The use of the joint support scheme flexible mechanism and its economic impacts in the Netherlands

Thomas Maidonis

MSc Environment and Resource Management
Institute for Environmental Studies (IVM)
Vrije Universiteit Amsterdam

August 2010, Amsterdam

The use of the joint support scheme flexible mechanism and its economic impacts in the Netherlands

MSc Environment and Resource Management
Institute for Environmental Studies (IVM)
Vrije Universiteit Amsterdam

Thomas Maidonis
Student No: 2005859
Email: mmaidonis@yahoo.com

First supervisor:
Dr. Onno Kuik
Institute for Environmental Studies (IVM)
Vrije Universiteit Amsterdam

External supervisor:
Mrs. Karina Veum
Policy Studies Unit
Energy Research Centre of the Netherlands (ECN)

Second Assessor:
Drs. Frans Oosterhuis
Institute for Environmental Studies (IVM)
Vrije Universiteit Amsterdam

August 2010, Amsterdam

Acknowledgements

First of all, I would like to express my appreciation to the professors and all those who contributed to this high quality program. Its multidisciplinary and multicultural character has been especially inspiring throughout the whole year. My special thanks go to Dr. Onno Kuik (IVM) for his kind and unreserved support during these last five months. I would also like to express my gratitude to Mrs. Karina Veum (ECN) for her inspiring guidance and Mr. Paul van den Oosterkamp (ECN) for giving me the opportunity to work on this project. Special thanks to Drs. Frans Oosterhuis for assisting me in shaping this thesis to what it is in its final version and Mr. Remco van Stein Callenfels (CertiQ) for his detailed feedback.

Table of contents

List of abbreviations

B€	Billion Euros
BOE	Barrel of oil equivalent
CHP	Combined heat and power
CO2	Carbon dioxide
EIA	Energy Investment Allowance scheme
EU	European Union
FIP	Feed-in premium
FIT	Feed-in tariff
GO	Guarantee of origin
GW	Gigawatt
GWh	Gigawatt-hour
kW	Kilowatt
kWh	Kilowatt-hour
M€	Million Euros
MEP	Milieukwaliteit van de elektriciteitsproductie
MS	Member State
MSW	Municipal solid waste
Mtoe	Million tonnes of oil equivalent
MW	Megawatt
MWh	Megawatt-hour
NAT	National target fulfilment
NL	The Netherlands
NOx	Nitrogen oxide
R&D	Research and development
RD&D	Research, development and demonstration
RE	Renewable energy
REC	Renewable energy certificate
RECS	Renewable energy certificate system
RES	Renewable energy sources
RES-E	Electricity from renewable energy sources
RPS	Renewable portfolio standard
SDE	Stimuleringsregeling duurzame energieproductie
SE	Sweden
TGC	Tradable Green Certificates
TREC	Tradable renewable energy certificate
TWh	Terawatt-hour
US	United States

List of tables and figures

1. Introduction

1.1. Problem definition

In April 2009, the European Parliament and the Council of the European Union adopted the new Directive on the promotion of the use of energy from renewable sources. The Directive sets binding national targets on each of the Member States with regard to the share of renewable energy in their final energy use in the year 2020. For the Netherlands, this means that a renewable energy share of 14% of the final energy use needs to be met. The Directive provides EU Member States with four flexible mechanisms to achieve their respective mandatory renewables target. These are:

- Statistical transfers between Member States (Article 6),
- Joint projects between Member States (Articles 7 and 8),
- Joint projects between Member States and third countries (Articles 9 and 10),
- Joint support schemes (Article 11).

In addition, the Dutch Government has set up the Working Group on Energy and Climate to design, among others policies, the market stimulation of renewable energy. In 2010 the expenditures for these policies are about 1.8 B€ and are to be reduced by 20% on a net basis (*Jansen et al, 2010b*).

The aim of this research project is to investigate whether the use of a joint support scheme can help the Netherlands meet the 2020 targets in a cost-effective way. The focus will be on the comparison between the continuation of the current support scheme and the introduction of a joint Swedish-Dutch system.

1.2. Research question

In order to answer the main research question which is *"what is the scope for use of the joint support scheme flexible mechanism of Renewables Directive for achieving cost-effectiveness in RES deployment and what will the total economic impacts on the Dutch society be?"*, answers to other sub-questions will have to be provided. These are: "what are the Dutch quantity targets and sub-targets from 2012 to 2020?", "which are the available instruments that can help meet these targets, which are the instruments currently used in the Netherlands and do they guarantee target accomplishment?", "should the joint support scheme flexible mechanism be used and with which country?", "what exactly are the design aspects of a potential Swedish-Dutch support scheme coordination?", "how will the two alternatives influence the market in the future?", "what are the criteria on which the evaluation should be based?", "how do the alternatives score against these criteria?", and finally "are the results robust?".

1.3. Methodological considerations

In order to gain further insight in the topic, **literature** review took place not only at a first stage but during the whole period of the report preparation also. For the definition of the policy problem this research has been based on *EU's Directive 2009/28/EC on the promotion of the use of energy from renewable sources* and on ECN's preliminary assessment on *"what* *is the scope for the Dutch government to use the flexible mechanisms of the Renewables Directive cost-effectively?"*. For the determination of the evaluation criteria Klessmann's paper on *"the evolution of flexibility mechanisms for achieving European renewable energy targets 2020: ex-ante evaluation of the principle mechanisms"* has been quite inspirational. In addition, for the quantification process data for the "continuation of the current support scheme" alternative have been retrieved from the *"Renewable Energy Industry Roadmap for the Netherlands"* report made on behalf of the EU's program "Intelligent Energy" while for the "introduction of a joint Swedish-Dutch scheme" alternative the same assumptions as in ECN's preliminary assessment mentioned above have been made. Regarding the above mentioned literature, this research aims at adding value in terms of calculating the extra benefit (or cost) that would derive from the introduction of a joint Swedish-Dutch support scheme including both monetary and non monetary aspects.

In addition, **meetings** with experts from the Energy Research Centre of the Netherlands (ECN) significantly assisted in shaping this thesis to what it is in its final version while information exchange with experts from ECN and CertiQ (the Dutch certificates issuing body) through internet took place throughout the period from March to August 2010.

In order to gain quantitative insight in the social benefits and costs of the two policies investigated, this research project will basically use a **cost-benefit analysis** (CBA) and in some cases a cost-effectiveness analysis (CEA) which is a sub-category of cost-benefit analysis. In the cases where quantification is not possible the evaluation of the alternatives is based on a qualitative analysis.

Cost-benefit analysis is a methodology used to assess the costs and the benefits accruing to society as a whole as a result of a project, programme or policy. It is used as an assisting quantitative analytical tool in making judgments and appraising available options related to the efficient allocation of resources. It identifies and attempts to quantify the costs and benefits of the alternatives and expresses available data in monetary terms. CEA differs from CBA in that benefits are expressed in physical units rather than in money units. Therefore, CEA is useful in areas such as health, education or job creation where it is easier to quantify costs and benefits in physical terms than to value them in money (*Financial Management Group, 2006*). The key steps in the cost-benefit analysis process are the following:

- Define the policy problem
- Identify the constraints
- Determine and describe the alternatives
- Describe the evaluation criteria
- Quantify costs and benefits
- Discount future stream of benefits and costs to calculate NPV
- Conduct sensitivity analysis

The strength of the method is that it provides a framework for analysing data in a logical and consistent way and, therefore, it is one of the best tools available to measure the impact of proposed economic initiatives on public welfare (*Financial Management Group, 2006*). However, it is important to mention that CBA deals with subjective ingredients such as shadow pricing of externalities and so is prone to criticism.

1.4. Structure of the paper

This paper is structured in ten chapters. Chapter 1 includes the problem definition the research question and the methodological considerations. Chapter 2 provides information about targets in the EU, the Netherlands and Sweden. Chapter 3 describes the support & flexible mechanisms available and focuses on support mechanisms in the Netherlands and in Sweden. Chapter 4 provides information about the extent to which the Netherlands and Sweden are expected to meet the targets. In chapter 5 the alternatives are determined and described. Chapter 6 provides a qualitative analysis of the effects of the two alternatives on the market. Chapter 7 sets the criteria against which the evaluation of the alternatives will be made while in chapter 8 the ex-ante evaluation of the alternatives takes place. In chapter 9 a sensitivity analysis is provided and, finally, the conclusions and further suggestions are discussed in chapter 10.

2. Targets in the EU, the Netherlands and Sweden

As indicated in the European Commission's Green Paper published on March 2006, Europe has entered a new energy era in the 21st century. In this new landscape the world's economic regions are dependent on each other for ensuring energy security and stable economic conditions, and for ensuring effective action against climate change. It is concluded that Europe's energy policy should have the three following main objectives:

- Sustainability
- Competitiveness
- Security of supply

To meet these objectives, the EU's leaders endorsed an integrated approach to a European climate and energy policy in March 2007. They agreed to set a package of demanding climate and energy targets (known as the 20-20-20 targets) to be met by 2020. These are:

- A greenhouse gas emissions reduction of 20% below 1990 levels,
- 20% of EU energy consumption to come from renewable resources,
- A 20% reduction in primary energy use compared to projected levels to be achieved by improving energy efficiency.

To implement the 20-20-20 targets, the "climate and energy package" became law in June 2009 after the European Commission's respective proposal. The package consists of the following elements:

- A revision and strengthening of the Emissions Trading Scheme (EUETS), the EU's market based tool for cutting emissions in a cost-effective way. Under this mechanism, the covered sectors are allowed to emit an always decreasing amount of greenhouse gases according to their historical emissions leading to a final 21% reduction below the 2005 level in 2020.
- A binding agreement for the non-ETS sectors such as transport, housing, agriculture and waste, so that they also contribute by a 10% emissions reduction in 2020 compared with 2005 levels. This burden is to be shared between the Member States taking under consideration their wealth (GDP/capita). This happens because economic growth of the poor Member States is needed in order to achieve balance within the EU and higher economic growth is likely to be accompanied by a higher level of emissions. In the Netherlands the target for the non-ETS sectors is a 16% emissions reduction, while for Sweden the emissions of the non-ETS sectors will have to be reduced by 17% in 2020 compared with 2005 levels. It is expected that together with the 21% reduction of the EU ETS during the same period it will accomplish the first objective of the EU Climate and Energy package (20% cut below 1990 levels by 2020).
- Binding national targets for energy from renewable sources that collectively reach a 20% share of energy from renewable sources and a 10% share of renewable energy specifically in the transport sector by 2020. For the Netherlands these targets are reflected by a 14% share of energy from renewable sources and a 10% share of renewable energy in the transport sector, while for Sweden these numbers are 49% and 10% respectively. The respective directive also improves the legal framework providing Member States with cooperation mechanisms to help achieve the targets cost effectively.

- A legal framework to promote the development and safe use of carbon capture and storage (CCS). CCS is a promising technology, though still expensive, that could prove to be very useful in meeting the EU's targets. Therefore, the EU plans to set up a network of CCS pilot projects by 2015 to test its technical and economic viability. For the Netherlands there are already 7 announced European CCS demonstration projects, while for Sweden there are no plans for such installations.
- An action plan on energy efficiency that creates pressure identifying 75 specific actions in ten priority areas to be implemented over a six-year period but does not address it directly.

The allocation of differentiated national targets is based on the Member States' welfare (as expressed by GDP) and not necessarily on the Member States' RES potential. The following table shows the different targets for the EU, the Netherlands and Sweden as indicated by the climate and energy package:

Table 1. Climate and energy targets for the EU, the Netherlands and Sweden

	EU	**The Netherlands**	**Sweden**
EU ETS sectors'' emissions reduction below the 2005 level	21%	21%	21%
non-EU ETS sectors'' emissions reduction below the 2005 level	10%	16%	17%
Renewables in final energy consumption by 2020	20%	**14%**	**49%**
Renewable energy in the transport sector by 2010 (indicative)	5.75%	5.75%	5.75%
Renewable energy in the transport sector by 2020	10%	10%	10%
Reduction in primary energy use by improving energy efficiency	20%	20%	20%

Source: Own elaboration

In order to ensure the accomplishment of the 14% target the 2009 Directive sets indicative sub-targets from 2011 to 2020. For the Netherlands, these are:

Table 2. The Dutch indicative renewable energy sub-targets

2005	**Average 2011 - 2012**	**Average 2013 - 2014**	**Average 2015 - 2016**	**Average 2017 - 2018**	**2020**
2.4%	4.72%	5.88%	7.62%	9.94%	14%

Source: European Parliament and Council, 2009

In addition to these targets, the Dutch government sets even more ambitious national targets through its Clean & Efficient Programme (Schoon & Zuinig). The set target for the share of renewable energy is higher than the EU's 2020 target of 14% renewables in total energy consumption, the emission of greenhouse gases is planned to be reduced by 30% by 2020 below the 1990 level and the level of energy efficiency was decided to increase by 2% annually with a current pace of growth of over 1% (*Rosende et al, 2010*).

It is here important to mention that the Dutch target of 14% of renewable energy in final energy consumption includes electricity, heating and cooling from renewable energy sources. For RES-E, which is the focus of this research, this 14% share is reflected by a target of 35% of RES-E in the total electricity consumption (*Jansen, 2010a*). In order to define the level of contribution (in terms of quantity) of renewables to electricity consumption according to the indicative sub-targets set by the Directive, data from the "Renewable Energy Industry Roadmap for the Netherlands" report made by the Fraunhofer Institute Systems and Innovation Research (Karlsruhe) in cooperation with the Energy Economics Group (Vienna) and ECOFYS Netherlands are used. In the report's "national target fulfilment" scenario, the following RES-E quantity targets have been assumed to ensure the 14% target achievement for the Netherlands:

Table 3. Contribution of renewables to electricity consumption for 2020 targets achievement

Netherlands	NAT (National target fulfillment)											
Technology	2005		Average 2011 - 2012		Average 2013 - 2014		Average 2015 - 2016		Average 2017 - 2018		2020 Targets	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Biomass	658.4	3,828	1,234.9	7,533	1,350.0	8,178	1,528.4	9,188	1,814.0	10,767	2,220.5	10,693
Solid	343.0	2,247	845.8	5,228	898.5	5,470	964.1	5,749	1,053.1	6,126	1,182.4	4,588
Biogas	79.5	294	114.3	621	164.1	942	263.7	1,588	445.9	2,696	717.0	4,086
MSW	236.0	1,287	274.8	1,683	287.4	1,765	300.5	1,851	315.0	1,945	321.1	2,019
Liquid	:	:	:	:	:	:	:	:	:	:	:	:
Concentrated Solar	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Geothermal	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Hydro, total	37.0	99	39.3	101	39.3	101	39.3	101	39.3	101	39.3	101
>10MW	37.0	99	37.0	100	37.0	100	37.0	100	37.0	100	37.0	100
<10MW	0.0	0	2.3	1	2.3	1	2.3	1	2.3	1	2.3	1
Of which pumping	:	:	:	:	:	:	:	:	:	:	:	:
Photovoltaic	51.0	34	348.9	268	771.7	583	1,668.6	1,240	2,458.5	1,818	2,738.9	2,023
Ocean	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Wind	1,224.0	1,957	4,445.0	10,659	6,071.8	14,818	7,641.5	19,790	9,808.1	26,668	12,129.8	33,960
Onshore	1,193.8	1,861	3,891.7	8,883	4,850.6	10,818	5,090.3	11,337	5,205.3	11,567	5,359.4	11,852
Offshore	30.2	95	553.3	1,776	1,221.2	4,000	2,551.2	8,454	4,602.8	15,101	6,770.4	22,108
Gross Final Consumption of electricity from RES	1,970.4	5,918	6,068.1	18,560	8,232.9	23,680	10,877.8	30,318	14,119.9	39,353	17,128.5	46,776

Source: Rosende et al, 2010

3. Support & flexible mechanisms

There are different types of promotional strategies that can help Member States meet the targets set out in their climate and energy policy. They can be direct or indirect and regulatory or voluntary (*Resch et al, 2005*). The focus of this research is on direct regulatory ones and a classification of them is provided in the following table.

