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Offshore wind farms as joint projects

On behalf of the
Nordic Working Group for Renewable Energy under
Nordic Council of Ministers

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THEMA CONSULTING GROUP

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Brief summary in English

Offshore wind in the Nordic region may play a part in meeting EU renewables targets in 2020 through the use of the joint projects cooperation mechanism. The Nordic region has a large potential for offshore wind which is competitive at the European level in the 2020 timeframe. While there are many barriers for realizing such projects, establishing a legal and contractual framework and an appropriate support mechanism is feasible. Any Nordic country seeking to offer joint projects as part of the 2020 target would have find buyers quickly, though.

About THEMA Consulting Group

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THEMA Consulting Group offers specialist competence in market analysis, market design and strategy consulting for the energy and power industry.

DISCLAIMER

This report has been prepared by THEMA Consulting Group for the Nordic Working Group for Renewable Energy under Nordic Council of Ministers (the "Recipients"). The Recipients have provided valuable insights and comments during the project period. In addition, the project team and the Recipients would like to thank participants at a Workshop in Stockholm April 16 2013 for their contributions. All conclusions and recommendations are the sole responsibility of THEMA Consulting Group.

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EXECUTIVE SUMMARY

Background

The EU Renewables Directive requires substantial investment in renewable energy throughout Europe, including the Nordic region. Renewable *electricity* will play a big part in reaching the EU renewable energy targets. In the Nordic countries, onshore and offshore wind, bioenergy and hydro power will all contribute to fulfil national targets. In addition, there is a potential for using Nordic renewable energy sources to help meet targets in other countries. Offshore wind is particularly interesting in this context, as single projects can provide large volumes, while at the same time the offshore wind potential in the Nordic countries is likely to be in excess of the national renewables targets. Against this background, obvious questions are how the potential for Nordic offshore wind can be utilized in a European context, and whether utilization of Nordic offshore wind potentials can help minimize the overall costs of meeting the EU renewables and emissions targets.

In a previous project commissioned by the Working Group for Renewable Energy (AGFE) under the Nordic Council of Ministers, the joint projects mechanism has been identified as an interesting opportunity for promoting offshore wind in the Nordic region. Specifically, joint projects can provide additional support to offshore wind in some Nordic countries where the national support systems give insufficient incentives for such investments. There may also be user countries that would prefer to enter into joint project agreements rather than using statistical transfers to meet their national 2020 RES targets. On this background, the AGFE has tendered a study of the Nordic countries as possible host countries for offshore windpower as joint projects.

The purpose of the project is twofold:

> *What are the possibilities for promoting offshore windpower in the Nordic region through the joint projects mechanism under the EU Renewables Directive?*
>
> *How can awareness and understanding of Nordic offshore wind as joint projects be raised among market players and governments in the Nordic region, as well as in other EU countries?*

The study was carried out by THEMA Consulting Group in collaboration with the Nordic Working Group for Renewable Energy (AGFE).

Meeting the national 2020 targets may require international cooperation

The RES Directive sets out mandatory targets for the share of renewable energy in the EU and its Member States; a 20% target for the EU's overall share of energy from renewable sources and a 10% target for energy from renewable sources in transport, with varying national targets. Meeting the targets with national measures and RES potentials alone may not be feasible in all Member States, at least not in a cost-efficient manner. The National Renewable Energy Action Plans (NREAP) submitted in June 2010 describe the national policies that are foreseen to reach the individual targets. The first national progress reports for the period 2009-2010 stated that two Member States had a deficit in meeting their interim target. A total of 22 Member States reported a surplus. One Member State (Sweden) has used one of the cooperation measures, the common green certificate market with Norway. 13 Member States have expressed interest in using cooperation measures, of which 9 are interested in selling a surplus. Three Member States have actively looked into cooperation measures or stated an intent to do so, namely Luxembourg, Sweden and the Netherlands.

Nordic offshore wind could provide an opportunity for meeting the RES targets of other European countries in a more cost efficient manner. However, the Nordic countries have announced different attitudes towards using cooperation mechanisms in general. While Sweden is actively seeking cooperation opportunities, Norway does not intend to use cooperation mechanisms beyond the joint certificate market with Sweden. Denmark considers participation in joint projects

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before 2020 as unlikely, while Finland thus far concentrates on national measures. Finland may however be interested in participating as host or user country depending on the relative costs of renewable energy in Finland compared to other Member States.

The Nordic countries could provide offshore wind for joint projects

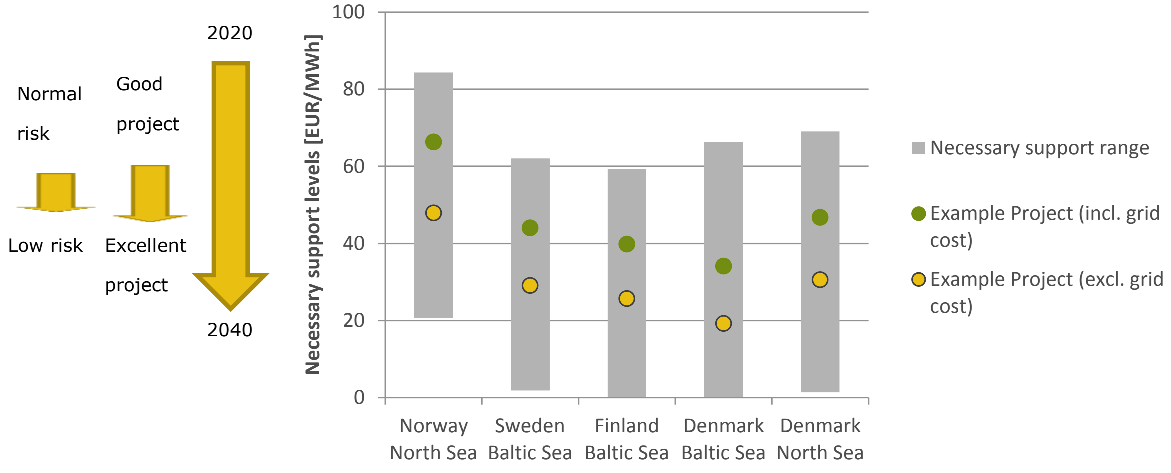
The Nordic countries are on track to fulfil their 2020 RES targets under the EU Renewables Directive. At the end of 2012, 1113 MW offshore wind power had been installed in the Nordic countries, corresponding to an annual generation of almost 4 TWh. Two wind parks under construction, Anholt (DK) of 400 MW and Kårehamn (SE) of 48 MW, will add 448 MW (around 1.5 TWh). IN addition, projects with a total capacity of 2.965 MW (10-11 TWh) are approved by national authorities, although construction has not yet started. Hence, there is significant potential for Nordic Offshore wind to be used as joint projects.

Nordic offshore wind is cost competitive compared to offshore wind in other European countries, but not necessarily the most cost-efficient surplus RES technology in Europe. However, potential national surpluses and deficits do not only depend on the renewable energy resources in different European countries, but even on the existence of well-adapted and stable support mechanisms.

