
E10E: Voluntary exchange market
E10F: Mandatory exchange market
P11G: Combination of two of the above

QUOTA DEFINITION
ELEMENT 11: QUOTA SIZE
E11A: the size of the quota is set based on the expected renewable electricity generation for year 20yy including an increase of 'x' percent

ELEMENT 12: DURATION OF SOS
E12A: The SOS will exist between 15-20 years

ELEMENT 13: TERM ON WHICH THE QUOTAS ARE SET
E13A: The quotas are fixed on the short-term for 5 years and proposed for remaining duration of the system, for which after 5 years the proposed targets can be adjusted based on a legally established framework
E13B: The quota are fixed on the short-term for 5 years and proposed for the remaining of the system, for which in year 'n' the quota of year 'n+5' is fixed based on the proposed quota on the long term and adjustments based on a legally established framework.

ELEMENT 14: SELF-REGULATION MECHANISM FOR THE TARGET SIZE
E14A: The quota is automatically adjusted in year 'n' with the percentage of certificate surplus/deficit of year 'n-1'
E14B: No self-regulating mechanism

ELEMENT 15: DIFFERENTIATION OF QUOTA PER TECHNOLOGY CLASS
E15A: One quota for all technologies
E15B: One quota for relatively mature and separate targets for immature technologies

FLEXIBILITY MECHANISMS
ELEMENT 16: BANKING OF CERTIFICATES
E16A: certificates cannot be banked
E16B: a certificate can be banked for 'x' years for an unlimited amount
E16C: a certificate can be banked for an unlimited period for an unlimited amount
E16D: 'y' percent of the quota can be banked for an unlimited period
E16E: 'y' percent of the quota can be banked for 'x' years

ELEMENT 17: EARLY BANKING
E17A: Early banking is allowed
E17B: Early banking is not allowed

ELEMENT 18: BORROWING OF CERTIFCATES
E18A: borrowing of certificates is not allowed
E18B: 'x' percent of the quota may be borrowed

ELEMENT 19: RECONCILLIATION PERIOD
E19A: Provide a reconciliation period of 3 months to suppliers to comply with the quota
E19B: Do not provide reconciliation to suppliers to comply with the quota

GOVERNANCE
ELEMENT 20: GOVERNING BODIES
E20A: Ministry of Economic Affairs
E20B: Agentschap NL
E20C: Office of Energy Regulation (Energie Kamer)
E20D: Tennet
E20E: CertiQ
E20F: APX-ENDEX
E20G: New specialized independent administrative body

ELEMENT 21: FOCUS OF GOVERNMENT INTERVENTION.
E21A: government focus on stability
E21B: government focus on adaptability

Figure 4.7 Overview of the elements of a Supplier Obligation System

5. REQUIREMENTS FOR DESIGN

This chapter has the objective to answer the following sub-research question:

'What are the requirements for the design of a SOS from the perspective of Essent?'

Requirements for the design of a SOS represent the needs or conditions that have to be met by the design of a SOS. In this regard, these requirements will assist in selecting the most suitable options from the design space that is developed in the previous chapter. The objective of the definition of the requirements is to realise a complete and mutually exclusive list of requirements. As Essent is the problem-owner of this research, the requirements will be identified from the perspective of Essent. For this reason, the requirements will be based on the needs and conditions of Essent regarding the SOS. In the introduction was identified that these needs both have to take into account the activities of Essent as a producer and as a supplier of renewable electricity. Therefore, the starting point of the identification of these needs will be a description of the current and projected activities of Essent regarding the production and supply of renewable electricity. Data for the description of the current activities of Essent will be derived from interviews with departments of Essent that are involved in the planning and execution of the production and sales of renewable electricity (Annex I).

In the introduction of this research was identified that a SOS designed from the perspective of Essent is only useful when this design also results in an acceptable situation for the Dutch society and energy sector as a whole. Therefore, the realisation of the interests of Essent in the design is limited by the realisation of an overall effectiveness, efficiency and equity of the scheme[4]. In order to do so, requirements which secure the overall performance of a SOS will also be identified in this chapter. This chapter is structured in the following way. Paragraph 5.1 will identify requirements for design of Essent as a producer of renewable electricity. Paragraph 5.2 will identify requirements for design of Essent as a supplier of electricity. Paragraph 5.3 will identify requirements for design from a general perspective. Lastly, paragraph 5.4 will conclude with an overview of the requirements for design.

5.1 Requirements of Essent as a producer for the design of a SOS

This paragraph will identify requirements for the design of a SOS of Essent as a producer of renewable electricity. This will be done by describing the current and projected activities of Essent in the production of renewable electricity in section 5.1.1. Based on this description, the requirements of Essent as a producer of renewable electricity will be identified, in section 5.1.2.

5.1.1 Current activities of Essent in the production of renewable electricity

Regarding the production of renewable electricity Essent has the objective to realise an electricity production of which 25 percent is generated by renewable sources in 2020. Furthermore, Essent has committed itself to the long-term objective to be completely CO_2 neutral in 2050 (Essent 2010). This section will describe the technologies and assets for renewable electricity generation that Essent has invested in or is planning to invest in, in order to realise these objectives.

Figure 5.1 illustrates how the renewable electricity production of Essent in 2009 is divided over different renewable energy technologies. From figure 5.1 can be seen that Essent has mainly invested in biomass co-firing. The point of view of Essent is that large-scale co-firing is crucial in achieving the renewable energy targets of the government in 2020, because it is a very cost-efficient

[4] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme, as was defined in chapter 2.

and flexible renewable energy source (Essent 2010). Furthermore, Essent sees a mature and liquid biomass market as an enabler for the creation of a bio-based economy in the Netherlands (Essent 2010). Figure 5.1 also shows the current and planned electricity production of Essent based on biomass conversion. The design of the SOS has to enable maintaining the current biomass assets, which are shown in this figure. Furthermore, also the projected investments in this technology, which are also shown in this figure, have to be enabled by the SOS. Moreover, Essent does not only require of the SOS to be able to invest in specific biomass conversion facilities. In order to develop more expertise in large scale biomass conversion, Essent also requires being able to invest in learning processes, economies of scale and long-term relations regarding the cultivation, transport and trade of biomass crops (Essent 2010). Therefore, the design of the SOS also has to enable the further development of biomass conversion on a long-term.

Lastly, Essent also wants to maintain the possibility to invest in the development of other technologies for renewable electricity generation, besides their focus on biomass conversion. The reason for this is to remain possibilities for alternative renewable asset strategies in case of unexpected developments or the saturation of the potential of biomass conversion in the Netherlands (Annex I; interview Romijn). From figure 5.1 can be seen that Essent has already invested in wind power. In the future it might be required to also invest in other technologies.

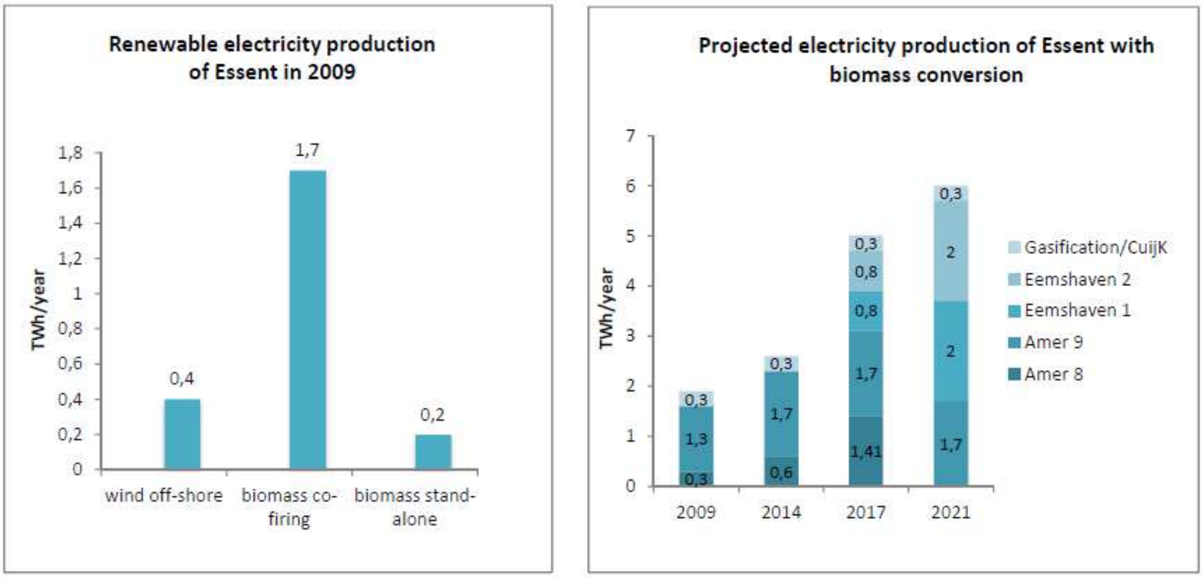


Figure 5.1 Renewable electricity production of Essent in 2009 and Biomass co-firing assets of Essent (Source: Essent, 2010)

5.1.2 Requirements for the design of Essent as a producer

The main objective of this research is to design a SOS which provides adequate incentives for investment in renewable electricity generation by Essent as a producer. The description in the previous section allows translating this general objective in the following needs of Essent as a producer for the design of the SOS:

1. The ability to maintain current activities in biomass conversion.
2. Long-term security on a return on investment in new biomass conversion facilities
3. Long-term the security on a return on investment in the further development, learning and scaling of/in biomass conversion methods
4. The ability to invest in the development of other technologies for renewable electricity generation.

Now these needs will be translated into requirements for design. Firstly, the ability to maintain current activities in biomass conversion will be discussed. The investments of Essent in biomass conversion were mostly done under the MEP scheme (Annex I, Interview Wijnen). For this reason, an adequate transition path between the ending of the MEP subsidies and the start of the SOS is important for Essent. The last biomass co-firing assets will stop receiving MEP-subsidy in 2015. Furthermore, assets for renewable electricity generation are in general allowed to receive a single term of public support at the moment (Ministerie EZ 2007). However, biomass conversion plants need to receive continuous support, due to its relatively high operational expenditures. For this reason it is important that Essent's existing biomass conversion plants, which already have received financial support, can still be included in SOS. Therefore, the need to maintain current activities in biomass conversion can be translated into the following requirements for design:

- a sufficient transition path between the ending of the MEP and the start of the SOS
- the inclusion of existing biomass conversion plants in the SOS

Secondly, the need of long-term security on the return on investment in new biomass conversion facilities will be translated into requirements. In order to realise long-term security on the return on investment in a specific biomass conversions facility, the SOS must guarantee *sufficient, predictable* and *continuous* financial support. *Sufficient* support is realized when Essent can sell most of its certificates for a price that compensates the difference between the total production costs and the electricity price. Therefore, long term security on the return on investment in a specific facility will require low price and volume risks in the SOC market. These two aspects can be compressed to 'low market risks' as a requirement for design (Bennink, Blom et al. 2010).

Furthermore, long-term security on the return on investment of a specific facility requires regulatory *stability* and continuity of the SOS. In the introduction of this research report was emphasised that stability also needs to be incorporated on the regulation level. On a regulation level regulatory stability mostly concerns the predictability of the market conditions (Bennink, Blom et al. 2010). For this reason, the condition for design concerning the stability of the SOS is translated into the requirement of 'stable market conditions'. Lastly, the need of long-term security on the return of investment in new biomass conversion facilities requires *continuous* support. Due to the relatively high operational expenditures of biomass conversion, it is important that the design of the SOS will not limit the financial support for biomass conversion to a specific term. Instead the SOS has to enable a continuous support for biomass conversion units. Therefore, the requirement of 'continuous support for biomass conversion' will also be added to the list of requirements for design.

The third need of Essent as a producer regarding the design of the SOS is long-term security on the return on investments in the further development and up scaling of biomass conversion methods. In order to secure this need in the design of the SOS, stability and policy continuity are required. This is covered by admitting the requirement of 'stable market conditions' to the list of requirements for design. This requirement thus plays an important role in the realisation of two of the needs of Essent as producer in the design of the SOS. The last need in the design of a SOS of Essent as a producer is the ability to invest in the development of other technologies for renewable electricity generation than biomass conversion. In order to fulfil this requirement the SOS must provide 'sufficient possibilities for technology diversification and the stimulation of immature technologies' (Jansen 2010). Therefore, this will also be included in the list of requirements for the design of the SOS.

This sub-paragraph has translated the needs of Essent as a producer regarding the SOS in requirements for design. Below in figure 5.2 an overview of these requirements is provided

Requirements for the design of a SOS of Essent as a producer of renewable electricity

1. A sufficient transition path between the ending of the MEP and the start of the SOS
2. The inclusion of existing biomass conversion plants in the SOS
3. Low market risks
4. Stable market conditions
5. Continuous support for biomass conversion plants
6. Sufficient possibilities for technology diversification and stimulation of immature technologies

Figure 5.2 Requirements for design from the perspective of Essent as a producer

5.2 Requirements of Essent as a supplier for the design of a SOS

This paragraph will identify requirements for the design of a SOS of Essent as a supplier of electricity. This will be done by providing a description of the current activities of Essent in the supply of renewable electricity in section 5.2.1. Based on this description, requirements for the design of a SOS will be identified in section 5.2.2. In addition, the introduction of a SOS will lead to new responsibilities in the supply of electricity. This means that the SOS will not only affect Essent as a supplier of renewable electricity, but also as a supplier of electricity in general. For this reason, also requirements regarding the interests of Essent as an obliged supplier within the SOS will be identified, in section 5.2.2.

5.2.1 Current activities of Essent as supplier of renewable electricity

Sales of green electricity in the retail and commercial market

Currently, the renewable electricity product that Essent sells to retail consumers is ‘green electricity’. Green electricity is offered to consumers by purchasing the quantity of GoOs that is equal to the total quantity of green electricity that is supplied to these consumers. Retail consumers are households or smaller enterprises. Essent offers 100 percent green electricity to retail consumers under the regime ‘grey=green’. This regime offer consumers green electricity for a price that is equal to the price of grey electricity. Furthermore, Essent is planning to offer more differentiated green products to their consumers in the future with respect to the origin of the electricity. For instance, this can be pure wind or solar power (Essent 2010).

Commercial consumers have more specific demands with respect to the origin of green electricity than retail consumers. On the one hand consumers in the B2B-market often demand wind power, because it is considered to be a bigger contribution to the transition towards renewable electricity than for instance hydro power. For this reason, purchasing wind power can contribute to a green image. On the other hand the B2B market often demands hydropower as this is currently the most cost-efficient form of renewable electricity available in Europe (Annex I, interview Wijnen; interview Van Mechelen). More specific requirements with respect to the origin of renewable electricity of different companies and sectors depend on their type of consumers, visibility to consumers, activities and social position (Annex I; interview van Mechelen).

Micro generation

In this research was identified that it is organizationally possible to include renewable micro generators in a SOS. Currently, Essent sells micro installations to consumers in order to attract new customers and earn on the sales of the micro installations. Within a SOS it will also be possible to receive a share of the return on the trade of the SOCs of prosumers (Annex I, interview Eijgelaar, interview Lenzen). In this respect, the inclusion of micro generation in the SOS is a manner to attract new customers and provide remunerated services on the installation of micro installations and the trade of SOCs. Therefore, the inclusion of micro generation in the SOS can provide new commercial opportunities for Essent.

5.2.2 Requirements for design of Essent as a supplier

In this section will be identified which requirements the activities described in the previous paragraph provide for the design of the SOS. Furthermore, it will be identified which requirements for design can be identified from the needs of Essent as an obliged supplier within the SOS.

Sales of green electricity in the retail and commercial market

An important aspect that needs to be incorporated in the design of a SOS from the perspective of Essent is that the current activities in the marketing of green products can be maintained. Based on the description of these activities above, the following needs regarding the design of a SOS can be identified:

- the ability to sell green electricity under the regime ‘green=grey’ to retail consumers
- the ability to sell differentiated green products
- the ability to offer different percentages of green electricity in the total supply

In chapter three was identified that GoOs cannot function as the certificate to verify the compliance to the quota obligation with. Instead a new certificate has to be created, referred to in this research as SOC. SOCs will function in parallel with the GoOs and have the function to prove the compliance to the quota obligation with. GoOs will solely maintain the function to verify the supply of renewable electricity to end-consumers with. This distinction of GoO and SOCs provides a clear answer to the question whether a SOS in the Netherland can fulfil the needs identified in this section and will now be further clarified.

Firstly, the distinction of GoOs and SOCs makes it possible to offer 100 percent green electricity within in a SOS under the regime green=grey, as the actual supply of green electricity is determined by the purchasing of GoOs. Because GoOs are traded on a European level, their value will remain the same within a SOS. Furthermore, the parallel GoO system makes it possible to deliver more renewable electricity to consumers than the SOS prescribes by its quota. The distinction of SOCs and GoOs also makes it possible to still offer a specific type of green electricity, like 100 percent wind power, within a SOS. This can be done by purchasing specific GoOs next to purchasing the quantity of SOCs to meet the quota obligation with. In this regard, an additional service of Essent to its customers can be to offer the possibility to fill in the obligation laid down by the SOS with a specific source of renewable electricity. This can be done by purchasing the GoOs of this source in the same amount as the required SOCs to fulfil the quota obligation for this consumer. From the above can be concluded that the needs of Essent as a supplier of renewable electricity are already covered by the precondition that the European legislation on GoOs has laid down for the use of GoOs in a SOS. Therefore, no further requirements for design from the perspective of Essent as a supplier of renewable electricity will be identified.

Micro generation

In order to be able to embrace the new commercial opportunities that the inclusion of renewable prosumers in a SOS provides, a requirement for design is ‘the inclusion of micro generation as an eligible source’.

New responsibilities of suppliers created by a SOS

In a SOS suppliers will be obligated to purchase SOCs equal to the quota that is laid down by the SOS. For suppliers within a SOS it will be important that they can comply with the quota set by the SOS against a reasonable certificate price. To this respect suppliers want to be able to purchase the amount of SOCs necessary to fulfil their obligation for a price that remains their competitive position in comparison with other suppliers. Therefore, suppliers also require the reduction of price and volume risks. These two needs can be compressed to the requirement of 'low market risks'. In this regard, this requirement thus not only applies to producers but also to suppliers.

This sub–paragraph has translated the needs of Essent as a supplier regarding the SOS into requirements for design. In figure 5.3 an overview of these requirements is provided.

Requirements for the design of a SOS from the perspective of Essent as a supplier of electricity

1. The inclusion of renewable micro generation
2. Low market risks

Figure 5.3 Overview of the requirements for design of a SOS from the perspective of Essent as supplier of electricity

5.3 Requirements from a general system perspective

The requirements for design from the perspective of Essent also have to secure an overall performance of the SOS, as was explained in the introduction of this chapter. Therefore, this paragraph will identify the main requirements for design from a general perspective. In chapter two several key challenges for design were identified which cover the main issues than can harm the effectiveness, efficiency and equity of a SOS. For this reason, translating the key challenges for design into requirements will result in incorporating the overall performance of the SOS in the development of its design. The following key challenges were identified in chapter two:

1. Reduce market risks for renewable electricity producers
2. Reduce excessive economic rents for renewable electricity producers
3. Reduce the possibility of market power
4. Reduce the unequal starting point of different type of electricity companies

The key challenge for design that considers market risks for renewable electricity producers is already incorporated in the list of requirements by the requirements of 'low market risks' and 'stable market conditions' of Essent as a producer. The other three key challenges still have to be incorporated in the list of requirements. The second key challenge will be translated into the requirement of 'fair economic rents for renewable electricity producers'. The term 'fair' in this requirement refers to the realisation of an even distribution of the benefit and costs of the SOS over the various stakeholders. The third key challenge will be translated into the requirement of 'low possibility of market power. Lastly, the fourth key challenge will be translated into the requirement of 'equal starting point for different type of electricity companies'.

This sub–paragraph has translated the needs regarding the design of a SOS from an overall system perspective into requirements for design. In figure 5.4 an overview of these requirements is provided.

Requirements for the design of a SOS from a general system perspective

1. Fair economic rents for renewable electricity producers
2. Low possibility of market power
3. Equal starting point for different type of electricity companies

Figure 5.4 Overview of the criteria for design of a SOS from the perspective of the key stakeholders

5.4 Conclusions

This chapter had the objective to answer the following sub research-question:

‘What are the requirements for the design of a SOS from the perspective of Essent?’

This has led to the identification of ten requirements for design of which of an overview is provided in figure 5.5. These requirements will be taken into account when developing the detailed design alternatives. The requirements incorporate the needs and interest of Essent as a producer and supplier of (renewable) electricity. Furthermore, they secure an overall system performance.

Requirements for the design of a SOS

1. A sufficient transition path between the ending of the MEP and the start of the SOS
2. The inclusion of existing biomass conversion plants in the SOS
3. Low market risks (both from the perspective of a producers and a supplier)
4. Stable market conditions
5. Continuous support for biomass conversion plants
6. Sufficient possibilities for technology diversification and stimulation of immature technologies
7. The inclusion of renewable micro generation
8. Equal starting point for different type of electricity companies
9. Low degree of possibility of market power
10. Fair economic rents for renewable electricity producers

Figure 5.5 An overview of the requirements for the design of a SOS from the perspective of Essent

The objective of the definition of the requirements for design was to realise a complete and mutually exclusive list of requirements. In order to secure the completeness of these requirements they were reflected by Essent. Essent agrees that this list of requirements effectively addresses the needs or conditions that have to be met by the design of a SOS. Furthermore, the requirements that secure an overall effectiveness, efficiency and equity of the SOS were compared with requirements for the Dutch support schemes for renewable electricity generation proposed in other studies. These studies propose reasonably comparable requirements, depending on the level of detail of the requirements (Bennink, Blom et al. 2010; Jansen 2010; Linden, Uyterlinde 2005). Secondly, it is assessed if the requirements are mutually exclusive. When the requirements are related to each other, it can be confirmed that the realisation of one requirement does not contribute to the realisation of another requirement. Therefore, the requirements defined in this chapter are with a great certainty capable of effectively steering the development of the design of a SOS, from the perspective of Essent.

6. CONCEPTUAL ALTERNATIVES FOR DESIGN

This chapter has the objective to answer the following sub-research question:

‘Which concepts for the design of a SOS can provide a stable SOS?

This will be done by identifying several conceptual alternatives for design that are able to structurally breach with the current trend of regulatory instability in the support schemes for renewable electricity in the Netherlands. In order to so the ‘object of research’ will be shifted from the ‘SOS self’ to the ‘governance of the SOS’ in this chapter. This shift makes it possible to step away from the rather narrow and detailed level of the regulation self, in order to observe how this regulation is positioned in its institutional environment.

By doing so, it will be possible to identify the origin of regulatory instability in the energy sector in the Netherlands. Insight in the origin of instability will again make it possible to understand how and under which conditions the SOS can be relocated in its institutional environment, in order to realize the required level of stability for a SOS. This will result in the identification of several frameworks or conceptual alternatives for design. In the remainder of this report these conceptual alternatives will be used as the starting point for applying the requirements for design to the design space of the SOS.

This chapter is structured in the following way. Firstly, paragraph 6.1 will provide more insight in the conditions in which stability in a SOS can be guaranteed, based on an understanding of the origin of regulatory instability in the energy sector. This will result in directions for the identification of conceptual alternatives, which will be done in paragraph 6.2. Then paragraph 6.3 will provide an overview of the possible conceptual alternatives and select the conceptual alternative(s) that will be further detailed in the next chapter. Lastly, paragraph 6.4 will end this chapter with conclusions on the identified conceptual alternatives.

6.1 Starting point for the identification of the conceptual alternatives for design

In this paragraph the starting point for the identification of conceptual alternatives for the design of the SOS will be identified. This will be done by analysing the origin of the pattern of regulatory instability in the support schemes of the Netherlands. For this analysis theories of Spiller and Tomassi (2005) on regulatory governance in the utility sector will be applied. Spiller and Tomassi (2005) offer very relevant insights in the ability of incentive regulation for the utility sector - like the SOS - to uphold itself well established and stable, by linking this ability to the institutional environment of the regulation.

6.1.1 Main issue in realizing stability in the regulation of the energy sector

Spiller and Tomassi (2005) offer an interesting viewpoint on the stability of regulation, by approaching regulation as the outcome of complex intertemporal exchanges among policy makers. From this perspective they identify the concept of ‘governmental opportunism’ as the main issue in realising stability in regulation of the energy sector. Governmental opportunism is understood “as the incentives politicians have to expropriate –once investments are made- the utilities’ quasi rents, so as to garner political support” (Spiller and Tomassi 2005 p 518).

Spiller and Tomassi assign the existence of governmental opportunism in regulation of the energy sector to the combination of the following three specific features of this sector:

- Production assets that are characterized by specific, sunk investments
- A whiff of monopoly, due to the economies of scale and scope
- A set of consumers which closely approximates the set of voters (Spiller and Tomassi 2005).

Due to the first feature, electricity producers will be willing to operate even if prices are below average costs, as operating costs do not include a return on sunk-investments. Therefore, laying down additional regulation after investments are made does not have to influence the supply in a sector that is dominated by specific, sunk investments. Furthermore, the whiff of monopoly inherently demands a certain degree of regulation. Lastly, the feature of mass consumption contributes to the political sensitivity of the energy sector. The combination of these three features creates that indirectly expropriating utilities can a government political support by simultaneously realising relatively low prices or a green image and the maintenance of service. For this reason, the combination of these three features of the energy sector enhances governmental opportunism. Now that it is clear why regulation in the energy sector can be subjected to governmental opportunism, this concept will be further applied to the former support schemes for renewable electricity and the proposed SOS.

6.1.2 Dutch support measures for renewable electricity

This section will start with providing a short overview of the different support schemes that were implemented that last 14 years. For a more extensive overview of the different support schemes is referred to Annex III. The first support scheme, implemented in 1997, was a voluntary SOS introduced by the energy sector self. This system was replaced by a fiscal system in 2000, which is called the 'Energy Regulating Tax' (in Dutch knows as the Regulerende Energie Belasting or REB). The REB was after several changes in its design replaced by a Feed-in-Premium. This Feed-in-Premium, introduced in 2003, is called 'MEP' (in Dutch known as Milieu Kwaliteit van de Elektriciteitsproductie). The MEP was cancelled in 2006 and replaced by a similar Feed-in-Premium, called the SDE, after an interim period of two years. In 2010 the SDE was stopped. In the short-term the SDE will be replaced by the 'SDE Plus', another feed-in-premium. This system is comparable to the SDE scheme, but has a more narrow and market-based scope in determining the eligible renewable production units for receiving subsidy. Lastly, it is proposed to replace the SDE Plus with a SOS around 2014. Figure 6.1 visualizes the succeeding support schemes of the Netherlands in a timeline.

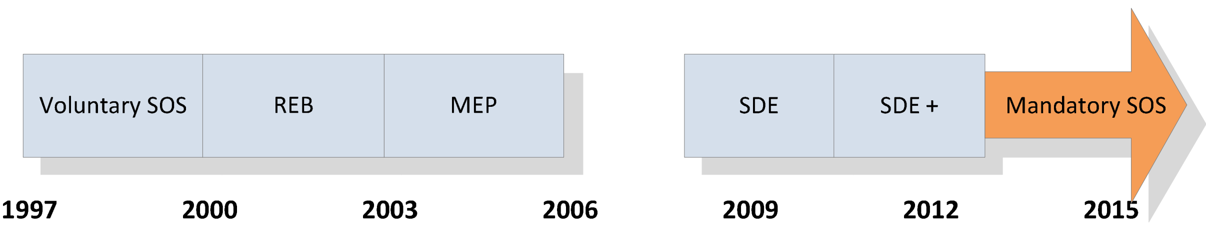


Figure 6.1 Timeline of former support schemes

Now the concept of governmental opportunism will be applied to timeline in figure 6.1. Although in the first place certain rational reasons can be found for the need of system replacements, in the same time can be concluded that these rational causes did not always necessarily had to result in a complete system change. Instead smaller adaptations in the existing system would have been sufficient. From this perspective the need for system adaptations was often used as a stepping stone for governments to fully replace the support schemes according to their needs in gaining political support. A certain degree of governmental opportunism thus indeed seems to be present in the former support schemes.

Furthermore, the definition of 'governmental opportunism' has to be broadened to a certain degree to be applicable here. Often the sudden and unexpected replacement or changes in former support schemes did not directly result in expropriating quasi rents, as a renewable generator who is offered subsidy by a feed-in-premium scheme will receive subsidy until the pre-defined term for this subsidy ends. In this respect, it can be observed that government opportunism did not always occur for economic reasons, as was proposed by the definition of Spiller and Tomassi, but also for more ideological reasons. However, the unexpected changes in support schemes and related uncertainty in future possibilities for renewable electricity generation did heavily interrupt the earlier established and thus expected investment framework. The renewable electricity sector is a sector which is surrounded by a technological learning process and therefore heavily investing in a learning curve. For this reason, breaking the promised investment framework for short-term electoral gain can be seen and defined as governmental opportunism, despite its specific reasons.

Based on the reasons describe above, it is assumed that the former support schemes were to at least to a certain degree affected by governmental opportunism. Therefore, the possibility of governmental opportunism will now be translated to the situation in a SOS. Once renewable electricity producers have made investments within a SOS, the government is able to adapt the design of the SOS in such a way that the certificate price will be too low to earn back their investments. However, due to the sunk character of investments in renewable electricity this will not affect the total renewable electricity generation on the short-term. Therefore, these actions will not harm the short-term effectiveness of a RPS. In the same time the costs for the end-consumer of the RPS will be reduced, due to a lowered certificate price. From this can be concluded that the short-term costs of governmental opportunism in a RPS are relatively low in comparison to its potential benefits, which might further induce governmental opportunism in a RPS. Therefore, the next section will assess how effective the Dutch institutional environment so far was in realising regulatory governance that limits governmental opportunism and how the design of the RPS can embrace this (Spiller and Tomassi 2005).

6.1.3 Institutional environment of the Netherlands

For the future stability of the SOS it is vital that the possibility of governmental opportunism is limited by its institutional environment. It does not lie in the scope and theoretical background of this research to fully investigate the characteristics of the Dutch institutional environment and polity, in order to define the specific reasons why the Dutch institutional environment is currently not able to do so. However, from an empirical perspective can be assumed that this is the case, as since 1997 more than five different support schemes were adjusted, cancelled and replaced unexpectedly in response to the needs of the incumbent government. Therefore, it is also assumed that the Dutch institutional environment is not able to bind future governments in adapting the rules and procedures in a SOS to their current needs, resulting in a highly unstable investment framework.

For this reason, the main challenge the design of a SOS is to reposition itself in the present institutional environment of the Netherlands. Otherwise the SOS will alternate with the identity of the ruling politicians, resulting in unstable policy and not providing the necessary safeguards for investors (Spiller and Tomassi 2005). Therefore, the design of the governance of the SOS has to lay down procedural and policy rules that restrict the ability of future government to randomly intervene in the design of the scheme. Or it has to move the responsibility for the governance of the SOS away from the direct influence of politics and thus governmental opportunism. In order to further investigate the possibilities for these two main options, they will be related to the dynamics in the former support schemes. This will result in defining a starting point for structurally securing stability in the SOS.

6.1.4 Starting point for structurally securing stability in the SOS

In this section we will further explore how the ability to constraint governmental opportunism is again constraint by the social, technical, legal and economic circumstances of the renewable electricity sector. In order to do so, the dynamics which the former and current support schemes faced will be studied. For a more extensive overview of these dynamics is referred to Annex III. Firstly, it appears that former support schemes were often confronted with developments or shocks in their environment. For instance, support schemes faced changing social preferences and visions regarding realising a sustainable energy supply. Besides that, former support schemes faced changes in the (perceived) potential of the available technologies for renewable electricity generation. Furthermore, the support schemes were subjected to changes in related European and national legislation. Moreover, the support schemes were confronted with the effects of an economic and financial crisis. In addition, the dynamics did not only have an exogenous origin, as support schemes were also often confronted with unexpected or undesired outcomes.

