What is the scope for the Dutch government to use the flexible mechanisms of the Renewables Directive cost-effectively?

A preliminary assessment

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Abstract

This report provides a preliminary assessment of the scope for cost-effective use by the Dutch government of each of four flexible mechanisms available to EU Member States to achieve their respective mandatory renewables target in year 2020. The flexible mechanisms, defined in the Renewables Directive 2009/28/CE, are:

- Statistical transfers between Member States.
- Joint projects between Member States.
- Joint projects between Member States and third countries.
- Joint support schemes.

In theory, *statistical transfers* and *joint support schemes* are the flexible mechanisms with the most potential for cost-effective use. The Dutch government is advised to explore each of these options. In this report, it is argued that in practice well-designed *joint support schemes* are likely to turn out having most potential. To that effect, the report presents a concrete suggestion on the most promising short-term application. To successfully harness a substantial part of the *joint support schemes* potential warrants protracted efforts in the design phase: the devil is in the detail.

Moreover, the *joint projects between Member States* mechanism may well turn out to provide some interesting opportunities. For collaboration between the Netherlands and a selection of (four) other Member States some technologies to focus upon are identified. Reasons are given why the flexible instrument *joint projects between Member States and third countries* is poised to have quite limited potential to cost-effectively contribute to the Dutch renewables target in year 2020.

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De pas in werking getreden richtlijn hernieuwbare energie (‘de richtlijn’) legt aan elk van de lidstaten een bindende nationale doelstelling op voor het aandeel hernieuwbaar in het finale energieverbruik in het jaar 2020. Dit weerspiegelt de in Europa breed-gedragen positieve waardering van een aantal extra voordelen van hernieuwbare energie bovenop de bijdrage ervan richting een koolstofarme energie-economie. Voor Nederland bedraagt de voornoemde bindende doelstelling hernieuwbaar 14%. Voorts stelt de richtlijn de boekhoudmethode vast die gehanteerd dient te worden om de doelstellingsrekeneenheden te meten. Dit zijn de eenheden (in MWh) die tellen voor het behalen van de doelstelling door een lidstaat. De richtlijn biedt de lidstaten de gelegenheid om een gedeelte van hun nationale EU doelstelling onder bepaalde voorwaarden in het buitenland te behalen De lidstaten, waaronder de Nederlandse overheid, kunnen in principe buitenlandse doelstellingsrekeneenheden verwerven. Zij dienen dan gebruik te maken van een of meerdere van de flexibiliteitsmechanismen, die in de richtlijn gedefinieerd zijn, namelijk:

- ‘Statistische overdrachten’, d.w.z. overdrachten van doelstellingsrekeneenheden.
- Gezamenlijke projecten tussen EU-lidstaten.
- Gezamenlijke projecten tussen EU-lidstaten en derde landen.
- Gezamenlijke steunsystemen (voor vermarkting van hernieuwbare energie).

Dit rapport analyseert de ruimte die er voor Nederland bestaat voor het inzetten van deze ‘flexmechs’ om zijn bindende doelstelling van 14% hernieuwbaar in 2020 te behalen **tegen lagere kosten voor de Nederlandse samenleving dan zonder deze inzet mogelijk is**. In Nederland is een steunsysteem van kracht dat vormgegeven wordt door productiesubsidies voor de voortbrenging in Nederland van bepaalde hernieuwbare-energieproducten, de zogenaamde SDE-subsidies. Wij gaan er in dit rapport vanuit dat vanaf 2013 de eindverbruikers van elektriciteit via een opslag op hun elektriciteitsprijs de door de overheid betaalde SDE-subsidies voor productie door nieuwe hernieuwbare installaties dienen op te brengen.

Verreweg het grootste reële potentieel voor verlaging van de subsidielasten voor Nederlandse samenleving van het stimuleren van de vermarkting van hernieuwbare energie zien wij in het instrument *gezamenlijke steunsystemen*. Als de beste mogelijkheid hiertoe op korte termijn hebben wij een gezamenlijk *Renewable Portfolio Standard (RPS)* systeem - een verplichting hernieuwbare elektriciteit, op te leggen aan elektriciteitsleveranciers - geïdentificeerd. In het bijzonder gaat het om een gezamenlijk RPS-systeem met Zweden alsmede eventueel Noorwegen, met inbegrip van een certificatensysteem. **Dit levert een besparing aan marktsteun aan ‘hernieuwbaar’ voor de Nederlandse samenleving op die tot enkele honderden miljoenen euro per jaar belopen. Van groot belang hierbij is dat zo’n systeem in Nederland gecombineerd wordt met de huidige SDE regeling. De gemiddelde certificaatopbrengst dient dan verwerkt te worden in het huidige correctiemechanisme achteraf van de jaarlijkse SDE subsidie.** Zweden en Noorwegen bereiden de invoering van een gezamenlijk Zweeds-Noors systeem in 2012 voor. Wij adviseren dat de Nederlandse regering de mogelijkheden gaat verkennen om bij het Zweedse RPS systeem, mogelijk in combinatie met Noorwegen, aansluiting te verkrijgen. Een voortvarende aanpak kan Nederland meer mogelijkheid bieden op het ontwerp van dit tot stand te brengen gezamenlijke steunsysteem invloed uit te oefenen.

Het Nederlandse belang van het realiseren van een dergelijk gezamenlijk steunkader reikt bovendien verder dan het meer kosteneffectief realiseren van de doelstelling voor het jaar 2020. Het zou een belangrijke stap in de richting van een geharmoniseerd Europees steunkader voor elektriciteit uit hernieuwbare bronnen betekenen. Dit is voor een land met een open economie en beperkte hernieuwbare energie hulpbronnen als Nederland van groot belang. De andere kant

van de medaille is dat het realiseren van het bovengenoemde gezamenlijke steunkader een grote ontwerp- en onderhandelingsinspanning vooraf betekent. Met de invoering van een RPS systeem in Nederland alleen dient gerekend te worden met zeker drie jaar voorbereidingstijd: een jaar tot aan de politieke besluitvorming en twee jaar voor het rondkrijgen van de noodzakelijke wet- en regelgeving.

Het **theoretische** potentieel van het kosteneffectief gebruik van het instrument *statistische overdrachten* overtreft dat van het instrument *gezamenlijke steunsystemen* zo lang het laatste instrument niet in alle lidstaten wordt toegepast. Dit potentieel kan worden gerealiseerd indien de (overheids)partijen op deze markt economisch rationeel handelend, niet risicomijdend, en tevens perfecte voorspellers van de toekomstige marktomstandigheden zijn. Met het benutten van het theoretische potentieel kunnen netto-welvaartsbaten van miljarden euro per jaar behaald worden. Over het potentieel van dit instrument *in de praktijk* kunnen zeer uiteenlopende en navenant uiterst onzekere speculaties vooraf gemaakt worden. Vooralsnog hebben wij geen hooggespannen verwachtingen over de bereidheid van andere lidstaten om ruimschoots van te voren via termijncontracten voor de transfer van doelstellingsrekeneenheden geldig voor jaar 2020 te verkopen aan de Nederlandse staat tegen een voor Nederland kosteneffectieve prijs. De andere lidstaten, voor zover zij rationeel handelen, zullen immers eerst zekerheid willen verkrijgen dat zij binnenslands hun eigen doelstelling niet alleen op papier maar ook metterdaad gaan halen. **Toch adviseren wij de Nederlandse overheid ook de mogelijkheden voor kosteneffectieve inzet van dit instrument te verkennen. De bereidheid van andere lidstaten om doelstellingsrekeneenheden geldig voor jaar 2020 ruimschoots van tevoren contractueel tegen een voor Nederland kosteneffectieve prijs te verkopen, kan met relatief geringe inspanning snel per aanbestedingstender onder de 26 overige lidstaten getoetst worden.** Spoed is van belang om te voorkomen dat de markt voor statistische overdrachten wordt afgeroomd door andere lidstaten die ook met relatief hoge marginale kosten voor de realisatie van de doelstelling hernieuwbaar in jaar 2020 geconfronteerd worden. Erop rekenen dat Nederland aan het eind van de rit (ultimo 2020 / begin 2021) nog kosteneffectief van het betrokken instrument gebruik kan maken om een bepaald gedeelte van de 2020 doelstelling te halen lijkt een (te) riskante strategie voor doelstellingsrealisatie te zijn. De Europese commissie dient overigens nog uitsluitsel te geven over de details voor inzet van dit instrument.

Wij zien ook een zeker potentieel in kosteneffectief Nederlands gebruik van het instrument *gezamenlijke projecten met andere EU-lidstaten.* In principe zijn voor deze projecten op het gebied van hernieuwbare energie naast overheidsinstanties commerciële partijen uit de samenwerkende landen betrokken. Verzamelde informatie over hernieuwbare energie (te verwachten gerealiseerd potentieel versus nationale doelstelling; technologiekosten) in een viertal andere lidstaten, te weten Duitsland, Polen, Spanje en Zweden geven globale indicaties dat er binnen die landen vooral potentieel is voor gezamenlijke Nederlandse projecten met Polen en Zweden op toepassingen van biomassa-energie en wind op land. In Spanje zijn er vooral mogelijkheden voor gezamenlijke projecten voor elektriciteitsopwekking met zonne-energie. Vooraf moet dan per project tot contractuele overeenstemming gekomen worden over de verdeelsleutels tussen de samenwerkende lidstaten, zowel voor de financiering van de marktsteun als voor de te realiseren doelstellingsrekeneenheden. Door dit ‘maatwerk’ zijn de transactiekosten van het beschouwde instrument voor de betrokken projectpartijen per realiseerbare doelstellingsrekeneenheid onzeker maar niet onaanzienlijk. Derhalve ligt het niet in de rede dat dit instrument een grote vlucht zal nemen. Een robuuste, kwantitatieve schatting van het potentieel valt overigens niet vooraf te maken.

Het instrument *gezamenlijke projecten tussen EU-lidstaten en derde landen* betreft uitsluitend gezamenlijke projecten op het gebied van hernieuwbare elektriciteit. **Om doelstellingsrekeneenheden naar het doelstellingsconto van een betrokken EU-lidstaat overgemaakt te krijgen, dient de projectoperator een hiermee overeenkomend volume stroom fysiek naar de EU te exporteren.** Wij hebben specifiek de mogelijkheden geanalyseerd voor inzet van het betrokken instrument voor projecten in de Sahara op het gebied van grootschalige stroomopwekking met zonne-energietechnologie (CSP en PV). Onze conclusie is dat het potentieel voor kosteneffectieve inzet van dit instrument voor Nederland uiterst klein is. En wel om een viertal redenen: (i) aanwezigheid van de benodigde transmissiecapaciteit naar de EU als belemmerende factor; (ii) de transactiekosten die gemiddeld veel hoger zijn dan die voor *gezamenlijke projecten met andere lidstaten*, ondermeer in verband met het afdekken van de hoge gastland-gebonden risico's; (iii) de latente politieke problemen voor de gastlanden van het contractueel gemandateerd exporteren van stroom; en (iv) de aan dergelijke projecten verbonden leveringszekerheidsrisico's voor wat betreft de gecontracteerde fysieke levering aan de EU.

Summary

The Renewable Energy Directive that has recently entered into force ('the Directive') enforces 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. It reflects the broad-based European support for the additional benefits of renewable energy on top of its contribution to a low carbon economy. The target for the Netherlands has been set at a renewable energy share of 14%. In addition, the Directive establishes the accounting method that must be used for measuring the target crediting units. These are the units (in MWh) that count for the realisation of the target of a Member State. The Directive offers Member States the opportunity to realise part of their national EU target abroad under certain conditions. Member States, including the Netherlands, are allowed to obtain foreign target accounting units. To this end, they should use one of the flexibility mechanisms as defined in the Directive, i.e.:

- 'Statistical transfers', i.e. cross-border transfers of target accounting units.
- Joint projects among EU Member States.
- Joint projects among EU Member States and third countries.
- Joint support systems (for marketing renewable energy).

This report analyses the options for deploying these so-called 'flexmechs' in the Netherlands to realise its binding target of 14% renewable energy in 2020 **at a lower cost to Dutch society than would have been feasible without their deployment**. The Netherlands has a support system that provides production subsidies for renewable energy products produced in the Netherlands, the so-called SDE subsidy scheme. In this report it is assumed that, as of 2013, the end users of electricity will have to pay for the government's SDE subsidy for the production generated by renewable energy plants by means of a surcharge on the electricity price.

In our opinion the joint support systems instrument holds by far the largest real potential for lowering the cost to Dutch society for realising a certain share of renewable energy. The joint *Renewable Energy Portfolio (RPS)* system, imposing a mandatory minimum share of renewable electricity in total energy demand on suppliers, has been identified as the best option in the short term; more specifically: a joint RPS system with Sweden and possibly Norway, including a certificate system. **This will lead to savings in market support to 'renewables' for the Dutch society amounting to several hundreds of millions of euros per year. It is very important that such a system is combined with the current SDE subsidy scheme. The average certificate price must be included in the prevailing ex post adjustment mechanism to the preliminary ex ante disbursement of annual SDE subsidy.**

Sweden and Norway are preparing for the implementation of the joint Swedish-Norwegian system in 2012. We advise that the Dutch government starts exploring in earnest the possibility for joining the Swedish RPS system, possibly combined with Norway. It will take at least three years to prepare the implementation of the hybrid RPS/SDE system in the Netherlands: one year for political decision making and two years for establishing the required laws and regulations.

A dynamic yet prudent approach leading to the joining of the Swedish RPS system in 2014 or 2015 may give the Netherlands the opportunity to influence the design of this joint support system. It can also be relevant for the conclusions of the evaluation report about public support to increasing the share of renewable energy in final energy demand in EU Member States, to be published by the European Commission at the end of 2014. The Dutch interest in realising the above-mentioned joint support framework reaches beyond merely increasing the cost effectiveness of realising the target for the year 2020: it would be a major step towards a harmonised European support framework for electricity from renewable sources. This is very

important for a country such as the Netherlands, which has an open economy and limited renewable energy resources.

In order to realise the above-mentioned joint support framework, huge design and negotiation efforts are required. Moreover, the Dutch investment climate could temporarily be negatively affected by the uncertainty about a change in the system of the Dutch support framework that might be adverse to potential investors. In this respect it should be noted that the transfer to a hybrid RPS/SDE system will improve the risk profile (less *downside* risks) for investors who are eligible for SDE. Finally, a good market design that will result in a satisfactory operating liquid certificate market without large price volatility and market power is also an important item to be considered.