Baltic Sea and the Danish North Sea projects are the most cost-competitive projects and require the least additional support

The figure below summarizes the necessary support levels for projects in the four Nordic countries defined as the project LRMC (long-run marginal cost) minus power price. The power prices used are the average of THEMA's reference prices for 2020-2040 in the respective countries. High and low power prices reflect sensitivities for high and low fuel and CO_2 prices. With fuel and CO_2 prices expected to increase towards 2040 and giving an upward drive to Continental and Nordic power prices, the high end of support levels are expected in the early phase of the projects. Increasing power prices will result in a significant decrease in necessary support levels over time.

Figure 1 Required support levels for Nordic Offshore wind



Source: THEMA Consulting Group

In *Denmark* we find the lowest necessary support levels of the Nordic countries. The main reasons are excellent wind resources in combination with shallow waters. Another reason is the strong link of the Danish power system to the Continental thermal dominated power system, which gives the highest power prices in the Nordic countries thereby reducing the need for additional support on top of the power price. Our Danish Baltic Sea type project would require an average direct support level of 34 EUR/MWh if grid-to-land investments are paid by the project and about 19 EUR/MWh if the grid-to-land investments are paid by the government. The North

Sea type project will require an average support level of 47 EUR/MWh incl. grid cost and 31 EUR/MWh without.

Finnish projects profit from relatively low investment and O&M costs due to closeness to shore, lower water depths and good wind resources. Our Finnish type project would require an average direct support level of 40 EUR/MWh if grid-to-land investments are paid by the project and about 26 EUR/MWh if the grid-to-land investments are paid by the government. The Finnish type project in our study has a long-run marginal cost of 89 EUR/MWh including grid connection costs and 75 EUR/MWh without grid connection costs. This means that it is unlikely that offshore wind parks would be built under the current support scheme which provides a maximum subsidy of 83.5 EUR/MWh.

Despite excellent wind resources, the typical *Norwegian* project shows the highest cost of all four type projects in the Nordic countries With 116 EUR/MWh (including grid connection costs). The main reason is higher investment costs due to high foundation costs (deeper water). Even without taking grid connection costs into account, the project LRMC is 97 EUR/MWh. As illustrated in Figure 1, Norwegian offshore wind requires the highest necessary support levels compared to the other Nordic countries, also due to a slightly lower expected power price in Norway. The Norwegian type project would require an average direct support level of 66 EUR/MWh if grid-to-land investments are paid by the project and about 48 EUR/MWh if the grid-to-land investments are paid by the government.

Sweden. Our typical Swedish project shows a long-run marginal cost of 93 EUR/MWh including grid connection costs and 78 EUR/MWh without grid connection costs. This means that no offshore wind parks would be built under the current green certificate support scheme. Necessary Swedish offshore wind support levels range from 2-62 EUR/MWh during 2020-2040. Our Swedish type project would require an average direct support level of 44 EUR/MWh if grid-to-land investments are paid by the project and about 29 EUR/MWh if the grid-to-land investments are paid by the government.

A regulatory and contractual framework must be in place

Presently, no joint projects have been realised in Europe. The RES Directive provides the opportunity to set up joint projects but leaves the actual composition of joint projects to the Member States. Due to the lack of experience in actual composition of joint projects, the governance or legal requirements (to which we often will refer to as barriers) for participating countries are all but clear. However, we may offer some general perspectives on the regulatory and contractual framework, which will inter alia consist of:

- An agreement between Member States, which can comprise a definition of the specific project, a timeline with milestones, duration period, compliance clauses, license requirements, and commitment of the various participants.
- Specific national requirements in order to gain national acceptance for joint projects
- A financing model for transfer of the necessary support from the user country to the host country.
- A reporting system towards the European Commission on the joint projects.

Integrating joint projects in the user country’s support system is the easiest option, but feasibility depends on the support system

Integration of joint projects into national support systems can be viewed from the perspective of the user country and from the perspective of the host country.

One of the most plausible options would be to let the user country include designated offshore wind sites or installations into its national support scheme. This would allow investors, both nationally as well as internationally, to invest in the joint project. In such a construction the user country will be financing the joint project as any other national project, the only difference being the location of the offshore wind generation is in another country. The host country will exclude the project's RES generation from its national targets for the duration of the project. When applying this type of structure, the user country could integrate the joint project into its national support system. Integrating the financing of a joint project within their national support scheme would additionally stimulate national participation and transparency in the user country.

National support systems vary in application and coverage; some systems remunerate investors ex post, others stimulate investments ex ante. A type of a tariff guarantee (feed-in or premium) is well suited for joint projects as they can be targeted towards specific technologies and geographical areas. Integration of a joint project in a national support scheme of this kind could therefore be an interesting possibility. Other types of support systems, e.g. a certificates scheme or tax exemptions, appear less suitable for inclusion of joint projects. This is mostly because such schemes (or support systems) are technology neutral or remunerate investment ex post. In particular, technology neutral support systems cannot ensure promotion of a specific technology, like offshore wind.

Integrating joint projects in the support system of a host country seems difficult, because the remuneration responsibility lies with the user country. Furthermore, double funding and double counting of joint projects must be avoided.

The participating countries can also opt for a separate support scheme tailored to joint projects. This option comes very close to a joint support scheme, but distinguishes itself by the host country having a more passive role, merely providing the site or installation. Although purely hypothetical, this option raises a number of legal and economic issues, for instance overlapping jurisdictions and mechanism design that must fit in with the electricity markets involved and other national support systems. This can be done, but is more complex and probably less efficient than using a suitable national support system in the user country.

Timing and public acceptance are crucial barriers to overcome

A support system and a regulatory framework are necessary prerequisites, but not sufficient for joint projects to be realised. We have identified four main barriers for joint projects: timing, uncertainty of demand from user countries, the existence of alternative ways for the user country to reach the RES target, and public acceptance in both user and host country.

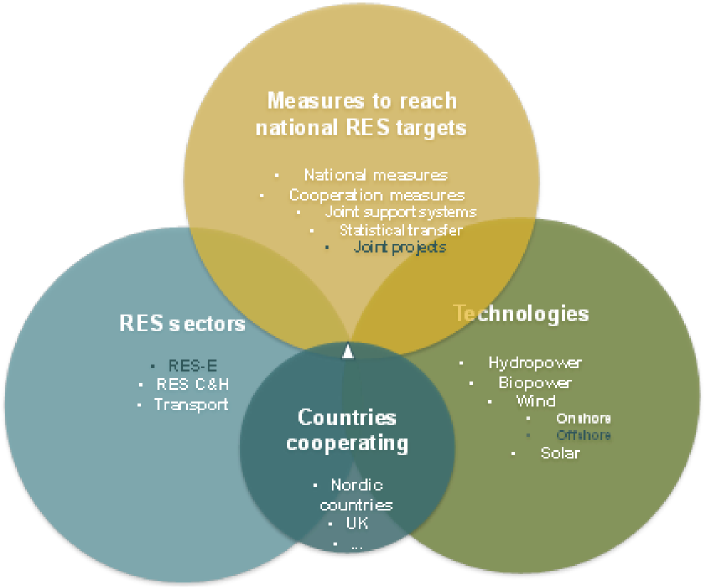
From the host country point of view, time to develop the legal framework for joint projects and to develop the projects themselves, are the most difficult barriers to overcome. Public acceptance for external effects in the host country, such as decreased power prices for producers and lower tax income, or the need to investments in additional transmission capacity to export parts of the generated strong power balance constitute important barriers as well, but may be more easily overcome.