Table 4. Types of promotional strategies

	Price-driven	Quantity-driven
Investment focused	Investment incentives	Tendering system
	Tax credits	
Generation based	Feed-in tariffs and premiums	Tendering system
	Production tax incentives	Quota obligations based on TGC

Source: Resch et al, 2005

Feed-in tariffs (FITs) and feed-in premiums are generation-based price-driven incentives. Under this scheme, there is a legal obligation to utility companies or supplier or grid operator to buy electricity from renewable energy producers at a premium rate, usually over a guaranteed period. The extra cost is shared among all energy users, thus being reduced at minimum possible levels. The tariff rates are regulated by the government and are scientifically determined for each technology to ensure the profitable operation of the installation. It usually takes the form of either a total price for RES-E production, or an additional premium on top of the electricity market price paid to RES-E producers. FITs allow technology specific and band-specific promotion as well as an acknowledgement of future cost-reductions by implementing decreasing tariffs.

FITs are a temporary measure to develop the competitiveness that will result from economies of scale. Competitiveness with conventional electricity sources will be reached in different regions at different times. Therefore they are adjusted at regular intervals to comply with market developments and also adapted to national conditions. It is also important that FIT are guaranteed for a certain period (usually 10-20 years), since the costs are related to the initial investment. This issue represents an important parameter for assessing the actual financial incentive. The system was practically invented in the US in 1978 by the Public Utility Regulatory Policies Act (PURPA) whereas in Europe, Germany has established, supported and improved FIT schemes from 1990 onwards.

Quota obligations based on Tradable Green Certificates (TGCs) are generation-based quantity-driven instruments. The government defines targets for RES-E deployment and obliges any party of the electricity supply-chain (e.g. generator, wholesaler, or consumer) with their fulfillment. Typically, governments mandate a minimum share of capacity or generation of electricity (generally grid-connected only), or a share of fuel, to come from RES. The share required often increases gradually over time, with a specific final target and end-date. Once defined, a parallel market for RE certificates is established and their price is set according to demand and supply conditions (forced by the obligation). Hence, for RES-E producers, financial support may arise from selling certificates in addition to the income from selling electricity on the power market.

Production tax incentives are generation-based price-driven mechanisms that work through payment exemptions from the electricity taxes applied to all producers. This type of instrument thus differs from premium feed-in tariffs solely in terms of the cash flow for RES-E producers: it represents an avoided cost rather than additional income.

Tendering systems are quantity-driven mechanisms. The financial support can either be investment-focused or generation-based. In the first case, a fixed amount of capacity to be installed is announced and contracts are given following a predefined bidding process which offers winners a set of favorable investment conditions, including investment subsidies per installed kW. The generation-based tendering systems work in a similar way. However, instead of providing up-front support, they offer support in the size of the 'bid price' per kWh for a guaranteed duration.

Investment incentives establish an incentive for the development of RES-E projects as a percentage over total costs, or as a predefined amount of Euro (€) per installed kW. The level of incentive is usually technology-specific.

Tax credits are investment-focused price-driven mechanisms that work through payment exemptions from the investment taxes. This type of instrument thus differs from the investment incentives in that it also represents an avoided cost rather than additional income.

In addition to the regulatory instruments described above, more and more voluntary approaches have appeared with on-going market liberalisation. They are mainly based on the willingness of consumers to pay premium rates for RE. However, in terms of effectiveness so far (i.e. actual installations resulting from their appliance) their impact on total RES-E deployment is negligible.

In most cases a single support instrument is not effective for the parallel development of the various types of RES available in one country, due to regional variations in resource potentials and differences in renewable technology costs. Hence, very often Member States have introduced a combination of support schemes to facilitate investments in a customised approach. A common practice has been to apply investments subsides or soft loans in addition to the main support scheme, being either feed-in tariffs or quota obligations.

In April 2009, the European Parliament and the Council of the European Union adopted the new Directive on the promotion of the use of energy from renewable sources. The Directive provides EU Member States with four additional **flexible mechanisms**. The also called "flex-mex" are mechanisms that can help Member States to coordinate in order to achieve their respective mandatory renewables targets using the already known support schemes and not new support schemes. These are:

- Statistical transfers between Member States (Article 6),
- Joint projects between Member States (Articles 7 and 8),
- Joint projects between Member States and third countries (Articles 9 and 10),
- Joint support schemes (Article 11).

Within **statistical transfer** the Member States may agree for the statistical transfer of a specified amount of energy from renewable sources from one Member State to another. The transfer does not affect the achievement of the national target of the involved Member States meaning that the country delivering must first ensure that it is on track fulfilling its own commitment. The transferred amount must be deducted from the amount of energy from renewable sources that is used for the compliance of the country making the transfer.

Furthermore, it can be added to the amount that is taken into account when measuring the compliance of the country accepting the transfer. The Directive requires that the Commission is notified on the transfers by all Member States involved.

The concept of **joint projects between Member States** means that two or more Member States may cooperate on all types of joint projects relating to the production of renewable electricity, heating and cooling meaning that one country having more favourable conditions to increase renewable energy production will host the project and the other country or countries will also benefit from the production. This co-operation may also involve private operators. The host country must notify the Commission on the amount of renewable energy that will be counted towards the national target of the other country. This is likely to require yearly reporting between the participating countries and the Commission.

By the mechanism of **joint projects between Member States and third countries** the Directive also enables one or more Member States to cooperate with one or more third countries in all types of joint projects regarding the generation of electricity from renewable sources. A prerequisite to the acceptability of the project is that the electricity produced within the project must be consumed in the Community area. Furthermore, the third country cannot provide support for the RES production, other than investment aid.

The concept of **joint support schemes** means that two or more Member States can decide to jointly or partly co-ordinate their national support schemes for RES production. In this case, a certain amount of energy from renewable sources produced in the territory of one participating Member State can be counted towards the target of another participating country. This requires a statistical transfer of a specified amount of RES production between the participating countries or alternatively, they must set up a specific distribution rule that allocates the produced RES between the participating Member States (*Ruokonen et al, 2010*).

3.1. Support mechanisms in the Netherlands

After a period during which support was high but markets quite open, a feed-in premiums system was introduced in 2003 in order to trigger the development of renewable energy (*European Renewable Energy Council, 2010*). Under the so called MEP scheme (environmental quality of electricity production), Dutch producers of renewable electricity feeding into the public grid receive a fixed fee per kWh for a guaranteed period of ten years. Additionally, a certificate system was also introduced in July 2001. Although successful in encouraging investments, the 'MEP-premium' was abolished in August 2006 due to budgetary constraints. Since then, investments in new RE installations have fallen down to practically zero.

In October 2007, the Dutch government published a new regulation for a feed-in premium for renewable energy. The new support mechanism, called SDE ('Stimuleringsregeling duurzame energieproductie') resembles the old MEP premium system. For the new SDE regulation, a fund of 300 M€ to 350 M€ per year will be available by 2011. In contrast to the old scheme, the new one comprises an upper limit. In the first year, the premiums will be distributed on a 'first come, first go' basis. Another important change introduced by the SDE scheme was the introduction of an ex post power price adjustment in order to control the extent to which windfall profits occur more effectively.

Biomass and wind energy, that were already eligible for the old MEP regulation, will be eligible for SDE too, except for large co-firing of biomass in power plants. A new entry in the SDE is photovoltaics. Offshore wind has not yet been included, because no new permits have been issued. The duration of support is 15 years for wind and solar and 12 years for biogas and biomass. Because of sustainability concerns, liquid biomass fuels are excluded in the first year. Bio-energy producers will possibly be required to report on the sustainability of their biomass. The SDE will be evaluated in 2010. The table below shows the premium levels for the year 2009:

Table 5. Feed-in premiums in the Netherlands for the year 2009

Technology category	Base price 2009 in €/MWh	Feed-in premium 2009 in €/MWh (base price – price adjustment)
Onshore wind	118	69
Small Solar-PV-installations (0.6 - 15 kWp)	526	324
Large Solar-PV installations (15-100 kWp)	459	406
Hydro power <5 meters	125	81
Hydro power >5 meters	73	29
Biomass electricity [1]		
- Combustion (10-50 MW)	115-156	71-112
- Fermentation of bio-degradable waste	129-149	85-105
- Co-fermentation and small-scale combustion (top-up) (</= 10 MW)	152-177	108-133
- Other fermentation (liquid biomass)	158	114
Electricity production from landfills and sewage treatment (for power stations)	59	15
Electricity production in waste incineration plants (efficiency of the installation > 22%)	117-140	25-48

Source: Rosende et al, 2010

Additionally, there are three more incentive mechanisms working together with the SDE:

- **Tax incentive**: The Energy Investment Allowance scheme (**EIA**) is a scheme providing tax incentives allowing companies to deduct 44% of the investment amount for sustainable energy from the pre-tax profit and therefore to pay less corporate tax. EIA can be awarded over a maximum of 110 M€ investments per installation and it is yearly updated.
- **CO2 Reduction Plan**: Under this scheme, **incentives** are provided for projects that may reduce CO2 emission. Renewable energy projects occupy a prominent place under this scheme.
- **40% subsidy**: All the sectors are eligible of a subsidy of about 40% for projects in R&D and marketing related to sustainable energy. The height depends on the duration and the aim of these projects and the limit for the subsidies is annually set (*Rosende et al, 2010*).

Table 6. The Energy Investment Allowance scheme for the year 2009

Technology	Capacity restriction [kW]	Maximum promotion
Photovoltaic solar energy system	>0.09	3000 €/kWp
Wind turbines off-/onshore	?25	3000 €/kW
	>25	600-1,000 €/kW
Boiler based on biomass	-	-
Cogeneration plants based on biomass	-	-
Hydropower	-	-
Heat pumps	-	200€/kWth
Heat pump boiler	-	-
Biofuel production installation	-	-

Source: Rosende et al, 2010

There is currently no policy regarding joint projects, although the Netherlands is open to proposals and ideas from other Member States (*Directorate for Energy and Sustainability of the Netherlands, 2009*).

The Dutch Government has set up the Working Group on Energy and Climate to design, among others policies, the market stimulation of renewable energy. In 2010 the expenditures for these policies are about 1.8 B€ and are to be reduced by 20% on a net basis.

The Dutch Green Certificate System

The Dutch green certificate system that was introduced in July 2001 is a voluntary market. This means that no targets are set upon market actors. As from 1 January 2004 the Dutch certificate issue system is managed by CertiQ established by TenneT (the Dutch national grid operator) as a subsidiary to perform this task on its behalf (*Voogt et al, 2006*). Besides GOs, CertiQ also manages the issuing of RECS certificates and Dutch CHP certificates. The production certificates introduced can be both GOs and RECs. However, as soon as the certificate is transferred to a non-Dutch account, the GO becomes void and only the RECS certificate remains. Issued certificates are valid for one year. The producer of guarantees of origin indicates the trader to which the certificates will be transferred after creation. The certificates are placed on a trader’s account. The trader himself may choose which certificates he wants to use. He can either transfer such a GO to the account of another trader within or outside the Netherlands or use (redeem) it as proof of delivery of renewable electricity to a consumer. The Office of Energy Regulation (Energiekamer) is charged with verifying if the trader meets the legal requirements for cancelling GOs.

The support of production of renewable electricity under the SDE scheme, while tied to the green certificates scheme, is in no way linked to GOs being traded among account holders. CertiQ sends information on the GOs issued to NL Agency (Agentschap NL) on a daily basis. NL Agency uses this information to determine the amount of support to which the producer is entitled under the SDE scheme. However, it is important to mention that this does not involve any trading of GOs whatsoever. Instead, the mere fact that GOs were issued entitle the producer to an amount of financial support.

There are no policy objectives or renewable energy targets formulated in the Dutch Guarantees of Origin regulation, however the Dutch government aims with the system to support the renewable energy target mentioned in the EU RES-E Directive.

Demand for renewable electricity certificates increased to about 21,500 GWh in 2008. This is about 5,000 GWh more than the year before, and the equivalent of 18% of total electricity consumption (*CBS, 2009*). The price of imported GOs is very low as the Dutch demand/import is not subtracted for the realisation of the RES-E target by the exporting country. In the beginning of 2005 the price of a GO could be found around 20-25 €cent/MWh.

Table 7. Overview of certificates from CertiQ, excluding certificates for CHP (GWh)

	2002	2003	2004	2005 [2]	2006	2007	2008
Certificates issued							
Domestic production	2,357	2,648	4,077	6,733	8,198	6,704	9,000
Imports	8,149	9,713	10,462	9,799	9,110	12,271	18,924
Total	10,506	12,362	14,539	16,532	17,308	18,975	27,924
Certificates cancelled	3,662	12,315	16,227	14,791	14,567	16,620	21,530
Certificates expired	6	1,831	297	228	1,227	832	426
Certificates withdrawn [1]	20	42	119				
Certificates for own consumption	–	–	65	339	305	251	328
Exports	–	–	3	26	186	233	1,476
Stock on 1 January	636	7,456	5,628	3,455	4,580	5,603	6,643
Stock change	6,819	–1,828	–2,173	1,125	1,023	1,039	4,165
Stock on 31 December	7,456	5,628	3,455	4,580	5,603	6,643	10,807

[1] From 2005 onwards these are subtracted from certificates issued.
[2] There is a statistical discrepancy in the net result for 2005. Because of the small amount (20 GWh), the cause was not investigated.

Source: CBS, 2009

3.2. Support mechanisms in Sweden

The green certificate system in Sweden came into force on 1st May of 2003. It is a system of tradable green certificates promoting renewable energy through a governmentally decided demand-side quota obligation and it replaces earlier policy instruments that had a similar goal, such as public grants, subsidy programmes and investments schemes (*Rydén et al, 2006*). The scheme aims at assisting the growth of RES-E by stimulating cost-effective penetration of RES independent from the state budget. On 1 January 2007 the Renewable Energy with green certificates bill came into force incorporated a new target of 17 TWh by 2016 (*European Commission, 2008*). In June 2009, the Parliament decided to further raise the target for the electricity certificate system on the level of 25 TWh in 2020 relative to the production level in 2002 (*Swedish Energy Agency, 2009b*).