The **theoretical** potential for the cost effective use of the instrument *statistical transfers* even exceeds the potential of the instrument *joint support systems* as long as the instrument is not implemented in all Member States. This potential can be realised if all (government) parties act economically rational and not risk-avoiding, and if they are perfect predictors of future market conditions. The potential of this instrument in practice could be subject to widely varying and highly uncertain speculations beforehand. For the time being, we do not hold high expectations of the willingness on the part of other Member States to transfer to the Netherlands − at a cost-effective price and well in advance via forward contracts − target accounting units, which are valid for the year 2020. The other Member States, to the extent that they act rationally with risk-avoiding preferences and perceived uncertainty about future realisation of their own target, may well feel the need to have more certainty first about whether they will realise their target within the country, not only on paper but also in reality before considering to sell target accounting units. **Nevertheless we advise the Dutch government to actively explore the options for cost-effective deployment of this instrument. The willingness of the other Member States to contractually sell target accounting units, valid for the year 2020, to the Netherlands well in advance at a (for the Netherlands) cost-effective price can be tested quickly with relative minor effort by means of a tender among the 26 other Member States.** Due expediency is also important for this measure. It seems too risky a strategy to count on the fact that the Netherlands will be able to deploy the instrument in a cost-effective manner in realising part of the 2020 target towards reconciliation (in the first months of 2021). The European Commission still needs to communicate the implementation details of the *statistical transfers* instrument.

We also perceive a certain potential for cost-effective Dutch implementation of the instrument *joint projects with other EU Member States*. In principle, commercial parties from the collaborating countries might be involved in these projects in the field of renewable energy in addition to the government bodies. Gathered information about renewable energy (anticipated realised potential versus national target; technology costs) in four other Member States, i.e. Germany, Poland, Spain and Sweden, provide global indications that in these countries there is largely a potential for joint Dutch projects with Poland and Sweden in energy from biomass and onshore wind. In Spain there are mainly opportunities for joint projects for electricity generation from solar energy. Per project contractual agreement needs to be reached among the collaborating Member States about the relevant distribution shares; i.e. both the distribution shares for financing market support and (possibly other) distribution shares for the realized target accounting units. As a result of these tailor-made agreements the transaction costs of the instrument per realized target accounting unit will be uncertain but rather large for the involved project parties. It is therefore not anticipated that this instrument will be booming. Yet a robust quantitative estimate of this potential cannot be made in advance.

The instrument *joint projects among EU Member States and third countries* only entails joint projects in the field of renewable *electricity*. **To realize a transfer of accounting units to the the involved EU Member State(s), the project operator needs to export a corresponding physical flow of electricity to the EU**. We have specifically analysed the options for deploying the instrument for projects in the Sahara in the field of large-scale electricity generation with solar technology (CSP and PV). Our conclusion is that the potential for cost-effective deployment of this instrument by the Netherlands to achieve its 2020 target is very small indeed. This conclusion is based on four arguments: (i) the very limited presence of required transmission capacity to the EU; (ii) the transaction costs that are on average much higher than those of *joint projects with other Member States*; (iii) the latent political problems for the guest countries of the contractually mandated export of electricity; and (iv) the security of supply risks with regard to the contracted physical supply to the EU Member States that are involved in such projects.

1. Introduction

1.1 Report background

The Working Group on Energy and Climate, henceforth referred to as 'the Working Group' has to design for consideration by the Dutch Government among others policies regarding public expenditures on the market stimulation of renewable energy. In 2010 these expenditures are poised to amount to about € 1.8 billion. One of the variants to be designed by the Working Group should structurally reduce these and other public expenditures by 20% on a net basis.

The Dutch government has to design both effective and cost-efficient policies. In this respect, effectiveness relates to compliance with the Dutch targets specified by the legislation following the 2008 EU Energy and Climate package as well as addressing the targets indicated in the 'Clean and Efficient' climate policy package promulgated by the Dutch government in 2007 (VROM, 2007). The focus in the assignment of the Working Group to ECN is on the target of a 14% share for renewables in Dutch final energy use in 2020, mandated by the Renewables Directive 2009/28/CE.

This second report of a sequel of three project reports reflects on the scope for opportunities abroad that the Directive 2009/28/CE (Renewables Directive) offers for cost-effective use by the Dutch government to meet its 14% renewable energy target as defined in this Directive. To that effect the Renewables Directive has defined certain mechanisms to facilitate the Member States to engage in specific forms of international co-operation to make a contribution towards complying with their specific RES targets. One of the elements to be considered is the scope for harnessing the renewable electricity potential outside of the EU in desert areas for the options CSP and solar PV. Furthermore, the Working Group is interested in how the cost of renewable electricity in the Netherlands compares to neighbouring countries (situation to date in and year 2020, the year in which Member States are assumed to achieve their assigned renewables targets).

1.2 Objective and research questions

This report sets out to provide essential information to assist the Working Group in making informed judgments on the opportunities the Renewables Directive offers for cost-effective achievement of the renewables target in 2020. It seeks to provide as much insights as feasible with the constraints of the present project for answering the following questions:

- What are the prospects for the Netherlands to meet its 2020 renewables target in relation to selected other EU Member States based on existing documents?
- What are the comparative advantages for selected EU Member States regarding renewables?
- What is the scope for the Netherlands to use the flexible instruments specified in the Renewables Directive 2009/28/CE to meet part of the Dutch renewables target for year 2020 abroad in a cost-effective way?

We provide special attention to the questions of the Working Group regarding possible cost-effective opportunities for the Netherlands outside the EU, notably in desert areas. In this report projected developments of *ex ante dynamic efficiency* rather than *revealed static efficiency* are supposed to shape the principal criterion for designing cost-effective policy strategies to comply with the ambitious targets set for the Netherlands in this package.

1.3 Report outline

Chapter 2 provides a short background on targets and trends regarding renewables deployment in the Netherlands. Chapter 3 provides information on comparative advantages in the renewables area for five selected countries including the Netherlands. Finally, in Chapter 4 an assessment is made of the scope for cost-effective use of the flexible mechanisms of the Renewables Directive to meet part of the Dutch renewables target abroad.

2. Dutch renewables targets and recent deployment trends

2.1 Introduction

This chapter provides some background information to the key questions of this report. We will briefly explain two key issues for the issue at stake: i.e. the target accounting units and major uncertainties regarding boundary conditions for use of the flexible mechanisms.

Firstly, we will briefly explain the target accounting units and their implications for the contribution of distinct renewable technology options.

Second, we will indicate some major uncertainties with notable impact on the cost-effectiveness of renewables. This, in turn, has implications for the socio-economic costs of market-support policies for renewables and for what this report is about: the scope for cost effective use by the Dutch government of the three flexible mechanisms of Directive 2009/28/CE.

2.2 Targets

The 2008 EU Energy and Climate package implies the following energy targets for the Netherlands:

- A mandatory GHG emissions reduction target of 20% compared to GHG emissions in year 1990 for the Dutch installations falling under the EU emissions trading system ETS (including large fossil-based power plants), to be tightened to 30% contingent on the assessment by European Council and Parliament evolving GHG policies by major EU partners; the EU is responsible for the EU ETS sector.
- A mandatory GHG emissions reduction target for the non-ETS sector for the Netherlands of in 2020 with regard to corresponding emissions in year 2005 of 16%, to be tightened to a percentage level to be established later contingent on the assessment by European Council and Parliament evolving GHG policies by major EU partners; the individual Member States are responsible for controlling their GHG emissions in the non-ETS sector.
- *A mandatory target of 14% renewables in final energy consumption.*
- A mandatory target of 10% automotive transport fuels from renewable sources including renewable electricity.
- An indicative target of 20% energy efficiency improvement with respect to an officially unspecified baseline (presumably the baseline of the 2005 PRIMES scenario).

Why should there be a dedicated framework to mandate support measures to market deployment of renewables, given the EU ETS carbon market framework? Indeed, the EU legal framework, including the Renewables Directive, to mandate support measures by the Member States will contribute towards compliance with the GHG emissions reduction targets. Yet a dedicated fostering of promising technology development and/or market deployment of promising high-cost renewables can be justified on account of a range of arguments. The most important ones are their expected more favourable unit cost evolution as against conventional energy (fostering dynamic market efficiency through use of technology with higher learning rates). A second key argument is security of supply in the face of rising dependence on extra-EU imports of fossil fuels coupled with increasing market concentration on the supply side of international fossil fuel markets. Orthodox economists adhering to the efficient market hypothesis believe that market participants do fully discount supply security risks in their market behaviour. In other words, supply security externalities would be negligible. Yet a wealth of evidence exists, refuting the efficient market hypothesis.[1] This still leaves the challenge to design effective and cost-efficient policy measures to achieve set mandatory renewable energy targets to be adequately addressed.

The indicative targets specified by the Dutch Government in the 2007 Clean and Efficient policy package are:

- GHG emissions reductions ($tCO_{2\ eq.}$) in 2020 compared to GHG emissions in 1990 by 30%.
- *A share of renewables in gross energy consumption in 2020 of 20%.*

The Government Agreement of the Balkenende IV Administration and its 'Schoon en Zuinig' climate policy package mention an indicative target of 20% renewables (i.e. energy from renewable sources) in the Dutch energy mix of year 2020. This indicative target diverges from the mandatory target spelled out for the Netherlands in year 2020 regarding the share of renewables in EU Directive 2009/28/2009 not merely in the specified percentage point value. They also diverge in accounting unit.[2]

2.3 Trends in Dutch renewable energy performance

CBS has compiled a table showing the renewable energy performance of the Netherlands in 2008 applying the three calculation methods explained in the previous Section. We reproduce this table below (Table 2.1). The table indicates that in year 2008 according to the accounting method of the Renewables Directive the Netherlands stands at 3.7% (including heatpumps and biofuels). This compares e.g. to the indicative average target for the Netherlands in years 2011/12 amounting to 2.8% and a mandatory target of 14% in year 2020 (See Section 3.1 hereafter). For the time being, the Netherlands is above its indicated target trajectory but the road to 14% is poised to be quite tough. The largest contributions as shown in the fourth column of Table 2.1 are made by the following technologies:

- Wind energy (14.1 PJ, i.e. 10^{15} Joules)
- Biofuels for road transport (14.0 PJ)
- Heat pumps (9.9 PJ)
- Household wood stoves (9.3 PJ)
- Biomass co-firing in large-scale power plants (9.0 PJ)
- Municipal waste, renewable fraction (9.0 PJ)
- Other biomass combustion (6.5 PJ).

1 Orthodox economists with a strong believe in unbridled markets and in the absence of serious supply security externalities include Douglas Bohi and Michael Toman (Bohi and Toman, 1996). See for further comments on this issue (Jansen and Seebregts, 2010).

2 Reinoud Segers has presented insightful further explanations of energy accounting issues in amongst other (Segers, 2008).

Table 2.1 *Renewable energy performance of the Netherlands according to three distinct calculation methods*

	Substitution	Primary energy	Gross final energy consumption according to the EU directive on renewable energy	
			With heat pumps and biofuels	Without heat pumps and biofuels
	TJ			
Hydro power	840	367	360	360
Wind energy	35,061	15,322	14,053	14,053
Solar electricity	330	138	138	138
Solar heat	861	879	879	879
Heat pumps	4,622		9,884	
Heat/cold storage	820		113	113
Municipal waste, renewable fraction	12,716	29,266	9,004	9,004
Biomass co-firing in large scale power plants	19,692	19,692	9,143	9,143
Wood stoves for heating in industry	2,508	2,678	2,678	2,678
Household wood stoves	5,464	9,316	9,316	9,316
Other biomass combustion	9,111	12,825	6,486	6,486
Landfill gas	1,307	1,778	828	828
Biogas from sewage purification plants	2,262	2,046	1,815	1,815
Biogas on farms	2,845	3,691	1,435	1,435
Other biogas	1,679	1,782	1,336	1,336
Biofuels for road transport	14,032	14,032	14,032	
Total renewable energy	114,151	113,811	81,501	57,584
Total use of energy (PJ)	3,319	3,330	2,227	2,227
Share of renewable energy (%)	3.4	3.4	3.7	2.6

Source: CBS, 2009: Table 2.4.5.

Recent trends regarding the penetration of renewables in Dutch energy supply are brought out by Table 2.2 below, again compiled by the CBS (CBS, 2009). This table provides an overview of renewable energy developments in the Netherlands, including the penetration of renewable energy technologies in Dutch renewable energy supply (RES) over the period 1990 - 2008. The figures in the table are based on the substitution method (avoided primary energy from fossil sources and avoided CO_2 emissions) as defined by the Protocol Monitoring Renewable Energy (SenterNovem, 2006). We do not dispose of trend figures covering such a long period based on the final energy use method mandated by the Renewables Directive. Yet the year on year trend figures - as against the relative share figures within a year - are by and large not much influenced by the choice of renewable energy accounting *numéraire*.

The following technologies have grown relatively fast of late:

- *Large renewable energy share; very fast penetration*
  - Biofuels for road transport
  - Biogas on farms
  - Biomass co-firing in large power plants
  - Heat pumps
  - Wind energy
- *Small renewable energy share; fast penetration*
  - Heat/cold storage
  - Solar electricity
  - Solar heat
  - Other biogas.

We remark with respect to wind energy that the CBS does not yet distinguish between onshore wind and offshore wind, although these are two technology categories with quite diverging cost characteristics.

Table 2.2 *Renewable energy performance of the Netherlands according to substitution method as defined by the Protocol Monitoring Renewable Energy*

	1990	1995	2000	2005	2006	2007	2008**	2008**
Avoided use of fossil primary energy (PJ)								*Share within renewable energy (%)*
Combination of source and technology								
Hydro power	0.8	0.8	1.2	0.7	0.9	0.9	0.8	0.7
Wind energy	0.5	2.8	6.9	17.2	22.5	28.2	35.1	30.7
Solar								
Solar electricity	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.3
Solar heat	0.1	0.2	0.4	0.8	0.8	0.8	0.9	0.8
Ambient energy								
Heat pumps	.	0.3	0.6	1.8	2.6	3.4	4.6	4.0
Heat/cold storage	0.0	0.0	0.2	0.5	0.6	0.7	0.8	0.7
Biomass								
Municipal waste, renewable fraction	6.1	6.1	11.4	11.9	12.4	13.0	12.7	11.1
Biomass co-firing in large scale power plants	–	0.0	1.8	30.5	29.4	15.7	19.7	17.3
Wood stoves for heating in industry	1.3	1.6	1.8	1.9	2.1	2.4	2.5	2.2
Household wood stoves	6.2	5.3	5.7	5.5	5.5	5.5	5.5	4.8
Other biomass combustion	0.4	0.6	2.3	4.4	5.3	5.6	9.1	8.0
Landfill gas	0.3	2.1	1.9	1.6	1.5	1.4	1.3	1.1
Biogas from sewage purification plants	1.9	2.2	2.3	2.1	2.1	2.1	2.3	2.0
Biogas on farms [3]				0.1	0.5	1.4	2.8	2.5
Other biogas	0.5	0.8	1.0	1.2	1.4	1.4	1.7	1.5
Biofuels for road transport	–	–	–	0.1	2.0	13.0	14.0	12.3
Type of energy								
Electricity from domestic sources	6.3	10.6	22.0	60.3	65.4	59.0	74.6	65.4
Heat and cold	10.4	10.3	13.7	18.5	20.9	22.6	24.3	21.3
Gas	1.4	1.9	1.9	1.6	1.5	1.3	1.2	1.1
Transport fuels	0.0	0.0	0.0	0.1	2.0	13.0	14.0	12.3
Total use of renewable energy	18.1	22.8	37.6	80.5	89.8	95.9	114.2	100.0
Calculation of the share of renewables in energy supply								
Total energy use in the Netherlands (PJ) [2]	2,702	2,964	3,065	3,311	3,233	3,353	3,330	
Contribution of renewable energy to the national energy balance sheet of Statistics Netherlands (PJ)	31	36	55	94	100	106	125	
Total use of energy in the Netherlands with renewable sources according to the substitution method (PJ)	2,689	2,951	3,048	3,298	3,222	3,343	3,319	
Share of renewables in energy supply (%)	0.7	0.8	1.2	2.4	2.8	2.9	3.4	
Calculation of avoided emissions of CO_2								
Avoided emission of CO_2 due to the use of renewable energy (kton)	1,124	1,454	2,480	5,659	6,138	6,765	7,939	
Total CO_2 emission in the Netherlands (Mton) [1]	159	171	170	176	172	173	.	
Avoided emission of CO_2 due to renewable energy (% of total CO_2 emissions) [1]	0.7	0.9	1.5	3.2	3.6	3.9	4.6	

Source: CBS, 2009: Table 2.1.1.