Timing seems to be less of an issue in potential user countries. We expect user countries to be primarily concerned about reaching possible future RES targets (when cost-effective national options may be exhausted) and about public acceptance for investments outside of national borders. It is likely that Member States will attempt to link industrial policy decisions to joint projects, provided that this is in line with EU competition law and state aid guidelines.

Nordic offshore wind must compete with many other options

Potential user countries are likely to seek the least-cost-option to fulfil their RES targets. This may not only include their own RES-C&H (cooling and heating), transport and RES-E sector targets, but also the use of statistical transfer as a short-term measure. Joint projects will be squeezed between the long-term option joint mechanism and the short term option statistical transfer, as illustrated in Figure 2. Energy efficiency requirements complicate matters even more.

Figure 2: Many alternatives for Member states to comply with their RES targets



Source: THEMA Consulting Group

From a user country point of view, not only the least-cost technology is preferred, but also the fastest to build. Thus, the realistic potential for Nordic offshore wind as joint projects until 2020 is limited.

Of course, there may also be opportunities for Nordic offshore wind as joint projects beyond 2020. However, this depends on future EU RES policies which are currently in the making.

Raising awareness about Nordic offshore wind as joint projects is crucial and urgent

Even though there are many barriers for joint projects, Nordic offshore wind remains an interesting option for meeting the European 2020 RES targets. The next step for interested Nordic host countries should be develop the transparency and regulatory framework needed. A clear statement of political will is necessary in order to proceed. In order to facilitate realization of offshore wind projects until 2020, this framework should be put in place as soon as possible. The upcoming EU guidelines on joint mechanisms should allow for acceleration and some standardization of this process. An alternative, in order to stimulate joint project possibilities and mitigate first mover risks, is for example to widen statistical transfer cooperation agreements between Member States to allow (assessments of) joint project options too. Agreements could also contain a perspective beyond 2020, depending on EU renewables policies and targets after that date. Most of the current cooperation agreements include such a possibility.

Another possible way forward is to establish a “Nordic Project Bank” for offshore wind. The Project Bank can contain an overview of available projects, their volume, earliest production start, cost and required support levels, other relevant project data and the contact information of the project manager. This could, in the beginning, only include Swedish offshore wind projects, as Sweden is the only Nordic country currently stating an active interest in joint projects. At a later stage, the Project Bank may be extended to include other Nordic countries and technologies. The EU Transparency Platform (aimed at facilitating and promoting cooperation between Member States, in particular with regard to statistical transfers and joint projects) is another possible information channel for Nordic offshore wind.

Finally, there may be a role for Nordic cooperation in developing a regulatory framework for joint projects, even if the individual countries currently have different attitudes towards using the mechanism in practice.

SAMMENDRAG

Bakgrunn

Oppfyllelse av EUs fornybardirektiv fordrer betydelige investeringer i fornybar kraftproduksjon i EU og Norden. I et tidligere prosjekt i regi av Arbeidsgruppen for Fornybar Energi (AGFE) under Nordisk Ministerråd er samarbeidsmekanismen "Felles prosjekter" i fornybardirektivet identifisert som en mulighet for å fremme offshore vindkraft i Norden. AGFE har som en oppfølging av dette arbeidet bedt THEMA Consulting Group om å utrede følgende spørsmål:

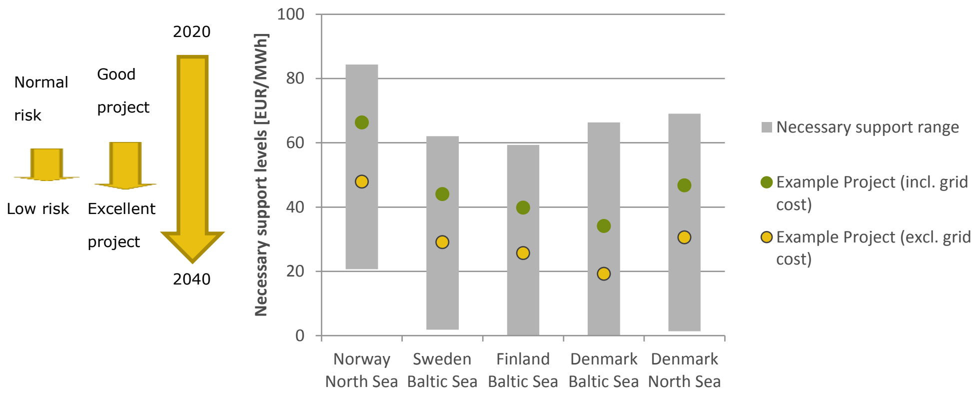
Hvilke muligheter finnes for å fremme offshore vindkraft i Norden gjennom samarbeidsmekanismen "Felles prosjekter" i EUs fornybardirektiv?

Hvordan kan det skapes bevissthet om og forståelse av dette temaet hos markedsaktører og myndigheter i Norden og i andre EU-land?

Offshore vind i Norden kan bidra til måloppnåelse i EU

Flere av EUs medlemsland har uttrykt ønske om å bruke samarbeidsmekanismer for å nå sine nasjonale fornybarmål i 2020. Land som Luxembourg og Nederland har aktivt begynt å se nærmere på slike mekanismer. De nordiske landene ligger an til å nå sine mål med egne ressurser, men har samtidig et betydelig potensial for offshore vindkraft. Offshore vind vil trolig spille en liten rolle for måloppnåelse i de nordiske landene, men er konkurransedyktig i et europeisk perspektiv. Prosjekter i Østersjøen og den danske delen av Nordsjøen er særlig interessante i dette perspektivet. De aktuelle prosjektene har fulle kostnader i overkant av 100 EUR/MWh og trenger relativt liten støtte sammenlignet med andre "overskuddsprosjekter" i Norden. Støttebehovet er innenfor nivåer vi observerer at mulige samarbeidsland betaler for prosjekter i dag, for eksempel Storbritannia, Nederland og Luxembourg.

Figuren nedenfor illustrerer nødvendige støttenivåer for typiske nordiske prosjekter. Figuren illustrerer også at støttebehovet vil avta over tid som følge av høyere kraftpriser og lavere kostnader for offshore vind.



Source: THEMA Consulting Group

Et regulatorisk og avtalemessig rammeverk må være på plass

Selv om vi har et betydelig nordisk potensial for offshore vind, må det fortsatt utvikles et regulatorisk og avtalemessig rammeverk for realisering av felles prosjekter. Det er i dag ingen prosjekter som har benyttet seg av Felles prosjekter-mekanismen, men et forslag til veiledning fra EU-kommisjonen er ventet sommeren 2013. Rammeverket må blant annet bestå av:

- En avtale mellom de deltagende medlemsstatene som omfatter en definisjon av prosjektet, tidsplan, varighet, rapportering, konsesjonskrav, forpliktelser og rettigheter for de ulike aktørene.