This description reveals that support schemes require substantial regulatory flexibility, in order to be able to effectively adjust to the significant internal and external dynamics that support schemes for renewable electricity face. If the regulatory flexibility to adjust to these dynamics will be largely reduced by the design of the governance of the SOS, this can result in ineffective regulation as it does not fit the existing circumstances. For this reason, laying down more procedural restrictions on the ability to adjust the design of a SOS will not offer a suitable starting point for constraining government opportunism. Instead the option that remains is to delegate the responsibility for the governance of the SOS to a third party with the objective to enable adaptations of the regulation in response to external and internal dynamics, while being insensitive to the randomness of politics. Therefore, this research proposes that a SOS can be both effective and stable if the responsibility for the execution, monitoring and adjustment of the SOS is delegated to a party that is not directly linked to electoral politics. For this reason, possible options to move the governance of the SOS from the central government to a party which is not directly influenced by electoral politics will be the starting point of the development of the conceptual design alternatives.

6.2 Identification of the conceptual alternatives for design

In this paragraph several concrete options will be identified that can more structurally secure the stability of the SOS. This will result in the identification of several conceptual alternatives for design. Starting point for the identification of these alternatives is that the design of the SOS can only secure stability if it delegates the responsibility for executing and monitoring the SOS to a party that is not directly connected to electoral politics. Based on this starting point, several possible conceptual alternatives for the design of a SOS will be proposed that can be divided in two main principles: internationalisation and self-regulation. In the two sections below will be elaborated how and why these principles can break the current pattern of institutional instability. Furthermore, several concrete alternatives for design will be identified based on these principles.

6.2.1 Internationalisation: connect and adapt the SOS to other countries

Internationalisation of a SOS is realised by allowing tradability of SOCs with another country that also has implemented a SOS. Implementing this option connects the Dutch SOS to a foreign SOS. In order to do so, the design and rules for this SOS will be laid down in an international agreement. Furthermore, also the execution, monitoring and possible adjustment of the SOS will fall under the responsibility of recurring bilateral consultations and cooperation. For this reason, internationalization delegates the responsibility for the SOS from the Dutch central government to an international cooperation. This will structurally separate the need for regulatory flexibility from political dynamics, as then the Dutch government will be restricted by more substantive international agreements and cooperation in their desire to change the system. Therefore, internationalisation of the SOS fulfils the starting point that was proposed to secure stability in a SOS.

In paragraph 2.3 was identified that the implementation of a European SOS is not very likely on the short-term. (Jansen and Uyterlinde 2004; EC 2011). However, regional convergence of support schemes is promoted by the European Commission (European Commission 2011). Articles 11 and 6 of Directive 2009/28/EC have laid down a legal foundation to couple the support schemes of different Member States, which makes this possible. As Sweden, Belgium, the UK and Poland have also implemented a SOS, the SOS of the Netherlands can be coupled to these systems in the transition towards a possible European SOS on the long-term. For this reason, alternatives that can provide an answer to structurally break the trend of instability in the Dutch environmental policy are:

- A1: Connect and adapt the design to the Swedish SOS
- A2: Connect and adapt the design to the SOS of the UK
- A3: Connect and adapt the design to the Belgian SOS
- A4: Connect and adapt the design to the Polish SOS

Regarding these alternatives needs to be added that also several additional advantages of internationalization can be found which will enhance the effectiveness, efficiency and equity of a SOS[5]. These advantages arise from the fact that a connection to another SOS leads to a larger market size. Firstly, a larger market size is likely to bring about a more stable price of certificates and alleviate the problems in setting an adequate quota, as were described in chapter 4 (Jansen, Lensink et al 2011; Agnolucci 2007). Furthermore, geographical market expansion reduces the possibility of market power (Jansen, Lensink et al. 2011). Lastly, a geographical market expansion often leads to more market transparency with a stronger drive towards a larger role for central trading platforms (Jansen, Lensink et al. 2011). The last results in a SOS that is better capable of creating a level playing field for all type of electricity companies. These effects of geographical expansion will also further enhance the stability of the SOS, as they decrease the possibility of unwanted outcomes of the SOS and therefore the need for unexpected interference in the design of the SOS.

However, also certain disadvantages and challenges in international tradability of SOCs need to be taken into account. Firstly, this option can lead to the support of foreign renewable electricity generation facilities and thus the support of a foreign economy by Dutch end-consumers. For this reason, coupling the SOS of the Netherlands to another Member State can become unpopular in the 'importing country' within a harmonized SOS. For this reason, differences in the national circumstances have to be taken into account when evaluating this option.

Furthermore, when the Netherlands wants to couple its SOS to an existing foreign SOS it will have to adapt itself to the foreign system, as this system is already locked-in due to the required stability of a SOS. This means that the Netherlands will not have the possibility to choose a design which completely fits their circumstances and preferences. So, also a trade-off has to be made between the degrees of freedom in the design of the Dutch SOS and the advantages of internationalisation. In this regard, another alternative based on the concept internationalisation needs to be added. It is also possible to implement a regional North-west European SOS. For this option, the Netherlands will be able to influence the design of this SOS from their own circumstances and perspective on the SOS, as there is not a design for this system present yet. Possible candidates for this system are Germany, Belgium, Sweden, the UK and the Netherlands. This leads to the following conceptual alternative for design:

- A5: Connect the design to North-west European SOS

Lastly, it has to be remarked that the connection of the Dutch SOS to one or multiple neighbouring SOSs is consistent with the realisation of a North-West European electricity market, which made significant progress the last years. Firstly, there was heavily invested in interconnection capacity

---

[5] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the, as was defined in chapter 2.

between the Netherlands, the UK, Germany, Belgium, Luxemburg, France and Sweden. So far, this resulted in the realisation of a single electricity market for France, the Benelux and Germany. Furthermore, also the network management was partly internationalized. So, from this perspective the harmonisation of the SOS to a (partly) North-West European level can be viewed as part of a larger development and possibly a logical next step of this development.

6.2.2 Self-regulation: a SOS established and under control of the energy sector

During this research and in other literature on SOSs it was automatically assumed that the SOS will be under hierarchical control of a government agency. However, Ostrom (1990) showed that government control is not always the only or most adequate arrangement for these kinds of institutions (Ostrom 1990). Instead she proposes the design of self-regulated institutions that are organized and governed by the users themselves. Also De Bruijn and Dicke (2006) propose that safeguarding mechanisms in which public values are hierarchical imposed by a government are not necessary the most effective in the utility sector. They observe that these hierarchical safeguarding mechanisms are not always able to deal with the often ambiguous nature of public values and the technical complexity of these sectors (Bruijn and Dicke 2006). For this reason, they provide a comparable alternative strategy for the safeguarding of public values in utility sector; a network mechanism in which is interacted and negotiated on the realisation of the public values by the relevant stakeholders (Bruijn van Dicke 2006).

In this respect, an interesting concept for the design of the SOS is a SOS which is established and executed by the energy-sector self. This option relocates the SOS in its institutional environment by delegating the responsibility for executing, monitoring, calibrating and adjusting the system from the Dutch government to the energy sector self. For this reason, it can structurally separate the need for regulatory flexibility from political dynamics. In order to create the regulatory stability that is required in a RPS, applying the concept of self-regulation can thus be very interesting. This leads to the identification of the following conceptual alternative for design:

- A6: A self-regulated Dutch SOS under control of the energy sector

Furthermore, Ostrom argues (1990) that when parties that are affected by the operational rules of institutions are allowed to participate in establishing and modifying the operational rules, these institutions are better able to tailor their rules to the physical circumstances (Ostrom 1990). Self-regulation can thus also contribute to a more effective and cost-efficient SOS, as the parties who design and execute the institutions will have a rich understanding of the complex systems and environment they work in. Secondly, self-organization will lead to constant stakeholder involvement and dialogue (Ostrom 2009). This will contribute to a more adaptive system overtime and therefore a more resilient system.

Long-term commitment of *all* the participants is vital for the sustainability of self-regulated institutions (Ostrom 1990). Therefore, the presence of long-term self-interest of the participants in this option needs to be further assessed, in order to secure the ability of a self-regulated SOS to maintain stable and well-established. The following aspects can be identified that can contribute to the long-term interests of energy companies to voluntarily commit themselves to a self-regulated SOS and to behave according to the norms laid down in its design.

Firstly, heavily regulated industries, like the energy sector often want to commit themselves to sectoral agreements or covenants with respect to the transition towards a more sustainable business. By committing themselves to sustainability, these industries prevent that the government imposes regulation on them, which they cannot influence. The last decade was characterized by instable and substantive government control on the development of the renewable energy sector.

This can be an important motivation for energy companies to voluntarily commit themselves to a collective-choice SOS and to behave according to the rules that were collectively laid down, in order to prevent future government interference.

Secondly, energy companies are currently confronted with a very uncertain future. It is unclear to what degree fossil fuels will be available in the next 50 years and how this will impact their prices (Shell 2011). Furthermore, it is unclear how the CO_2 price will develop. The commitment to a self-regulated SOS provides an opportunity to transfer these uncertainties by investing in different options for electricity generation, without compromising their competitive position in the Dutch electricity sector. Therefore, electricity companies also have an intrinsic reason to collectively commit themselves to a higher level of sustainability.

Lastly, also from an ethical perspective energy companies can have a long-term interest in investing in a sustainable electricity supply. Mainstream economics assumes that all individuals are fully rational and thus always prefer to maximize its expected utility and short-term material benefits, such as profits (Ostrom 2010). However, from interviews with different departments of Essent, it appears that Essent also takes certain ethical considerations into account when executing the production and supply of renewable electricity, which do not lead to maximizing profits (Annex I, interview van Mechelen; interview Wijnen, interview Arthers). Energy companies find themselves in a paradox, as they are listed international organizations on the one hand but on the other hand are assigned with fulfilling public values like the security and sustainability of the energy supply. A part of their continuity thus can be achieved by behaving rational, while the other part of their continuity lies also in their ability to satisfy their consumers and public environment by fulfilling their social responsibility on a credible manner.

From this can be concluded that there are several long-term interests and incentives for energy companies to commit themselves to a self-regulated SOS. However, these observations also have to be related to the diversity in the type of companies in the energy sector, identified in chapter 2. The observations above mainly apply to production- or vertical integrated companies. However, for supply-only companies these long-term interests might not be completely relevant. As commitment of all parties is required, the diversity of the energy sector can thus create a weakness in the ability of a self-regulated SOS to maintain stable and well-established. This has to be taken into account in the further exploration and comparison of this option.

6.3 Selection of alternatives for further research

The previous paragraphs have identified six possible design alternatives for a SOS in the Netherlands which are capable of securing the stability of the SOS. To these options now also the most likely alternative will be added as a default-option. From experiences with the design of SOSs in other Member States can be observed that the mostly likely alternative of a SOS is a national SOS which is under centralized government control (Lipp 2007; Bergek and Jacobsson 2010; VME 2010). For this option has to be realised that its stability cannot be secured in the Netherlands, as the governance of the SOS in this alternative is not moved away from the influence of electoral politics. However, as this alternative is the most probable option, it is relevant to compare the alternatives identified above to this option as a default option. Furthermore, it is interesting for Essent to understand how the most likely alternative has to be designed from their perspective. This leads to the following alternative for design:

- A7:Dutch SOS; under centralized government control

In figure 6.2 an overview is provided of all the conceptual alternatives that were identified in this chapter. The objective of this research is to design a SOS that provides both effective and stable incentives for investment in renewable electricity generation. Therefore, now a selection will be made from the identified alternatives, in order to detail them and further answer this question. For this reason, the concepts of internationalisation and self-regulation will be further compared. As the starting point for the identification of the conceptual alternatives was the realisation of stability, also the selection between these alternatives will be based on the ability to realise stability. In order to so, for both concepts the degree of independence of the new system administrators in relation to the central government will be further discussed. In this regard, it is relevant to assess the opportunities for the Dutch government to regain control over the execution and monitoring of the SOS.

In the option of internationalisation the Dutch government will commit itself to an international agreement. This agreement will lay down the design of the SOS and the rules in which this design can be adjusted and complementary national regulation can be laid down. This means that desired interference in the system will always be limited to bilateral consultation between the system operators of both countries. Furthermore, it will not be possible for the Dutch government to lay down national regulation that disturbs the functioning of the combined SOS. Lastly, prematurely ending this scheme is only possible to the degree in which the international agreement allows this. To summarize, the Dutch government will not have the ability to unilaterally change the agreement on the design of the SOS. For this reason, internationalisation assures a high level of independence for the cooperation of the Dutch and Swedish system operators of the SOS.

In the option of self-regulation the Dutch energy sector will commit themselves to a covenant, that lays down the design of the SOS and the rules in which this design can be adjusted. It is required that Dutch government is also one of the signers of this covenant in order to reduce future interventions. However, in comparison to the situation of internationalisation, in which the Dutch government will function as the co-administrator of the SOS, the Dutch government purely has a controlling function in the situation of self-regulation. As the government in a self-regulated SOS is not directly involved in executing, monitoring and adjusting the system, they will demand a certain freedom in adjusting or stopping the system when the SOS does not achieve the sustainability targets or the government does not agree with the way in which these targets are being met. As the Dutch institutional environment cannot secure that this freedom is not abused for gaining political support, it is questionable whether this covenant can fully secure the independence of the energy sector as the system operator of the SOS.

To summarize, it might be challenging for the option of self-regulation to fully restrict future governments in behaving opportunistic. From this comparison can therefore be concluded that internationalisation offers a stronger degree of independence for the system operator than self-regulation. Furthermore, the differences in the type of electricity companies might also undermine the long-term stability of a SOS based on self-regulation. For these reasons, it is assumed that governmental opportunism can be better avoided by internationalisation then self-regulation and therefore can better secure the long-term stability of the SOS.

For this reason, only the concept of internationalisation will be further investigated in the remaining of this research. In order to so, one alternative from A1 until A5 will be selected. Regarding this selection, it is interesting to determine which of these alternatives has a high potential regarding feasibility and performance. From this perspective a connection to the Swedish system is preferred. At various occasions the Swedish government stated its wish to engage in an international expansion of its SOS (Jansen, Lensink et al. 2011; SEA 2009). For this reason, the feasibility of this option is high. Furthermore, the SOSs of Sweden is in comparison with the SOSs of Poland, Belgium and the UK increasingly effective in reaching fairly ambitious system targets. Therefore the Swedish SOS is one of the most efficient national support schemes in Europe (Jansen, Lensink et al. 2011). This makes the potential performance of a SOS combined with Sweden also high. From this perspective, it is interesting to further detail alternative A1, which connect and adapts the design of the SOS to the Swedish SOS.

Lastly, in order to provide guidelines for the development of this alternative and a base of comparison, also the default-option for design will be further detailed in the next chapter. As this is the most likely option to be introduced it is important for Essent to understand how this option can be developed further in order to create effective incentives for design. Furthermore, it can provide Essent insight in how stability can be maximized on the level of the regulation self and which securities can be built into the design in order to cope with the remaining potential for instability.

ALTERNATIVES FOR DESIGN OF SOS FOR THE NETHERLANDS:

A1	Connect and adapt design to **Swedish** SOS
A2	Connect and adapt design to **Belgian** SOS
A3	Connect and adapt design to the **British** SOS
A4	Connect and adapt design to **Polish** SOS
A5	**North-west European** SOS (GER, UK, BE, SE & NL)
A6	**Self-regulated Dutch Hybrid** SOS; under control of the energy sector
A7	**Dutch Hybrid** SOS; under government control

Figure 6.2 Overview conceptual alternatives for design

6.4 Conclusions

This chapter had the objective to answer the following sub-research question:

'Which concepts for the design of a SOS can provide a stable SOS?

This question was answered by shifting the object of research from the 'SOS self' to the 'governance of the SOS'. Based on theories of Spiller and Tomassi (2005) on regulatory governance in the energy sector, the relation between the institutional environment of the Netherlands and stability of regulation of the energy sector was investigated. This showed that regulation in the energy sector can be subjected to governmental opportunism, due to a combination of its specific economic features. Furthermore, was empirically confirmed that the Dutch institutional environment is not able to effectively limit this form of opportunism.

In the search for possible manners to limit governmental opportunism in the SOS, taking into account the Dutch institutional environment, was identified that substantial regulatory flexibility is required in order to respond to the significant dynamics that surround support schemes for renewable electricity. Therefore, the only appropriate approach to structurally constraint governmental opportunism in a SOS is to delegate the responsibility for the governance of the SOS from the central government to a party which is not under direct influence of electoral politics. The general notion behind this is that delegation will lead to a more objective and substantive governance of the SOS and therefore a more consistent, coherent and predictable policy. This was the starting point for the identification of the following conceptual design alternatives for design:

- A1: Connect and adapt design to Swedish SOS
- A2: Connect and adapt to Belgian SOS
- A3: Connect and adapt to British SOS
- A4: Connect and adapt to Polish SOS
- A5: North-west European SOS
- A6: Self-regulated Dutch SOS under control of the energy sector

The alternative that connects the SOS to Sweden (A1) was selected from these six alternatives to be further detailed in the next chapter. Firstly, this alternative was selected because it is expected that internationalization is better able to secure the long-term stability of the SOS than self-regulation. Secondly, Sweden has the highest potential regarding feasibility and performance in comparison to the other alternatives based on internationalization. To this choice has to be noted that this does not mean that alternative A1 can fully constraint the possibility of governmental opportunism. Nor does it mean that self-regulation is not able to constraint government opportunism. This decision is the result of the expectation that internationalisation can to a greater extent avoid government opportunism than self-regulation. However, both concepts remain a potential solution to constraint governmental opportunism. For this reason, when it would appear that the concept of internationalization is not feasible in practise, it is recommended to further detail the option of self-regulation.

Lastly, examples of foreign SOSs show a system design which is based on a national SOS under the control of the central government. For this reason, the six alternatives, identified in this chapter, do not seem the most likely to be implemented. Therefore, the following default-alternative was identified that follows the example of other SOSs implemented in other countries:

- A7: Dutch SOS under control of the central government

As this alternative seems the most likely to be implemented, it is interesting to compare this with the detailed alternative A1. Furthermore, it can provide a guideline for the development of A1. Therefore this alternative will also be further detailed in the next chapter.

7. DETAILED ALTERNATIVES FOR DESIGN

This chapter has the objective to answer the following and sub-research question:

> 'Which design for a SOS can provide stable and effective incentives for Essent to invest in renewable electricity?

In order to answer this question the selected conceptual alternative identified in the previous chapter will be further detailed. This is a SOS connected to the SOS of Sweden. The connection of the Dutch SOS to the Swedish SOS will result in a loss of degrees of freedom in design, as the design of the Swedish system is for the largest part locked-in due to the required system stability of a SOS. Therefore, the default-option, which is a Dutch SOS under central government control, will be first developed in order to understand what the design of the SOS looks like from the perspective of Essent without being constraint by the existing situation in Sweden. In this way the development of the default option will provide a guideline for the development of the SOS connected to Sweden. This chapter is structured as follows. In paragraph 7.1 the default-option will be detailed. Then in paragraph 7.2 the design of the SOS that is connected to the Swedish SOS will be detailed. In paragraph 7.3 the results of detailing both alternatives will be compared. Lastly, paragraph 7.4 will end this chapter with conclusions.

7.1 The design of the default-option

In this paragraph the design of the default option will be further detailed. Regarding the default option has to be realised that the stability of this alternative cannot be structurally secured for the Dutch situation, as the governance of the SOS in this alternative is not separated from the direct influence of electoral politics. This means that stability for this design can only be realised for the degree in which stability can be introduced on the level of the regulation self. Furthermore, securities can be built into the design in order to cope with the remaining potential for instability. To this regard it is interesting to observe that the default-option also decreases the degrees of freedom in design by the need to build in certain securities to cope with the possibility of instability. In Section 7.1.1 the development of the default-option will be described. In section 7.1.2 remarks will be made on the challenges and trade-offs that were identified during this development.

7.1.1 Development of the default-option

In this section the design of the default option will be detailed by applying the requirements for design which were identified in chapter five to the design space which was identified in chapter four. In order to do so, every requirement for design will be connected to the relevant system elements. These system elements will then be filled in accordance to this requirement. During the discussion on the design space was explained that choices in certain system elements will limit and influence choices in other system elements. For this reason, the requirements will be discussed in the order that enables us to take this into account. Now per requirement for design the relevant system elements will be filled in.

The inclusion of existing biomass conversion capacity in the SOS

In order to realise this requirement in the design of the SOS element 3 is relevant, which describes the level of inclusion of existing renewable capacity. The option 'E3C: Fully include existing capacity, except for capacity which is still subsidized under the MEP scheme' fulfils the requirement and is therefore preferred from the perspective of Essent. However, the inclusion of existing capacity can result in economic rents for existing plants (Espey 2001; Bergek and Jacobsson 2010; Bennink, Blom et al. 2010). In chapter two was identified that economic rents can undermine the overall equity and efficiency of the SOS[6]. For this reason the inclusion of existing capacity has to be reduced as much as possible.

In order to do so, the differences in the ratio of operational and capital expenditures for biomass conversion versus other technologies have to be taken into account. From this perspective, it can be observed that existing biomass plants cannot continue their operation without inclusion in the SOS, while existing wind- and solar power plants can continue their operation without inclusion in the SOS. For this reason, excluding existing biomass installations provide the incentive to prematurely shut down biomass conversion plants and to invest in new plants. This does not lead to a cost-effective transition towards more biomass conversion in the total energy supply. Therefore, a more justified option that also fulfils the requirement of Essent is: 'E3D: Exclude MEP subsidized capacity and SDE subsidized capacity of which the subsidy term has ended, with an exception for generation facilities based on biomass conversion'.

Continuous support for biomass conversion plants

With respect to this requirement system element 9 is relevant which establishes the term of certificate allocation per production unit. In order to fulfil this requirement option: 'E9C: unlimited duration for participation' is preferred. The advantage of this option is that is drives down the certificates price as the capital expenditures can be divided over a larger amount of certificates. However, investors require a relative quick and secured return on investment in a system which is characterized by regulatory instability (Spiller and Tomassi 2005). This incentive for realising up-front rents can drive up the certificate price. For this reason, unlimited participation of production units in the SOS will likely lead to the support of renewable electricity production which is already profitable. This can result in economic rents for certain producers. As economic rents undermine the equity and efficiency of a SOS, limited participation for production assets is preferred from a general perspective.

To this regard, also the difference in CAPEX/OPEX ratio of biomass conversion and the other technologies for renewable electricity generation needs to be taken into account. From this perspective, the participation of assets in the SOS can be limited to the term on which the capital costs can be recovered, with an exception for biomass conversion for which the eligibility period needs to be unlimited. Jansen, Lensink et al. (2011) consider an eligibility period of 15 years appropriate to guarantee a capital costs recovery. Therefore the following option is selected to establish system element 9: 'E9B: 15 years of participation per asset, with an exception for biomass conversion for which the participation is unlimited'.

Fair economic rents for renewable electricity producers

This requirement can be fulfilled by reducing the economic rents that arise due to:

- Differences in costs of production technologies for renewable electricity generation
- Inclusion of existing capacity
- Unlimited participation

The last two aspects are already reduced by the design for the degree in which this results in an effective and efficient usage of the renewable production portfolio, as was described in this paragraph. This section will therefore only focus on the reduction of economic rents due to technological differences. The following options were identified that offer the possibility reduce this type of economic rents:

[6] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme and not economic efficiency, as was defined in chapter 2.

- Exclusion of immature technologies (Element 1)
- Differentiation of minimum prices (Element 4)
- Hybrid SOS (element 6)
- Differentiation in certificate allocation (Element 8)
- Separate quotas for all technology classes (Element 15)

In this section one option will be selected from these different options. With respect to this choice the main challenge it to find an optimum between embracing the key competence of a SOS which is to allow market forces to select the technologies and in the same time maximizing the equity and cost-efficiency of the SOS. The starting point for this choice will therefore be to allow market forces in the SOS where this will not lead to excessive economic rents due to technology differences.

When differentiating minimum prices based on production costs it is as attractive to invest in low-cost as high-cost technologies as the differences in minimum prices balance the income for the producers. For this reason, differentiated minimum prices will not lead to a selection of technologies by market forces. Also when the certificate allocation is differentiated for the level of maturity of the different technologies, it remains as attractive to invest in low-cost or high-cost technologies, as the SOC allocation balances the income for the producers. Therefore, the differentiation of certificate allocation will also not move the selection of renewable technologies from government evaluation to market forces. When separate quotas for different technologies classes are applied, the government will fully dominate the selection of the different renewable technologies. Therefore, also this option will not lead to an optimization of the renewable production portfolio by market forces.

Instead, it is important to make a clear distinction between mature and immature technologies, to be able to embrace the core competence of a SOS to apply market forces to the technology selection. For relative mature technologies the introduction of competition and thus selection by market forces can be an adequate instrument to realise economic efficiency. For immature technologies the introduction of competition is not an adequate instrument to realise economic efficiency as immature technologies are on different positions on the learning curve and can therefore not yet compete with each other. For immature technologies a certain degree of government evaluation in the selection of suitable technologies is thus still required. Therefore, this research proposes that relative mature technologies have to be able to compete with each other in the SOS, in order to realize a large scale cost-effective transition towards a renewable energy supply. Furthermore, immature technologies need to be stimulated with (additional) capped financial support to innovate them until they can compete with mature technologies. By doing this the price of SOCs will be set by the mature technologies which reduces economic rents for these generators, while still stimulating more immature and costly technologies. The provision of additional support for immature technologies can be done either within the SOS or in a separate system. This remains the following options to reduce excessive economic rents for renewable electricity producers:

- Exclusion of immature technologies from the SOS
- Hybrid SOS

When comparing the two options above, two disadvantages of the first option in relation to the second option can be identified. Firstly, the first option will lead to a lower degree of liquidity in the SOC market. Secondly, by separating the two systems the transition of immature technologies from the innovation support system to the SOS may lead to higher transaction costs then when an immature technology within a SOS can gradually move to participation without additional support. When immature technologies will participate in the SOS they will receive both the SOC price and an additional subsidy in order to cover their uneconomic top. The subsidy level is each year determined based on the present certificate price and production costs. When a technology appears to be able to compete with the mature technologies this subsidy will thus gradually diminish and thus lead to a gradual transition towards full system participation. Figure 7.1 shows the transition of relative immature technologies towards full system participation in a hybrid SOS.

To summarize, a hybrid SOS is the most suitable option to reduce economic rents due to technological differences, because it does not compromise the core feature of a SOS. In this system all technologies will receive certificates for which stand-alone biomass conversion, offshore wind, hydro and solar power plants will receive additional subsidy. Lastly, several options were identified to finance and execute the additional subsidy in the SOS. All these options fulfil the requirement of Essent regarding the reduction of economic rents. For this reason, no further specifications on the execution of the hybrid character of the SOS will be made.

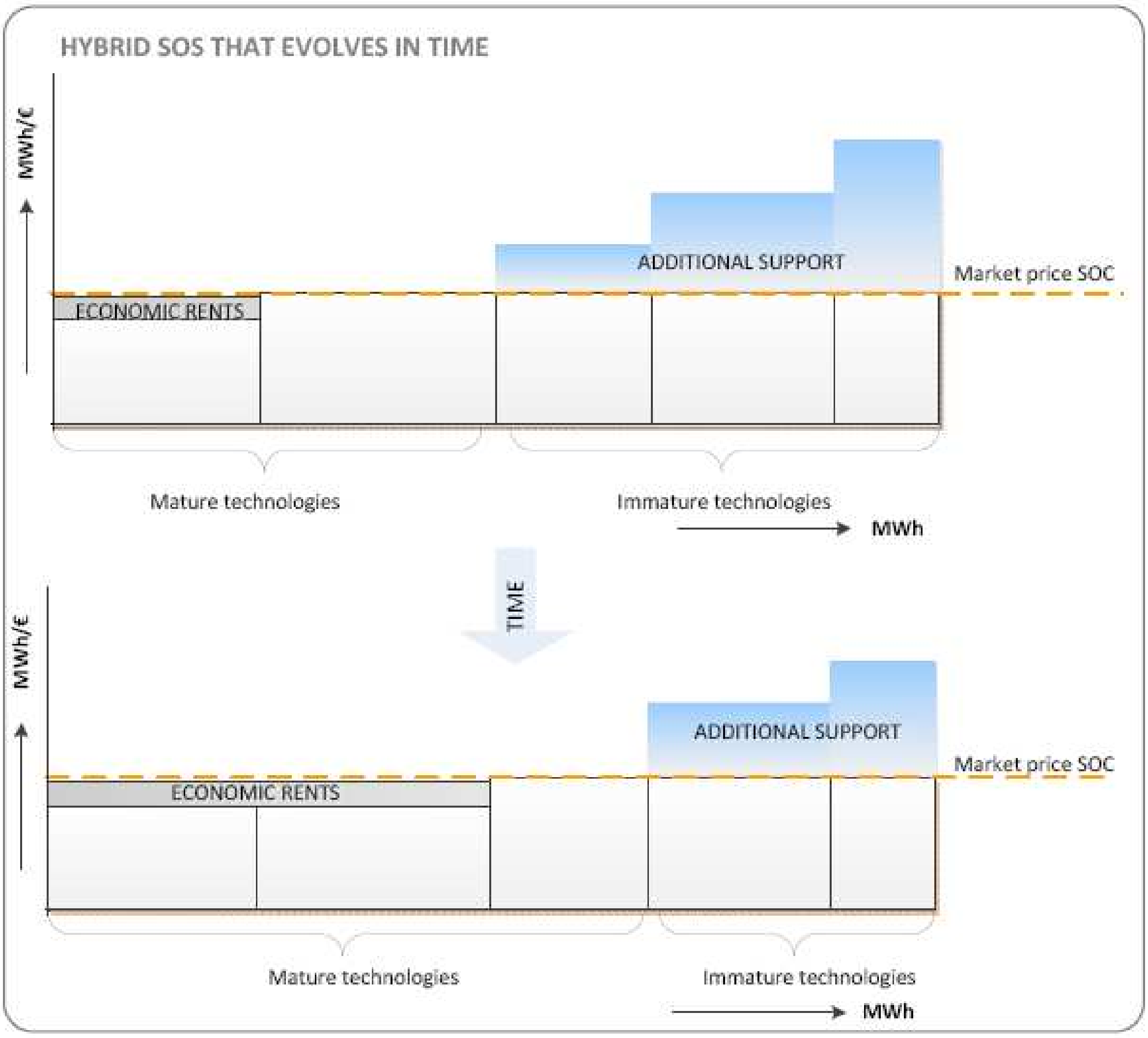


Figure 7.1 Effect of a hybrid SOS on the market price and economic rents in time

Sufficient possibilities for technology diversification and stimulation of immature technologies

Due to the availability of complementary subsidy for immature technologies, it remains possible to invest in relative immature technologies within a SOS, despite the existence of competition between technologies. Therefore, the choice of a hybrid SOS also enables possibilities for technology diversification and the stimulation of immature technologies in the most efficient manner.

Equal starting point for different type of electricity companies

Regarding the realisation of this requirement the market design of the SOS is important (element 10). In order to realise a level playing field for all type of electricity companies a mandatory anonymous and centralized trade platform is required. This market design will prevent that vertical integrated companies can internally sell their certificates, which would offer them a competitive advantage in comparison to supply- or production-only companies. Furthermore, during this research the following pre-conditions were identified that have to be embraced by the design of the SOS:

- The size of the SOC market at the start of the system
- A pattern of long-term trade in the electricity and GoO market

Regarding the size of the market in relation to the possible market design the following was identified in chapter three. Firstly, trade through auctions and tenders will be appropriate in a market with a small number of participants. When the trade volume is large enough SOCs can also be traded on exchange platforms. As the market size and number of market parties is fairly small at the start of the system the market design will be limited to mandatory anonymous auctions for the trade of SOCs. Auctions do not directly facilitate long-term trade. For this reason also futures and forwards of SOCs will be traded during these auctions. On the longer term the auction of SOCs and futures can be replaced by a mandatory centralized and anonymous exchange for these products.

Stable market conditions

The requirement of stable market conditions is realised by filling in different type of system elements. Firstly, the elements in the category governance will contribute to the stability of a SOS as they further detail the governance of the SOS. Secondly, the term on which the quota is set will influence the predictability of the market conditions. Lastly, the way in which the penalty price and unit base of SOCs are set in the SOS will determine its stability. Now these system elements will be filled in with the objective to maximize the stability of the market conditions, structured by the sub-sections 'Governance', 'Term on which the quota are set' and 'Other'.

Governance

In order to further detail the governance of the SOS, the governing bodies (element 20) and the focus of these bodies with respect to possible interventions in the SOS (element 21) have to be determined. Both will be discussed here.