Swedish green certificates are also called *elcerts*. One elcert is issued to each approved producer for each produced and metered megawatt-hour (MWh) of electricity from renewable energy sources, or from peat. The energy sources that currently entitle Swedish power producers to issue green certificates are wind power, solar energy, wave energy, geothermal energy, new hydropower and existing small-scale hydropower, and biofuels (including peat). The demand for electricity certificates is created by the obligation that electricity suppliers and certain electricity users are required to purchase certificates corresponding to a particular proportion of their electricity sales or electricity use. This proportion, or quota, has been decided for each calendar year, and set at such a value that the system will play its part in achieving the objective of increasing the production of electricity from renewable energy sources to the desirable level. Up so far, the system covers only electricity produced in Sweden but Sweden and Norway have agreed to establish a joint market for green electricity certificates from 2012 onwards. The new scheme would be compatible with the Swedish model (*EurActiv, 8 September 2009*).

Elcerts are issued and credited to the RES-e generator's account by the Swedish National Grid Company (Svenska Kraftnät). The Swedish National Grid Company is responsible for establishing and maintaining the register of certificate accounts and monitors and analyses the development of the certificate market. The Swedish Energy Agency (STEM) enforces the compliance. The certificates remain valid as long as no producer uses it as proof of delivery of renewable electricity to a consumer or transfers it to the RECS system. Brokers/traders are allowed to participate in the market.

When the system was introduced no policy plans for the post-2010 period were announced, implying a very short anticipated lifetime for the system. However, in 2006 a few important changes in the system were implemented. Most importantly, in order to reduce the political uncertainty the life time of the system was extended until 2030. Moreover, a producer can receive certificates for a maximum of 15 years, and production from facilities taken into operation after 2016 cannot receive any certificates after the system is terminated in 2030.

Trade has to be reported to the Swedish National Grid Company. The system mostly works with bilateral trades. The producers mainly have agreements for their whole yearly production so when the certificates are issued they are directly moved to a buyer’s account. During 2003 there was a rapid escalation of the price, going from around 17 to 25 €/certificate. Prices reached a peak of 26-29 € at the beginning of 2004 followed by a rapid fall that brought the prices around 21 € in April-May 2004. In 2005, prices have been within the range of 21-23 €/certificate (*Voogt et al, 2006*). The average certificate price of the Swedish RPS in year 2008 was about 29 €/MWh (*Jansen et al, 2010b*).

Additionally, since 2005 there is an investment subsidy covering 30% of the total investment for all renewable energy technologies. When the quota system was introduced it replaced all other support schemes, except one “environmental bonus” to wind power.

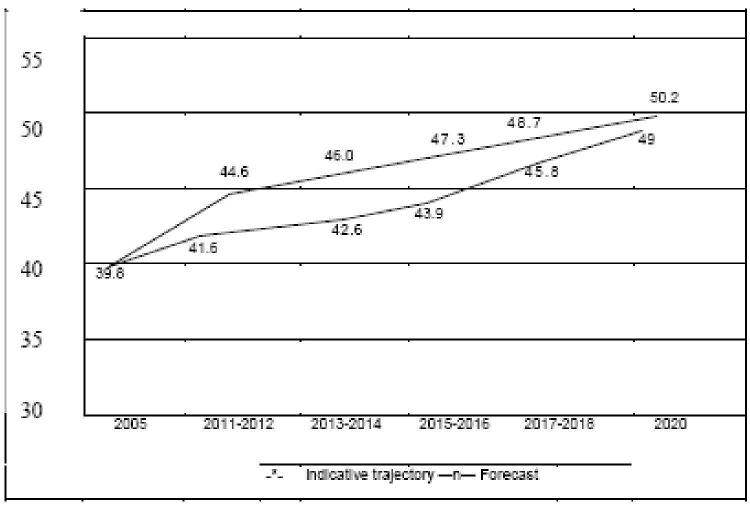
4. Reaching the targets

In 1997 The European Commission proposed that the EU should aim to reach a 12% share of renewable energy by 2010. Directives were adopted in the electricity and transport sectors that set national sectoral targets. The latest Commission's progress report (2009) indicates that the EU is unlikely to reach either the target for the share of electricity from renewable energy sources or the target for the share of renewable energy in transport for 2010, despite the legislation, the recommendations, the exhortations and even legal proceedings against some Member States. That said, there has been limited recent progress. Whilst some recent progress has been achieved, the rate of growth remains slow and the barriers to growth, across all sectors, remain high in most Member States.

Member States have been asked to submit documents giving their forecast of the target reaching in 2020 and the expected use they will make of the flexible mechanisms contained in the Directive. According to their forecast documents, ten Member States expect to exceed their national targets for renewable energy with an overall surplus of 5.5 Mtoe, and five expect to have a deficit of in total 2 Mtoe and, thus, need to use the Directive's cooperation mechanisms and reach their target by developing some renewable energy in another Member State or a third country (*European Commission, 2010*).

For **Sweden** the effort for reaching the targets seems to be optimistic. According to the forecast document, Sweden will lie above the indicative trajectory throughout the forecast period, but the margin will reduce and be so small by 2020 that it will clearly fall within a margin of uncertainty. The following figure shows the Swedish Energy Agency's forecast renewable energy excess compared to the indicative trajectory:

Figure 1. Forecast excess compared to the indicative trajectory



Source: Swedish Energy Agency, 2009a

For **the Netherlands** the case is not the same. In its forecast document, the Dutch Directorate for Energy and Sustainability state that the Netherlands will attempt to meet the 2020 target by using adequate domestic sustainable energy production. Consequently the Netherlands does not currently expect to use production from other EU countries in order to achieve the objectives laid down in the Directive. In the unlikely event that less renewable energy is produced than stated in the indicative trajectory temporary efforts will be made to intensify the policy on the basis of energy production. As indicated in the forecast document, both the forecast excess and the deficit compared to the indicative trajectory are expected to be of zero level.

According to their forecast documents both the Netherlands and Sweden are expected to meet the 2020 targets with no or small adjustments on their current support schemes. The criterion of effectiveness (see section 7.1) seems likely to be met, nevertheless the possibility of further cost effectiveness through the use of the flexible mechanisms should be investigated.

In order to check the eventuality of occurrence of the above mentioned forecasts in practice, data from the Green-X model that was applied in the "futures-e" project to perform a detailed quantitative assessment of the future deployment of renewable energies on country, sectoral and technology level are used. The core strength of this tool lies on the detailed RES resource and technology representation accompanied by a thorough energy policy description, which allows assessing various policy options with respect to resulting costs and benefits. The results show that with a strengthening of the current national policy the Netherlands is likely to reach a 12.4% share of RES on the gross final energy demand (the target is 14%) and a 34.5% share of RES-E on gross electricity demand in 2020. Sweden is expected to exceed the target reaching a 51.3% share of RES on the gross final energy demand in 2020.

Table 8. Green-X "Strengthened national policy" scenario results

Breakdown of 2020 RES deployment by country & by technology (expressed in terms of final energy [TWh/yr.])	Netherlands	Sweden	European Union
RES category	NL	SE	**EU27**
RES Electricity			
Biogas	3,7	1,1	**88,5**
Solid biomass	7,0	12,1	**195,7**
Biowaste	2,0	1,0	**33,6**
Geothermal electricity	0,0	0,0	**8,3**
Hydro large-scale	0,1	66,7	**326,3**
Hydro small-scale	0,0	5,0	**63,1**
Photovoltaics	0,3	0,0	**27,0**
Solar thermal electricity	0,0	0,0	**13,9**
Tide & wave	0,0	0,0	**6,9**
Wind onshore	8,6	6,8	**307,5**
Wind offshore	19,4	1,5	**181,4**
RES-E total	41,2	94,3	**1252,3**
RES-E CHP	5,2	12,9	**194,6**
Share on gross electricity demand	34,5%	61,1%	**35,3%**
RES in total			
RES total[1]	75,6	194,0	**2984,9**
Share on gross final energy demand[1]	12,0%	51,5%	**19,8%**
RES total[2]	*78,1*	*193,2*	***2984,9***
Share on gross final energy demand[2]	*12,4%*	*51,3%*	***19,8%***
RES target for 2020[3]	*14%*	*49%*	***20%***
Corresponding national target fulfillment[2]	*89%*	*105%*	***100%***

Notes: 1 ... biofuels accounted according to production / domestic resources, 2 ... biofuels accounted according to consumption (10% target), 3 ... according to the revised RES directive as agreed in the European Parliament and Council in December 2008.

Source: Resch et al, 2009

5. Alternatives to be compared

5.1. Determination of the alternatives

In this research two different alternative support schemes as from 1/1/2012 will be taken under consideration for evaluation and comparison:

- The continuation and strengthening of the current Dutch support scheme, and
- The introduction of a Swedish-Dutch joint support scheme.

Determining the second alternative it is important to explain the reasons why the joint support scheme flexible mechanism was chosen and why Sweden is the most proper partner country to implement such a coordination with.

On one hand, the Netherlands is a country with a prosperous and open economy which depends heavily on foreign trade and is noted for stable industrial relations (*UHY, 2010*). On the other hand, the Dutch domestic untapped low-cost RES potential is limited. Therefore, it seems that the country could prove a fertile ground for a market based flexible mechanism such as the joint support schemes. On the contrary, statistical transfers and joint projects are less market oriented options that are based on contracts. In addition, single joint projects can not support the deployment of significant amounts of foreign RES potential for Dutch target counting. A further standardisation of joint projects actually heralds the introduction of a joint support scheme (*Klessmann et al, 2010*). However, the introduction of a joint support scheme does not eliminate the eventuality of making use of the other flexible mechanisms.

There are several reasons for the Netherlands to choose a joint cooperation with Sweden. From an economic perspective, Sweden has a large untapped low-cost RES potential, especially on-shore wind energy sources potential. From a political perspective, Sweden is open for an eventual support schemes coordination, being the MS that strongly lobbied in favour of the inclusion of the joint support schemes as a flexible mechanism in the Renewables Directive (*Jansen et al, 2010b*). In addition, Sweden is a reliable partner MS as it is politically more stable and financially safer than other European countries with untapped low-cost RES potential like Spain and Poland.

5.2. Description of the alternatives

As already mentioned in section 3.1, for the first alternative, the continuation of both the current Dutch FIP scheme called SDE as the main support scheme and the current additional incentive mechanisms working together with the SDE are assumed. In addition, a strengthening of this overall support is also an important assumption due to the failure of the continuation of the current support to meet the targets exactly as it is, as shown in the end of section 4. The Dutch green certificate system is assumed to remain a voluntary one and continue working under the current conditions.

Regarding the second alternative, the Swedish-Dutch joint support scheme investigated in this research is a hybrid demand-side RPS/FIP one. For the Swedish side, there is a continuation of the already existing demand-side quota obligation with a green certificates system in parallel. For the Dutch side, a demand-side quota obligation is introduced whilst keeping the existing SDE support and green certificates system in place. A hybrid demand-side RPS/FIP for the Netherlands in practice means that a quota obligation is introduced to electricity suppliers and certain electricity users. The SDE support will be given by guaranteeing a minimum certificate price well below the expected long-term marginal generation cost (not in a feed-in-premium form this time) (*Jansen et al, 2005*). The SDE support can be ex post adjusted in order to ensure better control of windfall profits. Guaranteeing a minimum certificate price is of great importance in order for more certainty to be provided to investors. In the mean time, a maximum certificate price could act as a cap on the additional cost per unit of RES-E. In conjunction with the target, the maximum certificate price could also fix the maximum total additional costs. This way the existence of a competitive (more competitive than a FIP system) and fair (more fair than a pure RPS) system is assured.

The produced RES energy can be allocated to the participating countries either by statistical transfer or by a distribution rule agreed. Compatibility between the Swedish and the Dutch green certificates systems and the establishment of a uniform certificate price is vital for the smooth operation of the joint support scheme. Securing that the introduction of the joint scheme does not have a significant rising effect on the certificates' price is also of great importance. It can be expected that a joint support scheme will be introduced only if the economic and non-economic benefits are larger than the associated costs and risks (*Klessmann et al, 2010*). Therefore, a mutually beneficial situation needs to be created for both countries where a potential sell-out of the one country's low-cost sources in favour of the other is avoided. From a Dutch perspective, such a scheme would be beneficial because it would provide the Netherlands with access to lower-cost Swedish renewable energy sources. Although it would have an increasing effect on energy prices for the Swedish consumers, this would be offset by the fact that exports of renewable energy will significantly boost their economy. Therefore, it could be a mutually beneficial coordination.

6. Qualitative analysis

6.1. Continuation and strengthening of the current SDE scheme

In this part a qualitative analysis of the continuation and strengthening of the current SDE scheme is given. An insight on the effects that are expected to occur in the future on the quantity of RES deployed, the state's budget, the certificates' price, the windfall profits and the retail electricity prices for consumers is tried to be given.

Quantity of RES

Since 2003 when the MEP scheme was introduced, the yearly introduction of new RES capacity in the Dutch energy mix has been significant. It is expected that the Netherlands will be able to meet the 14% target in 2020 (which is reflected by a sub-target of 35% of RES-E in the total electricity consumption) relying on domestic RES potential but a parallel strengthening of the current SDE scheme is expected to be essential (see section 4).

State's expenditure

The need of introduction of a continuously rising amount of RES capacity in the Dutch energy mix in order to meet the targets and the continuously decreasing amount of domestic untapped low-cost RES potential are expected to cause a significant rise in the support level needed (*Jansen et al, 2010b*). Assuming that the government goes on with the current policy and does not shift these support costs on the electricity consumers' bill, it is expected that a significantly higher budget for the promotion of renewables will be necessary.

Certificates' price

The certificates' price is not expected to be tremendously affected by the continuation of the current SDE scheme as the certificates market will remain a voluntary one. However, a slight decrease of their price is expected to take place because of the coexistence of stable demand for certificates and increased supply of certificates that derives from the introduction of a continuously rising amount of RES capacity.

Windfall profits

Two of the main changes that the current SDE scheme introduced after the abolishment of the MEP one, were the introduction of an ex post power price adjustment and the set of a ceiling on the total expenditure for RES-E production. The technology specific nature of the scheme provides the government with the potentiality to adjust the premiums at a yearly level. This increases uncertainty for the investors, but it also provides the Dutch government with a tool to effectively control and reduce the likelihood of windfall profits occurrence. It is expected that the continuation of the current SDE scheme will not have any further impact on windfall profits in the future.

Prices for consumers

As mentioned before, it is assumed that the government will not shift the increasing support costs deriving from the continuation of the current SDE scheme on the electricity consumers' bill. However, it should be clear that the state's budget is constituted indirectly by consumers' taxes. The continuation of the current Dutch SDE scheme is expected to have a slightly decreasing effect on the retail electricity price (*Koutstaal et al, 2008*). In case that the government shifts the increasing support costs on the electricity consumers' bill, the state's expenditure on support of RES-E production can decrease to almost zero while consumers will meet a significant increase in their bills and might be repelled of buying green electricity. However, in this case their expenditure on taxes will be reduced.