- Avtaler/regelverk som ivaretar spesifikke nasjonale hensyn for å sikre offentlig aksept i landene som samarbeider ("brukerland" og "vertsland").
- En finansieringsmodell for overføring av nødvendig støttebeløp fra brukerlandet til vertslandet.
- Et system for rapportering om framdriften i prosjekter til EU-kommisjonen.

Det er enklest å integrere felles prosjekter i brukerlandets støttesystem, men det er flere muligheter avhengig av støttesystem

Utformingen av støtten til felles prosjekter kan prinsipielt skje på tre måter: a) Gjennom brukerlandets støttesystem; b) Gjennom vertslandets støttesystem eller c) Gjennom et eget støttesystem. Den første opsjonen er etter THEMAs vurdering den enkleste og mest realistiske, gitt at støttesystemet er basert på en ordning med feed in-tariffer og auksjoner, alternativt et påslag i markedsprisen (feed in premium), som kan innrettes mot spesifikke teknologier.

Å etablere et eget felles støttesystem for offshore vind reiser en rekke regulatoriske og juridiske problemstillinger knyttet til kraftmarkedsdesign og utformingen av støttesystemet. Det er derfor en løsning som i beste fall er tidkrevende å realisere. Å bruke nasjonale støttesystemer i vertslandene er lite hensiktsmessig, i hvert fall i Norge og Sverige der det er etablert et teknologinøytralt felles sertifikatmarked. Det kan dessuten være vanskelig å integrere utenlandsk finansiering av offshore vind i et nasjonalt system og sikre at produksjonen fordeles riktig mellom vertsland og brukerland.

Det er flere barrierer som må håndteres – timing er særlig viktig

Utover behovet for å etablere et regulatorisk og økonomisk rammeverk, er det en rekke andre barrierer for realisering av offshore vind som felles prosjekter. Offentlig aksept i de involverte landene er opplagt viktig. Det kan være kontroversielt å bruke nasjonal støtte til å finansiere investeringer i andre land, og vertslandet vil ikke uten videre akseptere ekstra miljøulemper og økte nettkostnader som følge av investeringene. Videre opererer nordisk offshore vind i konkurranse med andre teknologier i Norden og prosjekter i EU mer generelt, og det er en betydelig utfordring å få realisert prosjektene i tide for å bidra til måloppnåelse i 2020. Endelig er det så langt bare Sverige som har tatt et klart standpunkt for bruk av Felles prosjekter-mekanismen.

Bevisstheten om nordisk offshore vind kan økes

Til tross for de mange usikkerhetene og barrierene er nordisk offshore vind et alternativ for utbyggingen av fornybar kraft i EU både før og etter 2020. Nordiske land som er interessert i å fremme offshore vind, bør derfor komme raskt på banen og erklære en klar vilje til å finne praktiske løsninger. Et mulig startpunkt er å etablere en "nordisk prosjektbank" med informasjon om konkrete prosjekter innen offshore vind. Det er ingenting i veien for at ett land kan begynne alene og andre slutte seg til på et senere tidspunkt. De nordiske landene kan også samarbeide om utviklingen av et regulatorisk og økonomisk rammeverk, uavhengig av hvilke land som faktisk ønsker å fremme egne prosjekter. Endelig er det mulig å fremme offshore vind gjennom avtaler om statistisk overføring ("statistical transfer") med andre europeiske land.

1 INTRODUCTION

1.1 Background and problem statement

The EU Renewables Directive[1] promotes the use of energy from renewable energy sources (RES) and requires substantial investment in renewable energy throughout Europe, including the Nordic region. As part of energy from renewable sources, renewable electricity will play a big part in reaching the EU renewables targets. RES targets are high. Some Member States have to increase their renewable energy generation in the electricity sector by factor 6 to 12, while the resource situation in the different Member States differs, leading to rather high costs to fulfil the RES targets with national measures alone. Thus, the Directive allows international measures of cooperation to fulfil national targets:

- *Statistical transfer between Member States (all types of RES);*
- *Joint projects between Member States (only for RES-E and RES-C&H);*
- *Joint support schemes; and*
- *Joint projects between Member States and third countries (only for RES-E).*

In the Nordic countries, onshore and offshore wind, bio energy and hydro power will all contribute towards the national targets. Additionally, there is a potential for using Nordic renewables to meet targets in other countries. Offshore wind is particularly interesting in this context, as single projects can contribute large volumes, while at the same time an excess supply of offshore wind in the Nordic region is likely, i.e. compared to the national renewables targets. Two obvious questions are subsequently; how can the potential for Nordic offshore wind be utilised in a European context, and how can it help minimise the overall costs of meeting the EU renewables and emissions targets?

In a previous project commissioned by the Working Group for Renewable Energy (AGFE) under the Nordic Council of Ministers, the joint projects mechanism has been identified as an interesting opportunity for promoting offshore wind in the Nordic region. Specifically, joint projects can provide additional support to offshore wind in some Nordic countries where the national support systems give insufficient incentives for such investments. There may also be user countries that would rather enter into agreements on joint projects than use statistical transfers to meet their national 2020 RES targets. On this background, the AGFE has tendered a study of the Nordic countries as possible host countries for offshore windpower as joint projects. The purpose of the project is twofold:

> *What are the possibilities for promoting offshore windpower in the Nordic region through the joint projects mechanism under the EU Renewables Directive?*
>
> *How can awareness and understanding of offshore wind power as joint projects be raised among market players and governments in the Nordic region, as well as other EU countries?*

In order to analyse the above questions, we focus on the following issues:

- Existing Nordic support schemes for renewable electricity and the role of offshore wind in Nordic energy policy
- The competitive position of Nordic offshore wind in a European context

[1] Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, of 23 April 2009, OJEU L 140 5 June 2009.

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- The status of renewables targets and policies in EU countries
- Opportunities and barriers for realising Nordic offshore wind as joint projects, including governance, legal and financial requirements from host and possible user countries
- The revenue requirements for Nordic offshore wind given the outlook for the Nordic electricity market in the coming decades
- Possible ways of creating support mechanisms and a governance or legal framework for Nordic offshore wind as joint projects

The aim is to illustrate the possibilities at a high level, and not to detail all rules and mechanisms necessary to realise Nordic offshore wind as joint projects. This approach is in line with the overall objective of increasing awareness and understanding of the issue. The perspective of our analysis goes beyond the 2020 targets, illustrating a possible policy scenario where renewables targets and cooperation mechanisms extend beyond 2020. We use current policies as a starting point for the illustrative analysis. Our policy scenario does not constitute a prognosis for the development of EU climate and renewables policies beyond 2020. Finally, the emphasis of the study is on Denmark, Finland, Norway and Sweden.

The scope of the study is offshore wind power generation as joint projects defined in accordance with article 7 of the EU RES Directive. We use the following terminology for the countries involved in such projects; 'host country' for the country supplying the location and installation for the offshore wind park and 'possible user country' as the country receiving the agreed proportion or amount of energy from renewable sources produced from the installation in terms of the right to count it against its national RES target.