Allocation of administrative responsibilities

The allocation of administrative responsibilities in the default alternative of a SOS can increase the stability of the SOS by delegating these responsibilities to (relative) independent agencies were this is possible and appropriate. The following administrative responsibilities were identified in a SOS:

- Setting and correcting of the quota sizes
- Issuing of certificates
- Managing of certificate accounts
- Certificate trade operator
- Monitoring of compliance with the targets
- Setting and collection of penalties for non-compliance
- Calibration of the certificate market
- Market-maker: offering and administration of minimum certificate price

Furthermore, was identified that the following bodies can execute these responsibilities: the Ministry of Economic Affairs, Agentschap NL, the Office of Energy Regulation (NMA), the TSO (Tennet), APX-ENDEX, CertiQ and/or a new specialized independent administrative body. Now the responsibilities will be allocated to these executive bodies. The starting point for this activity will be to realise as much stability as possible and to match the new responsibilities of the SOS with the existing responsibilities of the administrative bodies. Firstly, the setting of the quota sizes will be the responsibility of the Ministry of Economic Affairs. The Ministry is responsible for achieving the target laid down by Directive 2009/28/EC and therefore the appointed body to lay down the quota sizes. As the Ministry of Economic Affairs is exposed to political dynamics, the term on which the quotas are fixed (element 13) needs to prevent extensive instability in the quota size. This will be further discussed below.

The issuing of SOCs and the management of the SOC accounts will be executed by CertiQ. CertiQ has both the expertise and resources for the certification of renewable electricity. For this reason, it is logical to assign CertiQ with the responsibility of issuing SOCs and managing the SOC accounts of the market parties. The trade operator of the SOS is responsible for organizing the periodic auctions of SOCs, forwards and futures of SOCs. APX-ENDEX is responsible for the power exchanges in the Netherlands. As APX-ENDEX already has experience with electricity trade it is logical to assign the execution of the auctions of SOCs also to this organization. However, APX-ENDEX is currently a commercial organization, which is allowed to make profit. If the competences of APX-ENDEX would increase with the responsibility for the SOC auctions their activities become more monopolistic. For this reason APX-ENDEX has to be regulated in order to be able to perform this activity (Annex I: interview De Jong; interview Andringa). Otherwise a new regulated administrative body needs to be established that can execute this task.

The responsibility for monitoring compliance with the quota, collecting penalties for non-compliance and calibration of the SOC market is assigned to the Office of Energy Regulation. This is done in order to maximize objectivity and substance in the daily execution of the SOS, without the influence of political shocks. The Third Energy Package of the European Union has further defined the function of the national energy regulators, which will lead to a higher level of autonomy and independence for the regulator with respect to the government. Furthermore, case law from the gas sector contributes to the increasing autonomy of the regulator (CBb 2010). In order to make this executive role division for the Office of Energy Regulation possible, the SOS has to be incorporated in the Dutch Electricity Law, as the regulator is responsible for the execution of this law.

Furthermore, the responsibility of market-maker will be assigned to Tennet. When a renewable producer offers his certificate to Tennet, Tennet will pay the minimum price to the generator and then offer the certificates to the highest bidder on the certificate market. The costs of being a market-maker will be added to the transmission costs. Lastly, an additional administrative responsibility for the SOS can be identified due to the hybrid character of the default alternative. The allocation of additional subsidies for immature technologies within the SOS will be executed by the same administrative bodies that currently allocate subsidies under the SDE scheme (Annex III). CertiQ will inform Agentschap NL on the renewable electricity production of producers that are eligible for additional support, based on which Agentschap NL will remit subsidy. Research centre ECN will advise the Ministry of Economic Affairs on the subsidy tariffs for the different eligible technologies, based on the average production costs, SOC-, electricity-, and CO_2 price.

Focus of intervention in the SOS

Regarding the focus of intervention, option 'E21A: focus on stability' is preferred. The establishment of this option means that it is not allowed to do structural interventions in the system once it is implemented, except on clearly defined correction moments laid down in the resolution on the SOS. This focus can only be implemented if the design of the SOS possesses sufficient self-regulating and flexibility mechanisms with respect to the quota size and price setting. This has to be taken when further detailing these system elements. In order to also allow a proper phase-in of the system, it is recommended to start the system with a focus on adaptability until the system has solved all its teething problems and then move over to a focus on stability to secure down a stable investment climate. This trial period can be set at one or more accounting periods. Condition for the success of this approach is that this trial period is clearly communicated to the market parties.

Term on which the quota are set

This sub-section will consider the system element that establishes the term on which the quota is set (element 13). In order to do so, first the elements 'quota size' (element 11) and 'duration of the SOS' (element 12) will be discussed. The main objective of the establishment of 'the term on which the quotas are set' is to maximize the predictability of market conditions.

Duration of the SOS

From the perspective of Essent a long lifespan of the SOS is beneficial as this creates the most possibilities for the further broadening and up scaling of current activities in the supply and production of renewable electricity generation. In chapter four was explained that the SOS requires a live span of at least 15-20 years in order to realise the national target laid down in Directive 2009/28/EC (Tilburg, Jansen et al. 2006). Within the range of 15 to 20 years it is preferred to set the duration of the SOS at 20 years, in order to create the longest lifespan for the further development of renewable production methods. For this reason the following option is chosen to fill in element 19: 'E19A: The SOS will exist 20 years'.

Quota size

Regarding the quota size the following option was identified: 'the size of the quota is set based on the expected renewable electricity generation for year 20yy including an increase of 'x' percent'. In this definition 'x' always has to balance the targeted capacity and the actual capacity. A realistic and pragmatic approach is required in finding this balance, as a too optimistically quota can lead to a very costly transition towards a renewable energy supply. In order to realise this realistic approach but in the same time also realise the targeted growth, the 'x' has to lie at the actual growth in capacity at the start of the system and at the desired growth in capacity on the longer term. As the sustainability objectives of the electricity sector will be based on the targets of European Directive 2009/28/EC for the Netherlands, the quota size has to contribute to a share of 37 percent of renewables in the total electricity production in 2020.

Term on which the quotas are set

In order to be able to set 'x' on the targeted growth instead of the actual growth of renewables in the electricity supply towards 2020, the quotas have to be fixed for a long-term. The longer the term on which the quotas are fixed the better producers are able to anticipate on this and the more the SOS is able to steer on targeted growth instead of actual growth. In order to realise the longest period for generators to anticipate on the future quotas the following option is preferred to establish element 12: 'E12B; The quotas are fixed on the short-term for 5 years and proposed for the remaining duration of the system, for which in year 'n' the quota of year 'n+5' is fixed based on the proposed quota on the long term and adjustments based on a legally established frameworks'. This option fixes at each point in time the quota for the next five years. This option will therefore reduce the ability of the Ministry of Economic Affairs to unexpectedly change the quotas. Furthermore, this option provides Essent a reasonably long period to anticipate to the future quotas. A disadvantage of the long-term fixation of the quota size is that the SOS will not possess much flexibility to react to unexpected outcomes of the SOS or developments in its environment with respect to the quota size. This will be taken into account when establishing the self-regulation mechanism for the quota size.

Other

In this sub-section two elements will be discussed that require or can require structural interference in the SOS. These options will be filled in with the objective to maximize the stability of the market conditions in the SOS.

Penalty price per unpaid certificate

The penalty price is established in system element 6. Regarding the settlement of the penalty price two options were identified. Firstly, it is possible to set a fixed penalty price. Secondly, another possibility is to set the penalty price as a percentage of the average certificate price of the previous accounting period. With a fixed penalty price the height of the penalty price is dependent on government evaluations, while with a penalty price based on a percentage the penalty price is dependent on the market price for certificates. For this reason, the option in which the penalty price is based on a percentage of the average certificate price is preferred, as it will provide Essent the most predictable market conditions and fewer possibilities for structural government interference in the system.

Regarding the height of the percentage the following trade-off was identified in chapter three. On the one hand it is very important that the penalty price creates a sufficient incentive for suppliers to comply with the obligation. On the other hand the penalty price also needs to be able to balance price volatility in order to secure the affordability of electricity (Espey 2001). For this reason, the following options to fill in system element 6: 'E6A: The penalty price is 150 % of the average certificate price of the last year'. As the Office for Energy regulation was assigned with the task of collection of penalties for non-compliance, this task now also includes to determine the penalty price based on 150% of the average certificate price at the end of the accounting period and to communicate this to the market parties in the SOS.

Unit of certificate

The unit of certificates is established in system element 8. Certificates can be denominated in MWh or in tonne avoided CO_2 emission. The calculation of CO_2 abatement per technology can be ambiguous (Espey 2001). Due to this ambiguousness a unit base for the certificate that is based on avoided CO_2 emissions might be more subjected to unpredictable evaluations of the system operator. Therefore, system element 8 will be established by the selection of option: 'E8A: 1 certificate per MWh renewable electricity generation'.

Low market risks from the perspective of a renewable electricity producers

The following system elements were identified that can contribute to the reduction of price and volume risks for investors:

- Minimum price (element 4)
- Mandatory tendering of long-term SOC contracts (element 10)
- Self-regulating mechanism for the quota size (element 14)
- Banking of certificates (element 16)

The first two options both at least guarantee renewable electricity producers a rate of return on a specific investment. This is important since the default option does not structurally secure the stability of the SOS. However, the introduction of both elements will be superfluous. In this section therefore a choice will be made between the two options. Furthermore, the self-regulating quota size will secure sufficient demand and therefore reduces market risks. Lastly, the banking of certificates provides producers more flexibility and therefore also reduces market risks. In this section first a selection will be made between the establishment of a minimum price and the obligation of long-term contracts. Subsequently, will be determined whether additional reduction of market risks by a self-regulating quota or the possibility of banking of SOCs is necessary and how this complements the earlier design choices.

Introduction of a minimum price or mandatory tendering of long-term SOC contracts

Firstly, the allocation of a minimum price for certificates for a pre-defined period can significantly reduce market risks for Essent, as it can offer a well specified guarantee on the return on investment within a SOS. This makes the investment-decision in new renewable electricity generation less complex and therefore more transparent and credible. Secondly, when long-term contracts are obliged in the SOS this will function like a feed-in-system, for which the tariffs are set by the market based on private information held by generators on the profitability of their scheme. This feed-in character reduces volume and price risks as the market would guarantee generators an income stream, which is known in advance and secures the return on investment (Agnolucci 2007). Therefore, the establishment of a minimum price or mandatory tendering of long-term contracts both significantly reduce market risks and result in lower costs for financing investments within the SOS.

Now a choice between these two options will be made. The obligation of long-term contracts requires long-term stability of the SOS. This long-term stability does not seem very likely for the default-option. For this reason, a market design which obliges suppliers to enter into long-term SOC contracts would completely transfer the market risks of generators to suppliers. As suppliers are not able to voluntarily commit themselves to the SOS while generators are, the obligation for long-term contracts is unfair to electricity suppliers. As Essent also requires low market risks as a supplier, this option is not preferred in comparison to the establishment of a minimum price. For this reason the establishment of minimum price is recommended to Essent.

As this minimum price is established in a hybrid SOS the minimum price will be based on the costs for electricity generation of mature or unsubsidized technologies. This leads to following option to fill in system element 5: 'E5B: a single minimum certificate price for all technologies, which is based on the integral costs of the mature (unsubsidized) technologies in the system and is yearly corrected for the CO_2 and electricity prices'. By establishing a minimum price in the SOS a trade-off is made between the existence of a clear return on investment for generators and the possible increase in electricity price for consumers. For this reason, the minimum price will be set at such a price level that the market-maker mechanism does not have to be applied under regular circumstances. The average market price of SOCs thus has to lie above the minimum price. Furthermore, the existence of a minimum price does not offer an incentive for investors to position their investment in the projected growth of the market in relation to the total demand set by the quota, which can result in over-stimulation by the SOS. This effect will be further discussed at the end of this paragraph.

Self-regulating mechanism for the quota size

A self-regulating quota can significantly reduce market risks for Essent in a SOS, as it will secure an adequate level of scarcity in the certificate market for both generators and suppliers. However, it might be superfluous to introduce both a minimum price and a self-regulating quota. Especially, as a self-regulating quota might reinforce the possibility of over-stimulation by the establishment of a minimum price. Despite this potential risk of over-stimulation it is still decided to implement this option in the design of the SOS due to requirements that earlier design choices laid down.

Firstly, as element 13 has established the fixation of the quota size for every next five years, a certain self-regulating ability needs to be added to the setting of the quota size, in order for the SOS to able to respond to external events or unexpected system outcomes. Secondly, a certain self-regulating capability is required because the focus regarding system intervention lies on stability. Lastly, the establishment of the self-regulating will also contribute to the affordability of the execution of the minimum price, because a surplus of certificates on the market can yearly be adjusted by this mechanism and thus reduces the need for producers to apply the minimum price. For the reasons stated above, is chosen to establish element 13: 'E13A: The quota is automatically adjusted in year 'n' with the percentage of certificate surplus/deficit of year 'n-1', if this is required.' At the end of the paragraph the potential of over-stimulation due to this decision will be further discussed.

Banking of certificates

The establishment of a minimum price will secure income for renewable producers. However, it is undesired that producers have to fall back on this mechanism too often, as this will result in the rise of electricity costs. Moreover, the self-regulating quota can only adapt to a surplus of certificates on the market after the end of an accounting period. However, the possibility of banking will enable renewable producers to instantly respond to surpluses in the SOC market. Therefore, the introduction and maximization of this option is desired in a SOS, next to the establishment of a minimum price and a self-regulating quota. For this reason, the establishment of the following option is preferred: 'E15C: a certificate can be banked for an unlimited period for an unlimited amount'. The banking of certificates is also preferred in order to enable the focus on stability with respect to the need for system intervention. Furthermore, additional advantages of allowing banking of certificates are that it leads to a more liquid market and more possibilities for capturing economies of scale in the size of renewable energy facilities in combination with the increasing quota (Rader and Hempling 2001).

Low market risks from the perspective of a supplier of electricity

Low market risks for suppliers within a SOS are realised by offering suppliers more flexibility in complying with the quota obligation. This will make them less vulnerable to price volatility on the certificate market. For this reason, this requirement can be fulfilled by the establishment of a reconciliation period (element 19) or allowing the borrowing of certificates (element 18). It is superfluous to implement both. As a reconciliation period will only assist in balancing short-term deficits on the SOC market, while borrowing can balance more lengthy imbalances, the borrowing of certificates is preferred. However, in order to also secure sufficient demand on the SOC market, the amount of SOCS that can be borrowed per accounting period is limited to 20 %. Furthermore, the banking of certificates will also contribute to the flexibility of suppliers, as this enables them to sell certificates when they are relatively cheap in order to bank them until SOCs become scarcer.

Low degree of possibility of market power

The banking of SOCs decreases the transparency of the certificate market, which will undermine the possibility of market power (Tilburg, Jansen et al. 2006). Therefore, this requirement is already fulfilled by allowing the unlimited banking of certificates (E16C).

A sufficient transition path between the ending of the MEP and the starting of the SOS

Regarding this requirement, two are options possible. Firstly, it is possible to realise the transition path as a component of the SOS. For this case it is preferred to allow 'early banking' in a SOS (E17A). This option enables Essent to generate and bank certificates between the ending of the MEP and the actual start of the SOS. At the start of the SOS, Essent can sell these certificates on the SOC market. Secondly, it is possible to realise a transition path independent of the SOS. In this case an intermediate system is required that continues the financial support for biomass conversion in the period between the MEP and the SOS. For this situation it is most logical that the assets that have run out of the MEP are included in the SDE plus. The reason for this is that the SDE plus is an existing system and that the resolution on the SDE offers the possibility for renewable electricity generation with relatively high operational costs to receive multiple terms of subsidy (Ministerie EZ 2007).

When comparing these two options, the first option is preferred as this requires fewer transactions in the transition phase and start-up of the system. Although it is theoretically possible to include SDE subsided capacity in the SOS, it creates more administrative pressure and complexity to adopt the capacity for which the MEP has ended first in the SDE plus and then in the SOS than to adopt it in the SOS instantly. For this reason, it is recommended to implemented 'early banking' in order to realise an adequate transition path. This option can in the same time contribute to a smoother introduction of the SOS. Regarding this recommendation, the required cash flow position of the biomass conversion facilities is not taken into account. If this is an issue for Essent than the option of inclusion in the SDE Plus is preferred.

The inclusions of micro generation in the SOS

System element 2 establishes the degree of inclusion of micro-generation. In order to follow the requirement for design the option 'E2A: full inclusions of micro installation' is preferred.

7.1.2 Remarks on the development of the default alternative

During the design of this default option certain issues were identified, which will be discussed here.

Biomass co-firing in relation to other technologies in a SOS

The development of the default option from the perspective Essent revealed the consequences of optimally embracing the features of biomass co-firing in a SOS. Biomass co-firing is characterized by high operational expenditures and relatively low capital expenditures. This feature of biomass conversion requires continuous support for plants based on this technology by the SOS. In this respect, co-firing has to receive support for a longer period than other technologies. Furthermore, it, by exception, requires the inclusion of existing co-firing facilities in the SOS. From this perspective biomass co-firing will have an advantaged position in comparison to other technologies in the SOS.

This advantaged position in the same time has to be nuanced to a certain degree. Firstly, co-firing facilities possess as balancing power in the SOS. In the Netherlands co-firing units are the only flexible plants in a SOS, as they have the possibility and incentive to balance surpluses of SOCs on the market by reducing their production. For this reason, biomass co-firers can reduce price volatility on the SOC market. The consequences of this for operators of co-firing units is that it will not always possible to operate at the planned or desired load. Under extreme circumstances, for instance in an exceptional windy year, this might thus heavily affect the income of co-firers. Secondly, technologies who receive both SOCs and additional subsidy are less vulnerable to price volatility on the SOC market, as the ex-post subsidy rate will balance a low average SOC price. Co-firing does not receive additional subsidy in the SOS and therefore is not able to transfer these price risks by additional subsidy income. This can move immature technologies forward in the merit-order at the expense of co-firing and onshore wind in the situation of a low certificate price. Furthermore, it makes investment risks smaller for renewable producers who invest in technologies that can both participate in the SOS and in a subsidy scheme than for producers that invest in a technology that can only participate in the SOS.

As the two mechanisms described above, mainly consider exceptions in the execution of the SOS in general these mechanisms might not fully take balance the identified advantaged position of co-firing in comparison to other technologies in the SOS. For this reason, it may be necessary to further balance these advantages by the system design. In order to do so the design of the SOS can require per SOC issued to a co-firing unit a production volume higher than 1 MWh of renewable electricity generation (Jansen 2011). The objective of this measure must not be to fully equalize the profits of co-firing and other technologies, as the core feature of a SOS, to acknowledge competition between renewable energy sources, has to be maintained. Instead, this measure must have the objective to equalize the relative advantages of the unlimited participation in comparison to limited participation, for the part in which this is not already balanced by the costs of offering flexibility to the system. It must be clear here that the establishment and calibration of the production volume per certificate for co-firing is a responsibility that requires a high degree of regulatory discretion. Thus, if under the condition that existing and new co-firing capacity can unlimited participate in the SOS it appears that such a measure is required, then the responsibility for this measure must be executed by the Office of Energy Regulation.

The reduction of risks for generators versus the risks of over-stimulation

The reduction of market risks for renewable producers is an important requirement for design from the perspective of Essent and from an overall system perspective. However, the development of the default-option in the paragraph revealed an inherent paradox in the reduction of market risks and the presence of over-stimulation due to this. The introduction of a minimum price and a self-regulating quota in the SOS can both lead to over-stimulation by the SOS. This means that more renewable electricity is produced than what is required to achieve the national target of Directive 2009/28/EC. However, not introducing these options within the present institutional environment can lead to underinvestment in a SOS, which again can lead to a relatively small and costly transition towards a renewable electricity supply, as was identified in chapter four.

Therefore, this paradox shows that designing a SOS in the current institutional environment is an inherent imperfect exercise. In this respect, it has to be accepted that at some point a choice has to be made between two perverse signals. For this example, this is the choice between a SOS that properly reduces risks for generators but can possibly lead to over-stimulation or a SOS that does not reduces risks for generators and can result in under-investment. The last will lead to a relative costly but ineffective transition. The first will lead to a relative costly but effective transition. Therefore, the possibility of over-stimulation in comparison to the possibility of under-stimulation is also preferred from a general perspective. Furthermore, if indeed a situation of severe over-stimulation will arise, it is still possible to cap the allocation of the minimum price to new production units.

7.2 The design for a SOS that is connected to the Swedish SOS

In this paragraph the design of the SOS that is connected to the Swedish SOS will be further detailed. This design will from now on be referred to as the ‘joint SOS’. The joint SOS is able to structurally secure regulatory stability, as the governance of this SOS is separated from the direct influence of electoral politics. As the options for this design are for the largest part locked in the by design of Swedish system, the requirements for design will be applied to the existing design of the Swedish SOS. For every requirement will be assessed if it is sufficiently fulfilled or that it demands changes in the Swedish system. Before the development of this design will be executed in this way, first relevant pre-conditions for this specific design will be identified by a description of the context of design in section 7.2.1. Subsequently, the actual design will be developed in section 7.2.2

7.2.1 Context of design

This sub-paragraph will describe the context of the development of the design of the SOS that is connected to the Swedish SOS. Firstly, the main characteristics of the Swedish system will be elaborated. Furthermore, the possible advantages and disadvantages of participation in a joint SOS for both the Netherlands and Sweden will be discussed, because this can influence the feasibility and future stability of the joint SOS. Also, the joint and separated system elements and processes in a joint SOS will be divided and further elaborated. Lastly, the legal basis for the design of the joint SOS will be described.

Description of the Swedish SOS

The Swedish SOS came into force in 2003 and is laid down in the ‘Act Concerning Electricity Certificates (2003:113)’ (Linden, Uyterlinde et al. 2005). The main characteristics of the Swedish system design are that it is fully technology neutral and excludes existing large scale hydro power (Jansen, Lensink et al. 2011; Bergek and Jacobsson 2010). An interesting aspect of the Swedish SOS is that Sweden and Norway recently have started negotiations on the possibility of a joint SOS (Jansen, Lensink et al. 2011; SEA 2009). This means that a connection to the Swedish SOS possibly will also lead to a connection to the Nordic system. The influence of this possibility on the design of the joint SOS will not be further taken into account during the development of this design.

Motives for participation to a joint SOS for the Netherlands and Sweden

Jansen, Lensink et al. (2011) state that "the key driver towards the establishment of market-based joint support scheme is to achieve higher efficiency in target compliance by capitalizing on the gains from trade". The higher efficiency is achieved because a joint SOS stimulates to allocate technologies for renewable electricity generation to the location where production costs are the lowest. In case of a Dutch-Swedish cooperation the Netherlands can expand its current position in biomass co-firing, while Sweden can expand its current position in small scale hydro and wind power (Jansen, Lensink et al. 2011). Furthermore, the Norwegian qualifying renewable resources are even more divergent from the Dutch source than the Swedish resources (Jansen, Lensink et al. 2011). For this reason, the realisation of a Norway-Sweden system would further enhance the economics of a Dutch accession to this system. Another cause for an increased efficiency in a joint support scheme is that Sweden can at relatively moderate cost produce additional renewable electricity on top of complying with its target, while the Netherlands at relative high marginal costs has to meet its target (Jansen, Lensink et al. 2011). These two arguments will be the main reason for the Dutch and Swedish governments to consider a joint SOS and have to be embraced by the design of the joint system.

Possible disadvantages of participation for the Netherlands and Sweden

As was discussed in the previous section, the marginal costs for achieving the national target laid down in Directive 2009/28/EC are lower in Sweden than in the Netherlands. This has two consequences. Firstly, it can result in a net import of SOCs originated Sweden by the Netherlands. Secondly, it can result in a rise of costs for the Swedish end-consumer. These consequences will now be shortly discussed.

Possibility of subsidizing of economic activities in Sweden by the Dutch end-consumer

In a combined system a part of the renewable electricity generation will move from the Netherlands to Sweden. Jansen, Lensink et al. (2011) concluded based on a quantitative analysis of the connection of the Swedish system to a Dutch hybrid system that a maximum of 9 TWh of Swedish certificates will be imported by the Netherlands per year in 2020. This imported production in 2020 comes from onshore wind (7 TWh) and stand-alone biomass conversion (2 TWh), which represents about 8 % of the total electricity production in the Netherlands. Furthermore, this is expected to result in a capital flow of about 30 Million euro's per year from the Netherlands to Sweden (Jansen, Lensink et al. 2010). The capital flow to Sweden is a trade-off with a higher efficiency in achieving the national target laid down in Directive 2009/28/EC. However, it is important to avoid surprises and realize acceptance on this outflow of capital from all the relevant stakeholders on beforehand, in order to achieve long-term commitment to this system from the Dutch stakeholders.

Possible rise of system costs for Swedish consumer

Because a joint SOS results in exporting renewable electricity for Sweden the projected certificate price of a joint SOS will rise in comparison to the projected certificate price of the Swedish SOS. However, it seems that in the same time a joint system will result in a decrease of the electricity price in Sweden, due to a higher share of renewables in the total electricity production (Jansen, Lensink et al. 2011). An exploratory study shows that the second effect is likely to be more dominant, but more profound research has to confirm this. This study does however show that the possible rise in system costs for the Swedish consumer can to a certain degree be balanced with a decrease in the electricity price due to the existence of a joint SOS. For this reason, the possible rise in system costs for the Swedish end-consumers is not defined a serious threat to the stability of the joint system, at this point.

Shared and national system elements and processes

In order to further develop the design of the joint SOS, it is important to understand which system elements and processes are unified and which of these aspects remain separated in a joint SOS. The starting point for this distinction is the quota and the question whether a joint SOS is based on a single quota or two national quotas. The national targets that were laid down in Directive 2009/28/EC are not equal for every Member State (MS). Furthermore, the national targets cannot always directly be translated to the quota size, as not all renewable electricity generation is eligible for participation in a SOS. For this reason, the establishment of a single quota in a joint SOS will always result in the situation where the end-consumers of one MS contribute to the realisation of the national target of another MS. Therefore, two quotas will be introduced in the joint SOS: one for Sweden and one for Netherlands. The compliance with this quota can however be realised by purchasing renewable electricity produced either in the Netherland or Sweden. This will still enable the advantages of a joint SOS.

In order to enable the distinction of quota's but in the same time allow tradability of SOCs between the two countries, the following processes and aspects of the joint SOS will be separated or unified. Firstly, a single trade platform is required to establish a unified SOC price for the joint SOS. Furthermore, the certificate accounts of all the market parties need to be operated on a central level in order to allow that Dutch suppliers can obtain Swedish SOCs and vice versa. Furthermore, this is also required to realise a single trade platform. However, the control of the certificate accounts of the suppliers on compliance with the quota at the end of the accounting period can be performed separately by the responsible Swedish and Dutch controlling authorities. Also the issuing of certificates to domestic renewable electricity production eligible for the SOS can be done separately.

Although the quotas are separate, this does not mean that either the Netherlands or Sweden can unilateral change the quota's once fixed. As both quotas determine the possibilities for investment, the Swedish producers anticipate on the Dutch quota and vice versa. For this reason, always a mutual decision is required if a MS wishes to change its quota once fixed. Furthermore, in order to realise a compatible execution of the separate processes in the joint system, these processes will be executed according to unified rules. These rules have to be laid down in the international agreement on the joint SOS.

Legal starting point for establishment of a joint SOS

The legal starting point for the establishment of a joint SOS is Article 11 and 6 of Directive 2009/28/EC. Article 11 establishes how MSs that implement a joint support scheme can account a certain amount of renewable electricity produced in the territory of one participating MS to the national target of another participating MS (EU 2009). With respect to the joint SOS, for every accounting period a statistical transfer of a specific amount of renewable electricity from Sweden to the Netherlands will be applied to realise this. Article 6 further details how this statistical transfer has to be executed. Figure 7.2 illustrates how the amount of renewable electricity produced in Sweden that needs to be accounted to the Netherlands by a statistical transfer will be determined. The figure shows that this is based on the translation of the national targets for both MSs into the quota sizes of both MSs in relation to the total renewable electricity production in both MSs.

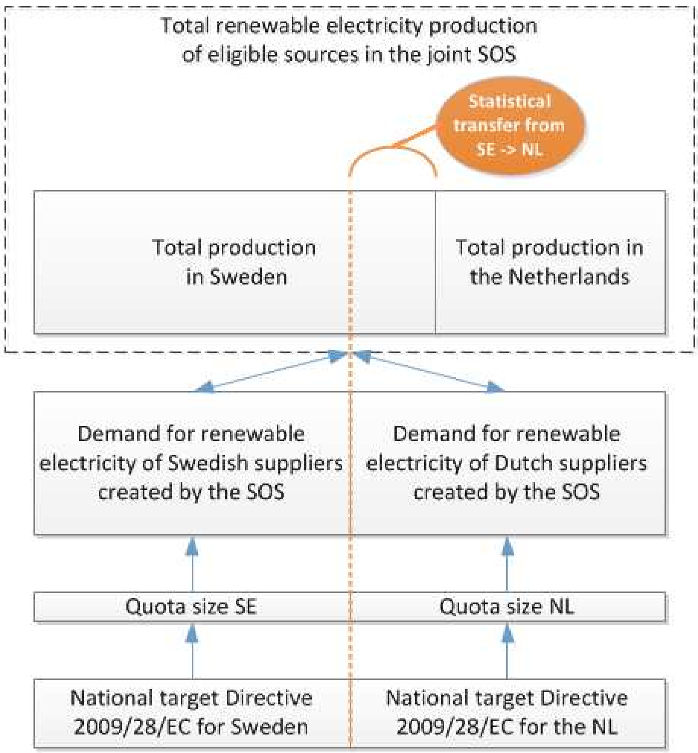


Figure 7.2 Relation between the national targets, quota size and the statistical transfer in a joint SOS

7.2.2 Development of the SOS connected to the Swedish SOS

In figure 7.3 an overview is provided of the main system elements of the Swedish SOS. Based on this figure will be identified if the requirements for design are properly covered by the Swedish design. Furthermore, it will be identified what possible adjustments have to be incorporated in the design of the joint system, based on the requirements. With respect to this has to be noted that mayor system interventions will not be possible due to a focus on stability of the Swedish system administrator. To this regard the development of this design will also reveal the actual loss of degrees of freedom due to a connection with Sweden. Now per requirement the relevant elements of the Swedish design will be discussed.

The inclusion of existing biomass conversion plants

As the design of the Swedish system includes existing capacity with an exception for large scale hydro power plants this requirement is fulfilled by the Swedish design. Because the inclusion of existing capacity is not limited to biomass conversion, as is proposed for the default option, this might result in economic rents for certain existing production units. However, as the inclusion of existing plants cannot be made undone in the Swedish system, this cannot be adjusted for the design of the joint SOS.

Continuous support for biomass conversion plants

The Swedish design limits the participation of production units to 15 years and therefore not fulfils this requirement. Adding an exception for this rule for biomass conversion will not severely interfere in the processes of the joint SOS. For this reason, it is proposed to add the exception of unlimited participation for biomass conversion to the joint system design. This decision can be further justified by the fact that biomass co-firing plays a major role in the Netherlands against a relative negligible role in Sweden. For this reason, it is thus important to optimally embrace the features of this technology in the joint design for the Netherlands.