3. Comparative advantages of the Netherlands and selected other Member States

3.1 Introduction

This chapter presents results of collected information on comparative advantages for the Netherlands and four other EU Member States on a number of renewable technologies. Collecting and maintaining up-to-date, credible, comprehensive information on renewables costs and potentials at EU level, disaggregated for the EU Member States, is very expensive and far beyond the scope of the present project. To date, results of the Green-X scenario runs by the Energy Economics Group (EEG) of the Vienna University of Technology serve as a the most important source for RES policy design work by the European Commission. EEG boasts - as stated by several officers of the Commission - 'the Community model for renewables deployment', Green-X, and consequently the most comprehensive set of information on current and projected future renewables deployment in the EU. A major part of the information presented in this chapter is based on information released by EEG (Resch et al., 2009). This public-domain information only gives indirect indications on RES cost advantages of each of the focus countries, when compared to each other. Information at country level on cost and potentials (projected 'realisable mid-term potentials' in the Green-X data base, used for modelling exercises) per RES technology category was only within certain limits available for the preparation of this report.[3]

The other EU Member States were selected in consultation with the Working Group under the given resource and time limitations of this study. Based on a brief assessment of potential scope for use of the flexible mechanisms by the Netherlands and criteria such as on the one hand proximity, geographic diversity and extent of coverage of the total EU RES potential, the following comparator countries were chosen in close consultation with the Working Group:

- Germany (proximity; large market with - to date - favourable regulatory framework for renewable generators and renewable project developers).
- Spain (sunny southern Europe; large market with - to date - favourable regulatory environment for renewable project developers; projected to be long on target compliance by a high MWh level).
- Sweden (large low/medium-additional-cost renewable potential; projected to be long on target compliance by a fairly high MWh level; stated commitment to more support harmonisation).
- Poland (largest new Member State; high low/medium-additional-cost renewable potential; projected to be long on target compliance by a high MWh level).

Section 3.2 provides information on the extent of compliance achievement by the five focus countries with regard to their respective 2020 RES targets, as projected by EEG. Projections by EEG on deployment of RES technologies in the five focus countries are dealt with in Section 3.3. Section 3.4 presents for each of the five focus countries ECN projections of the cost of three RES-E technologies. Section 3.5 winds up with findings on comparative RES advantages.

3.2 Projected target compliance

One of the recent Green-X model simulations is based on the 'Strengthened national support' scenario. This scenario assumes a continuation of national RES policies until 2020 with further optimisation in the coming years with regard to their effectiveness and efficiency. The fulfil-

[3] We are grateful to Gustav Resch for providing certain additional details regarding the Strengthened national support scenario.

ment of the target of 20 % RES by 2020 is pre-conditioned by the scenario, both at the EU level as well as at the national level. In the case that a Member State (MS) would not possess sufficient potentials that can be economically[4] exploited, virtual trade between MS governments based on statistical transfers or joint support schemes[5] between the MSs (i.e. where a MS possesses the possibility to trade its surplus to other MS) would serve as a complementary option.[6]

Modelling results are shown hereafter on the projected long/short positions of the five selected study countries regarding domestic compliance of their respective 2020 renewables target. **Generally, modelling results on the projections of target under- or over-compliance are very sensitive to modelling inputs such as price and renewable potential projections and on policy assumptions.** Given these *strong* qualifications, we have a fair amount of confidence that Spain, Poland and Sweden have the potential to become lover-compliant with a surplus of target accounting units, for Germany the result is rather uncertain (a deficit projected by just a small percentage), whilst the Netherlands stands a fair chance of being incompliant on sheer inlands renewable energy target achievement[7]. To reach the target set by the EC the Netherlands and Germany would then have to rely on the flexible mechanisms proposed in the new Renewable Energy Directive and import sufficient target accounting units to achieve target compliance. The projected net deficits in year 2020 for the Netherlands and Germany amount to -12.4 TWh and -5.5 TWh respectively. Figure 3.1 and Table 3.1 present the corresponding national target fulfilment rates for Germany, the Netherlands, Spain, Sweden and Poland respectively.

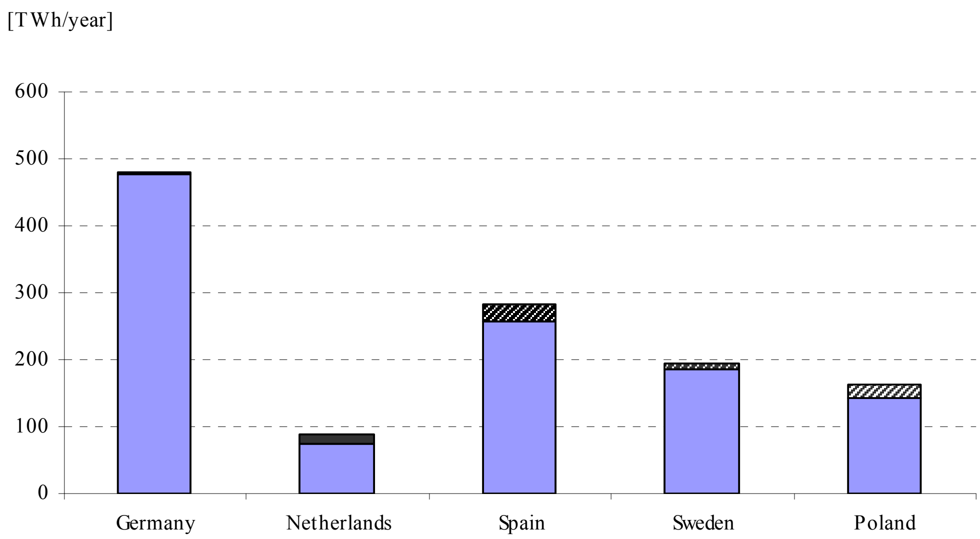

Figure 3.1 *Comparison of national RES deployment by 2020 for domestic target fulfilment, required import and available export RES volumes in EU-27 countries according to the GREEN-X case of 'strengthened national support'*

Legend: Blue corresponds to the domestic fulfilment. Black represents required import and dashed lines represent a surplus that would enable the sale of 'statistical transfers' to under-compliant Member States.
Source: Resch et al., 2008.

4 In the 'strengthened national support' scenario, economic restrictions are applied to limit differences in applied financial RES support among countries to a feasible level. Consequently, if support in a country with low RES potentials and /or an ambitious RES target exceeds the upper boundary, the remaining gap to its RES target would be covered in line with the flexibility regime as defined in the RES Directive via (virtual) imports from other countries. (Resch et al, 2008: 37).

5 See next chapter for an explanation of the flexible mechanisms, stipulated by the new RES Directive.

6 Further information on a recent Green-X modelling exercise can be obtained from http://www.futures-e.org/.

7 Even though the absolute renewable energy production figures are relatively small it is worthwhile mentioning the other countries that are projected to exceed their targets: Estonia, Lithuania, Slovakia, Bulgaria, Austria and Denmark. Furthermore we refer to the documents on target compliance prospects submitted to the Commission by (the great majority of) the MS governments by the end of January 2010, which are accessible on the website: http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm.

Table 3.1 *Projected renewable energy production in year 2020 in relation to the national targets defined in the RES Directive: Green-X Strengthened national support scenario*

	Inland RES generation [TWh]	RES Target [TWh]	Surplus(+) Deficit(-)	Corresponding inland target compliance achievement [%]
German	475.8	481.3	-5.5	98.9
Netherlands	75.6	88	-12.4	85.9
Spain	282.1	256.4	25.7	110.1
Sweden	194	184.5	9.4	105.1
Poland	162.8	143.2	19.6	113.7

Source; (Resch at al., 2009).

3.3 Projected deployment of RES technologies

Detailed information on (projected) deployment of RES technologies in EU Member States is provided by the Futures-e -Action Plan report (Resch et al., 2009). In this section we put the limelight on the five focus countries of this report, reproducing interesting results of the Green-X 'Strengthened national support' scenario. Detailed results of this scenario results can be found in Annex 1.

Figure 3.2 demonstrates the sector breakdown of the renewable energy production amounts[8] in 2020. This figure indicates that renewable heat and renewable electricity are poised to play a crucial role for Poland and Germany to reach their targets. Renewable electricity will play a dominant role in the Netherlands, Spain and Sweden. According to the Green-X projections Germany and the Netherlands could each achieve about 34% of their gross electricity demand from renewable energy sources. The corresponding share for Poland, Spain, and Sweden is 21%, 49%, and 61% respectively (Resch et al., 2009).

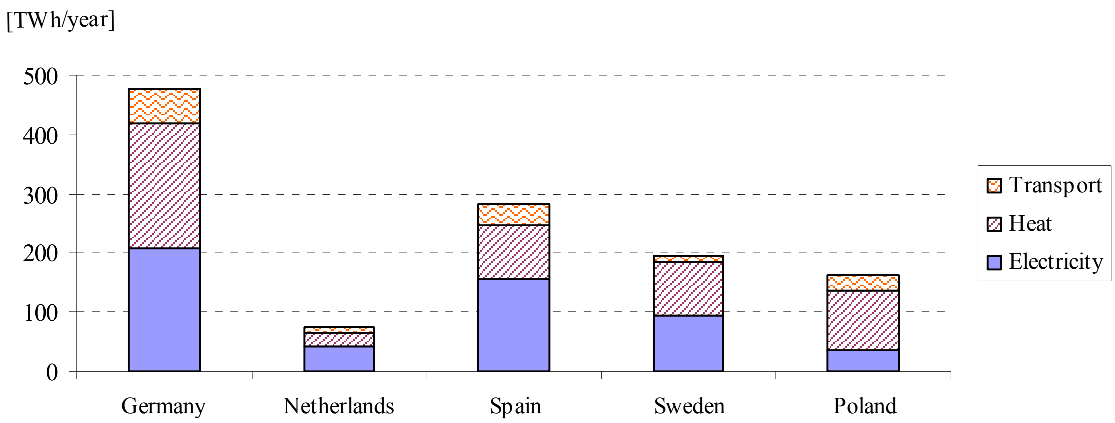

Figure 3.2 *Renewable energy production in 2020 (derived from the 'Strengthened national support' scenario)*
Source: Resch et al, 2009.

Figure 3.3 depicts for each of the selected countries the projected renewable electricity deployment levels in 2020 with a breakdown by technology (Resch et al., 2009). Onshore wind is projected to represent the key technology option for power generation in Spain comprising 38% of the total renewable electricity generation. Offshore wind on the other hand is set to play a key

[8] The results exclude biofuels trade to reach the 10% biofuel targets. It only includes national biofuel production values.

role in Germany and the Netherlands. According to Green-X 'Strengthened national support' model (Resch et al. 2009) in 2020 the Netherlands is projected to generate 19.4 TWh offshore wind electricity (in 2008 the amount was 0.8 TWh). Germany is projected to produce around 63 TWh electricity from offshore and 56 TWh from onshore wind in year 2020.

Biomass applications for electricity generation dominate Polish renewable electricity mix in 2020. In Poland around 66% of the renewable electricity can be derived from biomass resources, dominated by solid biomass use.

With regards to solar PV, to date Germany is one of the world market leaders. In 2008 the installed capacity of solar PV amounted to approximately 5 GW. The generation volume in 2008 was 0.8 TWh. This is projected to increase sharply and reach 17.5 TWh in 2020. The second major electricity generator from solar PV is Spain reaching 2.9 TWh in 2020. We note that these figures are highly sensitive to the subsidy levels in the coming years and the extent to which the high projected cost reductions will materialise indeed. It is noted that for small-scale PV in the built environment the all-inclusive electricity price for small-scale end-users is a key benchmark for the long run marginal cost of this technology to assess its commercial viability.

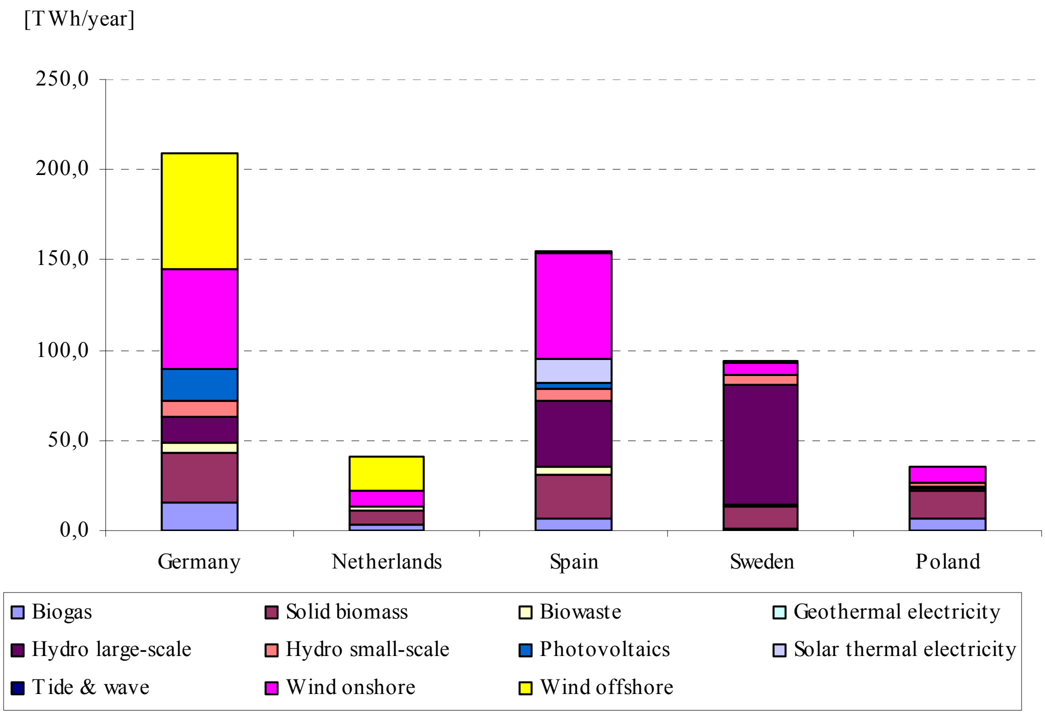

Figure 3.3 *Technology breakdown of renewable electricity production in 2020 for selected member states*
Source: Resch et al, 2009.