1.2 About the project

The project has been carried out by THEMA Consulting Group in collaboration with the Working Group for Renewable Energy (AGFE). Participants in a workshop in Stockholm April 16 2013 have provided valuable insights and comments to the work. All conclusions and recommendations are the responsibility of THEMA Consulting Group alone.

1.3 About the report

The report is organized as follows:

- In chapter 2, we describe the role of offshore wind in Nordic energy policy and analyse the role of Nordic offshore wind in a European context, including an overview of the potentials for such generation and projects in the region, both in operation and at a planning stage. Specifically, we consider the potentials and costs of Nordic offshore wind in comparison to renewable energy sources in other EU countries.
- In chapter 3, we give an overview of the 2020 renewables targets per EU country, Norway and Iceland, and consider the opportunities for Nordic offshore wind as contributor to reaching the renewables targets in selected countries. Furthermore, we analyse the possible governance and legal framework for joint projects.
- In chapter 4, we give specific examples of how joint projects can be implemented in practice. For this purpose we have created a set of typical Nordic offshore wind projects and analysed costs and revenue requirements for various cases. On that basis we analyse how suitable support mechanisms can be designed within the governance and legal framework established in chapter 3.
- In chapter 5, we discuss how awareness and understanding of joint projects can be raised in practice.
- In chapter 6, we sum up the analysis and our recommendations on the way forward.

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2 OFFSHORE WIND IN NORDIC ENERGY POLICY

There is a large potential for offshore wind in the Nordic region, but offshore wind is likely to play only a minor role in meeting the national Nordic 2020 RES targets, with the exception of Denmark. In a European context, we find that Nordic offshore wind is competitive and can contribute to meeting the overall European 2020 targets.

In this chapter, we describe the role of offshore wind in current Nordic energy policy. We start with an overview of the renewables policies in each Nordic country (targets, support systems, planning procedures) and the national targets, including any specific targets for offshore wind. We then move on to describing the potential and costs for offshore wind in the individual Nordic countries, and compare them to the potentials and costs of renewable electricity in the EU (all technologies).

2.1 Nordic renewables targets

The Nordic countries' renewable targets for 2020 are set out in the national renewable energy action plans (NREAP) provided under the EU RES Directive and national policy statements. Table 1 provides an overview.

Table 1: Nordic RES targets by country

Denmark	Finland	Norway	Sweden
30% renewable energy by 2020. Expectation due to national energy political agreement from March 2012: 36% 50 % of electricity consumption from wind power in 2020 Planning a total of 3300 MW wind power by 2020, of which 1500 MW offshore wind NREAP projection offshore of 856 MW reached 2012 Fossil-free heat and power production by 2035	38% renewable energy by 2020 Targeting 9TWh wind power production by 2025; previous plan was 2500 MW (6 TWh) by 2020 No NREAP projection for offshore wind	67.5% of renewable energy by 2020 Common target with Sweden of 26.4 TWh new renewable power 2012-2020 as part of a common green certificate market with Sweden No NREAP projection for offshore wind	49% renewable energy by 2020 Common target with Norway of 26.4 TWh new renewable power 2012-2020 as part of a common green certificate market with Sweden Non-binding planning framework for 30 TWh wind power 50% renewable power production by 2020 NREAP projection for offshore wind of 93 MW already reached

Source: DEA 2013, Energia 2013

Denmark. Denmark's EU obligation is 30% renewable energy in 2020. In March 2012, a broad majority in the the Danish Parliament made an agreement on the energy policy until 2020. The initiatives following this national agreement are expected to imply a 2020 RES share of approximately 36% and that an approximate 50 % of the electricity consumption will be covered by wind power (compared to 28 % today). This means that an additional 2000 MW of wind power capacity will be installed before 2020. Of this 1500 MW will come from offshore wind farms – 400 MW at Kriegers Flak (Baltic Sea), 600 MW at Horns Rev III (North Sea) and 500 MW as nearshore wind turbines. This will require new rounds with near- and offshore tenders. The NREAP 2020 projection for Danish offshore wind is already reached.

Finland. The Finnish renewable target is 38% by 2020, up from 28% in 2010. Finland aims to reach 6 TWh of wind power by 2020, but has no specific NREAP prediction for offshore wind.

Norway. Norway targets 67.5% of renewable energy in 2020. There are no technology-specific targets for renewable electricity. The common green certificate market with Sweden which Norway joined in 2012, aims to provide 26.4 TWh of new renewable electricity production in a technology-neutral way in both countries. Norway and Sweden will each cancel and thus pay for 13.2 TWh certificates in 2020, but the allocation of the installations between the countries depends on many factors such as resource distribution, tax levels and depreciation rules (THEMA, 2012). According to our certificate market analysis, onshore wind power with an annual generation of about 5-6 TWh could be installed in Norway until 2020. Under the current support schemes, we do not expect any offshore projects to be realized.

Sweden. The Swedish renewable target is 49% by 2020. Sweden aims at 50% renewable power production in 2020, and uses the technology-neutral common green certificate market with Norway as the main instrument to reach its renewable electricity targets. We expect about Swedish 9-10 TWh onshore wind power to be realized within the certificate market between 2012 and 2020. We do however not expect any offshore wind parks to be realized until 2020, except for E.ON's Kårehamn project (48 MW/0.2 TWh) which is due to be operational in 2013. The National Renewable Energy Action Plan (NREAP) 2020 prediciton for offshore wind has already been met. Sweden also has a wider socalled planning target of 30 TWh wind power by 2020, which should not be confused with a binding target.

2.2 Nordic wind power support schemes

Current support schemes for wind power in the Nordic countries are summarized in Table 2.

Table 2 Support systems for wind power in the Nordic countries

Norway	Sweden	Finland	Denmark
Green certificates Common certificate market with Sweden • Technology neutral: Targeting together with Sweden 26.4 TWh of new renewable power production 2012-2020 • Support level determined by supply and demand in the certificate market Investment grants for technology development[2]	Green certificates Common certificate market with Norway • Technology neutral: Targeting together with Norway 26.4 TWh of new renewable power production 2012-2020 • Support level determined by supply and demand in the certificate market	Feed-in tariff Onshore and offshore wind: feed-in premium, sliding • Guaranteed price 105.3 EUR/MWh until 2015, 83.5 EUR/MWh thereafter for a maximum of 12 years (until total installed wind power capacity reaches 2500 MW), capacity / wind park must be larger than 0.5 MW[3] Offshore wind: Investment subsidy for demonstration project	Feed-in tariff Onshore wind and open-door applications for offshore feed-in premium • 36.6 EUR/MWh plus electricity price, total capped at 57.4 EUR/MWh Offshore wind tenders: feed-in tariff • fixed total price, premium level defined via a tender process • limited to number of accumulated TWh

Sources: RES Legal EU, VTT 2011

[2] Enova (a state-owned enterprise) offers investment support for full-scale demonstration of new energy and climate technologies. Large-scale conventional offshore wind as described in the report would not qualify for investment grants from Enova.