The design of the Swedish SOS:

- fully includes micro generation
- includes existing capacity, with an exception for existing large scale hydro power with a capacity larger than 1,5 MW
- does not offer a minimum certificate price
- offers a penalty price that is set at 150 % of the average certificate price of the previous compliance period
- does not offer complementary support for immature technologies within the SOS
- allocates one certificate per MWh renewable electricity generation
- allows 15 years of participation for every renewable production facilities (E20A)
- trades SOCs fully bilateral or true brokers and via forwards on the Nord Pool
- applies a quota size that is set based on the expected renewable electricity generation for the year 20yy including an increase of x %
- lays down that the SOS will exist until 2030
- fixes the quotas until 2030
- does not possess a self-regulating mechanism for the quota size
- allows that a SOCs can be banked for an unlimited period and amount
- does not allow early banking
- does not allow the borrowing of certificates
- has incorporated a reconciliation period of one month
- divides the following responsibilities of the following executing bodies:
  - setting of the quota size: central government
  - issuing of certificates: TSO (Svenska Krafnat)
  - SOC trade operator: Nordic Power Exchange
  - Monitoring of compliance with the quota: Regulator (SEA)
  - Collecting penalties for non-compliance: Regulator (SEA)
  - Calibration of the certificate market: Regulator (SEA)
- Has adopted, despite a moderate system revision in 2006, a focus on stability regarding intervention in the system

Figure 7.3 Overview system design of the Swedish SOS
(Bergek & Jacobsson 2010; Jansen, Lensink et al. 2011; Linden, Uyterlinde et al. 2005; SEA 2009; McKinsey 2009)

Fair economic rents for electricity producers

The possibility of economic rents due to the inclusion of existing capacity is already discussed in the two previous sections. Therefore, this section will only discuss the reduction of economic rents from technological differences. The default option identified that the introduction of a hybrid element to the SOS is the most effective and efficient manner to do so. This is contrary to the Swedish design, which is fully technology neutral. However, the introduction of additional support for Dutch immature technologies in the joint SOS is not at odds with the proper functioning of a joint certificate market (Jansen, Lensink et al. 2011). For this reason, the technology neutral character of the Swedish system does not form a limitation on the possibilities for design regarding this requirement. Therefore, it is proposed to provide additional Dutch support for Dutch immature technologies in the joint SOS. Furthermore, the hybrid character will in the same time also prevent an extensive net import of Swedish certificates and thus an extensive net capital export to Sweden.

Sufficient possibilities for technology diversification

The availability of complementary subsidy for Dutch immature technologies remains possibilities to invest in relative immature technologies within a joint SOS. Therefore, this requirement is already fulfilled by the design of the joint SOS.

Equal starting point for different type of electricity companies

The Swedish design does not oblige that the trade of SOCs takes place on an anonymous and central trade platform, as was proposed by the default option. Instead, trade in the Swedish system mostly occurs bilateral (SEA 2009). This form of trade offers vertical integrated companies a competitive advantage in comparison to supply- and production-only companies because they can internally sell their certificates. However, as Swedish producers and suppliers already have committed themselves to long-term bilateral contracts in the present situation, it will not be possible to change this aspect of the design of the joint SOS. For this reason, it has to be accepted that this requirement cannot be properly fulfilled by the joint SOS. To this has to be added that a geographical market expansion often leads to more market transparency with a stronger drive towards central trading platforms (Jansen, Lensink et al. 2011). For this reason, the failure to meet this requirement by the joint SOS will thus partly be dissolved by the inherent features of a joint SOS.

Stable market conditions

From the development of the default option appeared that different types of elements contribute to the stability of the market conditions in a SOS. These are elements that further detail the governance of the SOS, elements that determine the term on which the quotas are set and elements that require recurring intervention in the system. Now for these elements the Swedish design will be assessed on the degree in which it provides stable market conditions.

Governance

For the Swedish design can be observed that in Sweden a similar division of responsibilities is applied as is proposed for the default option. The government sets the quota. Furthermore the main aspects of the execution and calibration of the system are the responsibility of the regulator. Lastly, the TSO is responsible for issuing the certificates. As these tasks allocations match, the task allocation that is proposed for the default options is proposed here for the joint SOS. As was explained in section 7.2.1, some tasks will be executed separately by national executive bodies and others under consultation of or in cooperation with the responsible executing bodies of both countries. This results in the following task allocation for the joint SOS:

Responsibility in the SOS	Executing body
Setting of the quota sizes	Recurring bilateral consultations between the Ministry of Economic Affairs of the Netherlands and the Ministry of Enterprise and Energy of Sweden
Issuing of certificates and management of the certificate accounts	NL: CertiQ, SE: Svenska Krafnat
SOC trade operator	Cooperation of APX-ENDEX and Nordic Power Pool
Setting and collection of penalties for non-compliance.	NL: Office for Energy regulation (NMA), SE: Swedish Energy Agency (SEA)
Monitoring of compliance with the targets	NL: NMA, SE: SEA
Calibration of the certificate market	Cooperation of NMA and SEA
Managing certificate account	Cooperation NMA & SEA
Allocation of additional subsidy for immature technologies	NE: CertiQ, Agentschap NL & ECN

Table 7.2 Allocation of administrative responsibilities joint SOS

Lastly, the Swedish government has adopted a focus on stability in intervening in the system. As appeared from the development of the default option, this also contributes to the stability of the market conditions. It is advised to add a trial period of one or more accounting periods that adopts a focus on adaptability to the focus on stability, in order to be able to solve the teething problems in the geographical expansion of the Swedish system.

Term on which the quotas are set

The Swedish design has set the existence of the SOS until 2030. Probably a new duration for the joint scheme will be laid down when the systems will be connected. However, this duration will never be shorter than until 2030. From the development of the design space appeared that this duration offers a sufficient time frame for investment. Furthermore, the term on which the quotas are fixed in the Swedish system is also until 2030. For this reason, the Dutch government will also have to set its quotas at least until 2030. The fixation of the quota until 2030 will contribute to the predictability of the investment climate. The quotas for the Netherlands will be established by the rule: 'the size of the quota is set based on the expected renewable electricity generation for year 20yy including an increase of 'x' percent'. In this definition 'x' will be equal to the actual capacity at the start of the system, as generators need time to anticipate to the new system and accompanying quota. Further along the system 'x' will lie at the desired growth in capacity with respect to the sustainability objectives.

Other

In the Swedish system the penalty is set at 150 percent of the average SOC price. Furthermore, the unit base for SOCs is established at 1 MWh per SOC. The development of the default option reveals that these design choices both contribute to predictable market conditions.

Low market risks from the perspective of a producer

The Swedish system does not provide a minimum certificate price or a self-regulating mechanism for the quota. The presence of these system elements appeared to be vital for the effectiveness of the default option. However, as a joint SOS can structurally secure long-term consistency and predictability in the governance of this system, these system elements are not required to the same extent as for the default alternative. This is further supported by the fact that the geographical market expansion of the SOC market in a joint SOS offers a more stable SOC market. In this respect, the unlimited flexibility in banking provided by the Swedish design in combination with the stable governance and SOC market of a joint scheme will offer renewable electricity producers sufficient possibilities to realise a rate of return. In addition, the fixation of the quota until 2030 also creates a long time-range for producers to prepare to the future demand for certificates and to balance temporary deficits and surpluses of certificates on the long-term. Lastly, the advantage of the lack of a minimum price and a self-regulating quota is that there is no risk of over-stimulation by the joint SOS. As this can require additional interference in the system, the lack of a minimum price and self-regulating quota further enhances the stability of the joint SOS.

Low degree of possibility of market power for certain electricity producers

Due to the geographical market expansion of the SOS, the market size and number of market parties will significantly increase. This will reduce the possibility of market power in the first place. Furthermore, the possibility of banking of certificates will further prevent this possibility.

Low market risks from the perspective of suppliers

The Swedish design does not allow the borrowing of certificates, as is proposed by the default option. Instead it offers suppliers a reconciliation period of one month. This period seems rather short. However, due to the geographical expansion of a joint SOS, the liquidity of the SOC market will increase. Furthermore, the geographical market expansion that involves the joint SOS reduces the possibilities of market power. Both will reduce the market risks for suppliers. For this reason, it is assumed that a reconciliation period of one month is sufficient to reduce market risks for suppliers in the joint SOS. Furthermore, the unlimited possibilities for the banking of certificates also offer suppliers possibilities to reduce market risks.

A sufficient transition path between the ending of the MEP and the start of the SOS
During the development of the default alternative is identified that it is preferred to introduce 'early banking' in the system, in order to realise this transition path. This will not structurally interfere with the functioning of the Swedish system, if properly embraced in the setting of the Dutch quotas. Therefore, the option in which Dutch generators can bank SOCs before the actual start of the joint SOS is preferred, in order to incorporate this requirement in the joint system design.

The inclusion of micro generation
As the Swedish design did not introduce a size limit for eligible production units, this requirement is fulfilled by the joint SOS.

7.3 Comparison of the joint SOS and the default option

This paragraph will shortly compare the two alternatives that were detailed in this chapter by the degree in which they fulfil the requirements. It is not the objective of this paragraph to rank the alternatives, as the joint SOS is in anticipation preferred to the default option, due to its ability to structurally secure its stability. However, it is still interesting the shortly observe how these two options relate to each other. Both alternatives were limited in their degrees of freedom for design. The default option was limited in the options for design by the need to build in certain securities to cope with the possibility of instability. The design of the joint SOS was limited in options for design due to the connection to the existing design of the Swedish SOS. Now, we will identify how these limitations in degree of freedom for design affected the ability of both designs to fulfil the requirements for design.

Firstly, it can be observed that both designs fulfil almost all the requirements. Only on the following aspects a significant difference can be found in the degree in which the alternatives fulfil the requirements. Firstly, due to the need to build in elements in the default design that can cope with the possibility of instability, the default design might result in over-stimulation. Therefore, a joint SOS is better able to realise an effective market than a SOS under centralized government control. Secondly, a joint SOS is able to structurally reduce the possibility of market power, due to the significant increase in market size and parties. While the default option can only prevent the abuse of market power due to the permission to unlimited bank SOCs. Thirdly, with respect to the requirement for design that states that the SOS has to offer an equal starting point to all different type of electricity companies, the default option scores better. The default options obliges that all the trade in SOCs takes place on a central anonymous platform. This reduces the potential advantages for integrated electricity companies in a SOS. The joint SOS also allows bilateral trade, which does not reduce this advantage. For this reason, the design of the joint SOS offers a lower degree of equity than the design of the default option. Lastly, the default option is better able to reduce economic rents for the degree in which these have an origin in the inclusion of existing capacity.

7.4 Conclusions

This chapter had the objective to provide an answer to the following research question:

> *'Which design for a SOS can provide stable and effective market incentives for Essent to invest in renewable electricity?'*

This question was answered by detailing the conceptual alternative that connects the design of the SOS to the SOS of Sweden. In order to provide guidelines for the development of this alternative and a base of comparison, first the default-option for design was further detailed. This is a national, under centralized government control. An overview of the results of the development of these alternatives is shown in below in figure 7.4 and 7.5. The design of the SOS connected to Sweden, shown in figure 7.4 and provides an answer to the sub-research question.

To these designs the following remarks were made. Firstly, the design of the default alternative revealed the implications of optimally embracing the features of co-firing in the design of a SOS. The solution that was suggested in order to cope with this has to be taken into account for both the designs. Furthermore, a comparison of both the designs showed that a joint SOS is better able to realise an effective market than a SOS under centralized government control. Moreover, a joint SOS can more structurally reduce the possibility for market power. On the other hand, the design of the default option is better able to offer an equal starting point for all type of electricity companies within a SOS and therefore provides a higher degree of equity in comparison to the joint SOS. Also, the default option is better able to reduce economic rents for the degree in which these have an origin in the inclusion of existing capacity.

Lastly, the following needs to be realised regarding the function of the designs. The objective of the development of both the alternatives was to identify how these alternatives need to be detailed, in order to incorporate the needs and interests of Essent. Furthermore, the objective was to show how these designs can be justified from a general perspective. However, this does not mean that these designs are necessary preferred by the Dutch government, the Swedish government or other stakeholders, as they can emphasis on other aspects of the design of a SOS. For this reason, it is important to realise that in reality a participatory design process will establish these designs. For the joint SOS the actual design process will exist of international negotiations between the governments of Sweden and the Netherlands. These negotiations will be influenced by the Dutch and Swedish energy sector and pressure groups in these countries. For the default option the actual design process exists of decision-making processes and consultations between the Dutch government and parliament, influenced by the Dutch energy sector, NGOs and pressure groups. The design proposed in this chapter can provide Essent the necessary knowledge and understanding on the possibilities for design from their perspective, in these processes.

THE DESIGN OF THE JOINT HYBRID SOS CONNECTED TO SWEDEN

The system design of the joint hybrid SOS:
-fully includes micro generation
-includes existing capacity, with an exception for existing large scale hydro power with a capacity > 1.5 MW
-does not offer a minimum certificate price
-offers a penalty price that is set at 150 % of the average certificate price of the previous compliance period
-allocates one certificate per MWh renewable electricity generation
-limits the participation per production unit to 15 years, with an exception for biomass conversion, for which the participation is unlimited
-trades SOCs bilateral or true brokers and via trade on the 'APX-ENDEX-Nordic Power Pool SOC exchange'
-applies a quota size that is set based on the expected renewable electricity generation for year 20yy including an increase of 'x' %
-lays down that the joint SOS will exist until 2030
-fixes the quotas until 2030
-does not possess a self-regulating mechanism for the quota size
-allows that a SOC can be banked for an unlimited period and amount
-incorporates a reconciliation period of one month
-allocates the following administrative responsibilities to the following executing bodies:
    -setting of the quotas for the Netherlands and Sweden: recurring bilateral governmental consultations
    -calibration the SOC market: cooperation of NMA and SEA
    -SOC trade operator: cooperation of APX-ENDEX and the Nordic Power Exchange
    -determining the penalty price: cooperation of NMA and SEA
    -managing certificate accounts: cooperation of CertiQ and Svenska Krafnat
-adopts an intervention focus on stability

Additional Dutch elements to the system design:
-offers complementary subsidy support for relative immature technologies within the system: stand alone biomass conversion, offshore wind, solar and hydro power
-allows early banking
-Allocated the following responsibilities to the following executing bodies:
    -issuing of certificates: CertiQ
    -monitoring of compliance with the quota: NMA
    -collecting penalties for non-compliance: NMA
    -allocation of complementary subsidies for immature technologies: CertiQ & Agentschap NL

Additional Swedish elements to the system design:
-does not offer complementary subsidy support for immature technologies
-allocates the following responsibilities of the following executing bodies:
    -issuing of certificates: Svenska Krafnat
    -monitoring of compliance with the quota: SEA
    -collecting penalties for non-compliance: Regulator SEA

Figure 7.4 System design for the joint hybrid SOS connected to Sweden

THE DESIGN OF THE DEFAULT OPTION FROM THE PERSPECTIVE OF ESSENT:

- fully includes of micro generation
- excludes existing MEP subsidized capacity and SDE subsidized capacity of which the subsidy term has ended, with an exception for existing biomass conversion facilities
- offers a single minimum certificate price, which is yearly corrected for the CO_2 and electricity prices and is based on the integral costs of the mature (unsubsidized) technologies in the system
- offers a penalty price that is set at 150 % of the average certificate price of the previous compliance period
- offers complementary subsidy support for immature technologies within the system
- the following technologies will receive additional subsidy at the start of the system: stand-alone biomass conversion, offshore wind, hydro and solar power
- allocates one certificate per MWh renewable electricity
- limits the participation per asset to 15 year, with an exception for biomass conversion for which the participation is unlimited
- obligates centralized and anonymous auction moments for the trade of SOCs and futures/forwards in SOCs
- applies a quota size that is set based on the expected renewable electricity generation for year 20yy including an increase of x%
- lays down that the SOS will exist for 20 years
- fixes the quotas on the short-term for 5 years and propose the quota for the remaining of duration of the system, for which in year ‘n’ the quota of year ‘n+5’ is fixed based on the proposed quota on the long term and adjustments based on a legally established frameworks
- automatically adjusts the quota in year ‘n’ with the percentage of certificate surplus/deficit of year ‘n-1’, if this is required
- allows the banking of SOCs for an unlimited period for an unlimited amount
- allows early banking
- allows the borrowing of SOCs limited to 20% of the total quota size
- allocates the following administrative responsibilities to the following executing bodies:
    - setting of the quota size: Ministry of Economic Affairs
    - issuing of certificates: CertiQ
    - SOC trade operator: APX-ENDEX (if regulated: otherwise a new authority)
    - Monitoring of compliance with the quota: Office for Energy regulation
    - Collecting penalties for non-compliance: Office for Energy regulation
    - Calibration of the certificate market: Office for Energy regulation
    - Market-maker: Tennet
    - Allocation of additional subsidy for immature technologies: CertiQ & Agentschap NL
- Adopts a intervention focus on stability

Figure 7.5 System design of the default option from the perspective of Essent

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Currently a new support scheme for renewable electricity is discussed in the Netherlands. This support scheme has the objective to contribute to the national target on the share of renewables in the energy supply, set down in Directive 2009/28/EC. Essent, problem-owner of this research, believes that a SOS is the preferred support scheme for the Netherlands. This research had the objective to develop a design for a SOS for the Netherlands that can provide Essent more understanding of what this design can look like from their perspective, taking into account the Dutch circumstances. For the development of this design was identified that a SOS has to provide effective incentives for Essent to invest in renewable electricity. Furthermore, it was identified that the stability of the SOS is an essential precondition for the SOS to be able to provide effective incentives for investment. Therefore, the following research question was posed for this research:

"How can a Supplier Obligation System for the Dutch electricity sector provide effective and stable incentives for Essent to invest in renewable electricity to be able to contribute to the European targets on renewable energy?"

With respect to this research question was noted that the realisation of effective and stable incentives for investment also had to incorporate the interests of Essent as a supplier of electricity. Furthermore, the realisation of effective and stable incentives was limited by the realisation of an overall effectiveness, efficiency and equity of the scheme[7]. The research question was answered by developing a design for a SOS that can provide both effective and stable incentives for Essent to invest in renewable electricity. This design is based on a connection to the Swedish SOS and shown in figure 8.1. In the remaining of the conclusions the main characteristics of this design will be recapitulated. This description will verify why the design proposed by this research is an answer to the research question. Furthermore, it will show the advantages and disadvantages of this design. Lastly, remarks on the development of this design will be made.

Firstly, the connection to the Swedish SOS was chosen as the conceptual frame for the design of the SOS, in order to offer stable incentives for investment. The proposed design was developed under the realisation that "the impact of regulatory incentives only comes the forefront if the regulatory governance successfully has been put into place" (Spiller and Tommassi, 2005, p 516). Therefore, before the design of the SOS was detailed, the object of research was temporarily shifted from the 'SOS self' to the 'governance of the SOS'. This was done in order to identify possible concepts for design that can secure a stable SOS. Based on theories of Spiller and Tomassi (2005) on regulatory governance in the energy sector, the relation of the institutional environment of the Netherlands and the stability of regulation in the energy sector was investigated. This showed that regulation in the energy sector can be subjected to governmental opportunism, due to a combination of its specific economic features. Furthermore, it was empirically confirmed that the Dutch institutional environment is not able to effectively limit this form of opportunism.

In the search for possible manners to limit governmental opportunism in the SOS was identified that an appropriate manner to structurally constraint governmental opportunism in a SOS is to delegate the responsibility for the governance of the SOS from the central government to parties which are not under direct influence of electoral politics.

[7] The term efficiency refers here and in the rest of this chapter to the cost-efficiency of the scheme, as was defined in chapter 2.

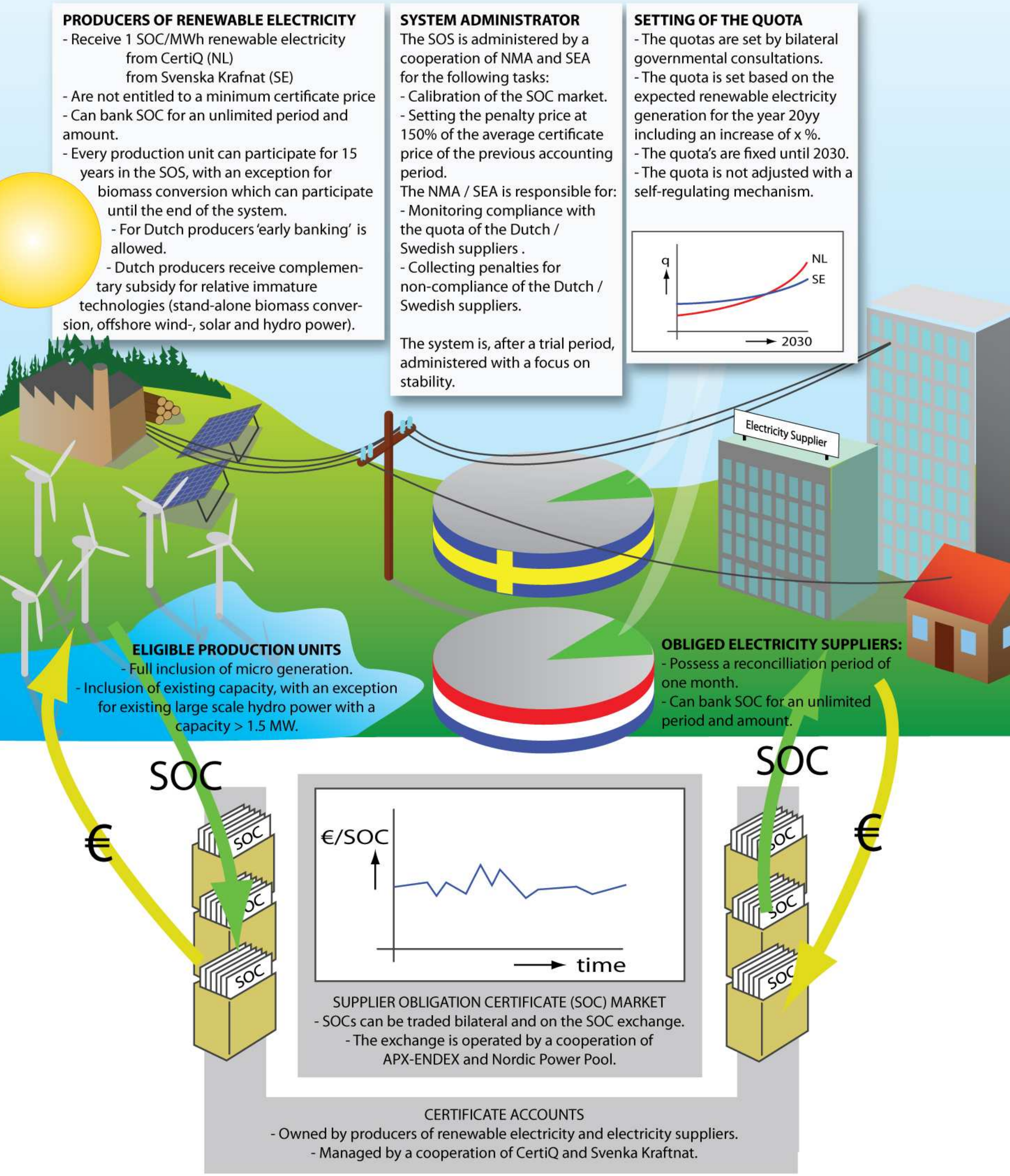


Figure 8.1 The design of a SOS that can provide effective and stable incentives for Essent to invest in renewable electricity generation

The main argument for this is that delegation will lead to a more objective and substantive governance of the SOS and therefore a more consistent and predictable policy. Based on the starting-point of delegation a SOS connected and adapted to the existing Swedish SOS was proposed. The connection of a SOS to the Swedish SOSs fulfil this starting point, as it delegates the responsibility for executing, monitoring and adjusting the SOS from centralized government control influenced by electoral dynamics to a bilateral cooperation of the Dutch and Swedish regulator and other specialized authorities. In addition, Sweden has the highest potential regarding feasibility and performance in comparison to the other European SOSs. Therefore, specifically a connection to Sweden was preferred.

Based on the concept of a connection to the Swedish SOS, the design was further detailed. This detailing mainly had the objective to realise effective incentives for investment and applied the 'SOS self' as the object of research. Firstly, the proposed design provides effective incentives for investment as it was detailed with an understanding of the common issues in a SOS. Moreover, the detailing of this design embraced the technical, legal and economic features of the Dutch renewable electricity sector, which assures a design that fits the present circumstances. Furthermore, effective incentives were realised by applying a list of complete and mutually exclusive requirements for design to the design space. This secured that the design of the SOS fulfils all the needs and conditions that have to be met in order to be effective. The detailing of the design resulted in filling in the 21 system elements that were identified during this research. An overview of these design choices is shown in figure 8.1. The main elements of the joint SOS are:

- A system duration and fixing of the Dutch and Swedish quotas until 2030
- The following allocation of administrative responsibilities:
    - The system is executed by a cooperating of the Swedish and Dutch regulator (SEA and NMA)
    - The setting of quota is done by bilateral government consultations
    - The issuing of certificates and the management of certificate accounts is done by the Dutch and Swedish TSO's (CertiQ and Svenska Krafnat)
- No establishment of a minimum price
- Additional support for relative immature technologies for the Dutch part of the system
- A market design in which SOCs are traded bilateral or through an exchange which is operated by a cooperation of APX-ENDEX and Nordic Power Pool

These main characteristics will now be shortly elaborated. Firstly, the proposed design has duration until 2030. This duration of the scheme creates a long-term framework for the expansion and broadening of the current activities of Essent in the supply and production of renewable electricity. Furthermore, the fixation of the quota until 2030 will contribute to the predictability of the investment climate during this period. Secondly, the administrative responsibilities of the joint SOS are for the largest part allocated to a cooperation of the regulators and TSO's of the Netherlands and Sweden. This will secure more regulatory discretion in the administration of the scheme, which can further enhance the consistency and predictability in the execution of the joint SOS.

The proposed design does not provide a minimum certificate price to offer additional certainty for investors within the SOS. For the following reasons, this additional guarantee on a return on investment is not necessary in the joint SOS. Firstly, the joint SOS secures long-term consistency and predictability in the governance of this scheme. Secondly, the geographical expansion of the SOC market in a joint SOS offers a more stable and liquid SOC market. Thirdly, the proposed design of the joint SOS allows unlimited flexibility in the banking of certificates. Fourthly, the joint SOS is planned until 2030. The combination of a relatively stable governance of the SOS and SOC market, unlimited possibilities for banking and a duration until 2003 creates sufficient possibilities generators to prepare for the future demand for certificates and to balance temporary deficits and surpluses of certificate market on the long-term. Therefore, an additional guarantee on a rate of return within the joint SOS by the means of a minimum price is not required. The advantage of the lack of a minimum price is that there is no risk of over-stimulation by the joint SOS.

Another interesting aspect of the proposed design is that it allows a hybrid character on the Dutch part of the joint SOS. This means that the Dutch government is able to offer immature technologies in the Netherlands additional subsidy, which makes it possible to still stimulate these technologies within the joint SOS. The last main characteristic of the joint SOS is its market design. Certificates can be traded bilateral and on an exchange in the proposed design. As the design of the joint SOS does not oblige a centralized trade of SOCs, vertical integrated companies will have a competitive advantage in comparison to production- or supply-only companies under this design. This aspect of the Swedish system cannot be changed for a joint Dutch-Swedish system, as this design choice in the Swedish system is already locked-in. In this respect, the only requirement that is not fully fulfilled by the proposed design is the requirement of an equal starting point for all type of energy companies. With respect to this, it however can be concluded that the connection to the Swedish SOS does not result in a significant loss of degrees of freedom in the design of the SOS for the Netherlands.

Furthermore, several advantages additional advantages of a connection to the Swedish SOS were identified during the further development of the design, which enhance the performance of the proposed. Firstly, a higher efficiency can be achieved by a joint SOS because it stimulates to allocate technologies for renewable electricity generation to the location where production costs are the lowest. In the case of a Dutch-Swedish cooperation, the Netherlands can expand its current position in biomass co-firing, while Sweden can expand its current position in small scale hydro and wind power (Jansen, Lensink et al. 2011). Another cause for an increased cost-efficiency in a joint support scheme is that Sweden can at relatively moderate cost produce additional renewable electricity on top of complying with its target, while the Netherlands at relative high marginal costs has to meet their targets (Jansen, Lensink et al. 2011). Thirdly, the geographical market expansion involving a connection to Sweden increases the liquidity of the SOC market. This can result in a more stable SOC market. Furthermore, geographical market expansion reduces the possibility of market power and creates a stronger drive towards a large role for central trade of SOCs.

However, these advantages of a joint SOS with Sweden are a trade-off with a possible shift of Dutch renewable electricity generation to Sweden. Jansen, Lensink et al. (2011) concluded based on a quantitative analysis of the connection of the Swedish system to a Dutch hybrid system that a maximum of 9 TWh of Swedish certificates will be imported by the Netherlands per year in 2020. This is around 8 % of the total electricity production in the Netherlands in 2020. As the share of renewable electricity in the total electricity production is targeted on 37 % in 2020, still 29% of the electricity that is generated in the Netherlands will come from renewable sources in a joint SOS with Sweden in 2020. Yet, it is important to avoid surprises and realize acceptance on this outflow of capital from all the relevant stakeholders on beforehand, in order to achieve long-term commitment to this system from the Dutch stakeholders.

To summarize, the design proposed by this research and shown in figure 8.1 provides an answer to the research question for the following reasons. This design provides effective regulation by the SOS, as it tackles the common issues in SOSs, embraces the current situation in the Dutch renewable electricity sector and incorporates the requirements for design, as much as possible. Furthermore, the proposed design delegates the responsibility for the SOS from centralized government control influenced by electoral dynamics to a bilateral cooperation of the Dutch and Swedish governments, regulators and TSO's. This will structurally secure a stable governance of the SOS, as it fully restricts the ability of the Dutch government to unilaterally change or cancel the SOS. In addition, the connection to the Swedish SOS revealed several synergies for the cost-efficiency and equity of the SOS and the functioning of the SOC market.

Remarks on the proposed design

To the proposed design the following remarks have to be made. First of all, it is important to realise that this design is only one of the possible valid answers to the research question, for the following reasons. Firstly, a rather theoretical and qualitative approach was applied to the development of the design. The development of the design of the 'SOS self' is based on literature that considers the mechanisms and processes in a SOS. However, a more quantitative model study on the SOS could possibly have led to another but also valid design. In this regard, we do believe that the order of a theoretical design-oriented research, followed by a model study is preferred. As than the theoretical design can form a useful starting point for the model study and be further optimized by the model study. Furthermore, the design of the 'governance of the SOS' is based on theories on regulatory governance in the utility sector. However, a survey with the governing and executing bodies that are concerned with the implementation and execution of support schemes might resulted in other valid insights in securing stability in a SOS. Lastly, this research applied a multi-disciplinary perspective and therefore mainly focussed on the interactions between the technical, economic, institutional and social aspects of the design of a SOS. However, a purely economic, institutional, technical or social perspective on the design might have offered more profound answers to specific parts of the design of a SOS. For these reasons, the design that is proposed in this research mostly functions as a theoretical and multi-disciplinary perspective on the design of a SOS for the Netherlands. In this respect, the design will become more valuable when related to other researches and perspectives on the design of a SOS for the Netherlands.

Secondly, also during this research alternative options were identified for the design that is proposed here. Firstly, several other alternatives for the concept of internalisation were identified, for which the connection might also reveal interesting synergies when further detailed. Furthermore, the concept of self-regulation remains interesting. This concept is based on a SOS which is established and executed by the energy-sector self. The choice between the concept of internationalisation and self-regulation was based on the expectation that internationalisation can to a greater extent avoid government opportunism than self-regulation. However, both concepts remain a potential solution to constraint governmental opportunism. Thirdly, a default-option for the design of a Dutch SOS was developed during this research. This option is a national SOS under centralized government control which seems, based on international observations, to be the most likely design for a SOS. Although the design of this option does not structurally secure the stability of the SOS, it does provide a certain degree of stability on the level of the regulation and has built in securities that cope with the remaining potential for instability.

In the introduction of this research the scope of the research was delineated to the development of a design for a SOS that can set the right economic and institutional conditions for the activities of Essent regarding renewable electricity. It was not considered which design is politically the most feasible, taking into account the current political processes in the Netherlands and Europe. However, with respect to the other alternatives for design identified during this research, it is interesting to shortly refer to the political feasibility of the proposed design. It is not certain that in practice the proposed design is feasible because the development of regulation is subjected to a broader social dialogue. Therefore, if it appears that in practise the implementation of the proposed design is not feasible, than the other options for internationalisation, the concept of self-regulation or the default-option identified in this research can also provide valid answers to the research question, within the limits of what is possible.

Furthermore, the following has to be remarked regarding the design. In this paragraph was already mentioned that the design was developed based on a theoretical understanding of the possible mechanisms in a SOS. However, it is difficult to exactly project how these mechanisms will behave in reality (Mac Gill, Outhred et al. 2006). In reality, practice will show what the emergent behaviour of the SOS is under the design that is proposed in this research. For instance, there might be certain unforeseen interactions among design choices or between the design choices and its dynamic environment. In this respect, it thus remains difficult to predict whether the proposed design will behave precisely according to theory in reality. In order to cope with this, a trial period of one or more accounting periods was added to the proposed design, with the objective to solve initial teething problems.