For each of the selected countries the projected renewable heat deployment levels in 2020 are shown in Figure 3.3 with a breakdown by technology (Resch et al., 2009). Among the options distinguished outside the electricity sector, solid biomass applied in the heat 'sector' is by far the most important option in Germany, Spain, Sweden and Poland, whilst the use of solid biomass in CHP plants is projected to be the second largest heat source in the four comparator countries in 2020. For instance, thanks to its abundant biomass resources Sweden is projected to provide around 69% of its heat demand from renewable energy sources, mainly solid biomass based on district heating abd individual pellet-fired boilers. In dedicated heat generation, modern small-scale biomass heating systems are dominant. In addition to solid biomass use of bio waste is noticeable in Germany and Spain, followed by Sweden for the supply of heating services. Not surprisingly, solid biomass use comprises 90% of the total renewable heat production in Poland. Moreover, in Germany and Sweden the market for heat pumps is expected to realize high and stable growth.

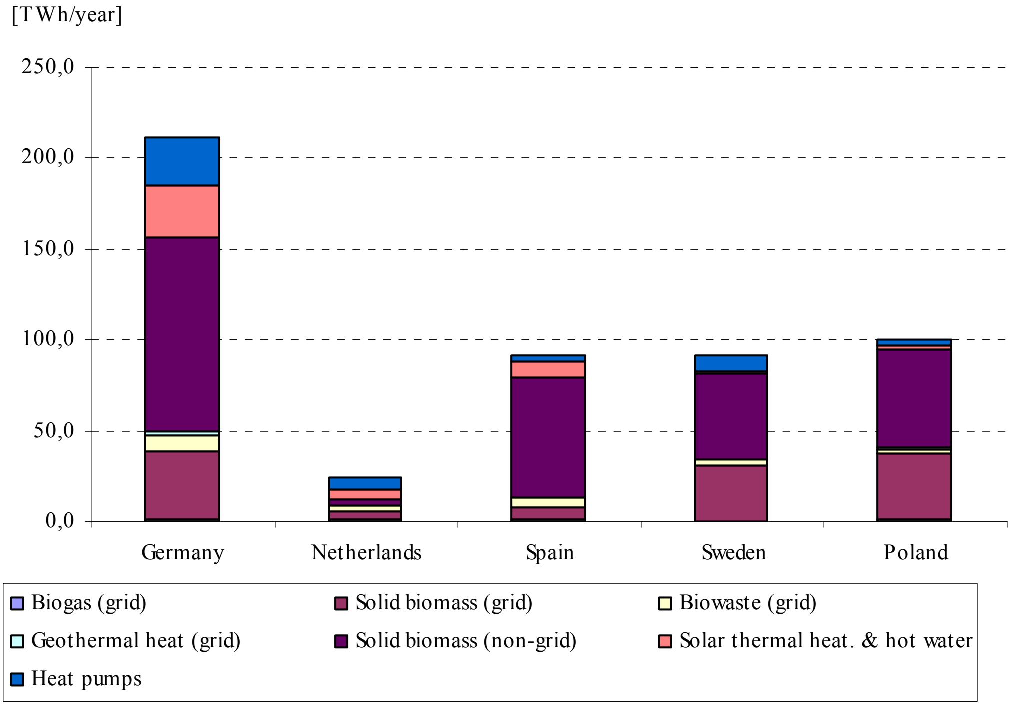

Figure 3.4 *Technology breakdown of renewable heat production in 2020 for selected member states*
Source: Resch et al., 2008.

3.4 Projected cost in 2020 of three important RES-E technologies

Apart from large hydro power, onshore wind and offshore wind are projected to deliver the lion's share of the renewable electricity produced in the EU by year 2020. The electricity generation from wind is projected to be around 489 TWh, corresponding to 39% of the total renewable electricity generation in 2020 (EU27). In the Strengthened national support scenario, also PV is poised to contribute a notable share, particularly for Germany generating 8.3 % of the renewable electricity mix in this country. Still, bioenergy is poised to play a dominant role in achieving the Europe's renewable energy target, corresponding to around 60% of the EU renewable energy target in 2020, especially because of its contribution to renewable heat and transport fuels.

With the confines of the present project we have sought to complement the information from the Futeres-e project, shown in the previous two sections with own cost projections for typical RES projects in each of the five focus countries, commencing operations in year 2008 and 2020.

A summary of cost projection results is shown in Table 3.2 below. The cost projections consider the perspective of project developers. The projections indicate that, among the focus countries, in the Netherlands and Germany both wind options can be utilised at lowest cost. The broadly better wind resources in the Netherlands would be offset by the better project implementation conditions in Germany, such as full socialisation of grid integration costs and price risk insurance and higher market volumes for major wind generator companies.

From these figures it should not be concluded that the other focus countries are not relevant for cost-effective wind power projects, notably onshore wind. By 2020 implementation of onshore wind power is poised to face severe scarcity problems for attractive new project sites in Germany, the Netherlands and Spain. By contrast, in Sweden and Poland this scarcity is likely to be much less severe.

Depending on the wholesale power price in year 2020, offshore wind is poised to remain an option with high additional costs, and as such not very attractive for cost-effective deployment of the flexibility mechanisms. Still it cannot be excluded that countries in North-Western Europe with a high potential for offshore wind (including focus countries Germany, the Netherlands and Sweden) will agree on a joint programme for the development of offshore wind including joint investments in a European 'supergrid' with an agreed allocation of market stimulation costs and benefits i.e. target accounting units.

The cost of PV is projected to decrease quite fast, if from currently still high cost levels. In Spain the unit cost of PV-generated electricity is projected to be lower than the cost of offshore wind. Even in Germany, the Netherlands, Poland, and - depending on the latitude of project sites and the prevailing all-inclusive electricity price for household customers - Sweden, the unit cost PV option is poised to come down to the level of 'grid parity' or even lower. Thus, as for the PV option, even in Central and Northern Europe commercial viability for a large niche market is projected to be emerging by year 2020. We caution that notably technological learning is a key uncertainty regarding this technology. Still it can be safely assumed that Spain will be a potentially attractive market for bilateral 'joint support projects' between Spain (as the host country) and the Netherlands, contingent on agreement over the division of resulting target accounting units between the countries concerned.

A final remark is that the high cost projections of PV in 2020 for the Netherlands should not necessarily be interpreted as an indication to slash market stimulation subsidies in the Netherlands. The Netherlands holds a strong position on innovative cost-reducing research in this area (see Section 4.5 hereafter). Outright discontinuation or stop-go policy regarding market stimulation will negatively impact on this position. Rather a *stable* closed-end (if fairly modest) market deployment subsidisation would seem in order. This would hold the more so, as also for the Netherlands the mid-term prospects for emerging commercial maturity of PV in the niche market of small-scale household-level application of PV are promising.

Table 3.2 *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
Solar PV		
Germany	450	180 - 200
Netherlands	465	190 - 210
Poland	465	190 - 210
Spain	300	110 - 120
Sweden	490	200 - 220

Source: ECN.

3.5 Conclusions

This chapter presented indirect and direct information on the relative comparative advantages among five EU Member States. The information points clearly into the direction of Sweden and Poland for potential bilateral collaboration regarding biomass applications in the heat and electricity sectors and onshore wind. For Spain PV could be an area for collaboration, albeit with appreciable less scope than the aforementioned areas. With Germany collaboration in onshore wind projects might present cost-effective opportunities. Yet it is rather uncertain as to whether Germany manages to develop a long position regarding compliance with its national target in year 2020.

4. Scope for cost-effective application of the flexible mechanisms

4.1 Introduction

This chapter provides a preliminary assessment of the scope for the Dutch government to rely in a cost-effective way on the flexible mechanisms on international co-operation as stipulated in the new Renewables Directive, i.e. Directive 2009/28/CE. Such use would reduce the subsidy burden for Dutch society of market stimulation to raise the share of renewables in Dutch gross final energy demand, consistent with target accounting rules defined in the Renewable Directive, to 14% in year 2020.

Section 4.2 explains some features of the Renewables Directive regarding national targets and some compliance procedures it requires. The scope for use of each of the four flexible mechanisms is assessed in Sections 4.3 - 4.6 respectively. Section 4.7 presents the main findings.

4.2 Some features of Renewables Directive 2009/28/CE

The potential cost for reaching *inlands* the national renewables targets do vary widely across MS. The information presented in the previous chapter suggests that the cost to achieve *inlands* the last marginal target accounting unit of the national 2020 renewables target as mandated for the Netherlands by the Renewables Directive, is appreciably higher compared to many other MS, such as Poland and Sweden. Therefore, in principle for achieving the RES target of 20% of gross final demand the EU at large - including in particular the Netherlands - can save on renewable energy stimulation transfers to the tune of billion of euros per annum by close, cost-effective collaboration between Member States on market stimulation of renewables. As, at least for the time being, the Member State governments do not wish to relinquish national support schemes, as a second-best solution in that respect the Renewables Directive stipulates four flexible co-operation mechanisms. These co-operation mechanisms are on a strictly voluntary basis without the MS having to involuntarily relinquish control over their respective support systems and renewable energy potentials.[9] The Renewables Directive sets a MS-specific mandatory target for the share of renewables in gross final energy demand (called gross final energy 'consumption' in EU legislation lingo) for each Member State, i.e. 14% for the Netherlands. EU-wide target compliance would bring the renewable energy share in the EU's final energy demand at 20% by 2020. As part of the overall target, a binding minimum target is set for each Member State including the Netherlands regarding the share in total in-lands automotive transport fuel consumption originating from renewable source such as 'sustainable' biofuels and renewable electricity. This mandatory standard is specified at 10%.

In terms of reaching the mandatory national targets, the Renewables Directive provides the flexibility to use, in addition to national support schemes, measures of cooperation between different Member States and with third countries in accordance with Articles 6-11 of the Renewables Directive. The purpose of such cooperation is to allow MS to partly fulfil their renewable energy target through relatively cheaper renewable energy sources from other MS or third countries that have higher potentials and thus lower production costs. The new flexible mechanisms included in the Directive are (i) statistical transfer, (ii) joint projects between Member States, (iii) joint projects between Member States and third countries and (iv) joint support schemes.[10]

9 Notably a proposal advanced jointly by the German, Polish and UK governments had a strong impact to that effect.
10 For ease of reference, Articles 5-11 of Renewables Directive 2009/28/CE have been reproduced in Appendix B.

The Renewables Directive requires each Member State to adopt, publish and notify to the Commission their National Renewable Energy Action Plan (NREAP) to demonstrate how they plan to meet the objectives of the Directive. Moreover, each Member State shall ensure that authorisation, certification and licensing procedures are simplified to remove barriers in the development of renewables market. These plans shall include (possible) co-operation between local, regional and national authorities, planned statistical transfers or joint projects. To assist Member States during their NREAP preparations, the Commission specified minimum requirements for the harmonised template for National Renewable Energy Action Plans in the Renewables Directive (European Union, 2009: Annex VI). These minimum requirements include renewable energy demand related data from 2010 onwards for each consecutive year until 2020. Member States are to submit their respective NREAP by June 2010. Each MS is requested to publish and notify by December 2009 its estimated excess renewable energy sources compared to the indicative trajectory that could be statistically transferred and the estimated potential for joint projects or its estimated demand for renewable energy to fulfil its 2020 renewable target.

Every two years the Member States are to report on the share of renewables they have achieved and the measures they have implemented to that effect. The Renewables Directive specifies the following interim targets: 20% of the final 2020 target in 2011/2012 (i.e. **2.8%** for the Netherlands); 30% in 2013/14 (**NL: 4.2%)**; 45% in 2015/16 (**NL: 6.3%)**; 65% in 2017/18 (**NL: 9.1%**). Unlike the 2020 target, *these interim targets are indicative*. Yet should the Commission deem any time as from the date of adoption of the Renewables Directive, that a Member State undertakes insufficient efforts to comply with the Renewables Directive, the Commission is entitled to start infringement procedures against the Member State concerned.

4.3 Statistical transfer between Member States

The first flexible mechanism to facilitate Member States that are below their indicated trajectory to meet their respective renewables target through in-lands market deployment of renewables is branded ‘statistical transfers’. It is set out in Article 6 of the Renewables Directive (See Annex 2). According to Article 6 (1): “Member States may agree on and make arrangements for the statistical transfer of a specified amount of energy from one Member State to another Member State.”

Although the EU has mandated a final energy consumption *numéraire* for renewable energy target accounting, so far the renewable energy statistics of the 27 Member States are production statistics as the so-called internal market for renewable energy is completely fragmented into 27 national markets.[11] The *statistical transfers* mechanism enables competent authorities of Member States to bilaterally transact - when certain conditions are met - part of official national renewable energy performance statistics *sheer for target compliance purposes*. The leading principle is to straighten out, to the extent possible, short MS positions with long positions of other MS regarding target compliance. In principle, the “statistical transfer of a specified amount of energy from one Member State to another Member State” can be interpreted to *de facto* create a *new* valuable commodity, i.e. *(cross-border) transferable target accounting units*, transacted between competent bodies assigned by Member State governments.[12] To the extent that such units are transacted indeed, the renewable energy target accounting is de-linked from the actual renewable energy performance of Member States as indicated by official statistics.

The market for statistical transfers between Member States is poised to be a strong suppliers market. This might well jack up the average unit price of transferable target accounting units by

[11] Nothing much has changed in this respect (Jansen and Uyterlinde, 2004).
[12] Proponents of fragmented EU markets in renewable energy and FIT-based support systems refer to the ‘statistical transfers’ mechanism as “virtual cross-border transfer of renewable energy” (which is neither applicable from a renewable energy consumption nor from a renewable energy production perspective) or “statistical renewable energy transfer” (e.g. Klessmann, 2009).

exercise of supply-side market power and strong demand-side competition. It remains to be seen as to whether Article 6(2) of the Renewables Directive constitutes a safeguard against exercise of market power. Article 6(2) mandates the transacting Member States to divulge the transaction price of "the energy involved".[13] Where and when applicable, the Commission is facing a difficult task in tracing any opaque side-deals between MS.