[3] Wind turbines not eligible will receive a fixed subsidy of 6.90 EUR/MWh.

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Norway. Norway promotes renewable energy through a common certificate trading scheme with Sweden. All new renewable energy generation is eligible for green certificates. In addition, grid operators are obliged to connect renewable energy plants to their grids in a non-discriminatory manner. This obligation also applies if the realization of the new connection requires the development of the grid (although the new plants may be subject to a connection charge to recover customer-specific investment costs).

Sweden. Sweden has been promoting renewable electricity through a green certificate system since 2003, from 2012 in a joint system with Norway. In addition there are tax regulation advantages for renewable electricity and a subsidy scheme for photovoltaic installations. Electricity generated from wind energy is eligible for tax privileges such as a lower property tax rate than other forms of power generation and energy tax exemptions subject to certain conditions.

The grid operators are obliged to connect electricity generation to the grid, transmit electricity and expand the grid. Feed-in or connection of renewable energy is not prioritized. Outside of the electricity sector, tax exemptions are the main incentives used to support renewable heating. The main incentive for renewable energy use in transport is a tax exemption for biofuels.

Finland. In Finland, electricity from renewable energy sources is mainly promoted through a premium feed-in tariff system. All technologies used for the generation of electricity from wind, biogas, wood chips or wood fuels are eligible as long as they are located in Finland or in Finnish waters, are connected to the grid, and meet economic and technical requirements for electricity generation.

The feed-in tariff is sliding and calculated based on a pre-defined target price per technology (83.50 EUR/MWh for wind power) minus the electricity market price, measured as three-month historic average. However, there is a floor for the electricity market prices of 30 EUR/MWh, implying that electricity market prices below 30 EUR/MWh thus represent a downward price risk for the producer. If the electricity price is less than 30 EUR/MWh, a fixed premium (53.50 EUR/MWh) is paid. The resulting feed-in tariff is guaranteed over a twelve year period. Until 2015, there is an “early bird” target price of 105.30 EUR/MWh. In addition, investments in RES are supported through state subsidies. Access to the grid by electricity produced from renewable energy sources follows the principle of non-discrimination and electricity produced from RES is not given priority.

The main support mechanism for heat produced from RES, is a “heat bonus” allocated to combined heat and power (CHP) plants fuelled by biogas and wood fuel.[4]

The current support system for offshore wind is under review, aiming to grant energy support for only one project. Granting and payment of such support require a government transfer notification to the EU commission and confirmation by the commission that the intended support complies with EU government transfer regulations. The intention is that the offshore wind power project will receive a feed-in tariff in accordance with the Act on Production Support for Electricity Produced from Renewable Energy Sources. Preparation of the legislative amendments required by the offshore wind power demonstration project, as well as preparation of the principles for the selection of the project, will be carried out in 2013. In April 2013 the Ministry of Employment and the Economy organized a hearing for offshore wind farms.

As a first step, a separate EUR 20 million appropriation has been earmarked for an offshore wind power demonstration project in 2015, in addition to the possibility of taking part in the tariff

[4] The connection of a heat generation plant to the grid is market oriented and priority is not granted to heat produced from RES. In transport, the main incentive for renewable energy use is a quota system.

system. The final decision to grant energy support to offshore wind power will be made in the end of 2014.[5]

Planning and licensing procedure for offshore wind farms and network investments

Norway: NVE has surveyed and proposed suitable areas for offshore wind in Norway and performed Strategic Environmental Assessments (SEA) for those areas. The permission process will follow the new Offshore Energy Act, which involves many of the same procedures as the legislation for onshore installations. Municipalities and counties are developing regional plans for wind power. Identified areas suitable for offshore wind can be found on www.havvind.no**.**

Sweden. Municipalities have developed comprehensive planning for areas on land and in the territorial areas. There is no controlled planning of marine areas. Permits under the Environmental Code must be sought from the county administration or environmental court. Municipalities have a veto, an issue which is highly debated.

Finland. The planning and permission process for offshore wind is identical to the planning process for onshore wind power. The Landscape Association and municipalities have developed regional plans and master plans pointing out areas suitable for wind power. Wind Planners are often regional and municipal because national wind maps have only been developed in recent years. Planning processes are time consuming. The system is perceived by the wind companies as very bureaucratic. A manual with instructions for planning and authorization process is proivded: **www.miljo.fi/wind**.

Denmark. The Danish Energy Authority (DEA) is the competent authority for Danish offshore wind power projects and provides a "one-stop-shop" throughout the permission process. Suitable areas for offshore wind are identified nationally. There are two options for planning processes: either the government calls for a tender or the so-called open-door procedure is used. In both cases, permission is required from the Energy Board. Network planning secures the right to connect the wind farm at no cost to the wind farm.

In the *government call for tender*, the DEA runs a tendering process for a specific offshore wind park project in a selected location. Bidders offer a price at which they are willing to produce electricity from the project. The lowest offered price becomes the fixed feed-in tariff for the project. The fixed feed-in tariff is granted for generation up to certain amount of power produced, calculated in TWh. In this option, the investment and operational costs for the transformer station and the transmission of power to land are carried by the TSO and paid by the electricity consumers.

In the *open-door procedure*, the developer takes the initiative to propose and establish an offshore wind park project in a specific location outside areas already designated for offshore wind, and is only allowed if no major public interest blocks the implementation of the project. The investment and operational costs for the transformer station and the transmission of power to land are to be carried by the developer.

Sources: RES Legal EU, DEA 2013

Denmark. Electricity from offshore windpower established after an open-door application receives a fixed feed-in premium on top of the market price for electricity. Offshore windpower established after a public tender receives a feed-in tariff in the form of a variable bonus paid on top of the market price for electricity. The sum of the market price and the bonus shall not exceed a statutory maximum per MWh.

Associations of wind energy plant owners and other local initiatives may apply for loan guarantees for feasibility studies that are conducted in the run-up to the construction of a wind-energy plant.

[5] Annukka Saari, Finnish Ministry of Employment and the Economy: email correspondence.