8.2 Recommendations

8.2.1 Recommendations for Essent

The proposed design shows what a SOS needs to look like from the perspective of Essent; it incorporates their interest as a producer and supplier of electricity and can be justified from an overall system perspective. However, Essent does not possess the decision-making power to unilaterally lay down this regulation. Instead the Dutch government will decide on the final design of the SOS, under influence of a stakeholder dialogue. Relevant stakeholders in this dialogue are other energy companies, NGO's, consumer- and employer organisations. In this respect, Essent is recommended to start the dialogue with these stakeholders on the connection of the SOS to the Swedish SOS. The detailing of this concept throughout this research revealed the possible advantages and disadvantages of a joint SOS with Sweden. These outcomes can provide a useful starting point for this dialogue.

As the proposed design fully incorporates the interests of Essent, Essent is recommended to advocate for the introduction of this design. The following elements of this design are specifically important for Essent to contribute to the stakeholder dialogue. Essent has specialized itself in biomass co-firing. As biomass conversion has relatively high operational expenditures, biomass conversion requires continuous additional support in order for this support to be effective and efficient. Therefore, the design of the joint SOS proposes to let biomass capacity continuously participate in the SOS, while the participation of other technologies is limited to 15 years. Furthermore, it proposes to include existing capacity. Moreover, as the production units of Essent based on co-firing were mostly supported by the MEP, it is proposed to realise a transition path between the ending of the MEP and starting of the SOS by allowing 'early banking' of SOCs. These conditions for the design of the joint SOS can be further justified by the fact that biomass co-firing plays a major role in the Netherlands against a relative negligible role in Sweden. For this reason it is thus important to optimally embrace the features of this technology in the design of the joint SOS for the Netherlands.

If the introduction of a SOS connected to Sweden does not appear to be (politically) feasible in reality, Essent is advised to further investigate the other alternatives based on the concepts of internationalisation and self-regulation, identified during this research. If this follow-up study does not lead to positive results or if these options also do not appear to be feasible, it is recommended to advocate for the introduction of the default-option for the SOS that was developed during this research. Regarding the default-option has to be realised that the stability of this alternative cannot be structurally secured for the Dutch situation, as the governance of the SOS in this alternative is not separated from the direct influence of electoral politics. This means that stability for this design is only realised for the degree in which stability could be introduced on the level of the regulation self. Furthermore, securities were built into the design in order to cope with the remaining potential for instability. In this regard, especially the following aspects of the design of the default-option are important to emphasize during the stakeholder dialogue on this option. Firstly, it is very important that a minimum price is established on a contract basis with the TSO for a pre-defined term. This can, despite uncertainty about the possibility of future investments, at least guarantee a return on investment for a specific production unit. Furthermore, the mayor responsibility for the execution of this system has to be allocated to the Office of Energy Regulation in order to realize the most substance and objectivity in the governance of the SOS, within this option. In order to do so, the SOS has to be laid down in the Dutch Electricity Law. Also, the needs regarding the inclusion of existing biomass capacity and the duration of participation for biomass conversion, as were mentioned for the design of the joint SOS, are important to be incorporated in the default option.

Furthermore, this research showed that the thought-leadership of Essent on preferred legislation must not only address the effectiveness of future regulation but also the stability of future regulation. For this reason, it is recommended to Essent to further investigate how the risk of governmental opportunism and accompanying regulatory instability can be restricted on forehand in other type of investment decisions, influenced by other sorts of legislation.

Lastly, while this research mostly focussed on providing incentives for investment for Essent as a producer, it also revealed the implications of a SOS for Essent as a supplier of electricity. In this regard, the following is recommended to Essent. Firstly, the current sales of renewable electricity within a SOS will not drastically change, as the certification of the supply of renewable electricity remains the same. However, several possibilities to differentiate yourself a as a supplier within a SOS were identified. It will be possible to fill in the obligation with a specific renewable source. Furthermore, it will be possible to offer more renewable electricity than obliged by the quota obligation. In addition, the SOS can renew possibilities for decentralised and micro generation by renewable sources. Moreover, from experiences in Belgium can be learned that a fierce competition can arise on the height of the SOS contribution in the market of commercial electricity users. With respect to these possibilities, Essent is recommended to further explore their possible new position as a supplier in the retail and commercial market within a SOS.

8.2.2 Recommendations for further research

In the conclusion was identified that it is not certain that the proposed design in practice will behave precisely as was predicted in theory. Therefore, it is recommended to do further research on this design. Firstly, further research has to test whether the SOS functions as is theoretically expected, under the proposed design. To this regard, further research can reveal the existence of possible unperceived interactions among design choices and between design choices and the environment of a SOS. Furthermore, further research can test how the design can be further optimized on the level of the system elements. For instance the exact degree of banking and borrowing of certificates, length of the reconciliation period and percentage on which the penalty price is based can be further optimized. Also the effect of the choices in market design on the liquidity of the certificate market and the certificate price needs to be further tested and optimized.

9. REFLECTION

In this chapter I will reflect on the development of the design of a SOS. The process of finding a proper framework for institutional design appeared the most challenging aspect of this research. In addition, this aspect was critical for the structure and therefore the quality of my research. For this reason, the first part of this reflection will zoom in on the search for a proper framework for institutional design. Furthermore, the introduction of this research stated that the development of the design of a SOS for the Netherlands is a relevant next step in defining the potential of this support scheme for the Netherlands. Therefore, the second part of the reflection will discuss the potential of the proposed design for the SOS in relation to the actual regulatory and political developments regarding the stimulation of renewable electricity in the Netherlands.

9.1 Framework for institutional design

During my education I was taught to apply technical or system-engineering frameworks for design to the institutional design process, in order to develop a clear structure for this process. For this reason, I have tried to apply the methodological framework for system design from Sage and Armstrong (2001) to structure my design process. This framework has its origin in the field of system engineering. Furthermore, I have thought about applying the meta-model for industrial design developed by Herder and Stikkelman, which has its origin in the field of industrial chemistry (Herder and Stikkelman 2004). Both these approaches appeared not to be useful for this research and also steered my research in somewhat wrong directions. From my opinion, the most important reason for this is that these approaches assume the possibility of optimizing, refining and testing design parameters. My experience is that the optimizing and testing of design parameter is not very relevant in institutional design, as design choices in institutional design are mostly based on a search for what is the most 'logical' considering the present circumstances, issues and possibilities.

In the meantime, my research provided me more understanding of the different issues and perspectives that were relevant in answering the research question. Based on these insights I finally developed a custom-made framework for design. From this description it must be clear that my research consisted of a rather iterative process, in which I first had to perform a large part of my research before I could actually structure the research. This iterative character is to a certain degree inevitable, as at the start of the research you cannot exactly know which aspects of the object of design will dominate the design process. However, this research could have been performed more efficiently, if a more appropriate structure for the design of this kind of regulations was available on forehand.

At the same time, I realise that the framework for design which was developed for this research is not yet applicable to future researches with the objective to develop an institutional design, as it was specifically developed for this case-study. In this respect, it is relevant to translate the framework I have developed to a more a general framework for institutional design. However, due to the diversity in types of institutions, the stakeholders that are concerned with the institutions and the economic, technical and institutional circumstances that surround institutions, it might be challenging to develop a single framework for institutional design that can effectively structure the design process of all types of institutions. This is perhaps also the most important reason why I could not find a useful framework for design for my research. However, I do believe that a general framework can be developed that defines the possible building blocks of an institutional design process and the possible relation between them. The overview of these building blocks can then better steer the exploratory part of researches on the development of institutional design and support in building a custom-made framework for design.

From this research appeared that this framework at least has to offer an approach to effectively incorporate the different levels of institutional analysis. In my case a distinction had to be made between the 'institution self' and the 'governance of the institution'. This division may be relevant for the design of all institutions. There are already analytical frameworks present that provide this distinction. A well-known example of this is the four-layered framework of Williamson (1998). This framework also makes an analytical distinction between the 'rules of the game' and the 'play of the game' (Williamson 1998). However, although these frameworks provide a useful structure to the analysis institutions, they do not offer clear guidelines on how to apply the different levels of institutional analysis in the design of institutions. Therefore, I believe that the structure that was created during this research to separate the design of the' institution' and the 'governance of the institution' in the institutional design process can be a relevant basis for the development of general framework for institutional design.

Furthermore, it appeared from my research that the aspect of the technical frameworks for design that structures design by applying requirements for design to the design space is also applicable and valuable for the design of institutions. For this reason, the framework for design which was developed for this research did incorporate this aspect of the technical frameworks for design. The development of the design space and identification of requirements for design thus can also provide important building blocks in a general framework for institutional design. The design space for institutional design will in general be more discrete. Furthermore, the requirements will be more qualitative than for technical design. This can make institutional design based on this approach somewhat ambiguous and possibly sensitive to subjectivity. Still I believe it will be very relevant to use this structured approach to secure that an institutional design incorporates the present circumstances and needs. Furthermore, the development of the design space will support incorporating international examples of similar institutions or relevant examples of other type of institutions. This can provide a more complete overview of the possibilities for design and therefore a more innovative design process.

Based on my research I therefore propose further research on the development of a general framework for institutional design that defines the possible building blocks of the institutional design process and their possible relations. This framework has to distinguish the analysis and design of the 'institution self' and the 'governance of the institution'. Also the framework has to incorporate the 'development of the design space' and the 'identification of requirements for design' as the central building blocks of an institutional design process. A possible starting point for this framework is illustrated in figure 9.1. Based on experiences with institutional design the body of the framework and the list of possible building blocks needs to be extended.

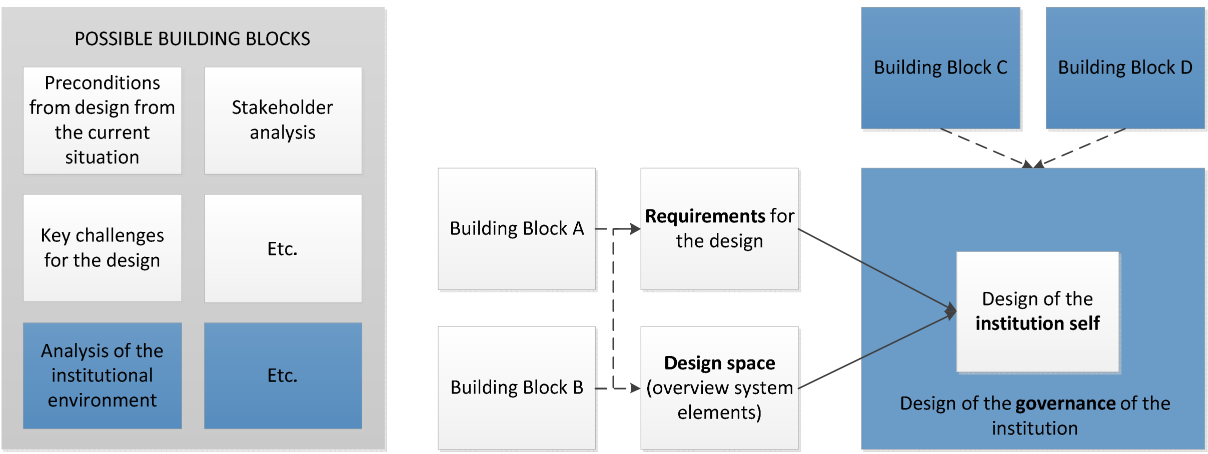


Figure 9.1 Starting point for the development of a general framework for institutional design

9.2 The proposed design related to the actual regulatory and political developments

During my research several developments have taken place regarding the stimulation of renewable electricity. It did not lie in the scope of this research to identify which design of a SOS is politically the most feasible, by taking into account the current political processes. However, it is interesting to shortly relate the design for the SOS proposed by this research to the actual political and regulatory developments. Therefore, this will be discussed in this paragraph.

Introduction of the SDE plus

In October 2010 a minority centre-right coalition government was established, existing of the VVD and CDA, with external backing of PVV. Although initially several political parties adopted a SOS in their election-programmes, the coalition proposed to transform the SDE to a 'SDE plus' scheme. In November 2010 the Minister of Economic Affairs presented a proposal on the implementation of the SDE Plus. The most important changes of the SDE Plus in comparison with the SDE are the introduction of one subsidy budget for all technologies and a phased opening for the subsidy. Within the phases subsidies will be granted to the most competitive projects on a tender basis. In this respect, the introduction of the SDE plus can be seen as a transition towards a more market based instrument, like the SOS. The SDE Plus will be financed by an additional 'sustainability tax' on the energy bill for both retail and commercial consumers. Eligible technologies for the SDE Plus are onshore wind power, biogas, hydro power, waste-conversion and stand-alone biomass conversion. This means that large scale co-firing of biomass, offshore wind power and solar power are not subsidized under the SDE plus.

Despite the introduction of the SDE plus this year, the stakeholder dialogue is continuing on the introduction of a SOS around 2015. An additional or new measure is required, as biomass co-firing and offshore wind power (technologies which are required to achieve the targets of 2020) are not supported by the SDE Plus at the moment (Lensink 2011). In April this year, the board of sector association 'Energie-Nederland' has unanimously endorsed the introduction of the SOS. Furthermore, the possibilities of a SOS were further discussed in several consultations on 'Energy' between members of parliament and the Minister of Economic Affairs (Algemeen Overleg Energie).

Comparison SOS and SDE plus

It is interesting to compare the SOS, under a joint scheme or the default-option, to a possible extension of the current implemented SDE plus with the still unsupported technologies. Firstly, this research revealed the potential of a SOS under the Dutch physical circumstances. It was identified that the Netherlands has a relatively steep supply curve of renewable electricity. A steep supply curve can undermine the equity and cost-efficiency of the SOS, because the marginal cost to reach the quota become relatively high. However, this aspect of the Dutch physical circumstances was solved by the proposed design by providing additional subsidy support for immature technologies. Therefore, it does not have to undermine the potential of a SOS in the Netherlands.

Secondly, some general advantages of a SOS can be found in comparison to a feed-in-system (FiS), like the SDE plus. Firstly, a SOS requires less direct government intervention, which in anticipation creates more regulatory stability than within a feed-in-system. This direct government intervention in a FiS comes from the fact that in such a scheme the subsidy tariffs and eligible technologies for subsidy are determined by government evaluation. In a SOS this is determined by market processes. Secondly, in this report was argued that a SOS is financially more sustainable than a FiS, as it not financed by government budgets. However, the introduction of the SDE Plus shows that a FiS can also be directly financed by the end-consumer. Hereby, it is relevant to realise that a SOS can provide a higher economic efficiency than a FiS, mainly because the technology selection is realised by marked forces. Therefore a SOS will create less pressure on the energy bill than a FiS. In this respect, a SOS remains financially more sustainable than a FiS. Another advantage of a hybrid SOS is that it is more suitable to be harmonized on a European level than a FiS. This research showed that it is possible to adopt an international SOS, in which additional subsidy support can be provided on a national level. In this respect, harmonisation of a hybrid SOS makes it possible to harmonize the SOC trade on a European level but in the same time allow a custom national support of relative immature technologies. Therefore, the establishment of a joint Swedish-Dutch SOS could be the first step in realizing a North-west European or European SOS. From this perspective, the introduction of a SOS, either on a national level or in cooperation with Sweden, can be a logical step to prepare for the possible European harmonisation of the stimulation of renewable electricity.

However, from the development of the design for a SOS for the Netherlands also several challenges for and disadvantages of a SOS can be identified. These challenges should be carefully weighed against the possible advantages of a SOS. The establishment of a SOS is the creation of a market, which is maintained artificially. In this respect, the SOS is a complex instrument. This complexity involves several challenges. Firstly, it will be difficult for the end-consumer to understand this system, which can undermine the public commitment to this system. Secondly, the complexity of the system will make it difficult to determine how the SOS will behave in reality under its design. This creates a risk of teething problems at the start of the scheme, which can result in a negative public image of the system. Both can result in a low degree of bottom-up commitment to the SOS, which can also undermine the stability of a SOS (Lipp 2007).

Furthermore, the complexity is reflected by the existence of several feedback loops in a SOS. An example of a feedback-loop that can heavily undermine the performance of a SOS starts with underinvestment. Underinvestment, whether due to high market risks or unstable market conditions, results in a quota obligation which is higher than the actual renewable electricity production. This again will result in a scarcity on the certificate market which will drive up the certificate price to the penalty price. The result of these interrelated mechanisms in a SOS is that the electricity consumer is going to pay a very high price for investments in renewable electricity, without them being realised. This form of system behaviour in a SOS is therefore very damaging for the overall performance of a SOS. In addition, the balance of the quota size in relation to the total renewable electricity generation is also subjected to uncertain external events, like the total electricity consumption, the wind conditions and shocks in the price of biomass crops, conventional fuels and CO_2. Furthermore, unexpected internal events can disturb the balance between the quota size and the total renewable electricity generation, like trips of renewable production units or delays in construction projects of new renewable production units. In a FiS, these dynamics can be balanced by the correction factor in the subsidy tariff. In a SOS these dynamics can heavily disturb the functioning of the scheme and result in a low effectiveness and cost-efficiency.

Conclusion

To summarize, a hybrid SOS can in theory provide are more stable, financially sustainable and cost-efficient long-term framework for the transition towards a renewable electricity supply than the SDE plus. These competences are even more present in a SOS which is connected to Sweden. However, the downside of this instrument is its complexity. The complexity of the scheme can result in unwanted system behaviour or a negative public image. Furthermore, it is more subjected to external and internal dynamics. This can drastically undermine the effectiveness, cost-efficiency and stability of the SOS, if not managed properly. Therefore, I believe, based on the experiences with Dutch and foreign support schemes I have studied, that the following aspects have to present for a SOS to obtain the potential which is expected here:

- Political and public commitment to this system on forehand of its implementation
    - which includes awareness of the potential pitfalls of the system
- Consistent and predictable system administration

- A sufficient and well communicated trial period at the start of the system, followed by a focus on stability regarding interventions in the system.

To the above I want to add that in my opinion there is no such thing as the 'one right instrument to support renewable electricity'. State-of-the-art examples of both the SOS and FiS show significant advantages and disadvantages. There is however 'one right way to support renewable electricity' and that is to provide a long-term stable and predictable framework for investment. In this respect, it does not really matter whether to implement a SOS or SDE Plus, if both schemes sufficiently support the technologies necessary to realise the targeted share of renewables. What does matter is that the support scheme will be able to realise intertemporal cooperation between policy-makers, in order to remain well established and stable over different government periods.

REFERENCES

Agnolucci, P. (2007). "The effect of financial constraints, technological progress and long-term contracts on tradable green certificates." Energy Policy 35(6): 3347-3359.

Bennink, D., M. Blom, et al. (2010). “Hernieuwbare elektriciteit; subsidiëren of verplichten?” Delft, CEDelft.

Bergek, A. and S. Jacobsson (2010). "Are tradable green certificates a cost-efficient policy driving technical change or a rent-generating machine? Lessons from Sweden 2003-2008." Energy Policy 38(3): 1255-1271.

Berry, T. and M. Jaccard (2001). "The renewable portfolio standard: design considerations and an implementation survey." Energy Policy 29(4): 263-277.

Bruijn, H. D. and W. Dicke (2006). "Strategies for safeguarding public values in liberalized utility sectors." Public Administration 84(3): 717-735.

Bruijne, M., de, Steenhuizen, B. et al. (2011), “How to design a new gas bid price ladder? Exploring market design issues in the new Dutch gas balancing regime.” Competition and Regulation in Network Industries 12 (10): 83-97

CBb (2010). “Uitspraak College van Beroep voor het bedrijfsleven, gaswet. LJN: BM9470, AWB 09/162 AWB 09/163 AWB 09/164, AWB 09/168 AWB 09/169 AWB 09/417” 29-06-2010, Den Haag

CBS (2010). “Hernieuwbare energie in Nederland 2009.” Den Haag, Centraal Bureau voor de Statistiek.

CertiQ (2010). "Wie is CertiQ." Retrieved 08-12-2010, 08-12-2010, from http://www.certiq.nl/wiecertiq/.

del Río, P. (2007). "The impact of market power on the functioning of tradable green certificates schemes." Energy & Environment 18(2): 207-231.

EC (2006). “European SmartGrids Technology Platform: Vision and Strategy for Europe's Electricity Networks of the Future.” European Commission Community Research. Luxembourg, Publications Office of the European Union.

EC (2010). "Emissions Trading System (EU ETS)." Retrieved 15-11-2010, 2010, from http://ec.europa.eu/clima/policies/ets/index_en.htm.

EC (2011). "Commission Communication on renewable energy, MEMO 11/54. " Date: 31/01/11, Brussels, European Commission

Espey, S. (2001). "Renewables portfolio standard: a means for trade with electricity from renewable energy sources?" Energy Policy 29(7): 557-566.

Essent (2010). “MVO Jaarverslag 2009.” ‘s-Hertogenbosch, Essent.

Essent (2010). “Position on a regulatory support system for renewable energy based on biomass co-firing”. 's-Hertogenbosch, Essent Corporate Affairs.

Essent (2010). "Profiel." Retrieved 2010, 2010, from http://www.essent.nl/content/overessent/het_bedrijf/profiel/index.html.

Essent (2010). "Renewable Visions 2010. " 's Hertogenbosch, Essent Business Development.

Essent (2010). "Standpunt: Groene stroom productie in Nederland. " 's Hertogenbosch, Essent.

EU (2009). "Directive 2009/28/EC; concerning common rules for the internal market in electricity." Directive 2009/28/EC, Brussels, European Union: 38.

Faaij, A. (2006). "Modern Biomass Conversion Technologies." Mitigation and Adaptation Strategies for Global Change 11(2): 335-367.

Gross, R., M. Leach, et al. (2003). "Progress in renewable energy." Environment International 29: 105-122.

Herder, P. M. and Stikkelman, R. M. (2004). "Methanol-based industrial cluster design; a study of design options and the design process. " Ind. Eng. Chem. Res., 42, 3879-3885.

IEA (2006). "Renewable energy: RD&D Priorities. " Paris, International Energy Agency.

IEA (2009). "Energy Policies of IEA Countries, The Netherlands, 2008 review." International Energy Agency, Paris

Jansen, J. C. (2010). "Preliminary qualitative assessment of proposed measures to foster renewable and low carbon sources in the Dutch electricity mix. " ECN Rapport. Petten, ECN: 64.

Jansen, J. C., S. M. Lensink, et al. (2011). " Cost-benefit analysis of alternative support schemes for renewable electricity in the Netherlands. " Petten, ECN.

Jansen, J. C. and M. A. Uyterlinde (2004). "A fragmented market on the way to harmonization? EU policy-making on renewable energy promotion." Energy for Sustainable Development 8(1): 93-107.

Jong, H., de. (2009). "Towards a single European electricity market. " Energy & Industry. Delft, Delft University of Technology.

Junginger, M. (2005). "Learning in Renewable Energy Technology Development." Department of Science, Technology and Society. Utrecht, Universiteit van Utrecht.

Koopmans, C., B. Tieben, et al. (2010). "Investeren in een schone toekomst; de kosten en baten van een duurzame energiehuishouding in Nederland. " Amsterdam, SEO Economisch Onderzoek.

Koutstaal, P., M. Bijlsma, et al. (2009). "Market performance and distributional effects on renewable energy markets." The Hague, CPB Netherlands Bureau for Economic Policy Analysis.

Langniss, O and R. Wiser (2003), “The renewables portfolio standard in Texas: an early assessment.” Energy Policy 31; 527-535

Lauber, V. (2004), "REFIT and PRS: options for a harmonised Community framework." Energy Policy*,* 32, pp. 1405-1414

Lensink S. (2010), "Beantwoording vragen omtrent Regeerakkoord", ECN, Petten, ECN-BS- -10-xxx

Linden, N.H., van der, M.A. Uyterlinde et al. (2005). "Review of international experience with renewable obligation support mechanisms. " ECN, Petten, LBNL-57666

Lipp, J. (2007). "Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom." Energy Policy 35(11): 5481-5495.

MacGill, I., H. Outhred, et al. (2006). "Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry." Energy Policy 34(1): 11-25.

McKinsey (2010). "Supplier obligation system as a potential alternative for the Netherlands." Amsterdam, McKinsey.

Mahr, D. (2010). "Biomass Attributes, Handling, and Processing Issues for Large Power Plants." ASME Conference Proceedings 2010(49354): 29-35.

Markvart, T. (2006). "Microgrids: Power systems for the 21st Century?" Refocus 7(4): 44-48.

Ministerie EI&A (2010), "Brief aan de Voorzitter van de Tweede Kamer, betreft SDE+." ETM/ED/10158983, Den Haag, 30-11-2010, Ministerie van Economische Zaken, Landbouw & Innovatie

Ministerie EZ (1997). "Actieprogramma 1997-2000: Duurzame energie in opmars. " Ministerie van Economische Zaken. Den Haag

Ministerie EZ (2003). "Algemene uitvoeringsregeling milieukwaliteit elektriciteitsproductie. BWBR001585." Den Haag, Ministerie van Economische Zaken

Ministerie EZ (2007). "Besluit stimulering duurzame energieproductie. " BWBR0022735. Den Haag, Ministerie van Economische Zaken.

Ostrom, E. (1990). "Governing the Commons: the Evolution of Institutions for Collective Action." Cambridge, Cambridge University Press.

Ostrom, E. (2009). "A General Framework for Analyzing Sustainability of Social-Ecological Systems." Science 325(5939): 419-422.

Rader, N. and S. Hempling (2001). "The Renewable Portfolio Standard; A practical guide." Washington DC, National Association of Regulatory Utility Commissioners.

Rijksoverheid (2009). "Nationaal actieplan voor energie uit hernieuwbare bronnen." The Hague, Ministerie van Economische Zaken, Landbouw & Innovatie

RWE. (2010). "About RWE." from http://www.rwe.com/web/cms/en/111466/rwe/rwe-group/about-rwe.

Sage, A.P., and Armstrong, J. E. (2000). "An Introduction to Systems Engineering."
SEA (2009). "The electricity certificate system 2009." Swedish Energy Agency. Eskilstuna, Edita Communication.
SEA (2009). "Renewable electricity through electricity certificates." Swedish Energy Agency, Eskilstuna, ET2009:12/150 ex
Shell (2011), "Shell Energy Scenarios until 2050; an era of volatile transitions" Shell international BV
Spiller, P. and M. Tommasi (2005). "The Institutions of Regulation: An Application to Public Utilities." Handbook of New Institutional Economics. C. Menard and M. Shirley, Springer US: 515-543.
Senternovem. (2010). "Stimulering Duurzame Energieproductie (SDE)." Retrieved 24 February 2010, from http://www.senternovem.nl/sde/index.asp.
Tilburg, X., J.C. Jansen et al. (2006). "Verplichting voor duurzame elektriciteit in Nederland; Verkenning van mogelijkheden en randvoorwaarden." ECN Rapport, Petten, ECN-E—06-038
Turkenburg, W. C. (2004). "Renewable Energy Technologies. World Energy Assessment: Energy and the challenges of sustainability." G. J. New York, UNDP: 219-272.
VME (2010). "Een leveranciersverplichting als alternatief voor een Nederlands duurzaam Energiebeleid:Eerste verkenning gebaseerd op vergelijkende leveranciersverplichtingen in Vlaanderen, Groot-Brittannië, Zweden en Polen." Den Haag, VME
Vries, J., A. Correlje, et al. (2008). "Electricity and gas markets. Dictaat SPM 9541." Delft, Delft University of Technology.
Williamson, O. E. (1998). " Transaction cost economics: How it works; where it is headed." Economist, 146, pp. 23-58.

Annex

Table of Contents

ANNEX I: INTERVIEWS

Tim Wijnen – Manager Sustainable Products & Support

Monday 4 October 13:00-14:00
Essent, Sales Portfolio Management, Pricing, Structuring & Forecasting

Department Sustainable Products & Support (Sales Portfolio Management)

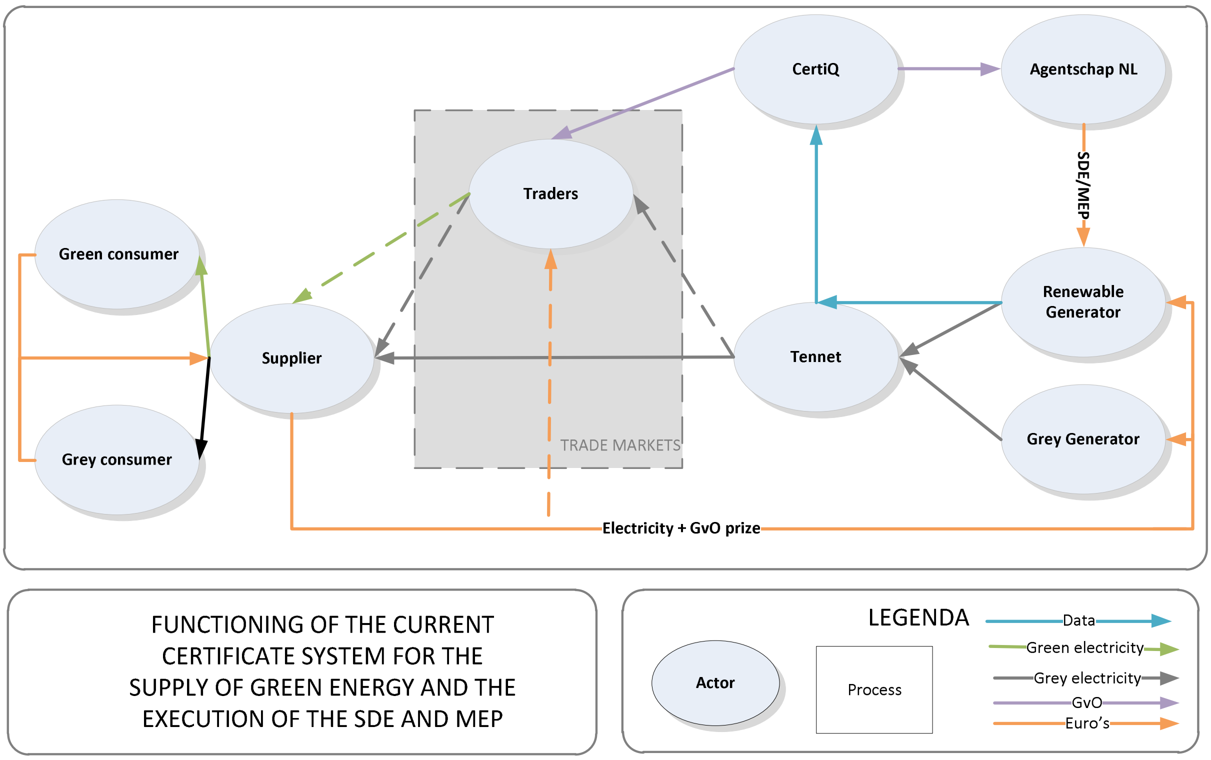
The department Sustainable Product & Support is responsible for the purchase and distribution of green products/certificates. The following certificates are purchased:

- GoOs
- Golden Standards (certificates that register CO_2 reduction, also known as 'white certificates')
- EU-ETS rights

With respect to the Supplier Obligation System (SOS), the GoOs are relevant to discuss further.

Functioning of the renewable electricity market

I showed Wijnen the following model of the functioning of the renewable electricity market. Wijnen confirmed that this model is a correct representation of the functioning of the renewable electricity market. The trade in electricity and GoOs is separated. If a supplier wants to sell green electricity to a customer he has to purchase both electricity and GoOs to do this.

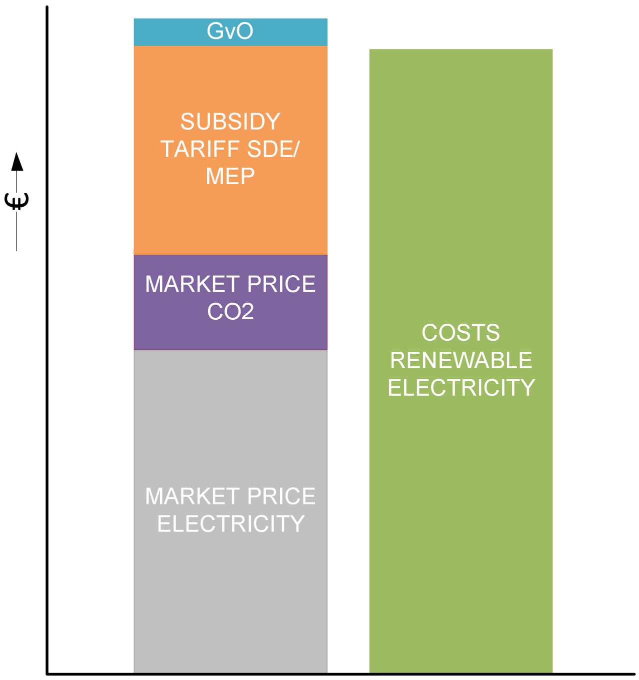


Trade of GoOs

The trade in GoO is organized completely bilateral. This has advantages and disadvantages for Essent SPM. On the one hand a bilateral market leads to a non-transparent price. Due to the non-transparency prices in GoOs can fluctuate and thus be unpredictable. Furthermore it is hard for new-entrants to determine their trade position. On the other hand consumers also do not have insight in the costs of renewable electricity. A GoO is a European product. The European Union provides guidelines for the certification of renewable electricity and the GoO can thus be traded on a European level.