The *theoretical* scope for cost-effective application of the 'Statistical transfers between Member States' instrument by the Dutch government is quite large. It is even exceeding the potential for *joint support schemes* as long as the latter is not applied EU-wide. The scope for cost-effective application of *statistical transfers* in its own right (unrelated to application of the other flexible mechanisms) *in practice* can be assessed ex ante on a very speculative basis only. *To test the potential the Dutch government is advised to organise* ***in the very near term*** *a tender for delivery per forward contract of target accounting units valid in year 2020 at cost-effective prices*. Towards target year 2020 the prices for ex post 'statistical transfers' of 2020 target accounting units by Member States that are over-compliant might well be high and availability might be low, as the EU at large being short is an event that has to be duly factored in. For that reason, fast action is warranted.

4.4 Joint projects between Member States

This flexible mechanism is covered by Articles 7 and 8 of the Renewables Directive. MS have to notify the Commission any joint project between MS in their territory that became effective after 25 June 2009. The MS concerned have to specify in the notification the proportion or amount of renewable energy to be regarded as counting towards the national overall target of another MS. They have to provide details such as: the period concerned (up to year 2020 at the latest), how will be the allocation of the 'renewable energy' (i.e. the target accounting units) between host MS and co-operating foreign MS; etc. Note that for realising the ex ante allocations to foreign MS at the same time the 'statistical transfers' instrument has to be used.

The potential for the Dutch government to obtain cost-effective target credits on account of this second flexible mechanism, defined in the Renewables Directive, depends on several 'host MS related factors'. These include:

- Capacity constraints including financing bottlenecks in any host Member States with regard to harvesting 'low hanging fruits'.
- The willingness to share the target accounting units that the joint projects between MS yield at prices that are cost-effective for the Dutch government and the private project stakeholders; in fact a host Member State should be willing to share 'low hanging fruits' in the form of low-cost renewable energy potentials with investing Member State(s) implied in a project under the third flexible mechanism without jeopardizing its own target compliance or facing substantially higher support costs because the low hanging fruits are harvested by investing MS.
- A positive price negotiation margin, shaped by (1) the marginal cost for the Dutch government to obtain inlands the target accounting units needed for bridging the envisaged target compliance gap and (2) the aggregate cost of national support measures per target accounting unit in the host MS of joint projects, after deduction of (3) the deadweight 'red tape' costs on the part of the Dutch government.

The social cost-effectiveness of applying the 'joint projects between MS' instrument by the Dutch government might be improved if joint projects are designed with application of technical know-how by private Dutch investors and/or other Dutch stakeholders.

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[13] This is a legal ploy where 'the energy involved' *de facto* refers to "(trades in) statistical transfers", which is different from trades in the underlying energy. These trades have been transacted *ex ante* and typically involve different market parties on the demand side than is the case with trades in the underlying energy.

In principle, the joint project between MS approach can have several advantages. It enables to mobilize cheaper renewable resource potentials and offers opportunities for the active involvement of the Dutch private sector. In fact, Member States and private companies can access to other Member State's resources, and transfer Dutch know-how in exchange.

Within a joint project, potential investing Member States seeking to obtain target credits in return will focus on:
1) Investing in projects that require lower market stimulation subsidy budgets compared to stimulating the marginal renewable energy sources within the investing MS.
2) Other socio-economic benefits, i.e. deployment of companies from the investing MS.
3) Avoiding additional network integration costs of stimulating inlands renewable energy generation (expansion of grid, congestion, balancing, etc.).
4) Simplified administrative, bureaucratic procedures for securing a mutually satisfactory distribution of target accounting units resulting from the joint projects concerned between host and investing foreign MS.

On the other hand a host country will focus on among others:
(i) Cooperating with those foreign company(ies)/governments that at the very least fully compensate additional costs/support measures applied, and bring in profit to host country stakeholders.
(ii) No exhaustion of host country's low-cost renewable energy potentials.
(iii) Using the co-benefit of GHG emission reductions towards its emission reduction target or selling it on top of the RE that is statically transferred (only applicable to non-ETS sector projects).
(iv) The other favourable local effects a joint project will bring in, such as employment, rural development, technology transfer, etc.

Particularly for bio-energy projects the experience gained through the JI projects indicate cooperation possibilities between Member Sates. For instance Bulgaria, Latvia, Romania and Poland have been involved in JI projects. Furthermore, MS with projected long positions, e.g. Sweden, Poland and Finland, might be targeted for opportunities using the flexible mechanism 'Joint projects between Member States'.

It is impossible to give any robust projection of the scope for cost-effective use of this instrument for cost-effective import of target accounting units. The administrative process for arranging the 'statistical transfers' poses severe constraints on the quantitative potential for cost effective renewables target credit. For that reason, we expect only a modest cost-effective contribution of 'joint projects between MS' towards compliance achievement of the Dutch RES target for year 2020. Evidently, this also depends on the elaboration to be given by the Commission on how this (and other) flexible instrument is allowed to be used for target compliance. In the previous chapter we have made suggestions which renewable energy categories can be focused upon in Germany, Poland, Spain and Sweden respectively.

4.5 Joint projects between Member States and third countries

The southern MS, including notably Italy, have lobbied intensively in favour of the third flexible mechanism which solely regards renewable *electricity*. The third flexible mechanism is covered by Articles 9 and 10 of the Renewables Directive. Any joint projects between MS and third countries that are to yield target credits for MS have to meet a number of conditions including the following ones:
- The whole volume of electricity underlying the notified target credits has to be imported physically into the Community.
- This implies that evidence has to be administered that corresponding interconnection capacity has been firmly nominated by all responsible system operators over the whole transmis-

sion trajectory from the host country to the importing MS (as specified in the notification) including the TSOs in any transit countries.
- The nomination period of nominated capacity and the electricity generation period have to match.
- The corresponding volume of electricity should not have received support from a support scheme of a third country.
- No target crediting after year 2020.

Furthermore, the Directive provides, to a certain extent, potential safeguards against infringement procedures on account of target under-compliance by MS involved in this mechanism related to long lead times for the construction of relevant interconnectors. Furthermore, the Renewables Directive does not address some serious issues related to this third mechanism:
- The potential host countries, especially in the Southern Mediterranean, are still quite poor and boast rapidly growing populations. Hence local pent-up demand for electricity is quite high and rapidly growing. Yet any financial closure of the projects applying the third mechanism will include quite firm 'take or pay' electricity export requirements.[14] This might create strong resistance among the host country population in want of basic electricity services.
- One of the key drivers of the support to renewable energy deployment mandated by the Renewables Directive is supply security. The Directive dugs the question on safeguards against acts of terrorism targeted at the vulnerable electricity supply infrastructure needed to endorse the giant projects entailed by the third flexible mechanism as well as the risks of breach of contract by host country stakeholders.

MS intending to go for the third flexible mechanism do need to address the aforementioned issues.

We hold quite subdued expectations for the scope for the Netherlands to cost-effectively acquire target credits on account of this third mechanism for the period with a 2020 horizon. Let us for example take the Desertec proposal. This proposal is embraced - *without any firm commitments* - by a number of private stakeholders with strong vested interests in the large-scale electricity supply paradigm. The Desertec initiative seeks as a first step a large amount of public money for merely undertaking a project feasibility study and as a second step public funding for investment in interconnections with Southern Mediterranean countries. The CPS technology at the giant scale proposed by Desertec is still to be proven. An enormous technological challenge is formed by the high water requirements of the technology under conditions prevailing in the Sahara Dessert. The Desertec consortium is currently showing grossly over-optimistic cost figures.[15]

We tentatively estimate the unit cost assuming the Desertec project to be commissioned at the beginning of target year 2020 at to-day's price level including the dedicated cost of transmission to Italy - assuming the Maghreb-Italy interconnector concerned to be realised on a merchant investment project basis - would be on the order of € 100 - 160 / MWh with busbar generation costs crudely estimated at € 85 - 130 / MWh. CSP is stated in the literature to have a fairly modest cost reduction potential. *We note that we do not consider a commissioning date before year 2023 for the Desertec proposed investments in generation and additional Maghreb-EU interconnection capacity feasible in practice.[16] This would imply that Desertec could not generate renewable target accounting units for EU Member States.*

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[14] Such contracts would mandate the export to specified EU destinations of a certain minimum annual power volume or a certain minimum proportion of the annual project output with a penalty clause for incompliance.

[15] See e.g. a presentation by Roberto Vigotti on http://www.clingendael.nl/ciep/events/20091022/.

[16] The IEA suggests a current cost of electricity bandwith for CSP applied in the Sahara of €100-150 /MWh. In the range indicated above applicable for installations installed in 2020 we have assumed (in the absence of further information) some economics of scale effects. Learning effects for CSP have been reported to be fairly limited.

For a centralised PV the corresponding range for power from a large utility scale Sahara project physically delivered in Italy might be on the order of € 110 - 160 / MWh with busbar generation costs projected at € 90 - 130 / MWh.[17] *In contrast to CSP at Desertec scale* large-utility-scale projects for PV in the Sahara are feasible to be commissioned by year 2020, assuming financial closure some 1-2 years in advance. The potential for PV to achieve cost reductions at somewhat longer term are much higher than for CPS (McKinsey, 2008).[18] Currently the unit cost level for for large (100 kW_p) PV systems in the Netherlands is € 410 - 460 / MWh. For large PV systems commissioned in the Netherlands in year 2020 the corresponding unit generation costs are projected to diminish to € 180 - 260 / MWh as against in Spain € 110 - 160 / MWh. The recent IEA PV Roadmap suggests that the lower limit of these two bandwidths could even be slightly lower (IEA, 2009).

The prospects for large-utility-scale Sahara projects by 2020 are appreciably more favourable than Desertec projects. *This does not refrain us from holding low expectations of availability of any Sahara renewable electricity projects for application as a 'joint project with third countries' to obtain credits for renewable energy target compliance by EU MS, as we consider the implementation issues mentioned at the onset of this section to be prohibitive.*

In conclusion, three issues impede realisation of electricity generation projects in third countries apart from the high unit generation cost of large-scale centralised CSP and PV projects *including investment costs in dedicated interconnections and operating transmission costs*. Firstly, the high deadweight administration costs to come to a financial closure of such projects, where a lot of public support commitments from MS and the Commission (e.g. TEN-E programme) are necessary to entice all private stakeholders concerned to sign up. Second, realisation of giant-scale power projects in third countries for firmly contracted exports to the EU might give rise to serious internal political problems in the host countries with populations in far much greater

[17] Based on annual insolation of (rounded) 2200 kWh / m^2 in Western Sahara, compared to 1900 kWh / m^2 in Spain and 1100 kWh / m^2 in the Netherlands. See: http://re.jrc.ec.europa.eu/pvgis/ Currently the unit cost level for for large (100 kW_p) PV systems in the Netherlands is € 410 - 460 / MWh. For large PV systems commissioned in the Netherlands in year 2020 the corresponding unit generation costs are projected to diminish to € 180 - 260 / MWh as against in Spain € 110 - 160 / MWh. The recent IEA PV Roadmap suggests that the lower limit of these two bandwidths could even be slightly lower.

[18] Dutch R&D is widely acclaimed to contribute importantly to fast cost reductions with PV technology. This is evidenced among others by World Energy Review Magazine article of May 2009:

"*Record module efficiency from ECN*

Researchers of the Energy research Centre of the Netherlands (ECN) have achieved a conversion efficiency of 16.4% across the aperture area on a full-size solar module, a new world-record efficiency for photovoltaic modules with multicrystalline silicon solar cells.

ECN says the record, using cells made from wafers supplied by REC Wafer Norway and Deutsche Solar, was achieved using industrial-scale equipment for interconnection and encapsulation of rear-contact cells provided by the Dutch equipment builder Eurotron. Financed by the European Commission within the project CrystalClear and by the Dutch government through SenterNovem, ECN developed the new module design and manufacturing process based metallization wrap-through (MWT) rear contact solar cells which are interconnected in modules using conductive adhesives and a patterned conductive foil. This technology has similarities with surface mounting of electronic components on a printed circuit board. The MWT technology improves conversion efficiency as it avoids metal strips used in standard modules to connect the front of one cell with the rear of a neighbouring cell which block part of the incoming light, and require spaces between the cells. In addition, the use of a patterned conductive foil results in lower resistance losses than for strips, also leading to higher module efficiencies.

The second benefit is that very thin and fragile, solar cells can be used and the world record module was built with 36 cells of 120 micron thickness only; much thinner than standard 180-200 micron cells.

Solland Solar will be the first manufacturer to use the technology in commercial production, later this year.

The previous world-record for module efficiency was held by the USA's Sandia National Laboratory, at 15.5% aperture-area efficiency."

The article above has already been over taken by events: early December 2009 ECN and REC have set a new world record for multicrystalline silicium cells of 17%, which got wide coverage in the scientific world on solar energy technology.

want of electrical end-use services, compared to EU citizens. Third, MS governments considering involvement in joint large-scale electricity generation projects in third countries need to duly allow for supply security risks. These risks derive from potential terrorist acts[19] and defaults on contractual obligations by host country contract parties. CSP projects in the Sahara have no potential to deliver target credits by 2020 as commissioning such utility-scale projects by *force majeure* year 2022 (as defined in the Renewables Directive) at the latest is impossible in practice. In contrast, utility-scale solar PV projects in the Sahara are. Yet in our view such projects are only politically feasible when they meet - without contractual diversions of power to the EU - the urgent needs of local populations for electric energy services.

4.6 Joint support schemes

Article 11 of the Renewables Directive, included as a result of strong lobbying by the Swedish government with support from the Commission, provides the possibility to coordinate their national support systems. Currently, within the EU or rather the EEA two movements towards a possible joint support system are discernible. The most advanced initiative is going on in the Nordics. Sweden and Norway seek to achieve a joint RPS (renewable portfolio standard) system starting in year 2012. Second, Germany, Spain and Slovenia have entered into collaboration on promotion of FIT systems and information exchange on best practices for FIT (feed-in-tariff) (and FIP, feed-in-premium, systems) with the ultimate objective of some form of support harmonisation.[20]

Regarding joint RPS systems, a quite common way of describing such systems in general reviews is to assume no supplementary support measures at all.[21] Yet in practice, successful RPS systems do not tend to be of the pure generic 'technology neutral' form, as typically assumed in many modelling exercises. For instance, the well-functioning RPS system, operated by the Texan Transmission system operator ERCOT, is superimposed on the Production Tax Credit facility for certain qualifying technologies, granted by the federal U.S. government.[22] In the European context, a joint RPS system can quite well co-exist with a supplementary national differentiation of technology-specific technologies based to a certain extent on subsidiarity. Collaborating MS will typically have different renewable resource endowments and might e.g. have a different industrialisation policy agenda.[23]

The *joint support schemes* mechanism poses a number of issues that needs to be addressed (e.g. Klessmann, 2009),

1) Framework conditions (especially power market conditions; extent of wholesale power price convergence). Generally the benefits of joint support schemes will be higher the more

[19] Desertec is claiming that a mashed Mediterranean supergrid would provide enough safeguards. This bags the question as to who will pay for a supergrid from Gibraltar via Algers, Cairo, Damascus and Istanbul to Europe with interconnectors to at least Spain, Italy and Greece.