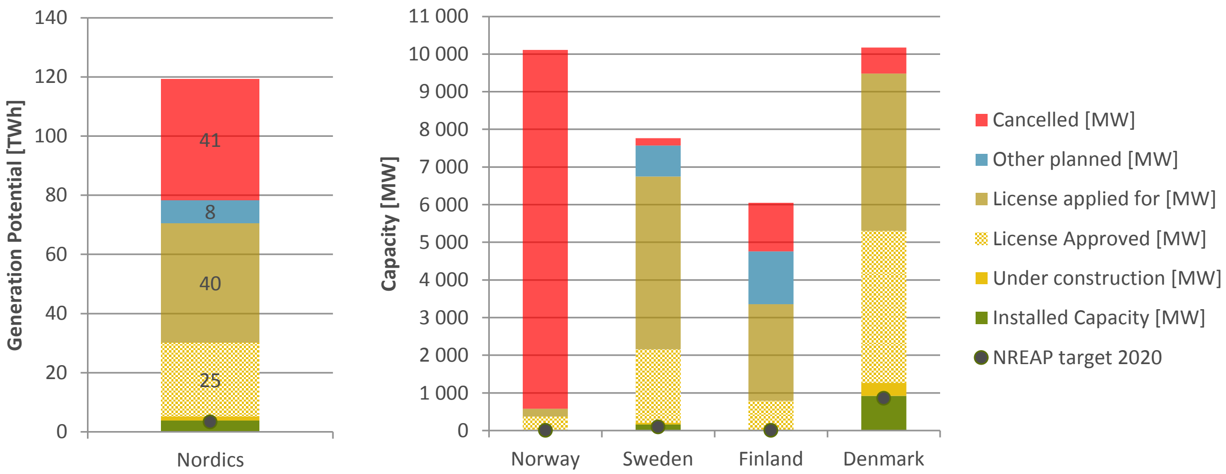
2.3 The Nordic potential for offshore wind

The Nordic potential for offshore wind is considerable. It forms a large part of the potential European surplus capacity (i.e. renewables potentials above level necessary for meeting 2020 targets), together with a potential surplus of solar photovoltaic generation in Southern Europe and a possible surplus of bio power in Eastern Europe.

At the end of 2012, 1.113 MW windpower was installed in the Nordic countries, corresponding to an annual production of almost 4 TWh. With the construction of the two wind parks Anholt of 400 MW (DK) and Kårehamn of 48 MW (SE), an additional 448 MW is coming online (an expected annual generation of around 1.5 TWh). Projects with a total capacity of 2.965 MW (10-11 TWh) are approved by national authorities but have not yet started construction.

Overall, the NREAP projections for offshore wind in the Nordic countries have been met as of today. Both Denmark and Sweden are slightly ahead of their projections. Denmark has however set a higher national ambition: to supply 50% of electricity demand by wind power, requiring around 2.000 MW re- and new investments. Neither Finland nor Norway has a specific national projection for offshore wind. Thus, additional offshore wind installed until 2020 could either be used to fulfil national targets by making up for lower RES contributions from other sources, or to fulfil other Member States national targets via joint mechanisms.

Figure 3 Nordic Offshore wind project pipeline



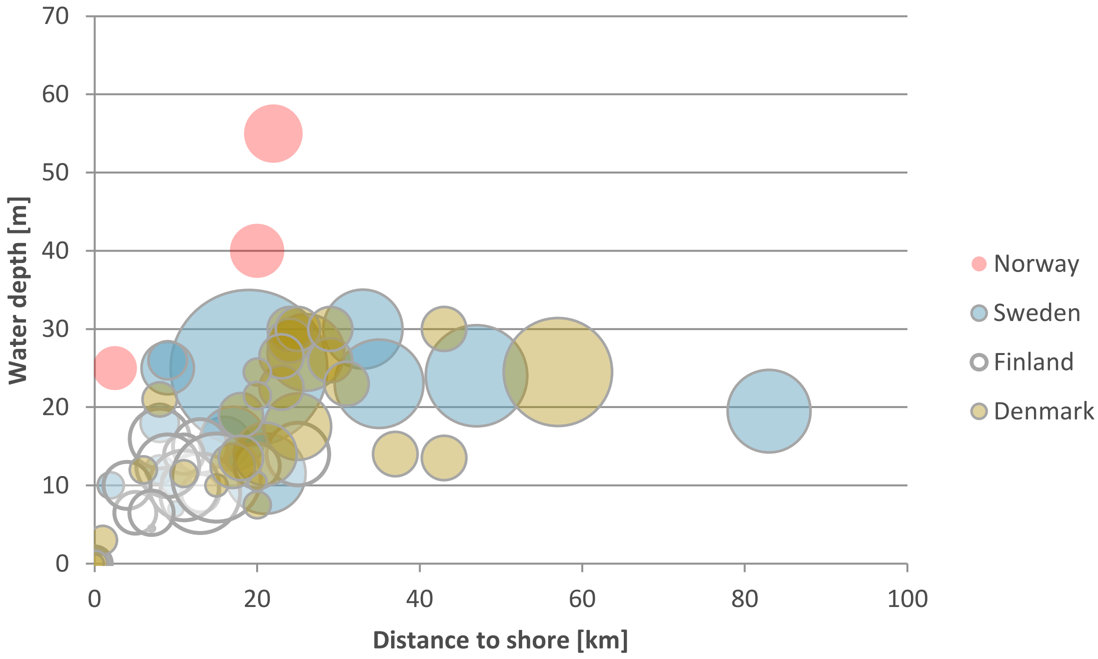
Source: EWEA 2013, 4cOffshore, Svensk Vindenergi, Energinet.dk, NVE[6]

The biggest mid-term potential exists in Denmark and Sweden, since the bulk of licence-approved projects is located there. Kriegers Flak, Horns Rev III and IV, Taggen and Blekinge Offshore appear as promising larger prospects. In Norway, offshore wind project planning has come to a temporary halt due to high costs and lack of incentives. We do not expect any new Norwegian offshore wind farms until 2020. In Finland, offshore projects with more than 3000 MW capacity are approved, but the current feed-in tariff is too low to trigger these investments.

The majority of the Nordic projects are located 15-35 km offshore and have an average water depth of 15-20 meters, see Figure 4. However, the conditions for offshore wind differ considerably between the Nordic countries. Deep waters even nearshore and good wind resources are typical for Norwegian projects, while most Finnish projects are located in nearshore shallow waters..

6 For Norway: "melding stilt I bero" counted as project cancelled.

Figure 4 Nordic offshore wind farms[7]



Source: THEMA, based on data from 4C Offshore

Cost differences between the wind parks can be mainly attributed to differences in investment costs and wind resources. Investment costs are estimated based on distance to shore and water depth as well as location. Wind resource estimates were taken from the developer as full load hours when available. To a lesser degree, O&M costs vary with distance to shore. Lower wave heights and a less corrosive environment favour Baltic Sea locations under the assumption that adapted "onshore" turbine technology can be used.

2.4 Nordic offshore wind farms in a European context

In order to evaluate the potential for joint projects, one must look at the national RES-E targets, their costs and the potential deficit or surplus in the respective countries.

To derive the supply curve – essentially an EU cost curve for renewable power – we use the announced NREAP generation targets by technology as a base, assuming 2011 NREAP targets for offshore wind are realised. The 2012-2020 NREAP offshore wind volumes form the initial supply curve of renewable energy that can be realized until 2020, adjusted for known realisable surplus in the Nordic countries and possible deficit in other countries. The Norwegian supply potential was added, based upon our wind Swedish-Norwegian database and analysis of the certificate market.

Generation potentials are split into three cost classes per technology (low, reference, and high) with 25% of the volume in the "low cost" class, 50% in the "reference" class and 25% in the "high cost" class. Investment cost and O&M cost estimates are THEMA calculations, based on investment cost data from Ecofys 2011, IEA 2011 and EWEA 2013 and developer information.

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7 License approved and license applied for.