Effectiveness of GoO system with respect to sustainability

Wijnen explains that the GoO system is not very effective with respect to sustainability, as the trade in GoO does not contribute to new investments in renewable production capacity. As hydro-power is cheap and largely available in Europe, the price of GoOs is very low and does not provide an incentive to invest in additional renewable production capacity. Wijnen states that only the height and possibility of the SDE subsidy is taken into account when deciding on investments in renewable production capacity. The GoO does not play a role in this decision. The price of GoO is relatively so low that not every producer subscribes himself for the GoO system. Lastly Wijnen explains that the subsidy amount of the SDE is not corrected for the GoO price, which makes the production of GoOs attractive. This is shown in the figure below.



Organization trade of GoOs within Essent

With respect to B2C, the GoOs from the renewable energy production of Essent are directly allocated to Essent B2C for a fixed price. The additional GoOs that are needed to fulfil the consumers demand for green energy is purchased on the GoO market. Essent could also choose to sell their produced GoOs to the market and purchase only hydro-power GoOs for their customers, but they choose not to do this, because they see it as their social responsibility to actually contribute to the transition to renewable electricity production. Furthermore Essent applies the rule 'grey=green' for the B2C market segment, which means that Essent offers green electricity for the same price as grey electricity. With respect to B2B Essent uses the rule 'grey=grey' and 'green=green', which means that customers in this segment pay a differentiated price for grey and green electricity. The green certificates needed for these customers are traded bilaterally. B2B customers have specific demands with respect to the accompanying green label of the green electricity. On the one hand the B2B-market often demands wind-power as it is considered to be a bigger contribution to the transition towards renewable electricity than for instance hydro and thus contributes to a greener image. On the other hand the B2B market also demands hydro-power as this is currently the most cost-effective renewable electricity.

Pricing mechanisms in the GoO market

The following aspects determine the price setting of GoOs:

- Currently, the biggest part of the European GoO market exists of Hydro-Power certificates. These certificates keep the price of the certificates very low, as hydro-power is relatively cheap
- Furthermore the quality of the GoO, determined by the green-label accompanying the GoO determines the price of a GoO. A green-label states the origin of the renewable electricity. For instance the price for a bio-power GoO lies around 0,80 €/MWh. For hydro-power this is 0,10 €/MWh. For solar-power this price lies between 1,00-1,25 €/MWh.

Performance CertiQ

With regard to the performance of CertiQ, Wijnen explains that he desires a broader responsibility in the current activities of CertiQ. Currently CertiQ only controls the issuing of GoOs. Once they have issued the GoOs to a producer their control stops. This means that CertiQ does not control if the required GoOs are purchased for the customers who purchase green electricity. Now this is only controlled by an accountant, who may we not specialized enough to do this.

Harmonisation of the European green certificate market

Wijnen argues that the harmonisation of European renewable energy policy would make a more transparent European renewable energy market possible. This could for instance make a European spot market for green certificates possible, which would be very beneficial for the transparency and efficiency of trade in green-certificates. Wijnen therefore advises to determine which SOS of other member states functions best and then adapt the design of the SOS for the Netherlands to this SOS, in order to leave options open to enlarge the trade market of green certificates within the obligation.

Organization trade in electricity

Wijnen explains that electricity is traded both bilateral as central on a spot-market. In the Netherlands APX-ENDEX is the organisation that facilitates the exchange market. There are several relevant spot markets. First APX-Power NL facilitates the daily balancing of supply and demand of electricity. Secondly, there is an imbalance market. This market manages the balancing of direct imbalance. Tennet, the system manager, identifies which party has a deficit and which party has complemented this deficit. Then the party with the deficit pays the imbalance market price for the complemented electricity to the complemented party. Lastly there is a 'futures' spot market. This market centrally trades in electricity on a longer term. Futures could be seen as equity options for electricity. In general Essent has contracts with customers that demand a certain amount of electricity in the future. This amount is covered party on the bilateral market and with futures and is balanced on the short-term on the spot market APX-POWER NL in order to divide risks.

Chris Arthers – Internal Corporate Responsibility consultant

Wednesday October 13th 15:00-16:00
Essent, Corporate Responsibility

Department Corporate Responsibility (CR)

CR is a staff department that supports business units in the implementation and execution of the corporate responsibility policy. One of the main objectives of CR is to increase the level of sustainability in the business of Essent in a pragmatic manner. CR would not be directly affected by the implementation of a Supplier Obligation System (SOS). Arthers does however state that the implementation of a SOS would heavily affect the organization of the sector and could therefore change relations between the departments of Essent. Arther is proponent of a SOS. He states that an SOS is always better than to be dependent of government subsidy as it is better for the image of

Essent to compete in a renewable energy market and achieve to be a market leader he than to be dependent from subsidies.

History of green certificates in the Netherlands

At the end of the 90's Dutch Distribution Company's voluntary committed them to deliver a fixed percentage of renewable energy in its total supply. This commitment was laid down in a covenant. Every distribution company was proportionally appointed with a specific target of renewable energy in its total supply. In order to realise these targets a trade system for 'Green Labels' was established. For this systems the 'Green Labels' only represented the 'sustainability aspect' of the produced energy and not the energy itself. This valuation of the labels made it possible for energy companies, which were in that time limited to a specific region, to sell and buy renewable energy over the border of their own catchment area. This was necessary in order to make it possible for every energy company to financially contribute to the covenant, despite of their specific geographic region and the possibilities to produce renewable energy that this region provides. In order to be able to contribute to the set targets the distribution companies were allowed to add a charge to the energy bill set between 1,25-2,5 % of total electricity price.

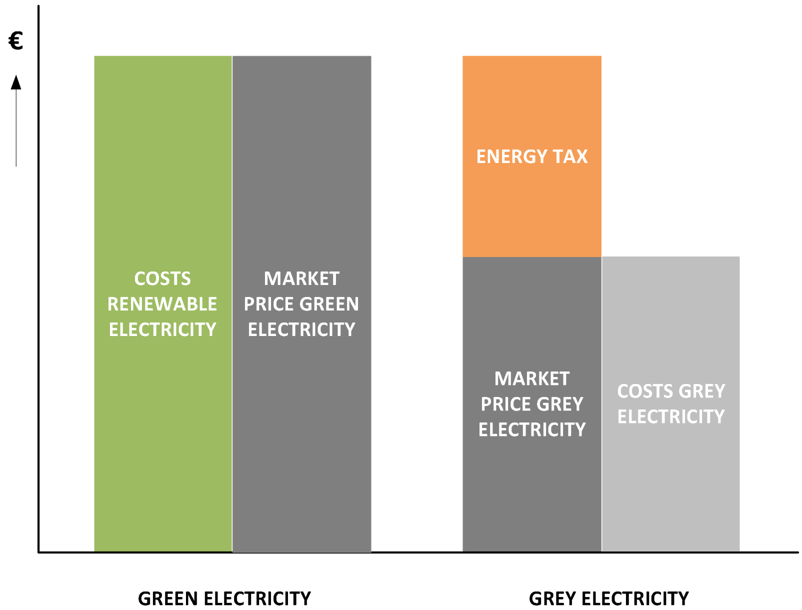
GoOs

Arthers explains that 1 MWh of green electricity is good for 1 certificate in the GoO system. The certificate states in which plant the electricity is produced, from which energy source and at what point the generator was connected to the grid. Also in this system the sustainability aspect of the energy is decoupled from energy itself.

History of support schemes for renewable energy

REB

Before renewable energy production was subsidized, renewable energy production was fiscally supported. This was done by posing an energy tax on electricity and gas, called 'Regulating Energy Tax' (In the Netherlands known as Regulerende Energy Belasting or REB). An exemption for this tax existed for renewable produced energy. Due to this energy tax exemption for green energy is was possible to settle the costs of renewable energy production to the consumers. How the grey and green electricity prices were related due to the charge of energy tax on electricity and the exemption of this tax for renewable energy production is shown in the figure below.



MEP

The REP was replaced by a feed-in-premium that compensates for the uneconomic top of renewable energy production in 2003. This support mechanism for renewable energy is called 'Environmental quality of the Electricity Production' (in Dutch known as or Milieukwaliteit van de Electriciteitsproductie or MEP). The MEP is executed with a fixed subsidy tariff for different categories of renewable energy technologies. Once the subsidy tariffs were set they could not be corrected for fluctuations in electricity- or CO_2 prices during the subsidy term. Only once, three years after the start of the MEP, it was allowed to adopt the subsidy tariff to current circumstances. This means that the MEP subsidy tariff cannot be corrected in the future for the price green certificates in a SOS. This means that it would be problematic to include with MEP subsidized production capacity in a Dutch SOS as this would undermine a level playing field. Lastly, the subsidy term for every category was fixed for 10 years within the MEP. The MEP became for several reasons very unpopular in Den Haag and was stopped in 2006. This means that the last renewable generators will fall out of the MEP in 2016.

SDE

The SDE succeeded the MEP in 2008. This means that for a period of 2 years there was no support scheme for renewable energy production present in the Netherlands. The SDE is very comparable with MEP, but was framed as a new measure, due to the unpopularity of the MEP, described above. Changes in comparison with the MEP are that the subsidy tariffs can be yearly corrected for the electricity- & CO_2 price and other elements that can influence the income of renewable energy production. Furthermore, also the subsidy term in the SDE is differentiated per type of technology (between 10 and 15 years). Shortly, the general idea behind calculation the SDE subsidy level is:

costs renewable energy production – benefits = subsidy level*

*It law is laid down in the SDE resolution that benefits can represent the electricity price, CO_2 price, GoO price and other elements that substantially influence on the benefits.

At the start of the subsidy term a base amount for the subsidy is set per category of renewable energy source. This base amount is yearly with the correction amount described above. In order of the Ministry of Affairs, research institute ECN advices the Ministry on the different eligible categories and the base amounts and yearly correction amounts per category. This advice does not have to be followed by the Ministry as they have the final responsibility for setting the categories and subsidy tariffs. Currently the CO_2 and GoO price are not taken into account when determining the correction amount, as their values are relatively too small.

Eligible sources

Essent has largely invested in large scale biomass conversion last years. Arthers explains that currently large scale biomass conversion is not an eligible category for the SDE. In addition to this he argues that in principle all renewable energy sources fall under scope of SDE, so that is could be possible that in the future a category for large scale biomass conversion would be added. He adds the following reasons why this was not done until now:

- Doubts on the level of sustainability of biomass
- Possible that this could also lead to the subsidizing of coal
- It was not a priority yet, as all biomass capacity is still covered by the MEP

Number of subsidy terms

Arthers explains that Article 3 of the resolution on SDE states that every investment in renewable energy production can receive only 1 term of subsidy. Article 3 also describes some exemption to this rule. One exemption is that if the exploitation costs of a renewable energy production are relatively large in comparison to the investment costs multiple subsidy terms are possible, when laid down in a

Ministerial arrangement. It could therefore be possible that Essent's capacity based on large scale biomass conversion would be allowed to fall under SDE. However Essent does realises that the subsidy amount under SDE will be lower than under the MEP.

Essent

As was explained Essent has largely invested in large scale biomass conversion. These investments were mostly done under the MEP arrangement. Arthers thinks that the following division can be made between MEP and SDE for Essent

- 99 % MEP (most investments between 2003 & 2006)
- 1 % SDE (no inclusion of large scale biomass)

This means that from the perspective of Essent it is very important that there is an adequate transition path from the MEP to the SOS or that the MEP will be succeeded by a new SDE term in an intermediate period.

SOS

With respect to a transition from the current situation to a SOS, Arthers explains that it is not possible for the Ministry of Economic Affairs to not comply with the agreed subsidy terms. The only exception to this rule could be when energy producers would voluntarily decide to step out of the SDE in return for participation in a SOS. Based on the above the following options were identified with respect to a transition from the current situation to a future situation that incorporates a SOS

1.
   a) Generation capacity that falls under the MEP should be excluded from participation in a SOS, as it is not possible to correct for the certificate price in a SOS.
   b) Generation capacity that falls under the SDE should be included in participation in a SOS
      - When it is legally possible to use the GoOs to prove compliance with the supplier obligation, as it is legally possible to correct the subsidy amount for GoO price.
      - When it is legally not possible to use the GoOs to prove compliance with the supplier obligation, but it is possible to correct the subsidy amount for the new established green certificates that will support the SOS.
      - When it is legally possible to let energy producers on a voluntarily basis switch form participation of the SDE system to participations in a SO S and energy producers are willing to make this switch.
2. Both capacity that falls under the MEP and SDE should be excluded when the above (1b) is not possible.

Xander van Mechelen – Manager Business Development

Wednesday October 13th 10:00-11:00
Essent, B2B, Value Chain Development

Demand B2B customers

Van Mechelen explains that he has seen an increase in demand for green certificates from B2B customers. Green certificates are categorized in:

- Silver standards (requirement=green)
- Gold standards (requirement= green & socially responsible)

With respect to specific demand profiles of B2B customers, van Mechelen outlines the following segments:

Business segments	Specific demand profile
Businesses that are in close connection to citizens **Example: TNT, Ahold**	Companies in this segment want to be 'green' in the most visible manner possible. This is for instance possible by executing transport with electric vehicles. Furthermore, these companies obligate themselves to be green by committing them to covenants and internal agreements. The general motivation behind the strategy of this segment is that it will lead to competitive advantages.
Banks and financial institutions **Example: Rabobank, Triodos**	These institutions have a lot of retail customers and therefore want to commit themselves to green energy. They choose for a fully renewable energy supply. Their specific criteria in de source of this energy is that is has to be of domestic origin. They currently mostly invest in wind-power and green gas.
NGO's **Example: WFF, Max Havelaar**	These institutions highly value the controllability of the source and production of the renewable energy. Furthermore they value a close connection to the people that were connected to the production of the renewable energy.
Greenhouse farmers	The approach of greenhouse farmers towards renewable energy is very pragmatic. They want to obtain the right to subsidies for 'environmental- and energy saving investments' in the most cost-effective manner. From this perspective they determine their demand for renewable energy products.
Other agri-business **Example: Friesland Campina**	The agri-business (milk sector) wants to grow but realises that this is only possible when their growth is fully sustainable. This realisation is partly caused by pressure from the government. Therefore they have committed themselves to five both national and European covenants with respect to sustainable business.
Energy intensive industries **Example: AkzoNobel, DSM**	This kind of industry mostly falls under the scope of EU-ETS. Therefore these industries mainly focus on staying below the CO_2 ceiling set by this system. They realize this by investing in energy saving adjustments and not so much by investing in renewable energy.

Behaviour of regulated industries

Van Mechelen explains that regulated industries often commit themselves to internal agreements or sectoral covenants with respect to the transition towards a more sustainable business in order to be one step ahead of the government. By committing themselves to sustainability in this way, these industries prevent that the government imposes regulation on them, which they do not have influence on.

Organization sales to B2B customers

Van Mechelen explains that B2B both sales to less energy intensive industries (Ahold, TNT etc.) as to energy intensive industries (Akzo, DSM). Only if the B2B customers demand for very specific energy contracts this is handled by trade.

Demand B2B customers in Supplier Obligation System

Van Mechelen expects that B2B customers will not demand more renewable energy than is laid down by the Supplier Obligation. He does however think that B2B customers will optimize their demand within this obligation with respect to the type and source of renewable energy based on their specific stakes as was explained above.

Position B2B with respect to a Supplier Obligation System

Van Mechelen argues that a Supplier Obligation System will only make the renewable energy market more mature. The process will lead to a lower renewable energy price and higher awareness at the consumers. Furthermore, he sees realistic possibilities for technology and product differentiation, as an obligated supply for B2B customers will lead to a higher level of awareness and experience and specific demand profiles. In general he believes that the government should shift their focus from production towards consumer awareness in realizing their sustainability targets. A Supplier Obligation System can contribute to this shift.

Dr. Hanneke de Jong – Senior Officer Regulatory Affairs

Thursday October 14th 13:30-15:00
Essent, Corporate Affairs

De Jong received her Ph.D. degree in May 2009 on a structured approach to European regulatory mode decision-making for the integration of the European Electricity Market.

Liberalisation of the European electricity market

De Jong discussed the several packages with respect to European energy legislation. In 1996 this package mainly focussed on the creation of a market for electricity by unbundling different activities in the supply chain. In the following packages this legislation was further detailed by adding concrete rules to the first package. Later on also a more regional approach was implemented. De Jong explains that a shift was made from a top-down approach towards a more bottom-up approach with respect to the defining of new European legislation. In the bottom-up approach new legislation is based on best-practises that arise in Member States or regions. This method is more based a trial-and-error strategy than on a systematic design of legislation. The Jong refers to certain parts of her dissertation for further background on the scope of European energy legislation. Further the stability of the legislation and regulation of the energy sector of Europe is discussed. Due to the frequent change in energy legislation the European energy sector experiences a high regulatory uncertainty, which has negative consequences for the investment climate of this sector.

Harmonisation of the European electricity market

Harmonisation of energy legislation is one of the most important issues with respect to the functioning of the European electricity market. Currently, certain Member States can have competitive advantages or disadvantages due to national legislation, which undermines a level playing field in the electricity market from a European level. De Jong explains that the focus of policy with regard to the harmonisation of the European electricity market mainly lied on the primary market processes and not so much on environmental quality. The focus with respect to European environmental policy mainly lied on objectives regarding the reduction of greenhouse gasses. These focus areas of harmonisation and environmental policy for the energy sector has led to a high fragmentation of energy policy on a European level; every Member State has own system to stimulate renewable energy production and consumption.

This fragmentation in policy has led to a very low degree of market coupling of the national renewable energy markets on a European level. De Jong expects that at least until 2020 no concrete measures to harmonize the environmental policy of the energy sector will be laid down by the European Union. Instead current learning processes in the different regions of the European Union will point out which system is the most appropriate for tackling greenhouse emission reduction. In the meantime it is important for Member States to define their own renewable energy policy. With respect to the 'bottum-up' approach of the development of regulation it would be even interesting for the Netherlands to develop a best practise with respect to renewable energy policy in order for this policy to be adopted on a European scale. The Netherlands should thus aim to be a best practise with their design of a SOS instead of adapting the design of the SOS to other Member States with the objective that this will open up options for further harmonisation.

Relation between the Ministry of Economic Affairs and the Office of energy regulation (Energy Kamer)

Formal relation

The Third Energy Package of the European Union has further defined the function of the national energy regulators. This should lead to a higher level of autonomy and independence for the regulator with respect to the government. Currently the Directive on this topic has not been implemented in the Netherlands as the Third Energy Package was adapted in 2009 and can be implemented until 2011. For this reason it is not fully clear how the Directive will be translated to the Dutch situation. Probably the implementation will lead to a formal reorganisation and the further formalization of the processes of the Office of energy regulation. Furthermore, the budget of the regulator will be separated from the Ministry of Economic Affairs. Lastly some new tasks will be added to the responsibility of the regulator. However these changes will not be very substantive as the Netherlands was relatively far in defining the responsibilities of the energy regulator in comparison to other Member States.

In the Netherlands the specific tasks of both the Ministry of Economic Affairs and the Regulator are very clearly defined. So there are not so much ambiguities in the division of their responsibilities. Although that the division is reasonable clear sometimes there are still grey areas. Recently a branch association for professional energy consumers has gone to Court about a decision of the Dutch regulator regarding gas transport tariffs. In June this year the Trade and Industry Appeals Tribunal (in Dutch College van Beroep voor het bedrijfsleven or CBb) has decided that the decision of the regulator was not valid as it was based on a policy rule of the Ministry of Economic Affairs. As the decision on transport tariffs should be taken by an independent regulator the decision of the regulator that was based on a Ministerial rule therefore had to be annulled. This case law shows the possible tensions between responsibilities of the Minister and Regulator and mostly shows a movement towards more autonomy and independence of the regulator.

Informal relation

De Jong explains that there is a constant power play present between the Ministry of Economic Affairs and the regulator, as they both want to obtain as much decision-making power as possible.

Differences in approach

With respect to the focus in the approach of the Ministry and the regulator the following distinctions can be made. The Ministry's approach will be in accordance with policy and have a focus on the realisation of societal objectives. Furthermore the focus of the Ministry is under direct influence of politics as the starting point for policymaking is determined by the political parties in the present coalition. The focus of the regulator lies on legal and economic aspects. Furthermore, they are not indirectly under influence of politics as they are an independent body. However employers of the regulator are mostly politically active the regulator can be under indirect influence of politics.

Possible division of responsibilities in SOS in the Netherlands

I presented the different tasks that need to be fulfilled in a Supplier Obligation System to De Jong. De Jong suggested the following governing bodies to be responsible for these tasks. The table below shows the overview of this discussion.

Task	Possible organizations	Why
Setting of the obligations target sizes	Ministry of Economic Affairs	This activity takes place on a policy level
Issuing of certification	CertiQ/ new authority	This is a specialized administrative task.

Organization of certificate trade	APX-ENDEX	APX-ENDEX already has experience with spot markets. De Jong ads that APX-ENDEX is currently a commercial organization, which is allowed to make profit. APX-ENDEX is part of Tennet. If the competences of APX-ENDEX would increase, for instance when being responsible for the organization of trade in TRECS, their activities could become more monopolistic. In this case has the APX-ENDEX should be regulated.
Monitoring of compliance with the targets	AgentschapNL/ new authority	This is an executing role
Setting and collection penalties for non-compliance	AgentschapNL/ new authority	This is an executing role
Calibration of the certificate market	NMa	De Jong explains that this could possibly be a task for the regulator. However in order to make this possible, the Supplier Obligation System should be incorporated in the Electricity law 1998, as the NMa is responsible for the execution of this law.
Market-maker	NMa	De Jong explains that this could possibly be a task for the regulator. However in order to make this possible, the Supplier Obligation System should be incorporated in the Electricity law 1998, as the NMa is responsible for the execution of this law.

Ludo Andringa – Senior Officer regulatory Affairs

Thursday, October 20th 14:00-15:00
Essent, Regulatory Affairs

Relation Agentschap NL & Ministry of Economic Affairs

Formal relation

Andringa explains that Agentschap NL is an 'independent administrative body' (in Dutch known as Zelfstandig Bestuursorgaan or ZBO). A ZBO is charged with a specific public task and have own budgets and competencies. They do however fall under one specific Ministry. The Minister is thus formally responsible for the actions of the ZBO. The ZBO is responsible for the execution of daily proceedings. Agentschap NL falls under the responsibility of the Ministry of Economic Affairs. However, they also provide services for other Ministries, like the Ministry of Housing, Spatial Planning and the Environment. The Ministry is responsible for policy making. Agentschap NL is responsible for the execution of this policy. Their tasks are the execution of subsidy regimes and other secretarial tasks. The execution of their responsibility mainly exists of administrative proceedings.

Informal relation

Andringa explains that the professional relationships between Agentschap NL and the Ministry are very close. Recently, a lot of attention was given to a closer cooperation between the Ministry and Agentschap in policy-making processes. During policy-making it is important to assess the practicability of the policy. Therefore Agentschap NL provides feedback on practicability in an early stage of the policy-making process. Andringa explains the following tensions between Agentschap NL and the Ministry. Agentschap NL can be disappointed in the degree in which the Ministry takes their advice into account. They feel that the Ministry approaches policy to much from an ivory tower. The

Ministry on the other hand can find Agentschap NL somewhat bureaucratic. Furthermore, they feel that Agentschap NL sometimes does not have enough understanding for the political circumstances. Andringa describes the difference between the relation between Agentschap NL and the Minister and the Ministry and Minister respectively unilateral and bilateral.

Division of tasks in Supplier Obligation System

The possible division of tasks in a Supplier Obligation System was discussed. In the table below an overview of this discussion is presented.

Tasks	Governing body	Why?
Setting of the obligation target sizes	Ministry of Economic Affairs	This is a task on policy level
Issuing of certification	CertiQ	CertiQ has a great expertise in the execution of this task
Organization of certificate trade	Regulated APX-ENDEX or new regulated exchange	Andringa states that this task could only be executed by APX-ENDEX if this organization was regulated. If this is not possible a new regulated body should be established that can execute this task
Monitoring of compliance with targets	NMa (or CertiQ, Agentschap NL)	Andringa thinks it is most efficient to let the NMa execute this task, as they have to control this compliancy anyhow in the execution of their responsibilities as a regulator. Andringa possibly also sees this role for CertiQ or Agentschap NL In the case of a hybrid SOS Agentschap NL certainly should be involved in this task
Setting and collection penalties for non-compliance	NMa (or CertiQ, Agentschap NL	Andringa thinks it is most efficient to let the NMa execute these tasks, as they have to control this compliancy anyhow in the execution of their responsibilities as a regulator. Andringa possibly also sees this role for CertiQ or Agentschap NL
Market-maker	No role for any governing body	Andringa argues that a market-maker is not a very appropriate role for a government. Furthermore he thinks it is better to adopt the system based on periodical evaluations that to have the SOS under constant intervention of the government as a market-maker

With respect to the division of tasks in a SOS, it could be interesting to compare this division of tasks in the execution of EU-ETS. The Dutch Emission Authority (in Dutch Nederlandse Emissie autoriteit or NEa) is a ZBO under the Ministry of Housing, Spatial Planning and Climate, who is responsible for the execution of the regulation and execution of the EU-ETS in the Netherlands.

Jo Mortier – Manager Regulatory Affairs, Essent Belgium

Tuesday 26 October 2011, 10.00-12.00
Legal & Regulatory Affairs, Essent Belgium

Essent Belgium

Jo Mortier is Manager Regulatory Affairs at Essent Belgium. Essent Belgium is an energy company in Belgium, which mainly focuses on the supply of electricity. Besides some small scale ELES projects, Essent Belgium is not active in the production of electricity. Essent Belgium is a new entrant in the Belgium energy market in which the incumbent is Electrabel.

General description Supplier Obligation System Belgium

In Belgium several Supplier Obligation Systems (SOS) are adopted. Every region, Wallonia, Flanders and Brussels has their own system. In Flanders two SOSs exist, one for renewable electricity and one for electricity from CHP. For these systems Green Certificates are allocated per MWh produced renewable electricity. Wallonia and Brussels both have one system which allocates Green Certificates based on the avoidance of CO_2. All three systems have adopted minimum prices that are differentiated per renewable energy technology.

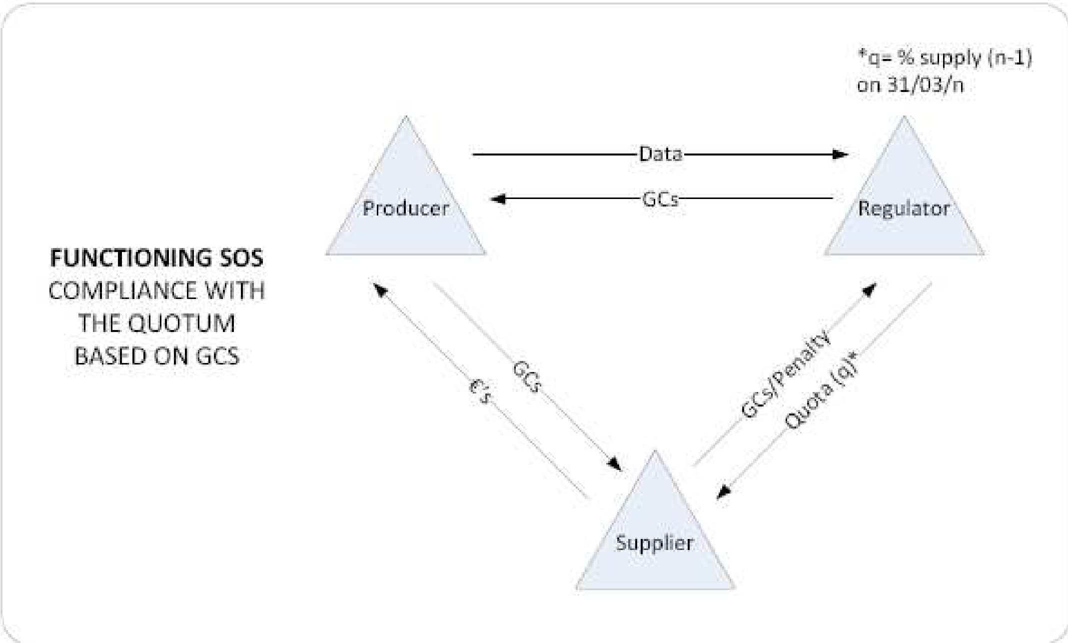
The regulator of Flanders, Wallonia and Brussels are respectively VREG, CWAPE and BRUGEL, which are responsible for the issuing of Green Certificates to generation capacity connected to the distribution network (< 70 kV) and regulation of the SOS within their own region. The federal regular is CREG, who is responsible for the issuing of Green Certificates to generation capacity connected to the transmission network (> 70 kV). Under this division off-shore wind-power is issued with GCs by the federal regulator, other technologies are issued by regional regulators.

Relation Guarantee of Origin (GoO) and Green Certificate (GC) systems

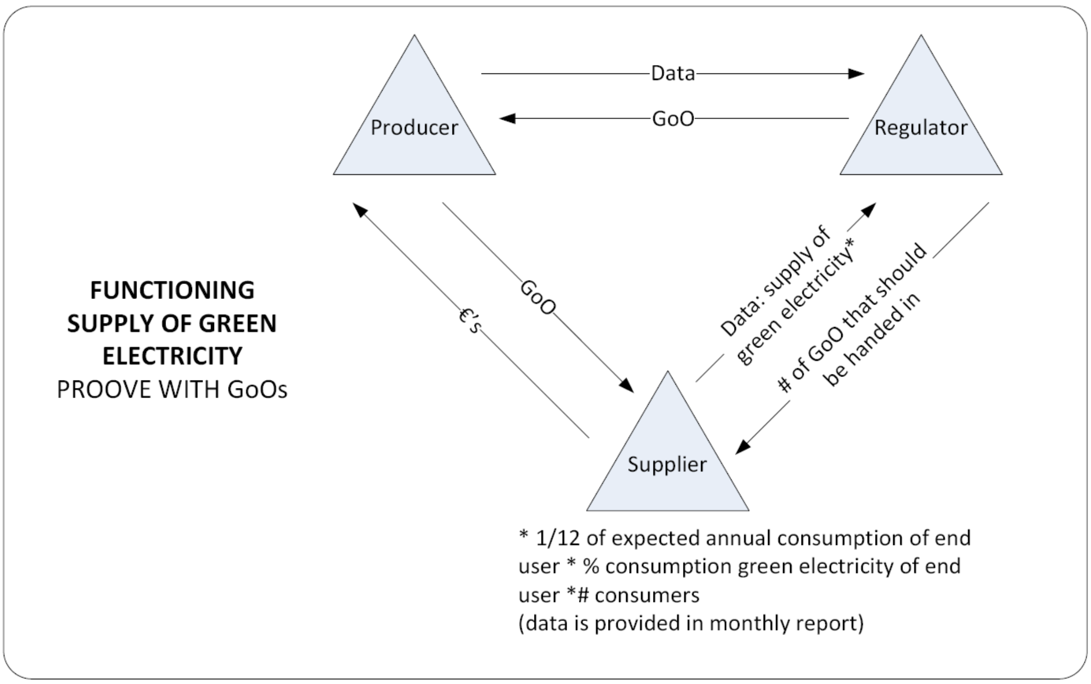
Belgium uses two different certificate systems to handle the administration of renewable electricity production and supply. Firstly, they use GoO certificates, these certificates are used to administer the supply of green electricity to consumers. Secondly, they use GC, these certificate are used to administer the compliance of suppliers with the quota of the SOS. GoOs are issued on a European level and can be traded on a European level. GCs are issued on a regional level and can only be traded and used for compliance of the quota within the same region. This means that GCs are not interchangeable on a federal level. Lastly, GoOs are granted to a renewable generator for the net energy production. This means that no GoOs are granted for the part of the produced energy that is used in the process of production. GC's are granted to a renewable generator for the gross energy production, so in this case is not corrected for the own use of the generator.