[20] In spite of generous funding of at least two international promotion workshops and two FIT joint support systems promotion reports by Fraunhofer Institute ISO, Karsruhe, and EEG, Vienna by the Ministry for Environment, BMU, of Germany and the Spanish government, no concrete design of a FIT-based joint support system has been produced so far; only some non-committal "best practices" recommendations for FIT systems (Ragwitz et al., 2008).

[21] Most reviews of FIT versus RPS support systems assume a 'one size fits all' generic RPS. This is conveniently self-serving for developing the *incorrect* argumentation that in general FIT systems, for national systems and notably for joint support systems would be more efficient in a static and dynamic efficiency sense than RPS. (See e.g., Ragwitz et al., 2007; Klein et al., 2008).

[22] For a further explanation of the hybrid RPS concept see (Jansen *et al.*, 2005)

[23] On the other hand, a certain co-ordination and convergence of technology-specific supplementary support measures could accelerate cost-reducing technology development and deployment towards commercial maturity. This applies in particular to still rather expensive technologies such as offshore wind. Support competition would lead to sub-optimal market deployment among the participating MS and to less stable market conditions for the offshore wind power industry.

the respective wholesale power prices in the MS concerned tend to converge towards each other.

2) Differentiated targets for the participating MS or a shared 'bubble target'. An evolution towards a joint target would be most optimal.
3) The extent of support differentiation among qualifying technologies and among MS.
4) Allocation of additional support cost of renewables including additional renewables-specific grid integration cost among MS and consumers. This is a major problem for joint FIT schemes, rather than for joint RPS schemes where the allocation problems tend to be dealt with in a market-based way.[24] To that effect it is important that balancing responsibility is arranged according to sound economic principles without biases pro or against certain technologies. In most FIT systems, e.g. the German one, renewable generators as against non-renewable ones can feed in without any regard to the balancing cost made on their behalf. For example in Germany, these are passed on by means of a complex vertical and horizontal cost equalisation procedure to (small-scale) end-users. In a joint FIT system these costs have to be allocated as well to participating MS and their respective end-users.
5) The Netherlands is a MS poised to be potentially short on its 2020 renewable energy target, unless very high support cost are to be expended compared to other EU countries. The only flexibility mechanism that offers market-based trading prospects is 'joint support systems between Member States', i.e. between the Netherlands and one or more potentially interesting MS. *The flexible mechanism 'joint support schemes' has the potential to unleash gains from trade to the tune of multi-billion euros of socioeconomic benefits for the partner countries involved*. The Netherlands is projected to have to spend some 61 billion euros (at current prices) on SDE and MEP support money for renewable electricity over the period 2012 - 2035 (3.2 billion euros in target year 2020). Should the Netherlands be able to intelligently apply the *joint support schemes* mechanism, up to several hundred million euros of SDE money per annum can be saved (See textbox below).

To illustrate the potential for savings on market stimulation expenditures by the Dutch society without adverse impact on Dutch target compliance, a concrete example might be instructive. In order to ensure 100% *inlands* target compliance, the Netherlands is planning for 6000 MW offshore wind power in 2020. Let's make the realistic assumption that 5200 MW of offshore wind power is in place by year 2020. If we assume a generation subsidy of on average €90 SDE / MWh and a production of 3700 MWh per MW per year, this boils down to € 1.7 billion SDE subsidy per year, or € 0.33 million SDE subsidy per MW per year. Should the Netherlands be able to enter in a common RPS (renewable portfolio standard) with Sweden, thereby keeping its current SDE support system in place but with an additional ex post adjustment of the subsidy amount to the average RPS certificate price this could bring in substantial benefits. The average certificate price of the Swedish RPS in year 2008 was about 29 € / MWh. Sweden has ample low-additional-cost renewable energy resources (biomass; onshore wind) that remain to be harnessed. Let us assume that a joint Swedish-(Norwegian)-Dutch RPS would yield an average certificate price in 2020 of 40 € / MWh. The governments of the countries participating in the considered joint support scheme can steer, in close collaboration, the allocation of target compliance between them as well as the resulting certificate price. This can be done, amongst others, through the fixing of the RPS system target and national supplementary support measures, e.g. the SDE system in the Netherlands. Let us assume that in the margin 2000 MW of Dutch offshore wind production will be replaced by extra renewable power generation in Sweden. Then Dutch electricity end-users have to stump up an annual amount of RES support subsidy

[24] The allocation of the additional cost of feed-in tariffs compared to wholesale market tariffs and of balancing cost to the (small-scale) end-users through a horizontal (between TSOs) and vertical (between suppliers for each TSO control area) in Germany is extremely complicated with high deadweight administrative cost for TSOs, DSOs, suppliers and other market parties concerned. To replicate the German FIT practice in a joint support system is hardly practicable. Moreover, the set of arrangements for a joint fund - indispensable for a joint FIT-based support system as opposed to a joint RPS-based system - such as the MS mix in the financing of the joint fund will be a hard nut to crack.

which is less to the tune of:

2000 [MW] * 3700 [h/yr] * (90 - 40) [€/MWh] = € 0.37 billion subsidy savings per year[25]

Moreover, in the Netherlands a substantial additional annual amount of savings on grid integration cost can be realised.

For Sweden such collaboration would have great benefits as well. If the aforementioned assumptions hold true Swedish society, i.e. the Swedish renewable energy industry and the Swedish government by way of value added tax, will be on the receiving side of substantial cross-border transfers, totalling:

2000 [MW] * 3700 [h/yr] * 40 [€/MWh] = € 0.30 billion per year

Last but not least, the countries participating in this joint support scheme would give the upbeat towards a genuine pan-European electricity market. In the absence of a credible carbon price, such a market would initially have a two-tiers character. One pan-European market segment would encompass electricity from commercially mature technologies and the other one electricity from promising technologies in need for justified market support, declining over time.

It is acknowledged that entering into, and implementing, a well-designed bilateral (or tri-lateral) 'joint support schemes' agreement will require a large preparation effort. For example, the joint RPS should be designed such that the upward impact of Dutch entry into the system on the certificate price will be modest. Otherwise, the Swedish electricity users could be affected in an overly negative way. Among others, the calibration of the Dutch SDE subsidies is an important instrument to that effect. *We conclude that the great potential benefits for the countries collaborating on 'joint support systems' (and for the EU at large to speed up the movement towards a single European market) warrants serious consideration of this possibility without delay.*

The most relevant features to focus upon to identify a potential partner MS for the Netherlands to enter into a joint support system include:

(i) Sincere willingness to engage in international cooperation to capture the gains of trade in qualifying renewable energy by private economic actors.
(ii) Potential to develop a long position in case of only inlands renewable target compliance at anticipated policy support efforts.
(iii) A complementary diversity of relatively low cost qualifying renewable energy sources.

A key pre-condition for a joint support system is certainty for Dutch investors in renewable electricity projects, including strong safeguards for continuity in SDE-equivalent support benefits entitlements.

A joint support scheme as indicated above would in fact improve certainty for Dutch renewable energy investors. This holds the more so with implementation of the envisaged change in the financing mode of the SDE by year 2012 from public expenditures to an SDE charge on the bill of electricity consumers. A hybrid RPS-SDE system in the Netherlands would totally remove power price risk to renewable energy investors. In the current SDE system they run a small price risk at unexpected large price drops as the SDE subsidy does not completely hedge against this risk. In contrast, a hybrid RPS-SDE system gives full risk coverage on ac-

[25] In the case of the Netherlands, offshore wind is the renewable electricity technology expected to make, in volume terms, the largest marginal contribution in 2020. Yet in the margin also a substantial amount of electricity is expected from small biomass-based plants; plants that are to require a higher production subsidy than offshore wind. Hence, replacement of Dutch electricity production from this category will **further boost** the potential savings on SDE subsidies of the proposed support scheme. On the other hand, it can be questioned whether Dutch net import of 7.4 TWh/annum of Swedish electricity can be realised without a serious price rise on the certificate market. If a lower volume than the 7.4 TWh/annum of expensive Dutch renewable electricity will be substituted by cheaper Swedish renewable electricity, this **reduces** the savings on SDE subsidy.

count of the opposite price movement of the power price and the RPS certificate price provided the average annual certificate price is included in the current ex post SDE subsidy adjustment mechanism. A shift of the SDE financing mode will shift the political risk from budget cuts by the government to the possibility of discontented electricity consumers in the event of surging electricity bills. A hybrid RPS-SDE system will reduce the SDE surcharge on the bill. Moreover, an RPS introduces an element of competition between different renewable technologies which provides stronger incentives towards cost reduction by renewable generators than the current SDE system. This competition is poised to occur on broadly equal terms by way of the SDE component of market stimulation.

Any producer surplus deriving from exercise of market power on the certificate market will be largely mitigated by inclusion of the certificate price in the ex post SDE adjustment mechanism. Even so, fair competition on the RPS certificate market is an issue deserving special attention.

4.7 Main findings

The new Renewables Directive shapes four target compliance flexibility instruments. We have identified three of these mechanisms as potentially interesting to bring down the burden of complying with the 2020 renewable target on Dutch electricity consumers.

The most important mechanism, warranting in our view further consideration without delay, is the *joint support schemes* instrument. A simple illustrative example of a joint support system with Sweden was given indicating that stakeholders in both countries stand to gain up to several hundred million euros per annum if their respective governments were to enter into such an agreement, i.e. electricity consumers in the Netherlands (higher consumer surplus) and the renewables industry (higher producer surplus) and the government (higher value added tax on certificates trade) in Sweden. These gains would be partially offset by a less fast increasing producer surplus in offshore wind project development in the Netherlands.

In the absence of EU-wide *joint support schemes* the theoretical potential of the instrument *statistical transfers* is even higher. Its potential *in practice* is highly uncertain though. In order to test the potential in practice of cost-effective contributions to target achievement by the latter instrument, in the very near term the organisation of a tender is warranted among the other 26 Member States to offer forward contracts for delivery of target accounting units for target year 2020 through *statistical transfers.*

Much more modest Dutch target burden reduction opportunities, but still meriting further consideration, are offered by the instrument *joint projects between Member States.*

We have addressed the mechanism *joint projects between Member States and third countries* with special attention for CSP and solar PV projects in desert countries. Our findings are that the potential for the Netherlands to realise savings on SDE expenditure in the run-up to and including target year 2020 are likely to be negligible.

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Appendix A Green-X 'Strengthened national policy' scenario results

Table A.1 *Green-X 'Strengthened national policy' scenario results*

Breakdown of 2020 RES deployment by country & by technology (expressed in terms of final energy [TWh/yr.])	Germany	Netherlands	Spain	Sweden	Poland	**European Union**
RES category	DE	NL	ES	SE	PL	**EU27**
RES Electricity						
Biogas	15,6	3,7	6,8	1,1	6,8	**88,5**
Solid biomass	27,8	7,0	24,1	12,1	14,8	**195,7**
Biowaste	5,6	2,0	4,9	1,0	1,5	**33,6**
Geothermal electricity	0,0	0,0	0,1	0,0	0,0	**8,3**
Hydro large-scale	13,6	0,1	35,6	66,7	1,4	**326,3**
Hydro small-scale	9,6	0,0	7,7	5,0	2,0	**63,1**
Photovoltaics	17,5	0,3	2,9	0,0	0,0	**27,0**
Solar thermal electricity	0,0	0,0	12,7	0,0	0,0	**13,9**
Tide & wave	0,0	0,0	0,3	0,0	0,0	**6,9**
Wind onshore	55,8	8,6	58,8	6,8	8,3	**307,5**
Wind offshore	63,1	19,4	1,3	1,5	0,2	**181,4**
RES-E total	208,6	41,2	155,0	94,3	35,0	**1252,3**
RES-E CHP	32,6	5,2	17,3	12,9	12,2	**194,6**
Share on gross electricity demand	34,1%	34,5%	49,3%	61,1%	21,3%	**35,3%**
RES Heat						
Biogas (grid)	0,9	1,0	0,8	0,3	0,9	**22,6**
Solid biomass (grid)	37,3	5,1	7,2	31,0	36,6	**270,2**
Biowaste (grid)	9,6	2,3	5,0	3,1	2,7	**60,1**
Geothermal heat (grid)	1,9	0,0	0,3	0,0	0,9	**17,1**
Solid biomass (non-grid)	107,3	4,2	65,7	46,8	53,6	**771,4**
Solar thermal heat. & hot water	28,2	4,9	9,0	1,8	2,2	**103,4**
Heat pumps	25,9	6,6	3,4	8,3	3,0	**119,6**
RES-H total	211,0	24,1	91,3	91,4	99,8	**1364,3**
Share on gross heat demand	15,8%	7,4%	20,2%	68,7%	17,5%	**19,6%**
RES Transport						
1st generation biofuels	12,5	1,7	10,2	2,6	20,4	**147,2**
2nd generation biofuels	1,4	0,1	2,0	0,8	2,5	**16,5**
Biofuel import	42,4	8,5	23,6	4,8	5,0	**204,5**
RES-T total[1]	56,3	10,2	35,8	8,2	27,9	**368,3**
Share on diesel & gasoline demand[1]	7,7%	5,6%	7,0%	9,2%	12,6%	**8,1%**
RES-T total[2]	*59,1*	*12,8*	*42,0*	*7,5*	*17,8*	***368,3***
Share on diesel & gasoline demand[2]	*10,0%*	*10,0%*	*10,0%*	*10,0%*	*10,0%*	***10,0%***
RES in total						
RES total[1]	475,8	75,6	282,1	194,0	162,8	**2984,9**
Share on gross final energy demand[1]	17,8%	12,0%	22,0%	51,5%	17,1%	**19,8%**
RES total[2]	*478,6*	*78,1*	*288,3*	*193,2*	*152,6*	***2984,9***
Share on gross final energy demand[2]	*17,9%*	*12,4%*	*22,5%*	*51,3%*	*16,0%*	***19,8%***
RES target for 2020[3]	*18%*	*14%*	*20%*	*49%*	*15%*	***20%***
Corresponding national target fulfillment[2]	*99%*	*89%*	*112%*	*105%*	*107%*	*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.