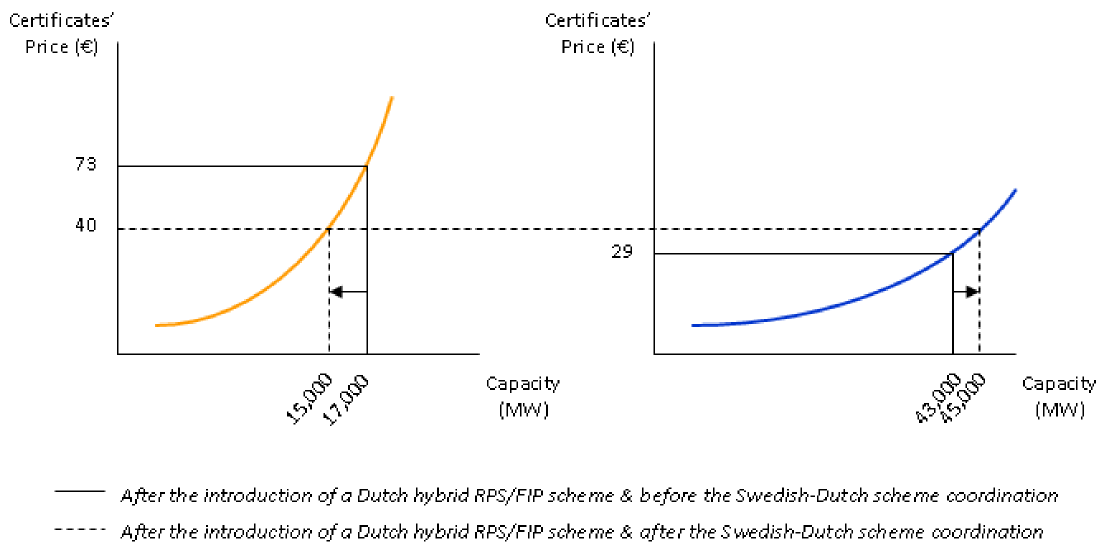
6.2. Introduction of joint Swedish-Dutch RPS/FIP system

In this part a qualitative analysis of the introduction of joint Swedish-Dutch RPS/FIP system is given. The effect of the introduction of such a system is, in principal, the sum of the effect caused by the introduction of a national Dutch RPS/FIP plus the effect that derives from the coordination with the Swedish scheme. An insight on the effects on the quantity of RES deployed, the certificates' price, the windfall profits, the retail electricity prices for consumers and the state's budget is tried to be given.

Quantity of RES

In a well designed demand-side Dutch RPS/FIP system, the quantity of RES deployment is expressed by the quota that has been set. The introduction of a Dutch RPS/FIP is expected to trigger the deployment of the lowest possible cost RES within the Dutch borders which currently is onshore wind power sources. However, in order to meet the 2020 targets, the Netherlands will also have to introduce important amounts of electricity coming from offshore wind power sources. Further coordination of the Dutch scheme with the Swedish one means that the RES-E production will take place in the country where it is the most profitable for the investor (*Morthorst, 2006*). It is assumed that through such a coordination, 2,000 MW of relatively high-cost Dutch offshore wind installations will have been replaced by 2,000 MW of low-cost Swedish onshore wind installations by 2020 and that a joint Swedish-(Norwegian)-Dutch support scheme would yield an average certificate price of 40 €/MWh in 2020 (*Jansen et al, 2010b*).

Figure 2. RES capacity to be installed with and without the Swedish-Dutch scheme coordination



Source: Own elaboration

This means that the Netherlands is expected to reach an overall capacity of about 15,000 MW of RES instead of 17,000 MW that the target accomplishment requires (see table 3), while the rest 2,000 MW will be installed in Sweden but still count for meeting the Dutch targets. This would increase the amount of RES capacity installed in Sweden from 43,000 MW (117,500 GWh) to 45,000 MW in 2020 (*Bryntse et al, 2010*). In addition, it is assumed that in order to get an equalised certificates' price of 40 €/MWh with a Swedish one of 29 €/MWh (see section 3.2) before the coordination, the Dutch one is assumed to reach the level of 73 €/MWh before the coordination (29*45,000 + X*15,000 = 40*60,000 => X=73). Figure 2 shows these projected shifts on the Dutch (orange) and Swedish (blue) supply cost curves. The difference in the steepness of the two curves is due to the fact that the Dutch RES potential is of higher cost than the Swedish one.

In this part, the factors that can influence the amount of shifted RES capacity from the Netherlands to Sweden are tried to be distinguished. It is now assumed that for both the Dutch and the Swedish investors the level of incentives (i.e. initial investment incentives or tax exemptions) and the RES technology used are the same. Therefore, the cash flow of costs is assumed to be equal. Differences between investors' profits in Sweden and in the Netherlands, thus, depend on the benefits. In order to make it more profitable for investors to deploy Swedish RES that is more cost effective under the above mentioned assumptions, we should have:

Assumptions / memo:
V_{NL} = wind velocity in the Netherlands = 5.8 m/s
V_{SE} = wind velocity in Sweden = 6.8 m/s
air density$_{NL}$ (d_{NL}) = air density$_{SE}$ (d_{SE})
certificate price$_{NL}$ (CP_{NL}) = certificate price$_{SE}$ (CP_{SE}) = certificate price (CP)
Swept rotor area$_{NL}$ (SRA_{NL}) = Swept rotor area$_{SE}$ (SRA_{SE}) (same technology used)
CPP = conventional power price

$$\text{Benefits}_{NL} < \text{Benefits}_{SE}$$

$$\text{power produced}_{NL} * \text{selling price}_{NL} < \text{power produced}_{SE} * \text{selling price}_{SE}$$

$$½ * d_{NL} * SRA_{NL} * V_{NL}^3 * (CPP_{NL} + CP_{NL}) < ½ * d_{SE} * SRA_{SE} * V_{SE}^3 * (CPP_{SE} + CP_{SE})$$

$$V_{NL}^3 * (CPP_{NL} + CP_{NL}) < V_{SE}^3 * (CPP_{SE} + CP_{SE})$$

$$195.112\ m^3/s^3 * (CPP_{NL} + CP) < 314.432\ m^3/s^3 * (CPP_{SE} + CP)$$

$$CPP_{NL} + CP < 1.6 * CPP_{SE} + 1.6 * CP$$

$$\mathbf{CPP_{NL} < 1.6 * CPP_{SE} + 0.6 * CP}$$

This means that conventional power price in the Netherlands can be more expensive than the Swedish one but should not be much more expensive if we want to assure that the Netherlands will take advantage of Swedish low-cost RES potential. Once we assure that the above mentioned inequality is taking place in reality, the more beneficial it becomes for Dutch investors to invest in Swedish potential the more Swedish potential will be used for Dutch target counting. This can be done by either decreasing the Dutch *conventional power price* (and thus decreasing the benefits deriving from investing) or decreasing the *level of incentives* (and thus increasing the investment costs) in the Netherlands.

Certificates' price

Currently the certificates system in the Netherlands is a voluntary one. The certificates' price is currently very low because of the simultaneous existence of oversupply and lack of demand for certificates. The introduction of a demand-side Dutch RPS/FIP system will set quotas on electricity suppliers and main electricity consumers. This will have a tremendous rising effect on the certificates' price which, as explained above, is assumed to lay around 73 €/MWh because of the significantly higher demand for certificates. However a ceiling will be set so that windfall profits are avoided and consumers are protected, while the current SDE support will be reflected by setting a minimum certificate price that reduces the risks for RES-E producers. Indicatively, it is mentioned that in the beginning of 2005 the price of a Dutch certificate could be found around 20-25 €cent/ certificate, while for quota based systems such as the UK, the Flemish and the Swedish ones the price was £32.33, above 100 € and within the range of 21-23 € per certificate, respectively (*Voogt et al, 2006*).

In a joint Swedish-Dutch coordination of the support schemes, the price of the certificates will be equalised for the region through trade (*Morthorst, 2006*). The introduction of a joint Swedish-Dutch support scheme will have a decreasing effect on the Dutch RPS/FIP certificates' price as it is expected to lay above 29 €/MWh (which is the Swedish price of certificates). The Dutch certificates' price is expected to be higher than the Swedish one because of the moderate Dutch low-cost RES potential. It is expected that a joint Swedish-(Norwegian)-Dutch support scheme would yield an average certificate price of about 40 €/MWh in 2020 (*Jansen et al, 2010b*).

State's expenditure

In principle, contrary to a FIP system, a quota based system is state budget neutral. A demand-side RPS represents rather a "stick" than a "carrot" for RES-E stimulation. However, in a hybrid RPS/FIP system some governmental expenditure might still exist in order that a minimum certificate price for RES producers is guaranteed. This minimum certificate price is expected to reduce the risks for green electricity producers comparing to a pure RPS with relatively low expenditure comparing to the current FIP system. The higher the minimum price is, the higher the state's expenditure will be and the lower the risks for the investors will be respectively.

Windfall profits

In principle, the introduction of a demand-side RPS would not provide the government with the ability to control the prices of RES-E and, therefore, the level of windfall profits for generators that own the installations with the lowest generating costs. Regarding the quota set, the higher the quota is the more costly RES potential will have to be deployed and the higher the certificates' price will be, leading to significant windfall profits for advantaged producers. However, in a hybrid RPS/FIP system, this problem is solved by setting a ceiling on the certificates price but setting a reasonable target would still be vital for the certificates' price development.

Prices for consumers

The introduction of an RPS in the Netherlands will shift the support of RES-E generation from the state's budget to Dutch consumers. It is expected that consumers will have to pay higher electricity bills, but they will also be alleviated by taxes or other instruments used by the government to constitute the SDE budget (*Koutstaal et al, 2008*). The introduction of a ceiling on the certificates' price will protect the consumers from paying extremely high electricity bills.

Further coordination with the Swedish system will also have an effect on Dutch consumers' bills. The Dutch moderate low-cost potential will, ceteris paribus (in practice it also depends on conventional power's price), give a higher price for certificates than the Swedish price. This difference will be decreased in a common certificates market which, through trade, will give an equal price both for Dutch and Swedish consumers. Therefore, the introduction of a joint scheme will reduce the Dutch consumers' bill (comparing to the introduction of a national Dutch RPS) while the opposite will happen for Swedish consumers. A certificates' price ceiling set by the Dutch side will also protect Swedish consumers and make the introduction of the Netherlands in the system smoother.

In the following table the qualitative effects of the continuation and strengthening of the current SDE and the introduction of a joint hybrid RPS/FIP system on the different aspects of the market are shown:

Table 9. The effects of the implementation of the alternatives on the market

	Quantity of RES	NL certificates' price	SE certificates' price	State's expenditure	Windfall profits	Electricity prices for NL consumers	Electricity prices for SE consumers
Continuation of the current SDE	↑	↑	-	↑	-	↓	-
Introduction of a joint hybrid RPS/FIP system	↑	↑	↑	↓	?	↑	↑
Introduction of a hybrid RPS/FIP system	↑	↑↑	-	↓	?	↑↑	-
Further coordination with Sweden	-	↓	↑	-	-	↓	↑

Source: Own elaboration

7. Evaluation criteria

The evaluation of the two alternatives will be based on criteria that are commonly used for evaluating environmental policies (*Klessmann, 2009*). As a basis for evaluating the two support schemes, this section structures the evaluation criteria commonly used for environmental policy evaluation in a systematic way, distinguishing main-criteria and sub-criteria.

Four groups of criteria will be used for the evaluation of the different flexibility mechanisms:

- Effectiveness – the extent to which a policy meets the national and European RES targets for 2020.
- Cost-effectiveness – the extent to which the policy can achieve its objectives at a minimum cost to society.
- Political and social criteria – the extent to which a policy finds the wide political and social support that is needed.
- Administrative criteria – the extent to which a support scheme can be smoothly operated in practice.

7.1. Effectiveness

The first evaluation criterion for a support scheme is its effectiveness. The effectiveness of an instrument can only be determined by estimating how well it is likely to perform and, in this case, by estimating the extent to which the support scheme is likely to meet the national and European RES targets for 2020. It is here reminded that the Dutch targets are reflected by a 14% share of energy from renewable sources and a 35% share of RES-E in the total electricity consumption in 2020.

7.2. Cost-effectiveness

The cost-effectiveness of a policy is a key decision parameter in a world with scarce resources. Given a particular goal, the most cost-effective policy is the one which achieves the desired goal at the least cost. Cost-effectiveness is distinct from general economic efficiency. Whereas cost-effectiveness takes a goal as given, efficiency involves the process of selecting a specific goal according to economic criteria (*Gupta et al, 2007*). In our case, the most cost-effective alternative is the one in which a given output in terms of RES-E (TWh) is produced from a minimum input (€). There are many components of cost, and these include both the direct costs of administering and implementing the policy as well as indirect costs, such as how the policy drives cost-reducing technological change.

Direct costs

One sub-criterion of cost-effectiveness is the extent to which a support scheme triggers the **development of** untapped **low-cost RES potential**. Such a development would potentially decrease the total costs for achieving the RES targets, and thus also limit the required amount of financial incentives (*Klessmann, 2009*).

A support scheme should support a fair distribution of profits to the energy producers preventing cases of **windfall profits**. Windfall profits can occur when premiums are set too high or rendered too high by innovation, and/or by increases in the price of electricity. The minimisation of these excess profits over and above the required rate of return would lead to the minimisation of undue costs for electricity consumers and thus have a certain impact on the acceptability of a support scheme from the public (*Klessmann, 2009*).

The introduction of significant amounts of renewable energy into the power system brings with it a series of economic impacts. At power system level, the costs can be either system balancing costs or **network integration costs**. The costs generated from the needs for new grid infrastructure in the Netherlands may differ between two support schemes because they depend on weather a support scheme boosts the introduction of significant amounts of RES-E within the Dutch borders or out of them (*van Hulle et al, 2009*).

Apart from the network integration costs, the introduction of significant amounts of renewable energy also leads to **avoided costs for grey electricity**. Therefore, the extent to which a support scheme boosts the introduction of significant amounts of RES-E within the Dutch borders or out of them determines the extent to which grey electricity production is avoided or not.

The Dutch **support scheme** for renewable electricity has been subject to rather frequent **changes** (see section 3.1), raising policy uncertainty to which investors perceive to be exposed. A major concern of developers of renewable electricity projects is continuity of the support scheme. Limitation of these changes compared to the current situation will help to mitigate policy uncertainty concerns.

Indirect costs

Regarding the **conservation of domestic potential**, the use of any flexibility mechanism could influence the support costs paid within national support schemes, since part of the low-cost domestic RES potential of a Member State is used by another. This could lead to increased future costs for the host country to reach national targets due to ''sell-out'' of low-cost potentials (this would depend on the available potentials and their cost curve) and to decreased costs for the other (*Klessmann, 2009*).

A **long-term aspect of cost-effectiveness** is the promotion of the early development of RES technologies needed on the medium or long-term. If such technological options are not developed in time, they might not be commercially available or very expensive when needed later on (*Ragwitz et al, 2007*).

7.3. Political and social criteria

Even if a policy meets the goal at least cost, it may face political or social opposition, i.e. if it disproportionately impacts – or benefits – certain groups within a society. From an economic perspective, a policy is considered to be beneficial if it improves social welfare overall. However, this criterion does not require that the implementation of that policy actually improves the specific situation of any one individual (*Gupta et al, 2007*). A number of political criteria need to be met to find wide political support for a proposed support scheme.

An important political criterion is the **sovereignty** of a policy on the Dutch national RES policy, i.e., to decide upon the design of the national RES support scheme, to control which RES installations are supported by the national support scheme, and to control the use of the national RES potentials (*Klessmann, 2009*). An indicative example is the loss of sovereignty of Norway in order to establish a common market for green electricity certificates with Sweden. When the Swedish government announced that the target for renewable energy production within its green certificate scheme would be increased to 25 TWh by 2020, Norway adopted a stance to match Sweden's ambitions on promoting renewables (*EurActiv, 8 September 2009*).