Functioning SOS Belgium

Mortier drew the schemes below to explain the functioning of the SOS in Belgium. First he explained the functioning of the GC system, which is used to prove the compliance with the quota set by the SOS. The regulator sets the quota, which is a percentage of the total electricity supply of the last year. The way to comply with the quota is to submit the number of GCs that corresponds with the quota. The GCs can be obtained by purchasing them from a renewable producer. A producer receives GCs of the regulator when he submits data on his production to the regulator.

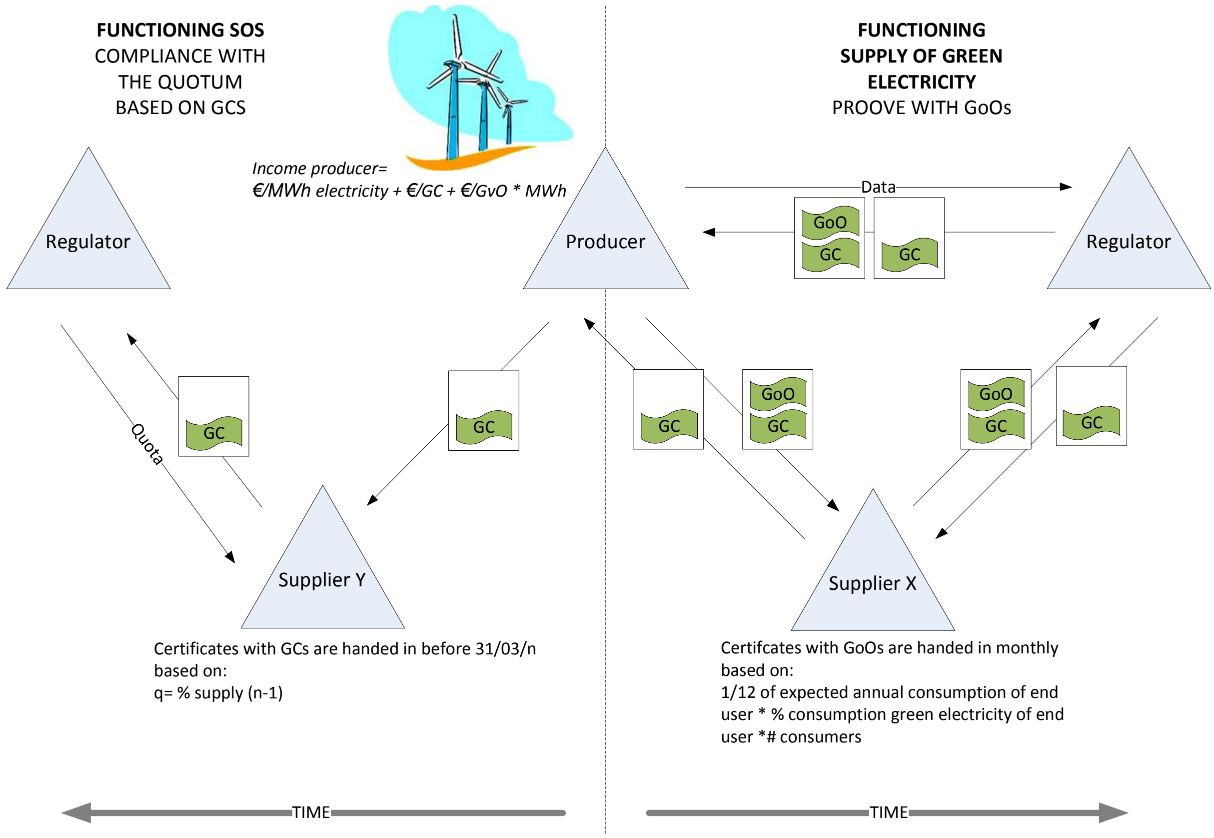


Then Mortier explains the functioning of the GoO system, which is used to administer the supply of renewable electricity to the consumers. This process starts with the supplier who monthly reports the amount of green electricity that was delivered to its customers to the Regulator. This amount is calculated based on the connection register. This register states the amount of consumers, the annual expected consumption of the consumers and the consumer's fuel mix. Once the Regulator receives this report, he determines the amount of GoOs that the supplier should admit and withdraws these GoOs from the suspense account of the supplier. The supplier fills the suspense account by buying GoOs on from a renewable producer. A producer receives GoOs of the regulator when he submits data on his production to the regulator.



In Flanders they decided to combine the GC and the GoO in one ticket. This leads to the following process. For the understanding of the process it is important to remember that a GC is issued for the net electricity production and a GoO for the gross electricity production. Furthermore it is important to realise that a ticket loses its validity once it is submitted to comply with the quota. Therefore a Supplier should first buy tickets from the producer that contains both a GoO and GC. This ticket can be submitted to the Regulator in order to prove the supply of renewable energy to the customers. Then the Supplier gets the tickets back, without the GoO component and returns this to the Producers. Then they Producer can sell the ticket with only the GC component to a Supplier who needs it for the compliance with its quota.

Mortier argues that this combined processing of GoOs and GCs makes the SOS in Flanders very complex, inflexible and non-transparent. Firstly, it delays the release of GCs on the market. Secondly, it makes the GoO contracts financially very heavy, as the producers requires a financial guarantee on the timely return of the ticket, which is based on the penalty price of the SOS. The producer lays down this financial guarantee in order to ensure his own liquidity.



Price mechanisms

Mortier explains that the penalty price is the most important parameter for the setting of the GC price. Currently the market price of GCs lies around 90% of the penalty price. The penalty price is Flanders is set at EUR 100,-. Mortier adds that currently almost never penalties have to be paid for non-compliance. With respect to a price floor, the Belgium SOS has implemented a minimum price for the certificates that is differentiated per technology. Mortier states that the minimum price was not designed to influence the price setting of GCs on the market. The main function of the minimum prices is to realise approval of financial institutions for investments in renewable energy generation. Van den Hurk asks how the government ensures that there is no surplus of supply of GCs, so that the GC prices drop below the minimum prices. Mortier answers that this is ensured with the legal arrangement that when in 2011 the number of produced GCs is bigger than the quota in 2012, the quota can be adjusted with the percentage surplus. With respect to this self-regulating mechanism, Mortier remarks that producers are currently protected with two measures, namely the minimum price and the adapting quota to a GC surplus. This redundancy in protection measures could lead to over-stimulation of investment in renewable generation capacity. Lastly, Mortier explains that the minimum price in Belgium is fixed, where the SDE tariffs in the Netherlands are yearly corrected for the electricity, CO_2 and GoO price. Also the fixed character of minimum prices can lead to over-stimulation. For instance the minimum price of solar power is currently EUR 390,-, while the average costs of solar power lie at EUR 200,-.

Trade in GCs and GoOs

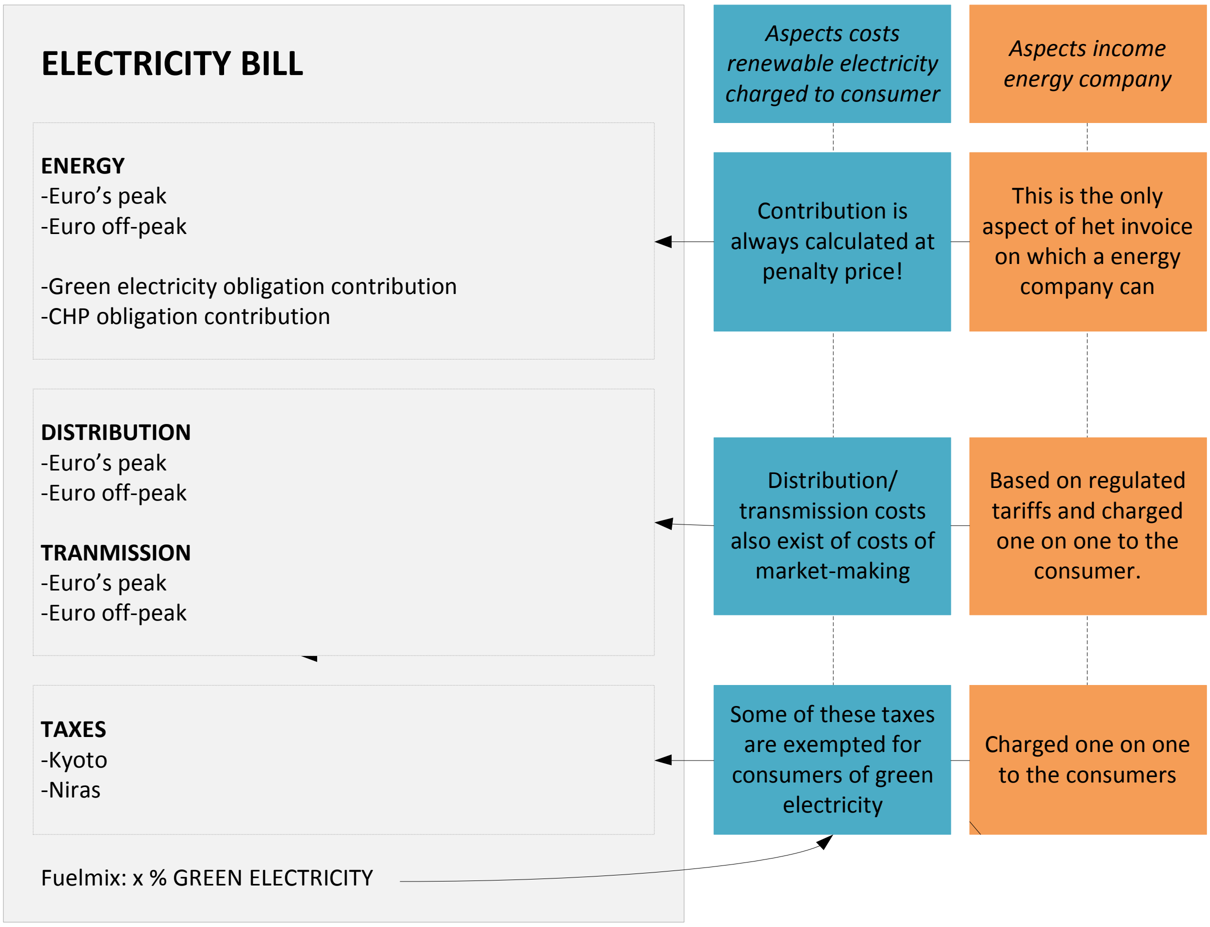
Producers have several options to sell GCs. GCs can be sold to DSOs/TSOs at the fixed minimum prices. Furthermore, GCs can be sold to traders or suppliers on a spot market (BELPEX) or bilaterally. Currently only solar panels get a higher price by selling the GCs to TSO/DSOs than on the market. TSO/DSOs sell their GCs to the highest bidder. If there is a negative difference between the price they paid to the producers and the price they received from the market, this is compensated in the network tariffs. Mortier explains that 99 percent of the total trade in GCs is done bilateral, either 'Over The Counter (OTC) or for the long-term. Within this 95% is contracted on a long-term (average 7 years). Temporarily deficits are traded OTC. Furthermore, suppliers help each other in periods of temporarily shortage, by exchanging GCs. The reason that most trade is done on a long-term basis is that long-term contracts are a condition for the approval of financial institutions on the financing of investments in renewable energy capacity. Trade on the spot market BELPEX was not successful so far. The auctions often did not provide an outcome as the spread between demand and supply was too large. One reason for the unpopularity of BELPEX is that trading parties have to pay an administrative charge for transactions but most importantly Mortier adds that the liquidity of the regional markets is too low for the proper functioning of a spot market. GCs have one market price, independent of the origin of the renewable electricity. GoOs do have differentiated market prices, with respect to the origin of the GoO, as customers can have a specific demand with regard to their renewable energy.

Market power incumbent

Mortier explains that the transition towards the SOS in Belgium was too sudden, which has led to a big advantage for the incumbent Electrabel, who is now able to set the certificate price. Electrabel was able to transform their coal-power plants into stand-alone bio-power plants. Furthermore, they can internally sell their GC for a low price and then sell the remaining GC for a relatively high price to the market, as there is no regulation on how internal allocation of GC's should be done. Summarizing, integrated energy companies have big competitive advantage over energy suppliers in Belgium SOS, due to insufficient time for preparation/adaptation for energy supply companies.

Energy bill

Mortier explained what the electricity bill for a consumer in Belgium looks like. This is shown below in an example of such an invoice. With respect to this invoice, the following aspects are interesting. Firstly, Mortier explain that only on the 'energy' component of the bill an energy company can make profit. The other elements are costs which are charged one to one to other organizations. The costs of the compliance with the quota set by the SOS are charged in the 'energy' part of the bill. Remarkable is that every energy company calculates the amount of contribution based on the penalty price instead of the actual prices paid for the GCs. According to Mortier energy companies do this, because the charge of the contribution is not regulated. Due to this there is currently no competition between energy companies in the price of the contribution for the SOS in the retail market. There is however a lot of competition between energy companies on the price of the contribution for the SOS in the B2B market. B2B customers get a discount on this contribution. This indirectly means that the discount on the contribution for the SOS that professional customer receives is paid by retail customers. With respect to B2B customers, Mortier adds that some customers themselves produce renewable electricity and can therefore be exempted from the contribution. In the second element of the bill, namely the transport costs, also the costs for the execution of the minimum prices are included. The costs for the role of market-maker for DSO/TSOs lie at EUR 490.000.000,- for the TSO/DSO's. This is 5 % of the total distribution costs, which are charged at the consumer. Also the last component of the bill is influenced by the supply of green electricity. When a customer purchases green electricity they can receive an exemption for different federal taxes, like the 'Kyoto tax' and the 'NIRAS tax'. Due to this exemption Essent Belgium can offer green electricity for the price of green electricity. Summarizing, on every component of the Electricity bill of the consumer the SOS is present. Remarkable is that the consumers (consumers federation) are not aware of this, due to the complexity of the system.



Harmonisation SOSs of Belgium

Currently, there is competition between the different regions in the realisation of new renewable energy capacity in their region. This competition makes it possible for energy companies to negotiate with the regional energy ministries on the amount of GCs they will receive for their electricity generation. Furthermore, a low degree of liquidity and presence of market power are consequence of regional SOSs, instead of one SOS on federal level. For these reasons the regional SOSs should be harmonized. In order to prepare harmonisation the penalty price of Flanders will in 2014 be changed to EUR 125,- in order to be similar to Wallonia en Brussels. Mortier states the following conditions need to be matched in order to make a harmonisation possible:

- Certificate allocation should be similar; so or based on CO avoidance or on renewable electricity generation
- Pricings mechanisms (minimum and penalty prices) should be similar

Governance

Energy producers can receive GCs for a limited amount of time within the Belgium SOS. These terms are the following:

- Renewable electricity: 10 years
- CHP: 4 years -> after 4 years the participation is regressively reduced
- Solar power: 20 years

Paul Romijn – Senior Business Portfolio manager

Monday 1 November 10.30- 12.00
Essent, Business Development, Concepts & Economics

Elements asset strategy

Romijn explains through which arrangements assets can be managed in the energy sector

Tolling deal/model

In a Tolling deal an energy company has an agreement with an investor in production assets. The energy company is responsible for the supply of input (coal/gas/biomass) and sales of output (electricity) under a certain price, while the investor is responsible for the investment, project development and operation of the assets. In this case the investor bares the financial risks of the investment and the energy company bares the risks of dynamics in input/output prices. Tolling deals are mostly handled via the Trade division of Essent in which BD mainly has an advising role.

Lock-in strategy

Romijn also elaborated on the lock-in strategy for assets. This strategy is the result of the optimizing of the allocation of the production park of Essent with respect to a division between short- and long-term contracts. As the electricity sector is dominated by long-term contracts with respect to both the input as output, 90% of the trade of RWE for 2011 is already locked-in. For 2012 the degree of lock-in lays around 50 %. For more details on the levels of lock-inn Romijn refers to RWE.com under the section 'investor relations'. Romijn adds that the lock-inn level for RWE will be similar to the lock-inn levels of Essent. Despite that a big part of the trade in raw materials and electricity is locked-inn by long term contracts; the actual dispatch of the assets of Essent is still very dynamic. In the end the optimizing of asset management is always short term as this is determined by the spot prices for raw materials, CO_2 and electricity. When the electricity price is relatively too low and/or the price of raw materials and CO_2 too high it still can be decided to switch of assets and purchase electricity from the market and sell the raw materials in order to comply with long-term contracts. For example, the usage of coal/biomass powered installation is firstly determined on the price of coal and CO_2. If it is decided to use the asset, then is determined which share of biomass is added to the conversion based on the price of biomass versus coal. This decision algorithm can change due to the existence of a Supplier Obligation System (SOS), as then also the price of Green Certificate will play are substantive role in this decision.

Investment in renewable electricity production assets

The final investment decisions with respect to new renewable electricity production assets are taken on the level of the Board of Essent. Currently no approvals are given for such final investments decisions if there is no guarantee on the obtainment of subsidy. The availability of subsidy is thus a critical requirement for investment in renewable production capacity. From this perspective can also be concluded that in general currently all the renewable production assets of Essent are subsidized

Term for participation within SOS

Currently, the subsidy terms are finite and determined by ECN. For a SOS also a term of participation of generators in the system has to be determined. Romijn explains that in general, if the participation term becomes longer, the Green Certificate price will become lower as the pay-back time will be longer. With respect to the design of the term of participation also the technical lifetime of assets is important. With respect to this, Romijn adds that:

- Windmills has an average technical lifetime of 10-15 years
- Solar panels are in principle technically written-off at the moment you purchase them as the currently technical developments in solar panels are so fast, that solar panels are technically outdated very fast.

Costs renewable electricity

With respect to the design of term of participation also the division of costs of the asset is very important. Romijn explains that the cost of renewable electricity production exists of three aspects, namely:

- CAPEX (Capital expenditures) -> investment costs
- OPEX (Operating expenditures) - > cost of raw material
- O&M (operations and maintenance) - > cost made in the operation of the assets

With respect to wind power, the OPEX is zero. However the O&M are relatively high if you allocate them to their load, which lies around 2200 hours per year. Especially for offshore wind power, the O&M costs are high as maintenance is less flexible in its availability. For solar power the same is true, the OPEX are zero and the O&M costs are relatively high as the load of solar panels lies at 900 hours/year. Therefore, for wind- & solar power the CAPEX & O&M dominate the choices in asset management. For large scale biomass conversion the CAPEX and OPEX dominate the choices in asset management, as the raw material determines the renewable character of the electricity. The differences in the relation of CAPEX and OPEX for biomass conversion versus wind- and solar power should be taken into account in designing a SOS, as biomass needs a constant stimulation for biomass conversion, while solar/wind power only need a temporary stimulation to earn back their investment.

Market incentives for investment in a Supplier Obligation System (SOS)

Within a SOS, Portfolio Management will determine which Green Certificate (GC) price is required in order to have a business case. From this perspective the minimum certificate price will be a very important parameter of the SOS for Portfolio Management when preparing investment decisions.

Electricity demand and supply in the Netherlands

In 2009 the electricity demand of the Netherlands was 120 TWh. Within this 25 TWh was demanded by households, 95 TWh was demanded for professional use.

New energy

The possibility of immature technologies becoming commercial technologies is discussed. With respect to tidal energy and blue energy (power from osmoses) Romijn expects that it will take another 20-30 years before these technologies become economically viable. For example, a new osmoses plant costs 300 million euros and no electricity producer will be willing to invest such an amount of money in an unproven technology. Romijn explains that the transition towards renewable electricity production is very slow and incremental, due to the capital intensive character of the energy sector and the uncertainty of it profitability. Despite that tidal energy might be a very promising technology it will take a long time for this technology to be on the same place in the learning curve as for instance wind power, as billions of euros were invested in wind power to realise their learning curve. As the realisation of a learning curve and thus the commercialisation of renewable technology are very expensive the transition towards a renewable electricity production can only take place incrementally and very slowly.

Marcel Eijgelaar – Innovation officer

Thursday November 4th 10:00-11:00
Essent, New Energy, Innovation

Micro generation

Currently there are three technologies used for micro generation by householders and businesses in the Netherlands, namely:

- CHP installations
- Solar panels
- Micro wind turbines

Eijgelaar explains that the efficiency of micro wind turbines is very low, compared to normal wind turbines. Therefore it better to invest in solar panels than in wind turbines on a micro scale.

Solar panels

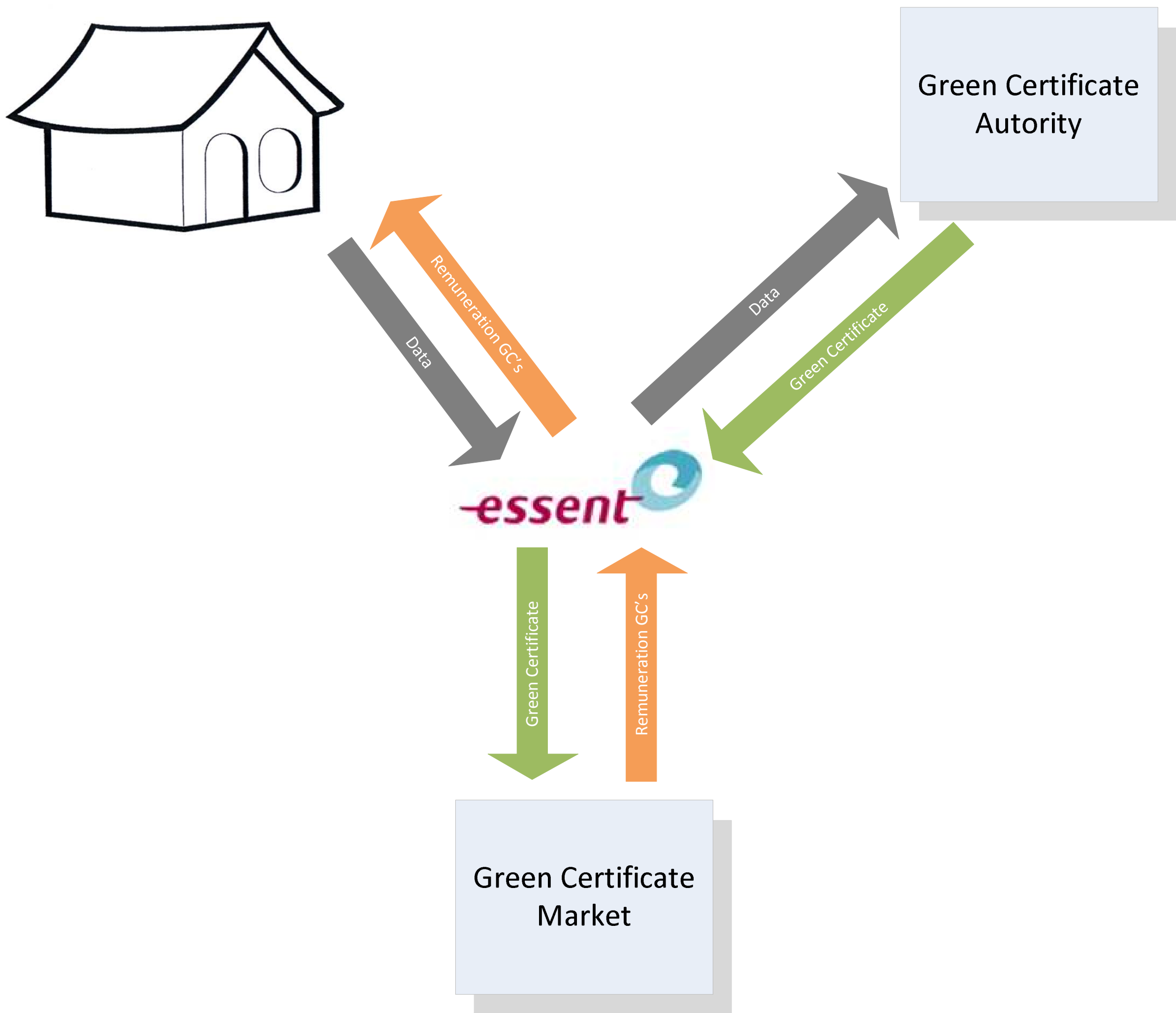
From research done by Essent appears that Essent should invest in solar-energy on a down-stream level. In order to realise this ELES and Essent Belgium offer solar panels to customers in a partnership with solar panels suppliers. New Energy determined the strategy for this service. In the Netherlands there are on average 850 full-load hours of sun per year. Furthermore an average micro solar installation for households has 1 kWh peak power. This means that per year an average household with a micro generation from solar panels produces 850 kWh of electricity. Currently there are two financial advantages for households who own solar panels and are net-electricity consumers. Firstly, they fall under a feed-in scheme in which they can feed-in electricity to the grid for the same price at which they purchase electricity. This means that they do not have to charge transport costs and taxes for this supply. Secondly, prosumers receive SDE subsidy for their gross electricity production, thus both for their own consumption as their supply. In order to be able to receive SDE every household need to have a production meter that measures their total electricity production. These production meters can only be placed on household-level and not on district level, as data on the gross electricity production is needed for the calculation of the total subsidy amount.

Supplier Obligation System

It would be possible to make micro generations an eligible source for a Supplier Obligation System (SOS), under the same arrangement as the SDE. In this system it would be most efficient if Essent would bundle the data of their prosumers. This is shown in the picture below. This process would not lead to a lot of additional requirements, as Essent current already administers the production and consumption rates of prosumers and currently production meters are already needed to administer this.

Essent

Currently Essent sells micro installations to customers in order to attract new customers and make a margin on the sales of micro installations. In the future it will also be possible to earn a share of return on the trade of the Green Certificates of the prosumers. The size of this share will be determined by the degree of competition in this prosumer market.



New Energy

Eijgelaar discusses the potential of new renewable technologies like blue, tidal and wave energy. With respect to these technologies Eijgelaar argues that the geographical potential of these technologies is very low in the Netherlands as there are only a specific number of locations suitable for these technologies. Furthermore, the implementation these technologies will have big impact on the ecology of the site and possibilities for shipping. Lastly the tides and waves in the Netherlands are not very powerful. He therefore expects that power from solar energy, wind energy and biomass conversion will dominate the future transition towards renewable energy. He does add that the availability of storage capacity and flexibility in demand due to the implementation of intelligent networks and electrical transport will further determine the potential of solar and wind energy.

Ineke van Ingen – Vereniging Energie Nederland

Wednesday 10 november, 14.00-16.00
Vereniging Energie Nederland, Den Haag

Vereniging Energie Nederland

The Vereniging Energie Nederland (E-NL) is the association of the energy sector and was established this year by the merger of VME Nederland and Energiened. Members of E-NL are energy companies. E-NL has the vision that a hybrid Supplier Obligation System (SOS) is the most adequate support mechanism for the transition towards a sustainable energy supply and carries out this message on behalf of all their members. E-NL has contact with all relevant stakeholders on this matter. The E-NL was successful in introducing the SOS in the discussion on alternative support measures for renewable energy, as currently more stakeholders are aware and familiar with this possibility. E-NL has identified that stakeholders have different concerns regarding the implementation of a SOS in the Netherland and therefore has initiated an external research on the design of a SOS for the Netherlands that should provide answers to these concerns. This research will start half November and will present its results in April or May 2011.

Hybrid SOS

E-NL acknowledges that excessive profits due to technology differences will be socially and politically unacceptable and that therefore some kind of technology differentiation is needed in the design of a SOS. As the SDE is already implemented in the Netherland and functions properly a hybrid SOS that would combine a standard SOS with the SDE would be the most logical possibility to realise this technology differentiation from the point of view of E-NL.

Members Energie Nederland

The energy sector exists of different type of companies. Firstly, there are integrated energy companies, who both produce as supply energy. These companies will both have interests in the SOS from their role as producers as their role as supplier. The ratio of production and retail activities is not for every integrated company the same, so also the specific interest in a SOS of integrated energy companies can differ from each other. Furthermore some energy companies are retail-only or production-only, which means that the respectively are purely energy supply companies or energy production companies

Interests members Energie Nederland regarding the SOS

With respect to the type of energy companies described above the following interests regarding the SOS can be identified. Integrated energy companies are separated here as producers and suppliers.

Producers

In general producers will require from the SOS an environment in which can be invested in renewable energy with an origin that fits their preference depending on their position in the market. For some producers this preference will lay at biomass conversion, for others at wind power. So, all the technologies should have a position in the SOS from the start of the system. Producers who specifically want to invest in offshore wind power will require additional support from the SOS in order to be competitive with other more mature technologies. The investment climate created by a SOS should provide long term and stable security in receiving support for renewable energy production, so that they can invest in both a learning curve in renewable electricity production as in specific renewable generation assets.

Suppliers

In general suppliers will require being able to comply with the quota set by the SOS without too many risks due to price volatility on the certificate market. Some suppliers will find it important to be able to market different green products in a SOS.

Retail-only

Retail-only companies will require that the design of a SOS will eliminate strategic behaviour of integrated energy companies and energy producers. This strategic behaviour can be the following. Firstly, integrated energy companies have the possibility to internally sell a part of their certificates. This gives the suppliers at integrated energy companies the possibility to purchase certificates for a predictable price and amount. The part of certificates that will be traded on the market could be available at a higher price, as the internal sales will increase the scarcity of certificates on the market.

Secondly, producers can strategically time the offering of certificates to the market in order to force up the price. The competition position of retail-only companies in comparison to integrated companies and producers can be undermined by these kinds of strategic behaviour. Therefore the retail-only company will strongly advocate for a design of a SOS which eliminates these kind of strategic behaviour.

All energy companies

Furthermore all energy companies realise that excessive profits due to large differences in production costs of different technologies will lead to a social unacceptable situation and therefore will undermine the system stability of a SOS. The prevention of excessive profits will thus also be a requirement for the design of the SOS from the perspective of all the energy companies. E-NL has to present a proposal for a SOS that represents all their members, as a proposal which is not supported by the entire sector is less credible. Therefore the requirements presented above should be all covered in the design of the SOS in order for E-NL to be able to present a credible and acceptable proposal. Summarizing, the members of E-NL pose the following requirements on the design of a SOS:

- Stable investment climate for producers
- Complying with the quota obligation without too many risks due to price volatility on the certificate market for suppliers
- Elimination of possibilities of strategic behaviour of integrated energy companies:
    - Internally providing certificates for a low price, while externally providing certificates for a higher price
- Elimination of possibilities of strategic behaviour of producers:
    - Strategically time the offering of certificates on the market in order to force up the price
- Reduce excessive surpluses for producers
- Possibilities for investment in all production technologies from the start of the system
- Possibilities for the marketing of different green products

Relation government and energy sector

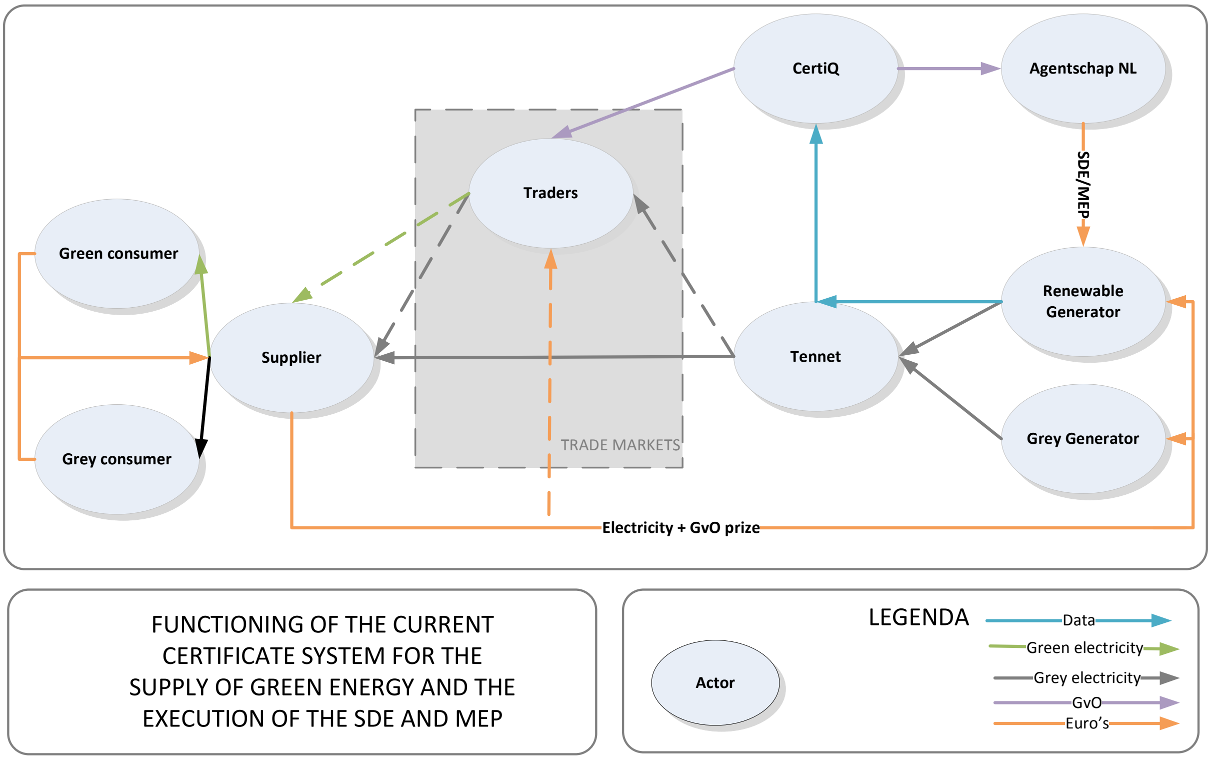
Due to different issues (handling MEP, SDE and unbundling) the last decade the relation between the energy sector and the government is more characterised by distrust. Therefore the government had tried to recover its control on the energy sector. For this reason the energy sector wants to propose a measure to support the transition of renewable energy themselves before the government lays down measure on which they cannot influence from their perspective. E-NL advocates that with respect to the role division in realising a sustainable energy supply the government should set the targets and the sector should execute the realisation of these targets. Furthermore, due to tendency of distrust the energy sector should be very clear and transparent on pros and cons of the SOS.