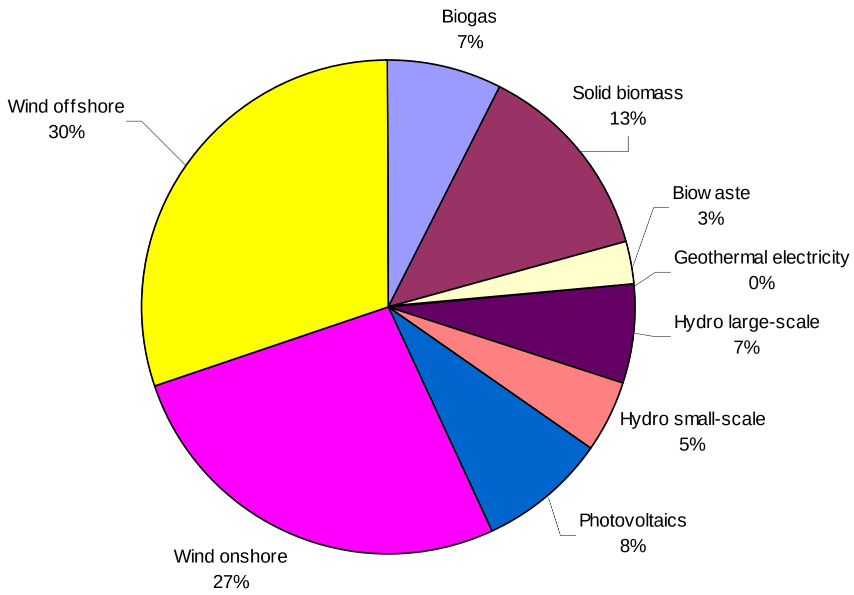

Figure A.1 *Germany-Breakdown of 2020 RES-Electricity deployment by technology*

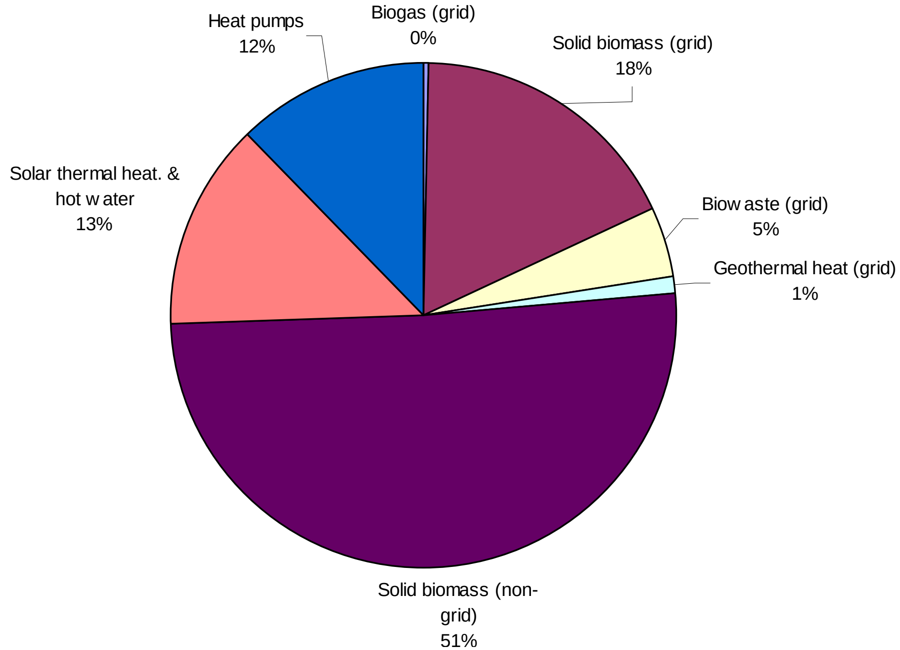

Figure A.2 *Germany-Breakdown of 2020 RES-Heat deployment by technology*

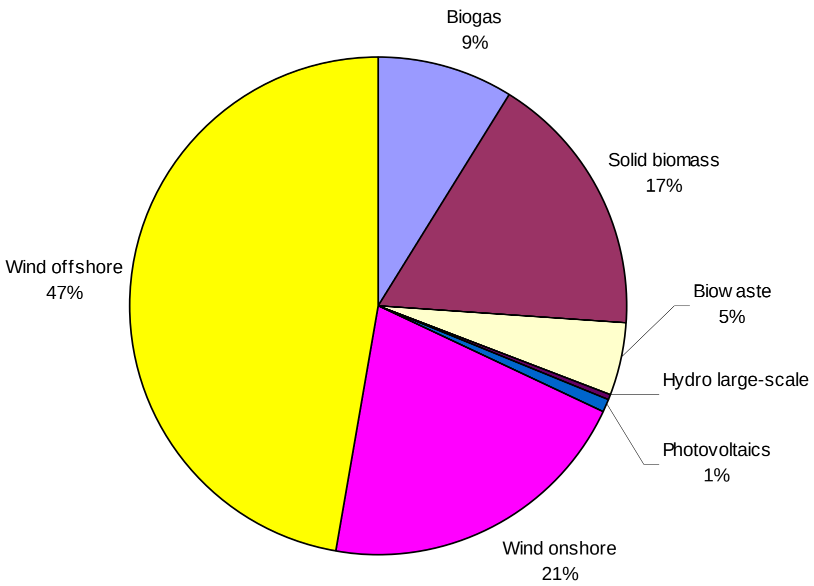

Figure A.3 *Netherlands-Breakdown of 2020 RES-Electricity deployment by technology*

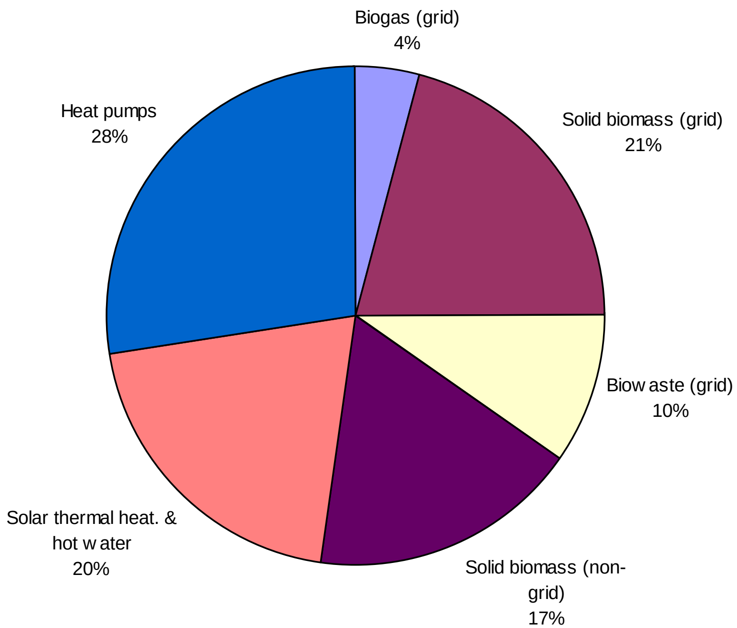

Figure A.4 *Netherlands-Breakdown of 2020 RES-Heat deployment by technology*

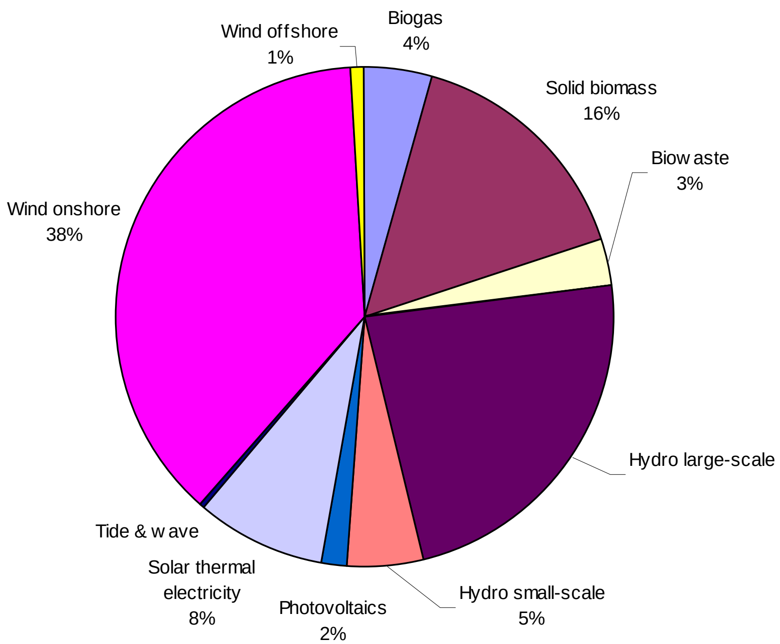

Figure A.5 *Spain-Breakdown of 2020 RES-Electricity deployment by technology*

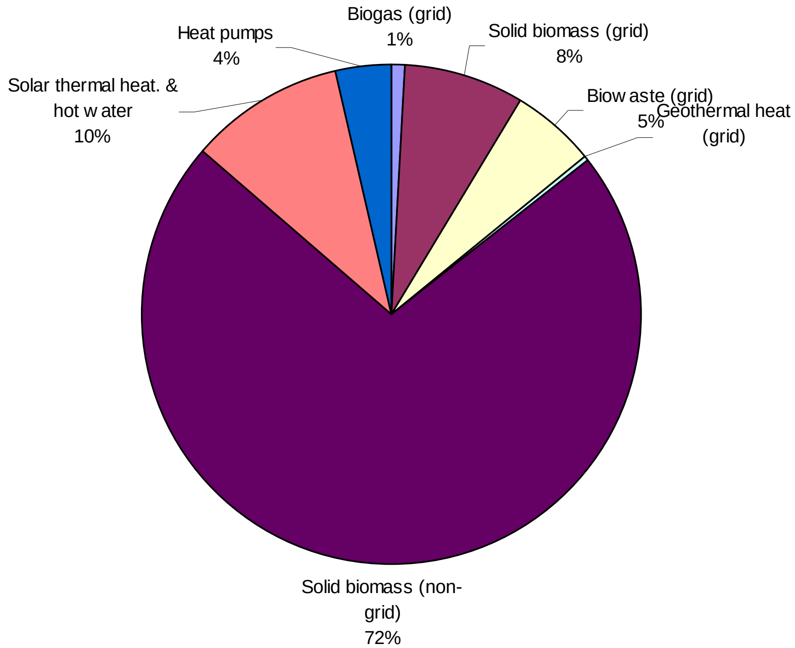

Figure A.6 *Spain-Breakdown of 2020 RES-Heat deployment by technology*

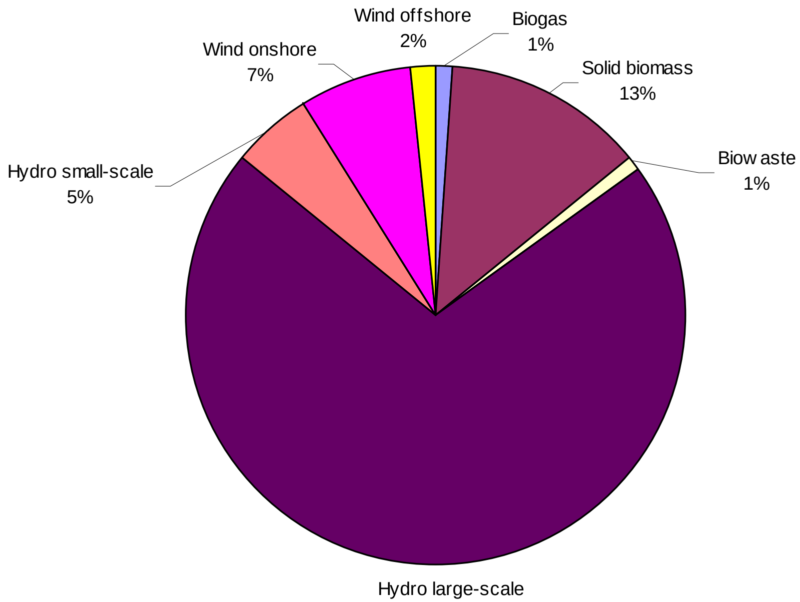

Figure A.7 *Sweden-Breakdown of 2020 RES-Electricity deployment by technology*

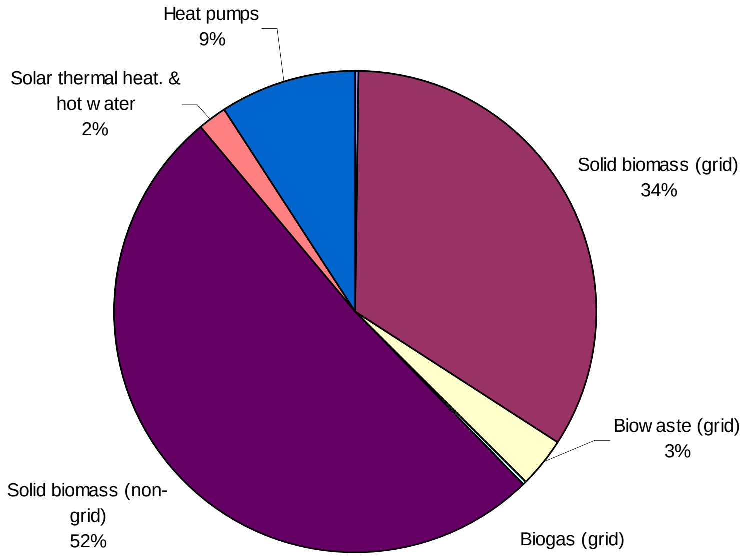

Figure A.8 *Sweden-Breakdown of 2020 RES-Heat deployment by technology*

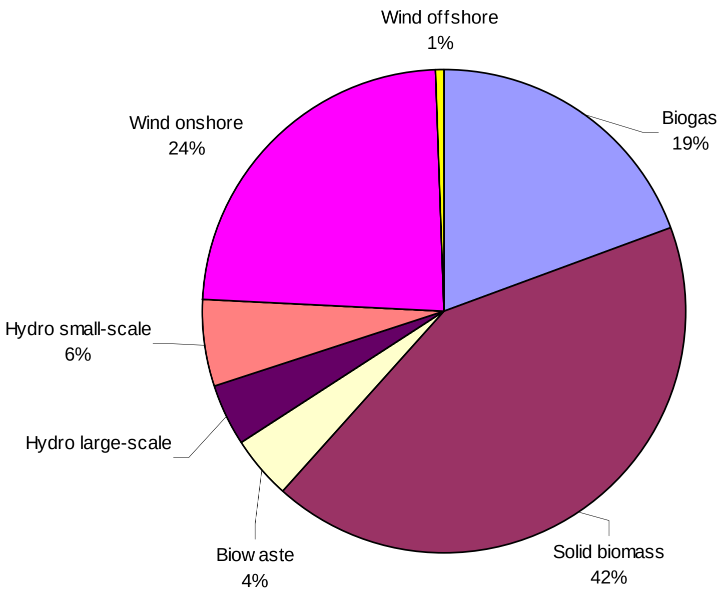

Figure A.9 *Poland-Breakdown of 2020 RES-Electricity deployment by technology*

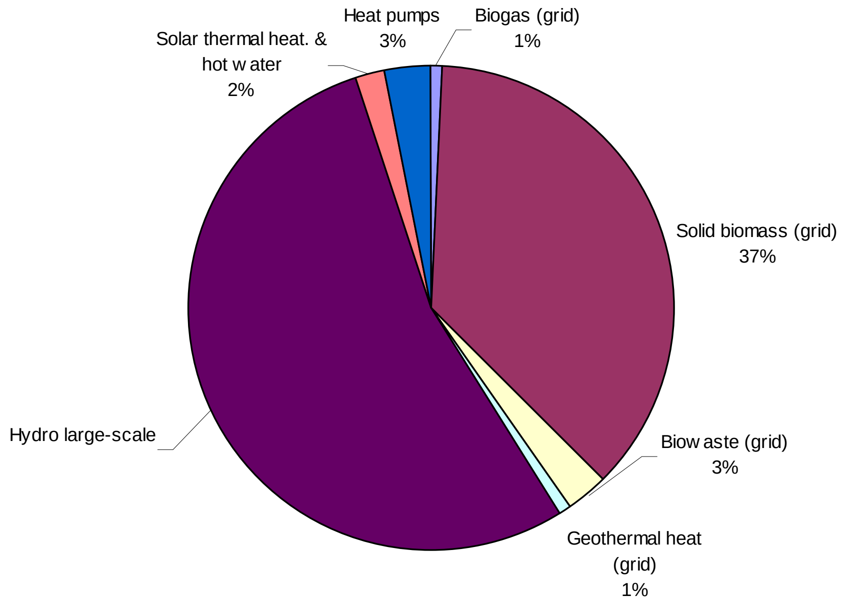

Figure A.10 *Poland-Breakdown of 2020 RES-Heat deployment by technology*

Appendix B Articles 5-11 of Renewables Directive 2009/28/EC

Article 5

Calculation of the share of energy from renewable sources

1. The gross final consumption of energy from renewable sources in each Member State shall be calculated as the sum of:

(a) gross final consumption of electricity from renewable energy sources;

(b) gross final consumption of energy from renewable sources for heating and cooling; and

(c) final consumption of energy from renewable sources in transport.