On the other side, a possible **harmonisation of support schemes at EU level** is expected to increase cost effectiveness for the EU as a whole because of the added value created in addition to the operation of national support schemes, e.g. by creating larger markets for RES which improves economies of scale for investors (*Klessmann et al, 2010*). Though, it is not predicted that the EU will force Member States to adopt a common harmonised support scheme soon. The extent to which a support scheme comprises a step for further harmonisation of support schemes at EU level could, thus, be another political criterion (*Klessmann, 2009*). If the Netherlands act proactively in this perspective, they can gain important experience from the designing and implementation process and be better prepared for a harmonised pan-European support scheme. In addition, expertise gained by the Netherlands being a first mover can be further used to serve the Dutch interests in case of an expansion of the Swedish-Dutch coordination including new comers or to advise the designers of joint support schemes between other Member States.

Another major political criterion is the **impact** that a policy has **on the government budget.** It can be a net drain on the budget or it can even bring in net public revenue. This impact on the government budget can have a certain effect on the acceptance of a support scheme by the political world.

As also explained in section 6, the investigated alternatives are expected to have certain **impacts on consumers' expenditure**. This sub-criterion should be taken under serious consideration as electricity consumers constitute a big part of the Dutch society and a policy could create or eliminate social opposition.

If a Member State supports a RES installation in another Member State, it may miss out on the **local benefits**. This seems only attractive if the price of the foreign renewable energy is lower than domestic renewable energy generation, if RES equipment from the receiving country is used (as a kind of export promotion), or if certain RES installations face acceptance problem in the receiving country (*Klessmann, 2009*). Such local benefits can be:

- **Increased security of supply**
- **Environmental benefits** (e.g. NOx emissions avoided)
- **Local job creation**

From the perspective of the host country, the use of a joint coordination seems only attractive if the benefits (i.e., the sales price plus the local benefits) outweigh the **local costs** and disadvantages (*Klessmann, 2009*). These can be:

- **Secondary support costs** (e.g. tax incentives) that are paid to the RES installation by the host country.
- **Local acceptance problems** (''not in my backyard'' opposition)

7.4. Technical criteria

Institutional realities inevitably constrain policy decisions. A support scheme that is well adapted to existing **institutional constraints** has a high degree of institutional feasibility. In reality, policy choices must be both acceptable to a wide range of stakeholders and supported by institutions, notably the legal system. Other important considerations include human capital and infrastructure as well as the dominant culture and traditions (*Gupta, 2007*).

Easiness of implementation is another important sub-criterion to be met. A support scheme might be well designed at a theoretical level but in practice it might face barriers of implementation because of high complexity of its rules and regulations (*Klessmann, 2009*).

A common concern is that ex ante cost estimates may not reflect the actual costs of a policy when it is assessed from an ex post perspective. This highlights both the uncertainty that is included in an ex ante cost-effectiveness evaluation and the attention that has to be paid from the researcher's side during the procedure of the evaluation.

8. Ex-ante evaluation of the alternatives

In this section, an ex-ante evaluation of the continuation and strengthening of the current feed-in-premiums scheme and the introduction of a Swedish-Dutch RPS/FIP system as described in section 5 against the criteria developed in section 7 is made. As much quantification of the costs and benefits of reaching the 2020 targets as possible is made for both the alternatives in parallel. In some cases the costs and benefits are calculated independently for the two alternatives and then get compared while for other cases the focus is only on the difference between the costs and benefits between the two alternatives. It is important to mention that some criteria, such as job creation, are quantifiable but still difficult to be expressed in monetary terms and other criteria, such as sovereignty or local acceptance problems, are not even quantifiable.

Before the evaluation against the different criteria, what is first needed to be done for the quantification process is to determine the quantity sub-targets per technology per year (see table 3) for both alternatives. The “National target fulfilment” scenario referred in table 3 retrieved from the REPAP report

Table 10. Normalised contribution of renewables to electricity consumption for 2020 targets achievement

Technology	31/12/2012		31/12/2013		31/12/2014		31/12/2015		31/12/2016		31/12/2017		31/12/2018		1/1/2020	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Biomass	1,264.3	7,703.5	1,313.7	7,962.5	1,386.3	8,391.5	1,478.9	8,890.8	1,577.7	9,485.2	1,741.2	10,330.2	1,886.8	11,203.8	2,220.5	10,693.0
Solid	858.5	5,306.4	885.0	5,388.0	912.0	5,552.1	949.6	5,662.8	978.6	5,835.2	1,037.3	6,034.1	1,068.9	6,217.9	1,182.4	4,588.0
Biogas	128.0	695.5	144.4	829.0	183.8	1,055.0	232.1	1,397.4	295.3	1,778.6	392.4	2,372.5	499.4	3,019.5	717.0	4,086.0
MSW	277.8	1,701.5	284.2	1,745.6	290.6	1,784.4	297.2	1,830.6	303.8	1,871.4	311.5	1,923.6	318.5	1,966.4	321.1	2,019.0
Hydro, total	39.3	101.0	39.3	101.0	39.3	101.0	39.3	101.0	39.3	101.0	39.3	101.0	39.3	101.0	39.3	101.0
>10MW	37.0	100.0	37.0	100.0	37.0	100.0	37.0	100.0	37.0	100.0	37.0	100.0	37.0	100.0	37.0	100.0
<10MW	2.3	1.0	2.3	1.0	2.3	1.0	2.3	1.0	2.3	1.0	2.3	1.0	2.3	1.0	2.3	1.0
Photovoltaic	383.8	294.8	694.5	524.7	848.9	641.3	1,501.7	1,116.0	1,835.5	1,364.0	2,212.7	1,636.2	2,704.4	1,999.8	2,738.9	2,023.0
Wind	4,566.9	11,014.2	5,840.1	14,109.8	6,303.5	15,526.2	7,207.9	18,409.5	8,075.1	21,172.5	9,065.6	24,287.2	10,550.6	29,048.8	12,129.8	33,960.0
Onshore	3,930.6	8,971.8	4,802.1	10,709.8	4,899.1	10,926.2	5,039.4	11,223.6	5,141.2	11,450.4	5,153.2	11,451.3	5,257.4	11,682.7	5,359.4	11,852.0
Offshore	636.3	2,042.4	1,038.0	3,400.0	1,404.4	4,600.0	2,168.5	7,185.9	2,933.9	9,722.1	3,912.4	12,835.9	5,293.2	17,366.2	6,770.4	22,108.0
Gross final RES-E consumption	6,254.3	19,113.5	7,887.6	22,698.0	8,578.0	24,660.0	10,227.8	28,517.4	11,527.6	32,122.6	13,058.8	36,354.6	15,181.0	42,353.4	17,128.5	46,777.0

Source: Rosende, D. et al, 2010 and own elaboration called "Renewable Energy Industry Roadmap for the Netherlands" is also the "continuation and strengthening of the current scheme" alternative being investigated in this research. In order to make this table more detailed and determine the quantities needed for target accomplishment at a yearly basis from the year 2012 (which is the base year assumed) and on, a normalisation has been made as shown in table 10 making a realistic and soft transition from one year to the next.

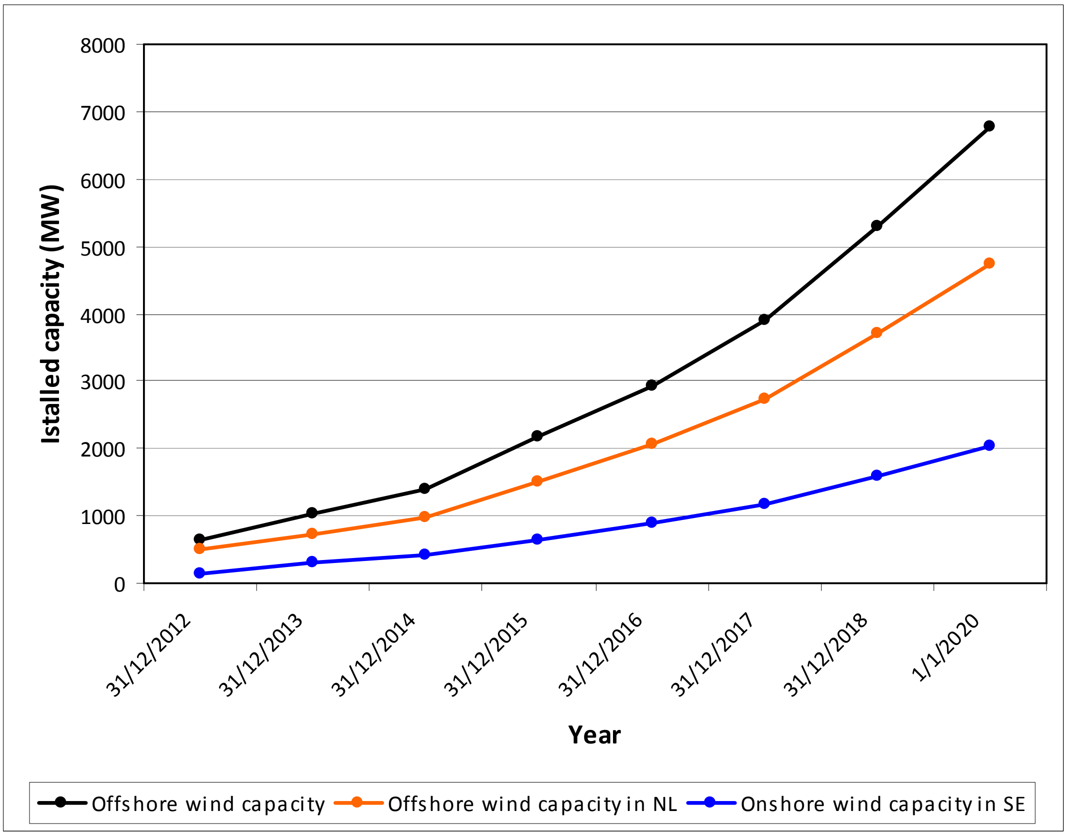
After having set the sub-targets per technology per year for the first alternative the same will be done for the "introduction of a Swedish-Dutch RPS/FIP support scheme" alternative also. In this case, the only difference is on the quantities of offshore wind as it is assumed that the offshore wind capacity sub-targets are decreased and replaced by Swedish onshore ones reaching a capacity of 2,000 MW in 2020. Table 11 shows how it is done in detail while in figure 3 a graphical depiction is given in order to make it more comprehensible (the black line (same as in the first alternative) is the sum of the orange one and the blue one).

Table 11. Wind installations as projected for the Joint support scheme alternative

Technology	31/12/2012		31/12/2013		31/12/2014		31/12/2015		31/12/2016		31/12/2017		31/12/2018		1/1/2020	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh
Wind	4567	11014	5840	14110	6303	15526	7208	18410	8075	21172	9066	24287	10551	29049	12130	33960
Onshore in NL	3931	8972	4802	10710	4899	10926	5039	11224	5141	11450	5153	11451	5257	11683	5359	11852
Onshore in SE	127	408	311	1020	421	1380	651	2156	880	2917	1174	3851	1588	5210	2031	6632
Offshore in NL	509	1634	727	2380	983	3220	1518	5030	2054	6805	2739	8985	3705	12156	4739	15476

Source: Own elaboration

Figure 3. Wind installations counting for Dutch targets



Source: Own elaboration

It is expected that the amount of onshore wind capacity in Sweden counting for the Dutch targets will grow gradually as shown in table 11 and figure 3 and it is assumed to cover a 30% of the Dutch offshore wind capacity that would be needed in order to meet the targets under the continuation and strengthening of the current support scheme (2,031.1 MW = 0.3*6,770.4 MW). Therefore, only 4,739.3 MW will have to be produced from Dutch offshore wind sources.

8.1. Evaluation against the criterion of effectiveness

The first evaluation criterion for a support scheme is its effectiveness in terms of the extent to which the support scheme meets the national RES targets for 2020. In this case that the target remains the same irrespective to the support scheme, the two alternative policies are assumed to be equally effective, because the target has to be reached either with the one or with the other policy. Therefore, it is assumed that the current scheme will be strengthened enough so that it boosts the introduction of the RES-E amounts needed to the power system, while for the Swedish-Dutch RPS/FIP system, it is assumed that the right targets will be set and that the system will be well designed and operate smoothly. The question that arises at this point is whether and to what extent one of the two policies scores better against the rest of the evaluation criteria.

8.2. Evaluation against the sub-criteria for cost-effectiveness

8.2.1. Development of low-cost RES potential

An insight to 2020, as expressed by table 3, helps us understand that the Netherlands can not rely on its domestic low-cost RES potential and only to meet the targets. This potential seems to be limited and meeting the 2020 targets is expected to require investments on higher-cost sources as well, such us offshore wind sources. Alternatively, it is likely that the introduction of a quota obligation will trigger the deployment of the lowest possible cost potential within the Dutch borders, while a joint Swedish-Dutch support scheme will stimulate access to new untapped low-cost Swedish renewable energy sources. Therefore, in the case of a joint coordination a higher level of cost effectiveness for the region as a whole is expected.

8.2.2. Windfall profits

Two of the main changes that the current SDE scheme introduced after the abolishment of the old MEP one, were the introduction of an ex post power price adjustment and the set of a ceiling on the total expenditure for RES-E production. The technology specific nature of the scheme provides the government with a tool to adjust the premiums at a yearly level and effectively control and reduce the likelihood of windfall profits occurrence. In the data retrieved from the "Renewable Energy Industry Roadmap for the Netherlands" report (*Rosende, 2010*) it is assumed that the continuation and strengthening of the current support scheme in the Netherlands will not have an effect on windfall profits.

On the contrary, the introduction of a demand-side RPS would not provide the government with the ability to control the prices of RES-E and, therefore, the level of windfall profits for generators that own the installations with the lowest generating costs. However, in a hybrid RPS/FIP system, this problem is solved by setting a ceiling on the certificates price. In addition, setting a reasonable target would be vital for the certificates' price development. As a result, it is assumed that investors' access to low cost Swedish onshore wind potential will not lead to extra windfall profits and that the government's involvement in influencing the certificates' price will lead to the diffusion of these lower costs to the final consumers (see section 8.3.4). Thus, both alternatives are expected to score equally good in this criterion.

8.2.3. Network integration costs

Meeting the 2020 targets based on the current feed-in premiums system, significant amounts of renewable energy would have to be introduced into the Dutch power system. This would require a significant amount of expenditures for new grid infrastructure. Such expenditures are expected to be lower in case that the Netherlands partly cover their needs for renewable energy by Swedish low cost RES potential.

As explained in section 6, it is assumed that the introduction of a joint Swedish-Dutch support scheme is expected to lead to the replacement of relatively high-cost Dutch offshore wind potential by Swedish low-cost onshore wind potential of a 2,000 MW capacity in 2020. The introduction of this capacity in the Swedish grid will bring with it network integration costs for Sweden. These costs would have to be covered by the Netherlands if this coordination does not take place as the same capacity would have to be introduced in the Dutch grid. It is expected that these network integration costs lie between 60 and 110 € per Dutch offshore kW installed (*Holttinen et al, 2006*) and the average of this range (85 €/kW) is assumed for the calculations. For every year (from 2012 to 2020) the new offshore wind capacity is multiplied by the network integration costs. The discounted sum for the continuation and strengthening of the current support scheme is about **406 M€** while for the introduction of a joint scheme with Sweden it is about **273 M€**, giving an amount of about 133 M€ avoided costs if the coordination takes place. It would be fair enough for Sweden to be compensated by this amount from the Netherlands and this should be considered during the negotiation processes, however in this analysis it is assumed to be an avoided cost for the Dutch side.