Micheal Lenzen – Policy Advisor CertiQ

Tuesday 23 November 2010. 11:00 – 12.30
TenneT, Utrechtseweg 310, Arnhem

Current use of Guarantees of origins (GoO)

Van den Hurk asked whether the figure below correctly represents the streams of GoOs. Lenzen confirmed that this figure is correct.



FUNCTIONING OF THE CURRENT CERTIFICATE SYSTEM FOR THE SUPPLY OF GREEN ENERGY AND THE EXECUTION OF THE SDE AND MEP

Lenzen explains that currently investment decisions regarding renewable electricity production assets in the Netherlands are taken based on available subsidy from MEP and SDE and not based on the value of GoOs, as currently GoOs do not represent the actual worth of the renewable electricity. With respect to this the currently low additionally of GoOs in the realisation of new renewable electricity production is discussed. At the moment GoOs are thus purely use to prove the supply of green electricity with. The price of GoO is differentiated for different renewable energy technologies due to a difference in scarcity of the different technologies and difference in the specific demand for a technology for professional and retail consumers.

Legal context GoOs

Directions for the issuing and use of GoOs are laid down in two European Directives, namely Directive 2001/77/EC Article 5 and Directive 2009/28/EC Article 15. In the first Directive the GoOs were founded, in the second Directive further details on the issuing and use of were laid down. Formally every Member State has to implement the last Directive in National legislation before December 5th of this year. One new element in the last Directive that can have impact on the future GoO price is that GoO will lose their validity 12 months after the renewable energy production. This element will make the scarcity of GoO on the market bigger and will therefore drive up the price of GoOs to a certain extent.

Use of GoOs in Supplier Obligation System (SOS)

If the GoOs can also be used in a SOS to prove compliance to quota with, depends on the framework that is set by the Directives mentioned above. Van den Hurk asks whether paragraph 9 of Article 15 of Directive 2009/28/EC could be conflicting with the use of GoO for compliance with the quota set by the SOS. Paragraph 9 states that Member States shall recognise GoOs of other Member States. When the GoOs would be used for the compliance with the quota, a Dutch GoO market would have to be established, next to the European GoO market, as the GoO price to prove compliance with should provide enough incentives for generators to invest in renewable production assets and the price of the European GoO is currently not high enough to achieve this. In order to establish a Dutch GoO market, foreign GoOs should be refused to this market, as they could undermine the required level of scarcity on the market. However this could thus probably be conflicting with paragraph 9 of

Article 15. Lenzen explains that he further has to explore this element of the Directive in order to be certain on which degree that the use of GoOs for the Dutch SOS violates the Directive from this perspective. He confirms that it might be juridical challenging.

Lenzen explains that another multi-interpretable element of the Directive is paragraph 1 and 2, of Article 15. Paragraph 1 explicitly connects the GoO to the labelling of renewable energy for the purpose of proving the renewable sources in the energy mix of the end-consumer. Paragraph 2 states that GoOs cannot have a function with respect to the proof of compliance with the targets regarding renewable energy supply for every Member State laid down by this Directive. As the GoO in a SOS would contribute to the compliance with the target regarding the level of sustainability of the electricity sector, this could also violate the Directive with respect to these paragraphs. Another unambiguous element of the new Directive that could restrain the use of GoOs in a SOS is paragraph 3 of Article 15. This paragraph states that the validity of a GoO ends one year after the production of the renewable electricity. This element decreases the possibility of the future SOS to bank certificates in order to create more flexibility for producers and suppliers in thus system and thus liquidity. Lastly, issued GoOs are currently tradable based on the net renewable electricity generation, while certificates that will be used to comply with the quota will be based on the gross renewable electricity production. This detail could also make it difficult to use GoO for the compliance of the quota set by the SOS with.

Consumers

To the above Lenzen adds that currently end-consumers find it difficult to understand the international trade in GoO in relation to their green electricity consumption. Adding a new certificate for the functioning of a SOS might add extra complexity to their understanding. From the perspective of the consumer therefore two parallel certificate systems might be confusing and less transparent.

Micro generation in a SOS

The concept of prosuming is discussed. It could be possible to let micro-producers participate in the SOS. Currently micro-producers that want to receive SDE subsidy have to apply for this at CertiQ. CertiQ automatically informs the DSO to which this micro-producer is connected on his appeal. The DSO controls whether the micro producers possesses a renewable production unit and the proper measurement equipment. When these requirements are fulfilled by the micro-producer the DSO approves the appeal and CertiQ switches on the GoO certification of this micro-producer. In general when producers apply for GoO certification at CertiQ they have to state a trade-account, as producers cannot have their own account. Producers will contractually lay down the return they receive from the traders for their certificates. This is also the situation for micro-consumers. So currently energy traders already handle the appeal for SDE for micro-consumers. This could function in the same way under a SOS. Essent could have the following role in this. Essent could apply the prosumer to CertiQ, install the production unit and measurement appliance for a remuneration. Furthermore should be laid down that the certificates issued based on the micro-generation of the prosumer is connected to the trade-account of Essent. Essent can then trade these certificates for the prosumer for remuneration.

Administrative responsibilities and roles in SOS

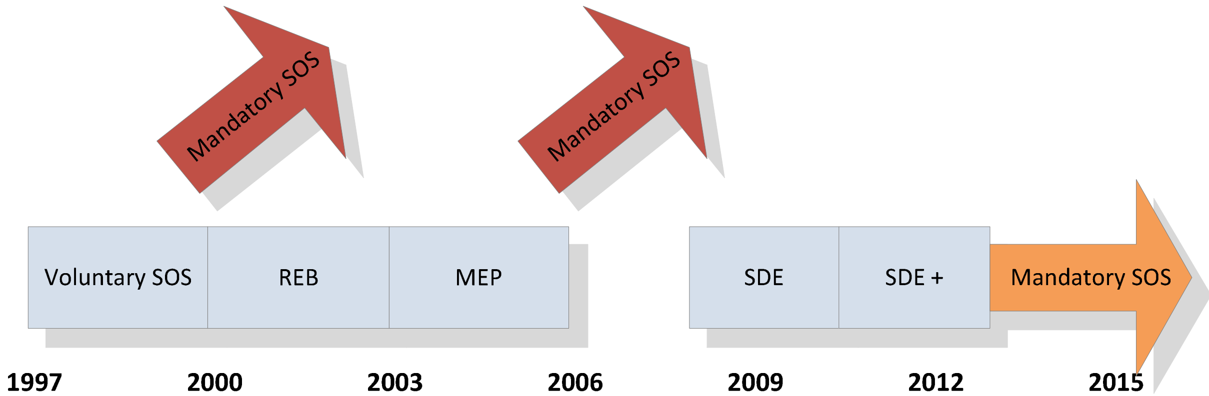
Lenzen explains that it would be logical that CertiQ would also issue the certificate for compliance with the quota set by the SOS, as CertiQ already possesses all the necessary infrastructures and procedures to issue certificates for renewable energy production. It would be a waste of money and effort to create a parallel organization for the issuing of certificates. Currently, CertiQ provides data on GoOs to the Energie Kamer, so that the Energie Kamer can control if energy companies properly matched the purchasing of GoOs to the supplying of green electricity to consumers. However the responsibility for the monitoring of the compliance with the quota could be partly placed as CertiQ. As TenneT both possesses data on the total supply of electricity as the renewable electricity production, CertiQ could easily structure these data and control to which degree suppliers have complied with their quota. This data could then be send to the Energie Kamer. The Energie Kamer would still have the end responsibility and decide based on the data of CertiQ which suppliers need to pay penalty and to what degree. Also in case of a hybrid SOS it would be logical to let CertiQ be responsible for the execution of certification as they currently already perform an informing role to Agentschap NL with respect to the allocation of subsidy.

Helma Kip – Policy advisor Essent Local Energy Solutions (ELES)

24 November 14:00 – 15:15
Essent, Den Bosch Willemsplein E.346

Climate policy for the electricity sector of the last decade

The timeline shown below was discussed.



This timeline starts with the Action plan for renewable energy for 1990-2000. In this plan objectives and measures regarding energy efficiency, energy reduction and renewable energy were laid down. With respect to renewable energy production it was difficult to lay down clear measures as not every energy company, then divided in different regions, had the same possibilities for renewable electricity production.

At that time the energy sector did not specifically desire the implementation of a Supplier Obligation System (SOS), as the targets for the share of renewable energy in the total energy supply were not as extensive as they are now. The sector did however desire the tradability of renewable electricity, for three reasons. The first reason was that they could then sell reliable and credible green products. The second reason was to create a solution for the difference in the potential for renewable energy production of different regions in the Netherland. The third reason was to introduce cost-effectiveness in the generation of renewable electricity. When the generation of renewable electricity was less expensive in a certain region, certificates could be sold from this region to a region in which the production would be more expensive. Because of these reasons the energy sector (trade association Energiened) created a system for renewable electricity certificates themselves, in order to realise the tradability of renewable electricity. The tradability of green certificates made it possible for Essent to start with the sale of green electricity in 1999, as the first energy company in the Dutch electricity market.

To the renewable electricity certificate trade certain targets for every energy supplier were laid down regarding the percentage of renewable electricity supply on the total electricity supply. In order to able to realise these targets a fee could be charged to the end-consumer. This fee is called the MAP-fee. This MAP-fee existed next to a contribution for renewable electricity generation also of a contribution for energy efficiency and reduction measures.

The energy sector proposed in 1997 that the certificate system would be further adopted and executed by the Dutch government. 'Energiened' sold the certification method to the government. Finally, the government succeeded with the labelling of renewable electricity in 2002/2003.
In 2000 the REB was introduced. REB was a tax on electricity supply charged at the end-consumer. The REB stimulated renewable electricity production in two ways. First renewable electricity supply was exempted from the tax. Secondly, the income from the tax on grey electricity was used to subsidize renewable electricity production.

The REB was not a stable system in itself as the degree of tax exemption became higher and the subsidy on renewable electricity generation became lower during period the REB was used. When in 2003 the renewable certificate market was harmonized on a European level the REB was not an appropriate measure to support renewable electricity anymore, as it led to tax exemptions for foreign electricity supply. Therefore, the part of the REB in which renewable electricity supply is exempted from tax, was annulled. A subsidy for renewable electricity production remained. This subsidy system was introduced under the name MEP in 2003.

The MEP became rapidly very popular, which made the system were expensive. Van den Hurk wonders why the government was not prepared for this as the costs for renewable electricity generation and the targets regarding sustainability were known on beforehand. Kip answers that the energy sector and NGO's warned the government on the insufficiency of the proposed budget for this system. However, the political instability was very high at that time, as a result of which no proper estimations of the pressure of the MEP on the government budget were made. Also the government did not expect the energy sector to act so fast.

Furthermore, the expectations on the contribution of the end-consumer regarding the MEP were wrongly assumed by the government. In first instance the end-consumer paid EUR 35,- per year as a contribution to the MEP. Then it was proposed to let the end-consumer pay EUR 100,- per year. However the Ministry of Finance did not approve of this because this amount would be too in relation to the financial resources of certain households. Due to this refusal, the budgetary issues of the MEP became worse and the MEP was suddenly stopped at 2005 for large scale biomass conversion. Since then no new systems were introduced to support large scale biomass conversion, which means that the last biomass support will end in 2015 if not new support mechanisms are implemented by then. The MEP ended for other technologies in 2006.

The energy sector also advised the government to make the subsidy tariffs flexible for changes in electricity prices and raw material prices at the start of the system. However, the Ministry of Finance did not approve of this at it would make their projections of the costs of the MEP too complex. The inflexible subsidy tariffs lead to surpluses for certain producers which also contributed to the unpopularity of the MEP. Another aspect that lead to the unpopularity of the MEP, regarding biomass conversion, was the fact the subsidy in theory did not necessary lead to renewable electricity production, as the economic dispatch of biomass conversion, despite the available subsidy of facilities might not always result in biomass co-firing. This led to unpredictability for the government in the realisation of their sustainability objectives. Due to its unpopularity, the MEP was followed up by the SDE. Although this was almost the same system as the MEP, except for flexibility in correction of the subsidy tariffs, the system was framed differently due to the negative image of the MEP.

Changing objectives

Next to that the measures to stimulate renewable electricity generation are different also the objectives of these measures rapidly change. The MEP started with the objective to realise a large scale transition towards a renewable energy supply. The SDE start with the objective to realise innovation of different technologies for renewable electricity generation. The SDE Plus (2011) will again have the objective to realise a large scale transition.

Conclusions

From the discussion above can be concluded that three types of instability can be identified in the Dutch climate policy for the electricity sector. First, there is instability in the type of measures. Secondly, there is instability within the measure, as REB and MEP were often changed during its existence. Lastly, there is instability in the long-term objectives that are connected to the support schemes. Furthermore, the measures above all were replaced due to a public connotation with a negative image. Kip explains that once a market system is associated with perverse incentives or certain other system failures it is very hard to remove this from the collective memory. So the system should from the start function properly, otherwise it would be very difficult to restore the trust in the system and the system might be replace due to its contamination with a negative image.

Consequence of instability of SOS for costs financing

With respect financing the investment of future assets under the SOS, financers would require expensive insurances for regulatory uncertainty if the SOS would be frequently changed.

Relation government

The relation of the government and the energy sector is discussed. Kip explains that the government currently does not see the energy sector as a fully commercial sector. The government expects that the energy sector themselves will also contribute to the transition towards a sustainable energy supply and sees the current and former support schemes as a contribution from their side. The government argues that if the energy sector can on average be profitable they should also themselves invest in renewable electricity, without necessarily being depended on support mechanisms. So it seems that the Dutch government does no see energy companies are listed international competing organizations, which have profitability and continuity as there general objectives. This misunderstanding creates a lot of distrust between the government and the sector. The government feels that energy companies only takes advantages of support schemes without themselves contributing to sustainability when this is not fully profitable. In this respect the government disregards the technical and economical investments that have been taken by energy companies. Such as were taken by Essent in the case of co-firing biomass in conventional coal plants and wood gasification.

ANNEX II: LITERATURE REVIEW

This part of the Annex will provide an overview of the literature that was studied for this research. The literature had to provide insight in the basic principles and key elements of a SOS. Furthermore, it had to provide understanding of the key-issues, possibilities and trade-offs for the design of a SOS. Relevant literature is therefore literature that discusses the design of a SOS. Furthermore, literature that describes and surveys the experiences of existing SOSs in other countries created more understanding of the possible elements and issues of a SOS. Lastly, literature that discusses the general advantages and disadvantages provided more insight in the different aspects of a SOS and how they can affect the performance of a SOS. Now per branch of literature shortly will be described which and how authors made a contribution to this.

The following literature considered the design of SOS. Espey (2001), Berry and Jaccard (2001) and Radar and Hempling (2004) in detail discussed the general key considerations and issues in the design of SOS. In addition, Bennink, Blom et al. (2010) and Tilburg, Jansen et al. (2006) considered the design of a SOS specifically for the situation in the Netherlands. Lastly, different authors approached the design of a SOS from one specific angle. Agnolucci (2007) discussed the design of a SOS by zooming in on the effect of long term contracts, based on an analysis of the possible market and price mechanisms in a SOS. Del Rio (2007) considered the design of a SOS by zooming in on the effects of market power in certificate market.

Furthermore, numerous authors have described and evaluated the experiences of existing SOSs in other European Member States, the United States or Australia. In Europe a SOS is implemented in the UK, Sweden, Belgium and Poland. Sometimes these evaluations were compared with evaluations of other SOSs or other type of support schemes applied in other countries. The SOS in the UK was considered by Lipp (2007), Klessmann (2008) and Bennink, Blom et al. 2010). The SOS in Sweden was at length discussed by Bergek and Jacobsson (2010), with special attention to the different type of economic rents generated by the SOS. Mac Gill, Outhred et al. (2006) identified design lessons from the experiences with a SOS in Australia. Lastly, Langniss and Wiser (2003) assessed the SOS of Texas, which is one of the most successful SOSs in the United States. Literature that compared the design and experiences from different SOSs are Berry and Jaccard (2001), who elaborated on SOSs of the US and Australia. Furthermore, Espey (2001) described and surveyed the different SOS systems in the US. Moreover he describes the design of the voluntarily SOS in the Netherlands as the first country in Europe to have adapted a SOS. Lauber (2004) described the experience with SOSs in the UK and US in order to define whether a SOS could be an option for a harmonized Community framework. VME (2009) compared the different SOSs applied in the European Union. Linden and Uyterlinde et al. (2005) compared the experiences of SOS in the UK, Sweden and the US.

Lastly, certain authors described the general weaknesses and strengths or pros and cons of a SOS. Bennink, Blom et al. (2010) assessed the possible advantages and disadvantages of a SOS in the Netherlands. Also in this type of literature on SOSs often comparisons were made with the weaknesses and strengths of other support schemes. Lauber (2004) and Lipp (2007) contributed to this comparison. Furthermore, Klessmann (2008) analyzed the advantages and disadvantages of different support schemes among which a SOS by zooming in on the degree of market risks of the different systems and the effect of this on the effectiveness and economic efficiency of these systems. The literature that was described and analysed in the literature review is mainly characterized by a descriptive, qualitative and pragmatic approach. Furthermore, they mainly apply a economic or policy perspective on the design of a SOS. From this perspective both the design-oriented approach and the incorporation of an institutional perspective of this research can contribute to the current available literature on SOS. Table 4.1 below shows an extensive and detailed overview of the literature that is discussed here.

Author (year)	Main topics	Interesting research perspective or results
Agnolucci (2007)	The design of a SOS, regarding long term contracts, based on an analysis of possible market processes	Financial constraints and technological progress can induce investors in a SOS to hold pessimistic expectations of their ability to sell green certificates and still make profit. The answer to this problem is oblige suppliers to offer long-term contracts to renewable generators by the design of the SOS
Bennink , Blom et al.(2010)	Pros and cons of a SOS in the Netherlands: • Comparison with other support schemes • Evaluation of SOS UK	
Bergek and Jacobsson (2010)	Evaluation SOS Sweden	• Extensive discussion on different type of economic rents in a SOS
Bernow (1997)	SOS US, with the focus of quantifying the impacts of a SOS using the National Energy Modelling System (NEMS)	• SOS would accelerate the sustained, orderly development of the renewables industry by increasing the market penetration of near commercial technologies, thereby allowing them to benefit from manufacturing economies of scale and technological innovation. • Introduction of technology band, specifying a percentage target of generation from each qualifying renewable technology
Berry and Jaccard (2001)	Design of SOSs	• flexibility mechanisms are widely accepted as desirable
Del Rio (2007)	Impact of market power on the functioning of SOSs, regarding cost-efficiency and cost distribution	• Market power in a SOS is more likely to occur when there is/are: o Not enough market parties o A small size of the market o Scarcity of renewable energy sources o Price fluctuations: increase the difficulties for smaller actors; therefore, unstable price might reduce diversity and market size. • Measures that may reduce market power on the supply side of the SOC market: o Oblige supplier to enter into long-term contracts o Make the demand obligation less rigid; allow banking and borrowing o Compulsory SOC sales
Espey (2001)	• Design of SOS • Description of general weaknesses and strengths of SOS • Comparison with other support schemes	Described the design of the voluntary SOS in the Netherlands (1997) as the first SOS in Europe
Klessmann (2008)	• Comparison different support schemes in Europe specifically on the degree of market risks for generators	• Klessmann approaches the comparison of support scheme based on the effect of the degree of market risks that exist in a type of regulation. She describes an interesting

	under a specific scheme • Evaluation SOS UK	trade-off between the effect low and high risks on the performance of a support scheme • Klessmann describes that the difference of market risks have a different effects on intermittent and non-intermittent sources, as intermittent sources are not always able to respond to market dynamics
Langniss and Wiser(2003)	• Assessment of SOS in Texas	• Success factors: the devil is in the details • Fundamental design principle which must be followed if an RPS is to function at low cost and with maximum impact: o Strong political support and regulatory commitment o Predictable long-term purchase obligation that drive new development and economies of scale o Credible and automatic enforcement o Flexibility mechanisms o REC market; improves tracking and liquidity, provide additional flexibility to suppliers and low overall cost of compliance o Favourable transmission rules and sitting processes o All principles support low-cost long-term contracting
Lauber (2004)	Possibilities of the harmonization of European electricity policy: • Comparison FiT & RPS • Evaluation SOS UK and US	Lauber argues that the coexistence of state-of-the-art models of both FiT as a RPS schemes is most likely to lead to a rapid transition to renewable energy
Mac Gill, Outhred et al. (2004)	Description of the objectives, design and outcomes of the Mandatory Renewable Energy Target in Australia.	• Mac Gill offers an interesting solution to include existing capacity in the SOS without making extra profits, by introducing a 'baseline' for existing generators. Existing generators can only earn certificates for generation that lies beyond the baseline. • Mac Gill states that despite of projections that suggested that biomass would make the greatest contribution to the 'technology neutral' scheme, in practice and number of proposed biomass project have encountered difficulties. Due to this the market has redirected its attention somewhat to other technologies, in particular wind project.
Rader & Hempling (2001)	Extensive overview of design choices and steps in a SOS	
Tilburg, Jansen et al. (2006)	Exploratory study for the possibility of a SOS in the Netherlands: • Comparison with other systems • parameters SOS • Evaluation of European	

	and US system • Possibility of harmonization of the system • Risks	
VME (2010)	• Evaluation of SOCs in Europe (Sweden, Belgium, UK and Poland) • Design of SOS	• provides a clear structure to categorize the different elements of SOS

ANNEX III: FORMER AND CURRENT SUPPORT SCHEMES FOR RENEWABLE ELECTRICITY

Voluntary Supplier Obligation System

At the end of the 90's Dutch distribution companies voluntary committed themselves to a SOS. The Netherlands were a pioneer in implementing this measure to support renewable electricity production. The voluntary commitment to the SOS was laid down in a covenant. Every distribution company was appointed with target of 3.2 % renewable energy in its total supply. In order to be able to contribute to the set targets the distribution companies were allowed to add a charge to the energy bill set between 1,25-2,5 % of total electricity price (Ministerie EZ 1997; Espey 2001) (Annex I, interview Arthers)

The following design choices were made in this system. The penalty for non-compliance was set on 150 % of the average market price for a MWh of renewable electricity. Furthermore, the obligation system was complemented with other support mechanism for technologies that were not yet commercially viable within the voluntary SOS. The voluntary SOS did however not directly lead to much trade or more investment in renewable energy. The main reason for this was that the system lacked certainty, as there was no security on the future development of the system after 2000 (Espey 2001). In first instance the intention was to restart the system on a mandatory basis in 2001 (Ministerie EZ 1997). However this was never proceeded, as the voluntarily SOS was succeeded by an energy tax in 2000.

The first green certificates in the Netherlands origin from the voluntary SOS and were called 'Green Labels'. The "Green Labels' were green electricity certificates that were needed to prove the supply of renewable electricity (Ministerie EZ 1997). Renewable generators meet customers in a power market and a market for 'Green Labels. The 'Green Labels' only represented the 'sustainability aspect' of the produced energy and not the energy itself. From a financial perspective the 'sustainability aspect' thus represents the uneconomic top of renewable electricity production. This valuation of the labels made it possible for energy companies, which were in that time limited to a specific region, to sell and buy renewable energy over the border of their own catchment area. This was necessary in order to make it possible for every energy company to financially contribute to the covenant, despite of their specific geographic region and the possibilities to produce renewable energy that this region provides (Annex I, interview Arthers). With 'Green Labels' distribution companies could either generate renewable power themselves, purchase power bundled with certificate elsewhere or purchase only certification to meet their obligation (Espey 2001). There was no differentiation regarding the number of certificates issued for different technologies. The green labels were in this system issued by KEMA-ECC (Espey 2001).

REB

After the voluntary SOS, renewable energy production was fiscally supported. This was done by posing an energy tax on electricity and gas, called the 'Regulating Energy Tax' (In Dutch known as Regulerende Energy Belasting or REB). An exemption for this tax existed for renewable produced energy. Furthermore, the funds receive from the taxes on grey electricity were used to subsidize the production of green electricity. During the existence of the REB the tax increased and the subsidy levels decreased. When the renewable electricity market was harmonized to a European level in 2003 the REB led to tax exemptions for foreign green renewable generators. Therefore the REB was stopped in 2003 (Annex I, interview Kip; interview Arthers).

MEP

The REB exemption was replaced by a feed-in-premium that compensates for the uneconomic top of renewable energy production in 2003. This support mechanism for renewable energy is called 'Environmental quality of the Electricity Production' (in Dutch known as or Milieukwaliteit van de Electriciteitsproductie or MEP). The MEP had the main objective to stimulate a large scale transition towards a renewable energy supply, with the stimulation of innovation as a secondary objective (Annex I; interview Kip). The MEP is executed with a fixed subsidy tariff for different categories of renewable energy technology. Once the subsidy tariffs were set they could not be corrected for fluctuations in electricity or CO_2 prices during the subsidy term. Only once, three years after the start of the subsidy term, the subsidy tariffs could be adapted to the present circumstances. The subsidy term for every technology category was fixed for 10 years within the MEP. Furthermore, the end-consumers paid a fixed fee for the MEP. This was set at EUR 35,- per year (Annex I, interview Kip).

For several reasons the MEP got a negative image. Firstly, the MEP became rapidly very popular, which created pressure on the government's budget. This pressure was increased as a proposal to increase the fee for the end-consumer was not approved of the by the Ministry of Finance. Furthermore, the fixed subsidy tariffs lead to surpluses for renewable generators. Lastly, the MEP did not necessary lead to renewable electricity generation in the case of large-scale biomass conversion (Annex I; interview Kip). For these reasons the MEP was stopped in 2005 for large scale biomass conversion and in 2006 also for other technologies. A SOS was proposed to succeed the MEP. This option was investigated by the Ministry of Economic Affairs as a number of politicians suggested the time was right to change the feed-in system to an obligation system. Finally, this proposal was not preceded and the MEP was succeeded by the SDE, described below.

SDE

The SDE succeeded the MEP in 2008, which means that for a period of two years there was no support scheme for renewable energy production present in the Netherlands. The effects of these two years are shown by a dip in investments in renewable energy capacity (CBS 2010). The SDE is comparable with MEP in execution, but was framed as a new measure, due to the unpopularity of the MEP, described above. Changes in comparison with the MEP are that its main objective shifted from a 'large scale transition' to 'innovation' (Annex I; interview Kip). Secondly, in the SDE subsidy tariffs can be yearly corrected for the electricity-, CO_2-, renewable certificate prices and other elements that can influence the income of renewable energy production based on Article 14 of the resolution on the SDE (Ministerie EZ 2007). Thirdly, the subsidy term in the SDE is differentiated per type of technology (Annex I, interview Wijnen). Fourthly, the SDE did not charge a contribution on the bill of the end-consumer (Annex I, interview Kip). Lastly, large scale biomass conversion is not an eligible category for the SDE.

At the start of the subsidy term a base amount for the subsidy is set per category of renewable energy source. This base amount is yearly corrected with the correction tariff described above. In order of the Ministry of Affairs, research institute ECN advices the Ministry on the different eligible categories and the base amounts and yearly correction amounts per category. Currently, the CO_2 and GoO price are not taken into account when determining the correction amount, as their value is relatively too small (Annex I, interview Wijnen). With respect to the number of available subsidy terms per generator Article 3 of the resolution on SDE states that every investment in renewable energy production can receive only one term of subsidy. Article 3 also describes some exemption to this rule. One exemption is that if the exploitation costs of a renewable energy production are relatively large in comparison to the investment costs. In this case multiple subsidy terms are possible, when laid down in a ministerial arrangement (Ministerie EZ 2007).

SDE plus

In November 2011 the Minister of Economic Affairs presented a proposal on the implementation of a new support scheme called the 'SDE Plus'. The main objective of the SDE Plus is to cost-effectively realise the targets the European target of 14 percent renewable energy in 2020 (Ministerie EL&I 2010). The most important changes of the 'SDE Plus' in comparison with the SDE are the introduction of one subsidy budget for all technologies, a maximum base subsidy tariff of 15ct/kWh and a phased opening for the subsidy (Ministerie EL&I 2010). The single subsidy budget and its phased opening functions as follows. Subsidies will be granted in 4 phases. In the 1st phase, projects that require a maximum of 9ct/Kwh are eligible. In the 2nd phase, projects that require 11ct/kWh, followed by the 3rd (13ct/kWh) and 4th (15ct/kWh) phases. Within the phases subsidies will be granted to the most competitive projects on a tender basis (Ministerie EL&I 2010). It is to be expected that the total amount of available subsidies will be consumed in the first and second phase. Subsequently, there will be no subsidy left for the more expensive projects in the 3rd and 4th phase. The total amount of subsidies is limited at 1.4 billion euros per year. Furthermore, the SDE Plus will be financed by an additional 'sustainability tax' on the energy bill for both retail and professional consumers and possibly party by a new coal- and gas tax (Ministerie EL&I 2010) Eligible technologies for the SDE Plus are onshore wind power, bio gas, hydro power, waste-conversion, and stand-alone biomass conversion. This means that large scale co-firing of biomass, co-generation, offshore wind power and solar power are not subsidized under the SDE plus. In order to offer energy companies sufficient time for preparation to the new SDE scheme, the scheme will open July 1st 2011 (Ministerie EL&I 2010). This means that between the SDE and the SDE plus there will a gap of a half year.

Summary dynamics in the support schemes

The first support scheme, implemented in 1997, was a voluntary SOS introduced by the energy sector self. This system was replaced by a fiscal system in 2000, which is called the 'Energy Regulating Tax' (in Dutch knows as the Regulerende Energie Belasting or REB). The REB was after several changes in the design of the system replaced by a Feed-in-Premium due to changes in related European legislation. This Feed-in-Premium introduced in 2006 is called 'MEP' (in Dutch known as Milieu Kwaliteit van de Elektriciteitsproductie). The MEP was cancelled in 2006 because it unexpectedly created a high pressure on the government budget and lead to economic rents for certain producers. Furthermore, the objective related to the support scheme changed from a 'large scale transition' to 'innovation'. The MEP was replaced by the SDE after an interim period of two years. This year the SDE was stopped due to a combination of high system costs, under-investment and the current credit crisis. On a short-term the SDE will be replaced by the 'SDE Plus'. This system is comparable to the SDE scheme, besides that it has a more narrow and market-based scope in determining the eligible renewable production units for receiving subsidy. Lastly, it is thus considered to replace the SDE Plus with a SOS around 2015.