Gas, electricity and hydrogen from renewable energy sources shall be considered only once in point (a), (b), or (c) of the first subparagraph, for calculating the share of gross final consumption of energy from renewable sources.
Subject to the second subparagraph of Article 17(1), biofuels and bioliquids that do not fulfil the sustainability criteria set out in Article 17(2) to (6) shall not be taken into account.

2. Where a Member State considers that, due to force majeure, it is impossible for it to meet its share of energy from renewable sources in gross final consumption of energy in 2020 set out in the third column of the table in Annex I, it shall inform the Commission accordingly as soon as possible. The Commission shall adopt a decision on whether force majeure has been demonstrated. In the event that the Commission decides that force majeure has been demonstrated, it shall determine what adjustment shall be made to the Member State's gross final consumption of energy from renewable sources for the year 2020.

3. For the purposes of paragraph 1(a), gross final consumption of electricity from renewable energy sources shall be calculated as the quantity of electricity produced in a Member State from renewable energy sources, excluding the production of electricity in pumped storage units from water that has previously been pumped uphill.
In multi-fuel plants using renewable and conventional sources, only the part of electricity produced from renewable energy sources shall be taken into account. For the purposes of this calculation, the contribution of each energy source shall be calculated on the basis of its energy content.
The electricity generated by hydropower and wind power shall be accounted for in accordance with the normalisation rules set out in Annex II.

4. For the purposes of paragraph 1(b), the gross final consumption of energy from renewable sources for heating and cooling shall be calculated as the quantity of district heating and cooling produced in a Member State from renewable sources, plus the consumption of other energy from renewable sources in industry, households, services, agriculture, forestry and fisheries, for heating, cooling and processing purposes.

In multi-fuel plants using renewable and conventional sources, only the part of heating and cooling produced from renewable energy sources shall be taken into account. For the purposes of this calculation, the contribution of each energy source shall be calculated on the basis of its energy content.

Aerothermal, geothermal and hydrothermal heat energy captured by heat pumps shall be taken into account for the purposes of paragraph 1(b) provided that the final energy output significantly exceeds the primary energy input required to drive the heat pumps. The quantity of heat to be considered as energy from renewable sources for the purposes of this Directive shall be calculated in accordance with the methodology laid down in Annex VII.

Thermal energy generated by passive energy systems, under which lower energy consumption is achieved passively through building design or from heat generated by energy from non-renewable sources, shall not be taken into account for the purposes of paragraph 1(b). 5.

The energy content of the transport fuels listed in Annex III shall be taken to be as set out in that Annex. Annex III may be adapted to technical and scientific progress. Those measures, designed to amend non-essential elements of this Directive, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 25(4).(1) L 140/30 EN Official Journal of the European Union 5.6.2009

6. The share of energy from renewable sources shall be calculated as the gross final consumption of energy from renewable sources divided by the gross final consumption of energy from all energy sources, expressed as a percentage.

For the purposes of the first subparagraph, the sum referred to in paragraph 1 shall be adjusted in accordance with Articles 6, 8, 10 and 11.

In calculating a Member State's gross final energy consumption for the purpose of measuring its compliance with the targets and indicative trajectory laid down in this Directive, the amount of energy consumed in aviation shall, as a proportion of that Member State's gross final consumption of energy, be considered to be no more than 6,18 %. For Cyprus and Malta the amount of energy consumed in aviation shall, as a proportion of those Member States' gross final consumption of energy, be considered to be no more than 4,12 %.

7. The methodology and definitions used in the calculation of the share of energy from renewable sources shall be those of Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics(1) (OJ L 304, 14.11.2008, p. 1.)

Member States shall ensure coherence of statistical information used in calculating those sectoral and overall shares and statistical information reported to the Commission under Regulation (EC) No 1099/2008.

Article 6

Statistical transfers between Member States

1. Member States may agree on and may make arrangements for the statistical transfer of a specified amount of energy from renewable sources from one Member State to another Member State. The transferred quantity shall be:

(a) deducted from the amount of energy from renewable sources that is taken into account in measuring compliance by the Member State making the transfer with the requirements of Article 3(1) and (2); and

(b) added to the amount of energy from renewable sources that is taken into account in measuring compliance by another Member State accepting the transfer with the requirements of Article 3(1) and (2).

A statistical transfer shall not affect the achievement of the national target of the Member State making the transfer.

2. The arrangements referred to in paragraph 1 may have a duration of one or more years. They shall be notified to the Commission no later than three months after the end of each year in

which they have effect. The information sent to the Commission shall include the quantity and price of the energy involved.3.

Transfers shall become effective only after all Member States involved in the transfer have notified the transfer to the Commission.

Article 7
Joint projects between Member States
1. Two or more Member States may cooperate on all types of joint projects relating to the production of electricity, heating or cooling from renewable energy sources. That cooperation may involve private operators.

2. Member States shall notify the Commission of the proportion or amount of electricity, heating or cooling from renewable energy sources produced by any joint project in their territory, that became operational after 25 June 2009, or by the increased capacity of an installation that was refurbished after that date, which is to be regarded as counting towards the national overall target of another Member State for the purposes of measuring compliance with the requirements of this Directive.

3. The notification referred to in paragraph 2 shall:

(a) describe the proposed installation or identify the refurbished installation;

(b) specify the proportion or amount of electricity or heating or cooling produced from the installation which is to be regarded as counting towards the national overall target of another Member State;

(c) identify the Member State in whose favour the notification is being made; and

(d) specify the period, in whole calendar years, during which the electricity or heating or cooling produced by the installation from renewable energy sources is to be regarded as counting towards the national overall target of the other Member State.

4. The period specified under paragraph 3(d) shall not extend beyond 2020. The duration of a joint project may extend beyond 2020.

5. A notification made under this Article shall not be varied or withdrawn without the joint agreement of the Member State making the notification and the Member State identified in accordance with paragraph 3(c).

Article 8
Effects of joint projects between Member States
1. Within three months of the end of each year falling within the period specified under Article 7(3)(d), the Member State that made the notification under Article 7 shall issue a letter of notification stating:

(a) the total amount of electricity or heating or cooling produced during the year from renewable energy sources by the installation which was the subject of the notification under Article 7; and 5.6.2009 EN Official Journal of the European Union L 140/31

(b) the amount of electricity or heating or cooling produced during the year from renewable energy sources by that installation which is to count towards the national overall target of another Member State in accordance with the terms of the notification.

2. The notifying Member State shall send the letter of notification to the Member State in whose favour the notification was made and to the Commission.

3. For the purposes of measuring target compliance with the requirements of this Directive concerning national overall targets, the amount of electricity or heating or cooling from renewable energy sources notified in accordance with paragraph 1(b) shall be:

(a) deducted from the amount of electricity or heating or cooling from renewable energy sources that is taken into account, in measuring compliance by the Member State issuing the letter of notification under paragraph 1; and

(b) added to the amount of electricity or heating or cooling from renewable energy sources that is taken into account, in measuring compliance by the Member State receiving the letter of notification in accordance with paragraph 2.

Article 9

Joint projects between Member States and third countries

1. One or more Member States may cooperate with one or more third countries on all types of joint projects regarding the production of electricity from renewable energy sources. Such cooperation may involve private operators.

2. Electricity from renewable energy sources produced in a third country shall be taken into account only for the purposes of measuring compliance with the requirements of this Directive concerning national overall targets if the following conditions are met:

(a) the electricity is consumed in the Community, a requirement that is deemed to be met where:

(i) an equivalent amount of electricity to the electricity accounted for has been firmly nominated to the allocated interconnection capacity by all responsible transmission system operators in the country of origin, the country of destination and, if relevant, each third country of transit;

(ii) an equivalent amount of electricity to the electricity accounted for has been firmly registered in the schedule of balance by the responsible transmission system operator on the Community side of an interconnector; and

(iii) the nominated capacity and the production of electricity from renewable energy sources by the installation referred to in paragraph 2(b) refer to the same period of time;

(b) the electricity is produced by a newly constructed installation that became operational after 25 June 2009 or by the increased capacity of an installation that was refurbished after that date, under a joint project as referred to in paragraph 1; and

(c) the amount of electricity produced and exported has not received support from a support scheme of a third country other than investment aid granted to the installation.

3. Member States may apply to the Commission, for the purposes of Article 5, for account to be taken of electricity from renewable energy sources produced and consumed in a third country, in the context of the construction of an interconnector with a very long lead-time between a Member State and a third country if the following conditions are met:

(a) construction of the interconnector started by 31 December 2016;

(b) it is not possible for the interconnector to become operational by 31 December 2020;

(c) it is possible for the interconnector to become operational by31 December 2022;

(d) after it becomes operational, the interconnector will be used for the export to the Community, in accordance with paragraph 2, of electricity generated from renewable energy sources;

(e) the application relates to a joint project that fulfils the criteria in points (b) and (c) of paragraph 2 and that will use the interconnector after it becomes operational, and to a quantity of electricity that is no greater than the quantity that will be exported to the Community after the interconnector becomes operational.

4. The proportion or amount of electricity produced by any installation in the territory of a third country, which is to be regarded as counting towards the national overall target of one or more Member States for the purposes of measuring compliance with Article 3, shall be notified to the Commission. When more than one Member State is concerned, the distribution between Member States of this proportion or amount shall be notified to the Commission. This proportion or amount shall not exceed the proportion or amount actually exported to, and consumed in, the Community, corresponding to the amount referred to in paragraph 2(a)(i) and (ii) of this Article and meeting the conditions as set out in its paragraph (2)(a). The notification shall be made by each Member State towards whose overall national target the proportion or amount of electricity is to count.

5. The notification referred to in paragraph 4 shall:

(a) describe the proposed installation or identify the refurbished installation;

(b) specify the proportion or amount of electricity produced from the installation which is to be regarded as counting towards the national target of a Member State as well as, subject to confidentiality requirements, the corresponding financial arrangements;

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(c) specify the period, in whole calendar years, during which the electricity is to be regarded as counting towards the national overall target of the Member State; and

(d) include a written acknowledgement of points (b) and (c) by the third country in whose territory the installation is to become operational and the proportion or amount of electricity produced by the installation which will be used domestically by that third country.

6. The period specified under paragraph 5(c) shall not extend beyond 2020. The duration of a joint project may extend beyond 2020.

7. A notification made under this Article may not be varied or withdrawn without the joint agreement of the Member State making the notification and the third country that has acknowledged the joint project in accordance with paragraph 5(d).

8. Member States and the Community shall encourage the relevant bodies of the Energy Community Treaty to take, in conformity with the Energy Community Treaty, the measures which are necessary so that the Contracting Parties to that Treaty can apply the provisions on cooperation laid down in this Directive between Member States.

Article 10

Effects of joint projects between Member States and third countries

1. Within three months of the end of each year falling within the period specified under Article 9(5)(c), the Member State having made the notification under Article 9 shall issue a letter of notification stating:

(a) the total amount of electricity produced during that year from renewable energy sources by the installation which was the subject of the notification under Article 9;

(b) the amount of electricity produced during the year from renewable energy sources by that installation which is to count towards its national overall target in accordance with the terms of the notification under Article 9; and

(c) proof of compliance with the conditions set out in Article 9(2).

2. The Member State shall send the letter of notification to the third country which has acknowledged the project in accordance with Article 9(5)(d) and to the Commission.3.
For the purposes of measuring target compliance with the requirements of this Directive concerning national overall targets, the amount of electricity produced from renewable energy sources notified in accordance with paragraph 1(b) shall be added to the amount of energy from renewable sources that is taken into account, in measuring compliance by the Member State issuing the letter of notification.

Article 11
Joint support schemes
1. Without prejudice to the obligations of Member States under Article 3, two or more Member States may decide, on a voluntary basis, to join or partly coordinate their national support schemes. In such cases, a certain amount of energy from renewable sources produced in the territory of one participating Member State may count towards the national overall target of another participating Member State if the Member States concerned:

(a) make a statistical transfer of specified amounts of energy from renewable sources from one Member State to another Member State in accordance with Article 6; or

(b) set up a distribution rule agreed by participating Member States that allocates amounts of energy from renewable sources between the participating Member States. Such a rule shall be notified to the Commission no later than three months after the end of the first year in which it takes effect.

2. Within three months of the end of each year each Member State having made a notification under paragraph 1(b) shall issue a letter of notification stating the total amount of electricity or heating or cooling from renewable energy sources produced during the year which is to be the subject of the distribution rule.

3. For the purposes of measuring compliance with the requirements of this Directive concerning national overall targets, the amount of electricity or heating or cooling from renewable energy sources notified in accordance with paragraph 2 shall be reallocated between the concerned Member States in accordance with the notified distribution rule.