8.2.4. Avoided costs for grey electricity

A similar approach has been followed for the calculation of the lower fossil fuel imports that would take place if the 2,000 MW as mentioned above are installed in the Netherlands and not in Sweden. For this sub-criterion it is assumed that the 2,000 MW (or 6,632.4 GWh) of offshore wind sources would replace the same amount of electricity produced from coal which is at the base of the Dutch energy mix. It is here assumed that the cost of electricity produced by coal in the Netherlands will be 75 €/MWh (*Seebregts et al, 2009*).

The results show that if this 2,000 MW wind capacity is installed in Sweden, there will be an increase in the overall costs of electricity production by coal in the Netherlands of about **1322 M€** discounted from 2012 to 2020.

8.2.5. Support scheme changes

Since 2003 quite a lot of changes in the Dutch support scheme have taken place. The MEP scheme was abolished in August 2006 and after a period of inaction it was followed by the current SDE (see section 3.1). These changes have raised the level of uncertainty for the investors. The introduction of a new joint support scheme would certainly increase this uncertainty once more and would run the risk of not ensuring the desirable level of stability in the market.

8.2.6. Conservation of domestic potential

For the Netherlands, the continuation of the current support scheme requires the deployment of a significant part of the Dutch domestic RES potential. The access to new untapped low-cost RES potential provided by a joint support scheme to the Dutch producers would allow the Netherlands conserve a small part of the domestic potential and be able to use it if needed in the future.

8.2.7. Long-term aspect of cost-effectiveness

Under the current policy instruments the Netherlands will more likely have to diversify their renewables mixture to cover their needs in renewables and meet the targets. The deployment of all the low-cost RES potential (basically onshore wind) will trigger research and development on other RE technologies such as offshore wind, solar, small hydro and biomass. Such a development will provide the Netherlands with the chance to increase the cost-effectiveness of currently costly renewable technologies and take advantage of not only applying them within the Dutch borders but also of being the first to diffuse them at European and Global level. It is likely that the introduction of a joint Swedish-Dutch support scheme will not stimulate further research and development as such a coordination probably reduces the costs for target meeting (the lower the costs, the lower the need of further reducing the costs through R&D), loosing this way the advantage of being a leading force in future renewable technologies. It is important to mention that a joint RPS/FIP scheme, in principle, does not exclude the eventuality of increasing the expenditures for research and development, but it is likely that these expenditures will rather be considered to be unnecessary in terms of meeting the 2020 targets.

8.3. Evaluation against the political and social sub-criteria

8.3.1. Sovereignty

The current SDE scheme is a national support scheme that is characterised by full national sovereignty. The Dutch government makes the final decisions on the design aspects of the scheme taking under considerations the stakeholders involved, having this way the power to control the installations to be supported and the domestic RES potential. The introduction of a joint support scheme would require a partly supersession of national sovereignty. The matter of designing the joint support scheme is intergovernmental and includes both the Dutch and the Swedish stakeholders. One single government can not control the installations to be supported and the level of deployment of the domestic RES potential by itself. It is important to remind that a scheme coordination between Sweden and Norway has already been negotiated and is to start in 2012. The earlier the Dutch government takes action for entering the coordination the higher the chances are that it will be able to influence the designing process.

8.3.2. Harmonisation of support schemes at EU level

The SDE system is a national support scheme and it does not trigger coordination between Dutch parties and parties from other Member States. As such, it can not be considered to stimulate schemes harmonisation or even coordination at EU level. On the contrary, a Swedish-Dutch support scheme can help surpass the barriers of interstate coordination leading to a common harmonised system. Experience gained from a potential Swedish-Dutch coordination would be taken under serious consideration during negotiations of how a possible harmonised pan-European support scheme should look like.

8.3.3. Impact on the government's budget

Under the current FIP scheme, the need of introduction of a continuously rising amount of RES capacity in the Dutch energy mix in order to meet the targets and the continuously decreasing amount of domestic untapped low-cost RES potential are expected to cause a significant rise in the support level needed (*Jansen et al, 2010b*). On the contrary, one of the main advantages of a quota obligation system with green certificates is that it aims at assisting the growth of RES-E by stimulating cost-effective penetration of RES independent from the government budget.

Table 12. Weighted average (2011 to 2020) remuneration for yearly new RES installations (€/MWh)

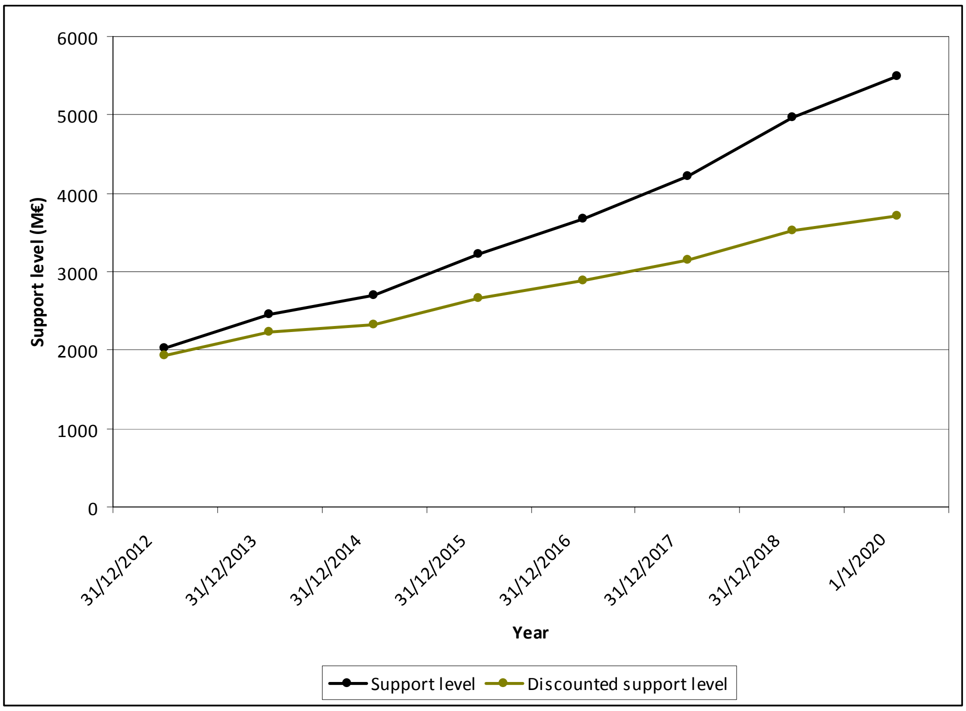
Biogas	139.1
(Solid) Biomass	107.0
Biowaste	96.6
Geothermal electricity	0.0
Hydro large-scale	0.0
Hydro small-scale	0.0
Photovoltaics	314.3
Solar thermal electricity	0.0
Tide & Wave	0.0
Wind onshore	98.5
Wind offshore	110.3
RES-E (average)	125.6

Source: Rosende et al, 2010

In order to calculate the overall need of support for reaching the 2020 targets, data from table 12 have been used. According to the authors this table "gives an indication on the necessary financial support by illustrating the weighted average (2011 to 2020) levelised (to a period of 15 years) total remuneration per MWh of RES generation for new installations in the NAT (National target fulfilment) case. This shows the gross support requirements as besides the financial premium offered by a RES support scheme also default revenues from the selling of the produced energy on the related energy market are included. Gross figures were selected here as net expenditures largely depend on the future development of energy and carbon prices at European as well as at global scale" (*Rosende et al, 2010*). It should be noticed that, a) the EIA deduction is included in the remuneration and b) the remuneration shown is an average value for new installations between 2011 and 2020. However, the second point is not expected to have a significant effect on the results of this analysis and for this reason no further attention is paid on it.

Therefore, quantities in table 10 have been multiplied with the remuneration level for each technology from table 12 and for each year (from 2012 to 2020). The results per year have been discounted assuming a 5% discount rate and 2012 as the first year. A graphic depiction of the support level needed per year is given in the following figure. As expected from the literature (*Jansen et al, 2010b*) the support level needed per year is continuously rising. The sum of these cash flows is 28,767.5 M€ (or **22,424 M€** discounted).

Figure 4. Support level per year



Source: Own elaboration

For the introduction of a joint Swedish-Dutch support scheme it is assumed that the certificates' price will not fall bellow the guaranteed minimum certificate price and therefore the level of support needed will be zero. However, it is assumed that there will be a continuation of the EIA scheme and it should be included because it was also included in the calculations of the overall support level of the first alternative. In this case, it is assumed that the EIA expenditure will continue in the future with a discounted maximum of 110 M€ per year (see section 3.1). For the period 2012-2020 it means government expenditure of **880 M€** in total.

8.3.4. Impact on consumers' expenditure

As explained above, the introduction of a hybrid RPS/FIP scheme reduces significantly the states expenditure providing consumers with alleviation of the extra electricity taxes or even extra income taxes that were essential in order to constitute the SDE budget. However, the introduction of a hybrid RPS/FIP system will have significant effects on the certificates market. Consumers will be additionally charged with the price of the certificates needed to meet their demand-side obligation. It is expected that the price of a certificate under a Swedish-Dutch hybrid RPS/FIP scheme will reach the amount of 40 €/MWh in 2020 (*Jansen et al, 2010b*). It is also assumed that the Dutch and the Swedish certificates' prices will instantly be equalised right after the joint scheme is activated. If we multiply this amount with the quantities of green electricity that are expected to be consumed in order to be in line with the indicative sub-targets, the extra costs for the consumers would be 10,104 M€ (or **7,904.5 M€** discounted).

However, in addition to this additional cost for the consumers there will also be an extra benefit (or avoided cost). Having assumed a same-level of profits for the investors because of the government's potential provided by the hybrid RPS/FIP scheme to influence the certificates' price by setting a ceiling price, the benefits (or avoided costs) of the investors' access to the Swedish low-cost wind potential will be diffused to the final consumers. In order to calculate what this avoided cost will be after the introduction of the joint Swedish-Dutch support scheme, the quantities to be produced and costs of the respective wind installations in both countries should be defined. For the quantity of onshore and offshore wind capacities needed for target accomplishment both within the Dutch borders and out of them, a 30% of the Dutch offshore wind capacity as indicated in table 11 is assumed to be replaced by Swedish onshore wind capacity for the whole period from 2012 to 2020. For the determination of the costs of the offshore wind installations in the Netherlands and the onshore wind installations in Sweden the analysis has been based on data retrieved from the following table published by ECN:

Table 13. Projected generation cost of renewable electricity technologies in 2008 / 2020

	2008 [€/MWh]	2020 [€/MWh]
Onshore wind		
Germany	105	65 - 75
Netherlands	95	65 - 75
Poland	100	75 - 85
Spain	90	70 - 80
Sweden	105	70 - 80
Offshore wind		
Germany	175	120 - 135
Netherlands	175	120 - 135
Poland	190	130 - 145
Spain	215	150 - 165
Sweden	190	130 - 145

Source: Jansen et al, 2010b

To make the analysis more realistic and specific a gradual, annual decrease of the costs has been assumed from the indicated cost in 2008 to the average of the projected range in 2020. In order to calculate the avoided cost provided to Dutch consumers by the access to Swedish wind potential, the onshore wind capacity that is projected to be installed in Sweden from 2012 to 2020 per year was multiplied by the projected costs of onshore wind technology in Sweden each year. The discounted sum of every year's cost was 1,425 M€ and it shows how much it will cost to reach 2,000 MW from Swedish onshore sources in 2020. In order to calculate how much this cost would be based on Dutch offshore wind sources the same amount of capacity was multiplied by the projected costs of offshore wind technology in the Netherlands each year. The discounted sum of every year's cost in this case was 2,410 M€. The difference between the two is **985.5 M€** and it reflects the avoided cost from such a coordination for the Dutch side (diffused to the Dutch consumers).

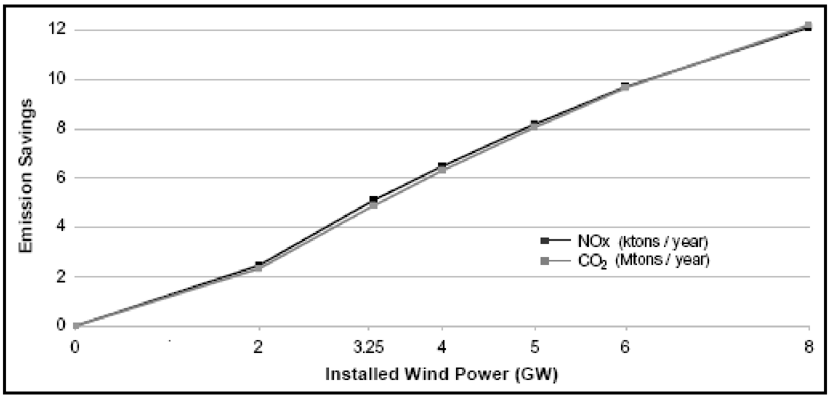
8.3.5. Local benefits

The bigger the amount of RES installations in Sweden for Dutch target achievement is the more are the local benefits that may be missed out for the Netherlands (gained for Sweden respectively). Such benefits can be typical local benefits that run after a RES installation such as increased security of supply, environmental benefits (e.g. avoided NOx emissions) and local job creation. On the contrary, the continuation and strengthening of the current SDE relies on the deployment of domestic Dutch RES potential and, thus, it takes advantage of local benefits that can occur. It is underlined that avoided CO2 emissions are not included as a sub-criterion because, either the RES capacity is installed in the Netherlands or in Sweden, at an international level the avoided CO2 emissions will be the same. Regarding security of supply, quantification is not possible, however it is obvious that the continuation and strengthening of the current support scheme alternative scores better than the Swedish-Dutch coordination alternative as 2,000 MW more RE capacity is expected to be installed within the Dutch borders. Regarding environmental benefits and local job creation, quantification is given in the following paragraphs.

Environmental benefits

As shown in figure 5 more than 2 ktons of NOx would be saved by the installation of 2000 MW offshore wind capacity in the Netherlands only for 2020. The cumulative amount of NOx emissions saved from 2012 to 2020 for these 2,000 MW would be **7,902 tons of NOx**. Assuming a cost of 8,647 $€_{2008}$/ton of NOx emitted (or 10,010 $€_{2010}$/ton of NOx emitted), the total discounted avoided costs deriving from the above mentioned avoided NOx emissions is about **59 M€** (*de Bruyn et al, 2010*).

Figure 5. NOx and CO2 savings as a result of wind power in the Netherlands

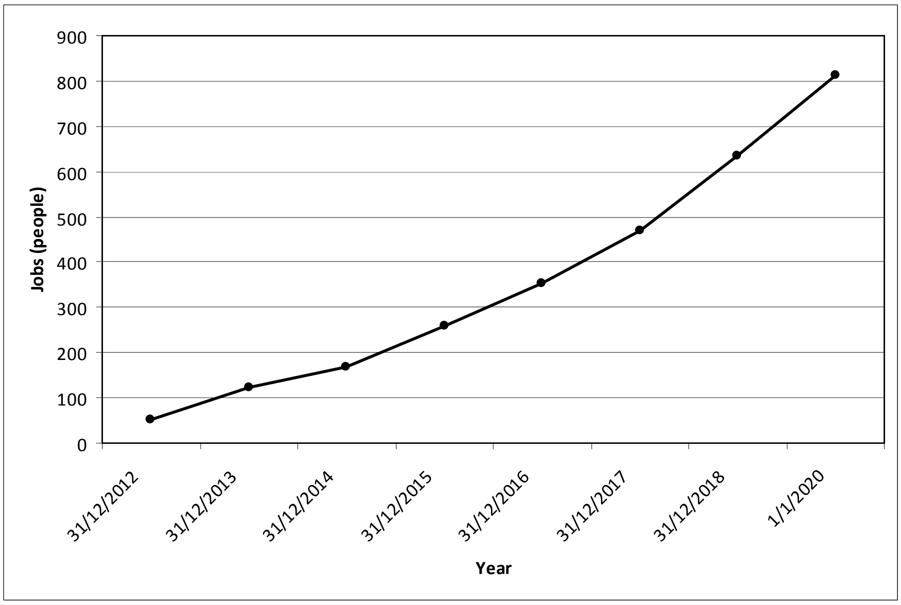


Source: Ummels, 2006

Local job creation

Another benefit that runs after the installation of wind capacity is the local job creation. It is assumed that 0.4 jobs are created per MW of cumulative capacity in operations and maintenance and other activities (*EWEA, 2009*). This gives an increasing number of job creation that in 2020 reaches about **812 jobs**.

Figure 6. Job creation in the Netherlands caused by the gradual introduction of 2,000 MW of offshore wind capacity



Source: Own elaboration

8.3.6. Local costs

Not only local benefits but also local costs can run after a RES installation. A joint Swedish-Dutch coordination could help the Netherlands avoid these costs which, from another perspective, will be an extra burden for Sweden. Such costs can be local acceptance problems (Swedish citizens' ''not in my backyard'' opposition generated by the extra wind turbines that count for the Dutch targets) and secondary support costs (e.g. tax incentives) that would be paid to the RES installation by Sweden. A fairly designed joint scheme should minimise or compensate such local costs, either indirectly, by money transfer from the Netherlands to Sweden or directly, by providing Dutch support to the RES installation (*Klessmann et al, 2010*).

8.4. Evaluation against the technical criteria

8.4.1. Institutional constraints

The introduction of joint Swedish-Dutch, RPS/FIP scheme would have to overcome institutional barriers both because of institutional changes because of the compatibility that has to be reached between the two countries' systems and because of a shift from a FIP system to a quota based one. Institutions involved from both sides in the whole cycle of the certificates system (CertiQ, TenneT, Energiekamer, Agentschap NL, Svenska Kraftnät, Swedish Energy Agency, etc) should cooperate with each other in order to reach a smooth system operation, therefore some of the existing institutions might need to alter their functions, new ones might need to be established and some of the existing institutions may even need to close down. Changes to the legal system will also need to take place. With the continuation of the current SDE scheme the above mentioned changes could be avoided.

8.4.2. Easiness of implementation

Regarding the introduction of a joint Swedish-Dutch, RPS/FIP scheme complexity issues during the implementation stage might arise. Such a hybrid system is more complex than the current FIP scheme at a designing level. It should not be underestimated that such a hybrid scheme has not been implemented previously and therefore there is not any previous example that can guarantee that it will bring the desirable outcomes. The high complexity of its rules and regulations might in practice create problems that have not been foreseen.

8.5. Summarisation of the results

In the following table all the results of the different parts of the evaluation process are collected and put together. The red coloured numbers indicate a cost and the green ones a benefit. Only for the government's budget and the network integration costs the calculations have been made separately for the two alternatives while for the rest of the quantifiable sub-criteria only the extra benefits or the extra costs deriving from choosing an alternative instead of the other have been calculated. The non-quantifiable sub-criteria are evaluated in a qualitative scale (-/+), where a green (+) is used for the cases where an alternative scores better (or less bad) than the other and a red (-) in cases where an alternative scores worse (or less good) than another respectively.

Table 14. Evaluation of the alternatives

	Continuation and strengthening of the current situation	Joint Swedish-Dutch Hybrid RPS/FIP
Effectiveness	+	+
Cost-effectiveness		
Development of low-cost RES potential	-	+
Windfall profits	+	+
Network integration costs (M€)	-406	-273
Avoided costs for grey electricity (M€)	0	-1,322
Support scheme changes	+	-
Conservation of domestic potential	-	+
Long-term aspect of cost-effectiveness	+	-
Political and social criteria		
Sovereignty	+	-
Harmonisation of support schemes at EU level	-	+
Impact on the government's budget (M€)	-22,424	-880
Impact on consumers' expenditure (M€)	0	-7,904 985
Local benefits	+	-
Increased security of supply	+	-
Environmental benefits	+	-
Avoided NOx emissions (tons)	0	-7,902
Avoided NOx emissions (M€)	0	-59
Local job creation (People)	0	-812
Local costs	-	+
Secondary support costs	-	+
Local acceptance problems	-	+
Technical criteria	+	-

Institutional constraints	+	-
Easiness of implementation	+	-

Source: Own elaboration

From an economic perspective, the introduction of a joint Swedish-Dutch support scheme scores better than the continuation and strengthening of the current support scheme saving **13,176 M€** for the Dutch society. It is important to mention that there are criteria such as job creation that are difficult to be expressed in monetary terms and other criteria that are not even quantifiable. Their qualitative character does not allow further reflection of the extent to which an alternative scores better or worse than the other and this is really important especially in future energy policy cases where costs and benefits can be extremely high. In addition, these criteria are not of equal importance because their weight on the final decision differs, however it is highlighted that, together with the quantifiable ones, they should also be taken under serious consideration during the decision making and negotiation processes.

9. Sensitivity analysis

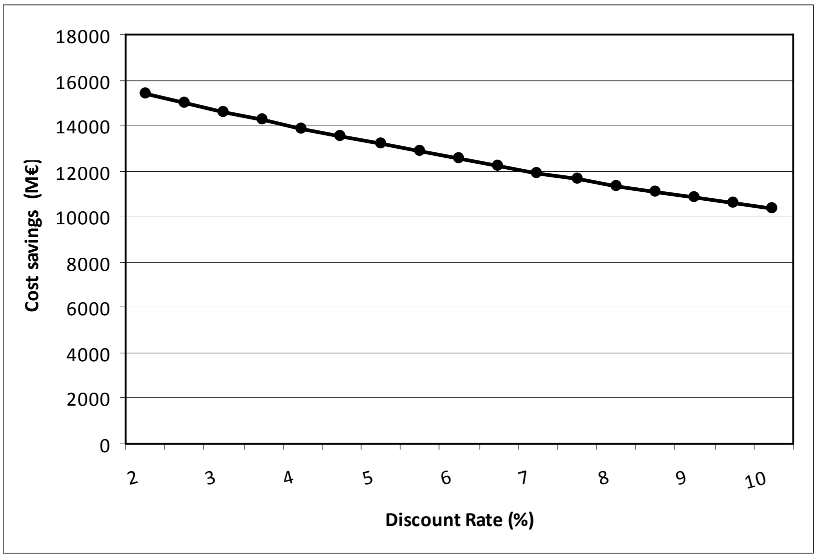
The aim of the sensitivity analysis is to test the robustness of the results achieved after applying the CBA method. The objective is to investigate what the effect on the cost savings will be in case of introducing a Swedish-Dutch support scheme instead of continuing and strengthening the current one for different values of the main assumptions. In particular, the assumptions that are expected to have had a significant effect as shown in table 14 are:

- The discount rate that has a significant effect on the net present value (NPV) of every monetarised criterion
- The certificates' price that has an impact on the consumers' expenditure
- The support level per technology that has an effect on the government's budget for the continuation and strengthening of the current support scheme scenario
- The cost of electricity produced from coal that has an impact on the avoided costs for grey electricity

A sensitivity analysis for different values of the NOx shadow price is not included since they don't have a significant impact on the overall costs (see table 14). The results are in favour of introducing a Swedish-Dutch support scheme when above zero and in favour of continuing and strengthening the current one when below zero.

Sensitivity analysis on discount rates

Figure 7. Difference in cost savings for the two alternatives for different levels of discount rate



Source: Own elaboration

As shown in figure 7, the Dutch society as a whole can save 10 to 16 B€ for different levels of discount rate if a joint Swedish-Dutch RPS/FIP is introduced. In particular, the higher the discount rate is, the lower these cost savings get, however they are not expected to reach a zero level in any case. Therefore, the different levels of discount rate are not enough to make the continuation and strengthening of the current support scheme a less costly option which makes the results robust.

Sensitivity analysis on certificates' prices

Figure 8. Difference in cost savings for the two alternatives for different certificates' prices

Source: Own elaboration

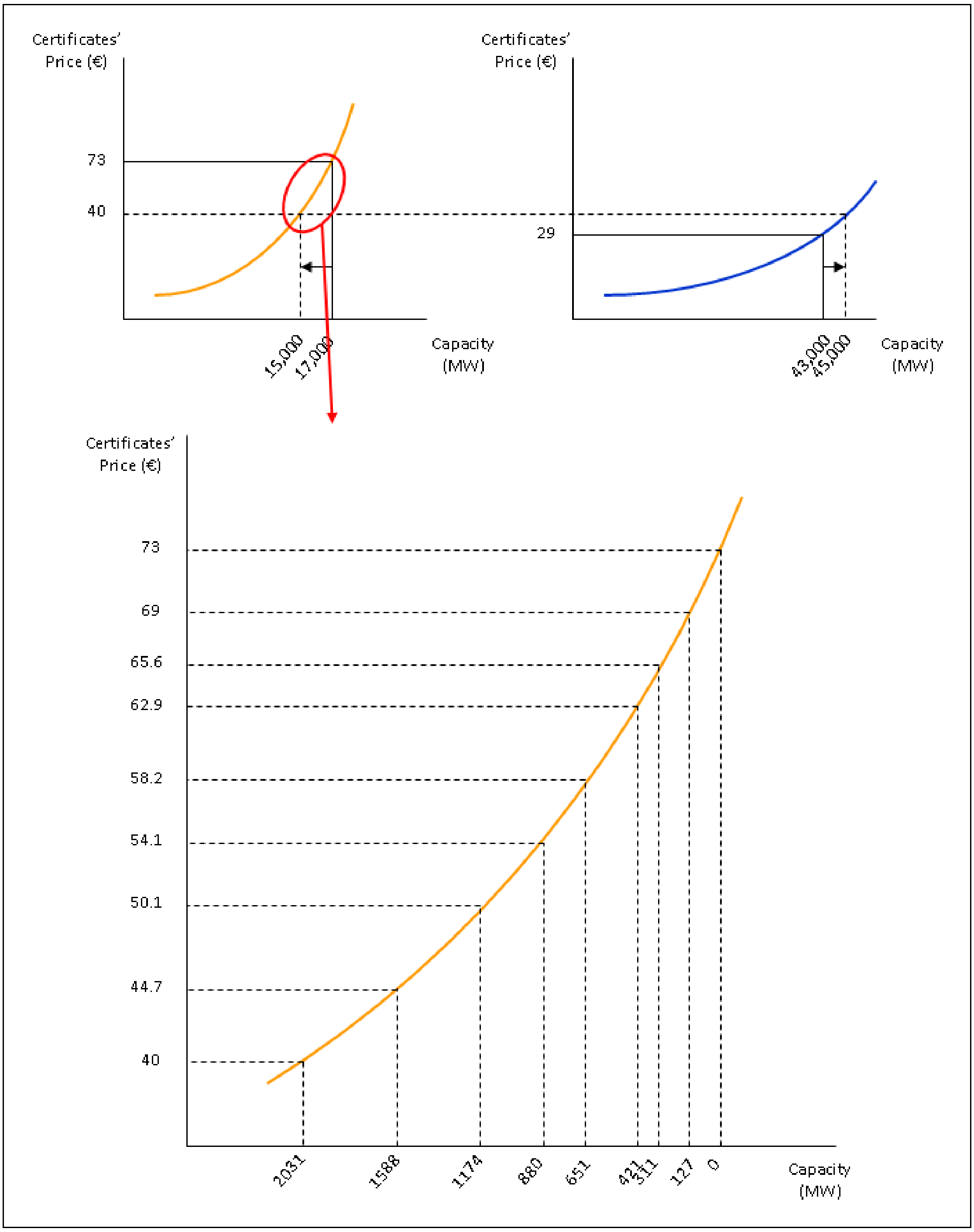
In figure 8, it is shown that the Dutch society as a whole can save 7 to 17 B€ for different certificates' prices if a joint Swedish-Dutch RPS/FIP is introduced. In particular, the higher the certificates' price is, the lower these cost savings get, always assuming the same level of profits as in the continuation and strengthening of the current support scheme alternative. However, assuming that Sweden influences the equalised certificate price more than the Netherlands as the amount of RES capacity to be installed in the two countries by 2020 is 45,000 MW and 15,000 MW respectively, it is expected that the equalised price will not lay above 70 €/MWh. This projection would prove to be wrong only in case that the Dutch certificates' price lays above 193 €/MWh which seems almost impossible to happen, taking under consideration the historical certificates' prices of the already existing quota based support schemes, which makes the results quite robust (*Voogt et al, 2006*), (29*45,000 + X*15,000 > 70*60,000 => X > 193).

As explained in section 8.3.4, it is assumed that the Dutch and the Swedish certificates' prices will instantly be equalised right after the joint scheme is activated. In this part a sensitivity analysis will also be made for the case that it does not happen. In this case, it is expected that two different prices will take place in the market and the more capacity is installed in Sweden the closer the cerificates' prices get achieving a final equilibrium in 2020 (see figure 2). What is now tried to be done is to project the future prices of the Dutch certificates starting from 73 €/MWh in 2012 (29*45,000 + X*15,000 = 40*60,000 => X = 73) and reaching the equalised price of 40 €/MWh in 2020. This projection will be based on the assumed Dutch cost curve as shown in figure 2, however this cost curve can be quite different in reality.

Figure 9 shows how exactly this projection was made. If we now multiply these prices with the quantities of green electricity that are expected to be consumed in order to be in line with the indicative sub-targets, the extra discounted costs for the consumers would be 10,645 M€ instead of 7,904.5 M€ that was the case previously. This leads to savings of **10,436 M€** for the Dutch society as a whole if the prices develop as shown in figure 9 after the introduction of a joint Swedish-Dutch RPS/FIP. It is reminded that if the Dutch and the

Swedish certificates' prices are instantly equalised right after the joint scheme is activated, the respective savings for the Dutch society are expected to lay around 13,176 M€ (see section 8.5)

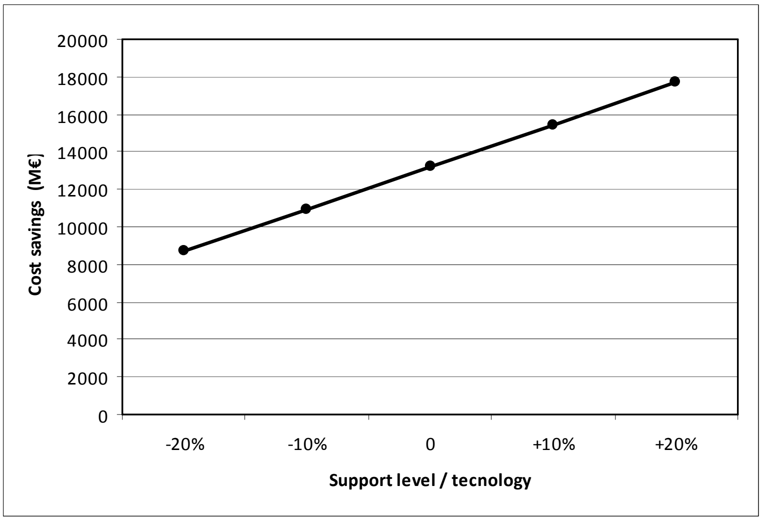
Figure 9. Dutch certificates' price projections reaching an equalised price of 40 €/MWh in 2020



Source: Own elaboration

Sensitivity analysis on the support level per technology

Figure 10. Difference in cost savings for the two alternatives for different support levels per technology

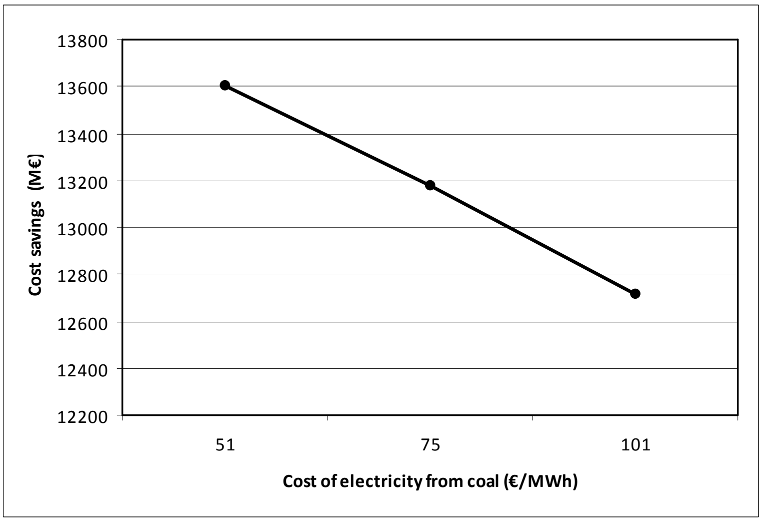


Source: Own elaboration

As shown in figure 10, savings of about 9 and 18 B€ can be achieved for different support level per technology in the continuation and strengthening of the current SDE if a joint Swedish-Dutch RPS/FIP is introduced. In particular, the lower the support level is, the lower these cost savings get, however they are expected to reach a zero level only after halving the support level. In this case, it is impossible that the support level will be enough to ensure target accomplishment. Therefore, the sensitivity analysis shows robustness of the results in this case also.

Sensitivity analysis on the cost of electricity from coal

Figure 11. Difference in cost savings for the two alternatives for different levels of cost of electricity from coal



Source: Own elaboration

As shown in figure 11, the difference between the costs saved for the alternatives can vary from 12.7 to 13.6 B€ depending on the cost of electricity from coal. In particular, the higher the cost of electricity from coal is, the less are the savings achieved from the introduction of a joint Swedish-Dutch support scheme, however they are not expected to reach a zero as the effect of the cost of electricity on the results is insignificant.

Extreme scenarios

In this last part of the sensitivity analysis, a further insight on what the effects on the results will be under extreme conditions is given. The “Extreme A” scenario includes the assumptions that effect the costs and benefits in a favourable way for the continuation and strengthening of the current scheme alternative while the “Extreme B” scenario does the same in favour of the introduction of a joint Swedish-Dutch RPS/FIP scheme. A third scenario called “Prospective” scenario makes assumptions as close to the prospective values of the assumptions as possible. The following table shows the results.

Table 15. The results in three different scenarios

Scenario	Extreme A	Prospective	Extreme B
Discount rate (%)	10	5	2
Certificates' price (€/MWh)	70	40	20
SDE support level	-10%	As projected	+10%
Cost of coal electricity (€/MWh)	101	75	51
Savings (M€)	**3,440**	**13,176**	**23,064**

Source: Own elaboration

As shown in the table, under normal conditions (prospective scenario) the introduction of a joint support scheme is expected to lead to savings of 13,176 M€. Assumptions that effect the costs and benefits in a favourable way for the introduction of a joint support scheme would launch the savings to about 23 B€, while the “Extreme A” scenario would decrease the benefits of the introduction of a joint support scheme with Sweden to only 3.5 B€.

10. Conclusions and discussion

This research has examined and evaluated two policy alternatives to reach the binding national target of 14% share of energy from renewable sources by 2020 in the Netherlands in the most cost effective way. The first alternative was the continuation of the current support scheme while the second one was the introduction of a Swedish-Dutch joint support scheme.

In the beginning it was explained that the legal framework that supports such joint coordination has been set by the EU and an overview of the Dutch targets and sub-targets was provided. Chapter 3 described what the available strategies to meet these targets are and described the current situation in the Netherlands and in Sweden. In chapter 4 it is concluded that meeting the targets with the continuation of the current support scheme is not thought likely to happen. Therefore, the first alternative changed from "continuation of the current support scheme" to "continuation and strengthening of the current support scheme" while the design aspects of the second alternative (a Swedish-Dutch hybrid RPS/FIP scheme) were described in chapter 5. Chapter 6 tried to give a first qualitative insight in what the effects that the implementation of the alternatives are expected to be on the Dutch society and in chapters 7 and 8 the evaluation of the alternatives was made. It is concluded that the introduction of the Swedish-Dutch hybrid RPS/FIP scheme assumed will lead to savings of 13,176 M€ compared to the social costs of reaching the targets with the strengthening of the current scheme. As explained in chapter 9 these results are quite robust.

It is very important to mention that there are criteria that are not quantifiable. Therefore, qualitative costs such as loss of sovereignty, decreased security of supply or decreased job creation compared to the continuation of the current support scheme are not included in these 13,176 M€. Such qualitative criteria can be highly important and, thus, have to be considered during the decision making and negotiation processes. The qualitative character of some criteria can be treated with further evaluation based on other tools like multi-criteria analysis (MCA), however such a method has other disadvantages.

The results of the sensitivity analysis show that there is a high level of certainty that a support scheme coordination between the Netherlands and Sweden can lead to cost-effectiveness and increased social economic welfare for the Netherlands. However, it is highly suggested that a similar research is made for the Swedish side in order to shed light on the impacts that such a coordination will have on the Swedish society. Another very realistic suggestion could be the inclusion of Norway in the coordination which was excluded in this research in order to simplify it. In any case, further research including more alternatives for the Dutch side should be made to make the decision objective. Such alternatives could be:

- The introduction of a feed-in tariffs scheme
- The introduction of a feed-in tariffs scheme and further coordination with other MS
- The introduction of a pure RPS
- The introduction of a pure RPS and further coordination with other MS
- The introduction of an RPS/FIP without coordination with another MS
- The introduction of an RPS/FIP and further coordination with MS other than Sweden

The ex-ante character of the evaluation of the alternatives requires that assumptions are made for the future increasing the uncertainty of the estimates and, therefore, the uncertainty of the results of this research. It is suggested that further research on the assumptions with the greatest impact on the results is conducted. Such assumptions are the future Dutch electricity demand throughout the period 2012-2020 which will significantly determine the amount of RES capacity to be installed, the future certificates' price for the same period which can significantly influence the results as the sensitivity analysis has shown and the future cost of electricity from coal throughout the same period.

References

Bryntse, G., Mattison, M., 2010. *Renewable energy policy action paving the way towards 2020: National Renewable Energy Source Industry Roadmap for Sweden.* Swedish Renewable Energies Association.

CBS, 2009. *Renewable energy in the Netherlands 2008.* The Hague/Heerlen.

de Bruyn, S., Korteland, M., Markowska, A., Davidson, M., de Jong, F., Bles, M., Sevenster, M., 2010. *Annexes - Shadow Prices Handbook*. CE Delft, Delft, the Netherlands.

Directorate for Energy and Sustainability of the Netherlands, 2009. *Forecast document.* The Hague

European Commission, 2006. *Green Paper of 8 March 2006 on the European Strategy for Sustainable, Competitive and Secure Energy.* Brussels.

European Commission, 2008. *Sweden – Renewable Energy Fact Sheet.*

European Commission, 2009. *The Renewable Energy Progress Report.* Brussels.

European Commission, 2010. *Summary of the Member State Forecast Documents.*

European Parliament and Council, 2009. *Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources.*

European Renewable Energy Council, 2010. *Renewable energy policy review: The Netherlands.*

European Wind Energy Association (EWEA), 2009. *Wind at Work: Wind energy and job creation in the EU.* European Wind Energy Association (EWEA)

Financial Management Group of the Department of Finance and Administration of the Commonwealth of Australia, 2006. *Introduction to Cost-Benefit Analysis and Alternative Evaluation Methodologies*. Commonwealth of Australia.

Gupta, S., Tirpak, D., Burger, N., Gupta, J., Höhne, N., Ivanova Boncheva, A., Kanoan, G.M., Kolstad, C., Kruger, J., Michaelowa, A., Murase, S., Pershing, J., Saijo, T., Sari, A., den Elzen, M., Yang, H., Haites, E., Pichs, R., 2007. *Policies, instruments and co-operative arrangements.* Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Holttinen, H., Meibom, P., Orths, A., Van Hulle, F., Ensslin, C., Hofmann, L., McCann, J., Pierik, J., Tande, J.O., Estanqueiro, A., Söder, L., Strbac, G., Parsons, B., Charles Smith, J., Lemström, B., 2006. *Design and Operation of Power Systems with Large Amounts of Wind Power, first results of IEA collaboration.* International Energy Agency's Global Wind Power Conference, Adelaide, Australia.

International Energy Agency (IEA), 2009. World Energy Outlook: executive summary. Paris, France

Jansen, J.C., Gialoglou, K., Egenhofer, C., 2005. *Market stimulation of renewable electricity in the EU: What degree of harmonisation of support mechanisms is required?*. Centre for European Policy Studies.

Jansen, J.C., 2010a. *Preliminary qualitative assessment of proposed measures to foster renewable and low carbon sources in the Dutch electricity mix.* Energy Research Centre of the Netherlands.

Jansen, J.C., Uslu, A., Lako, P., 2010b. *What is the scope for the Dutch government to use the flexible mechanisms of the Renewables Directive cost-effectively?: A preliminary assessment*. Energy Research Centre of the Netherlands.

Klessmann, C., 2009. *The evolution of flexibility mechanisms for achieving European renewable energy targets 2020: ex-ante evaluation of the principle mechanisms.* Energy Policy 37 (2009) 4966–4979.

Klessmann, C., Lamers, P., Ragwitz, M., Resch, G., 2010. *Design options for cooperation mechanisms between Member States under the new European Renewable Energy Directive.* Ecofys, Fraunhofer Institute for Systems and Innovation Research, Energy Economics Group (Vienna University of Technology).

Koutstaal, P., Bijlsma, M., Zwart, G., van Tilburg, X. (ECN), Özdemir, Ö. (ECN), 2008. *Market performance and distributional effects on renewable energy markets.* CPB Netherlands Bureau for Economic Policy Analysis, The Hague, the Netherlands.

Morthorst, P.E., 2006. *Assessment and optimisation of renewable support schemes in the European electricity market - Work Package 6: Interactions with other policies and markets.* RISØ National Laboratory, Energy Economics Group (Vienna University of Technology), Fraunhofer Institute for Systems and Innovation Research.

Ragwitz, M., Held, A., Resch, G., Faber, T., Haas, R., Huber, C., Morthorst, P.E., Jensen, S.G., Coenraads, R., Voogt, M., Reece, G., Konstantinaviciute, I., Heyder, B., 2007. *Assessment and optimisation of renewable energy support schemes in the European electricity market.* Karlsruhe, Germany.

Resch, G., Lopez-Polo, M.A., Auer, H., Haas, R., Energy Economics Group (EEG), Twidell, J., Kjaer, C., Chandler, H., 2005. *Electricity from renewable energy sources in EU-15 countries – a review of promotion strategies.* Energy Economics Group, Vienna University of Technology, Vienna, Austria.

Resch, G., Panzer, C., Haas, R., Ragwitz, M., Held, A., Rathmann, M., Reece, G., Huber, C., Faber, T., Morthorst, P.E., Jensen, S.G., Jaworski, L., Konstantinaviciute, I., Pasinetti, R., Vertin, K., 2009. *Furure-e Action Plan- Deriving Future European Policy for Renewable Electricity. Futures-e project.* Energy Economics Group, Vienna University of Technology, Vienna, Austria.

Rosende, D., Ragwitz, M., Klingel, M., Resch, G., Panzer, C., 2010. *Renewable energy policy action paving the way towards 2020: Renewable Energy Industry Roadmap for the Netherlands.* Fraunhofer Institute Systems and Innovation Research (Karlsruhe), Vienna University of Technology, Energy Economics Group (Vienna) and ECOFYS Netherlands.

Ruokonen, J., Sinnemaa, A.M., Magnusson, R., Gautesen, K., Seppänen, S., Opsal, S., 2010. *Analysis of the flexible support mechanisms in the Directive on the promotion of the use of energy from renewable sources.* The Nordic Working Group for Renewable Energy, GreenStream Network Plc.

Rydén, B., Abildgaard, J., Carlén, B., Engberg Pedersen, T., Fritz, P., Hamarsland, G., Gipperth, L., Havskjold, M., Honkatukia, J., Koljonen, T., Koreneff, G., Müller Engelbrektson, I., Ravn, H., Sandoff, A., Sköldberg, H., Springfeldt, P.E., Tennbakk, B., Tolonen, J., Torgersen, L., Unger, T., von Schemde, A., Widmark, A., 2006. *Ten Perspectives on Nordic Energy.* Nordic Energy Perspectives.

Seebregts, A., Groenenberg, H., 2009. *How may CCS technology affect the electricity market in North-Western Europe?* Energy Procedia 1 (2009) 4181–4191, Energy Research Centre of the Netherlands.

Swedish Energy Agency, 2009a. *Special Forecast Document for Sweden under Article 4(3) of Directive 2009/28/EC.* Swedish Energy Agency.

Swedish Energy Agency, 2009b. *The electricity certificate system, 2009.* Swedish Energy Agency.

UHY, 2010. *Netherlands - Country profile.* UHY International Ltd

Ummels, B.C., Gibescu, M., Pelgrum, E., Kling, W.L., 2006. System Integration of Large-Scale Wind Power in the Netherlands. Institute of Electrical and Electronics Engineers (IEEE).

van Hulle, F., Gardner, P., 2009. *Wind Energy - The Facts, Part II: Grid Integration.* European Wind Energy Association.

Voogt, M., Luttmer, M., de Visser, E., 2006. *Summary of the main report "Review and analysis of national and regional certificate schemes" produced within the framework of WP2 of the Eurowhitecert project.* Ecofys