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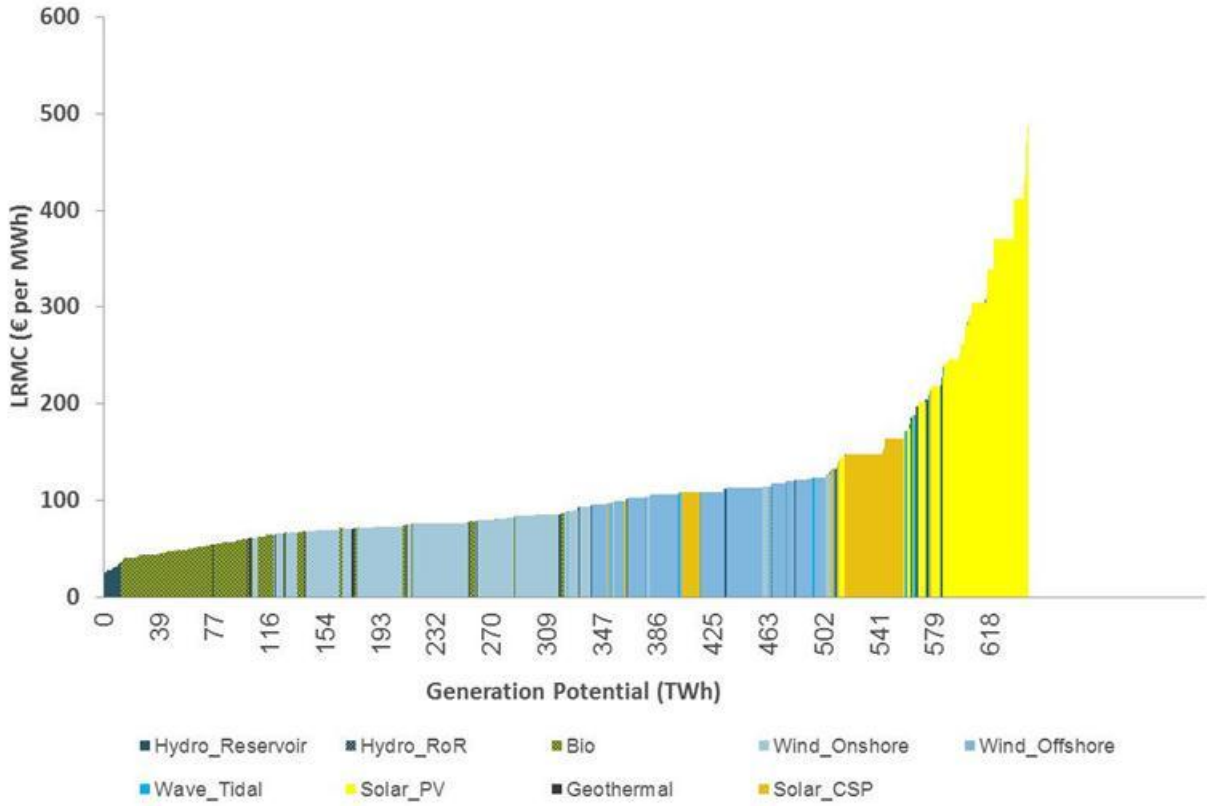
Figure 5 Cost curve for renewable technologies in the EU and Norway 2020

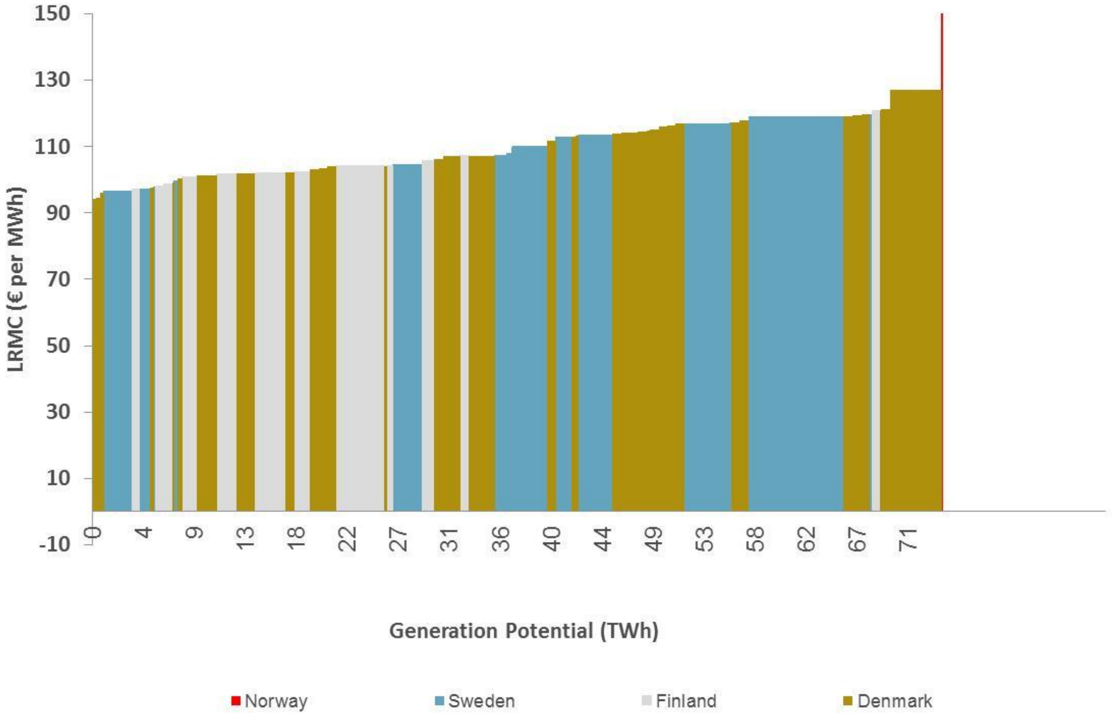


Source: NREAP, Ecofys 2011, THEMA estimates

The cheapest technologies in the European cost curve consist of hydro and biopower, followed by onshore wind, offshore wind and solar technologies. We expect a cost range for European offshore wind of 90-140 EUR/MWh for investments in 2019/2020.

In order to derive a realistic Nordic Offshore wind potential for joint projects, a thorough review of the surplus potential is necessary. Due to good wind resources, shallow waters and close distance to shore, many Nordic offshore wind parks figure well in the cost curve of all realisable offshore wind projects in the EU. While our list of Nordic projects contains about 71 TWh of potential production, we expect only a few TWh to be realizable until 2020. We expect Danish, Finnish and Swedish Baltic Sea Offshore wind projects to be the most cost efficient ones, see Figure 6. It has to be said, that uncertainty about full load hours and thus cost can be considerable for individual projects.

Figure 6: Cost curve Nordic offshore wind 2020



Source: NREAP, Ecofys 2011, THEMA estimates

2.5 Nordic positions on cooperation mechanisms

For the purpose of this report, we have collected statements on the official attitude towards the use of cooperation mechanisms from each of the Nordic countries. In the following paragraphs we summarise the respective positions.

2.5.1 Denmark

According to the Danish National Renewable Energy Action Plan from June 2010, Denmark expects to be able to fulfil its obligations for expansion with renewable energy up to 2020 with domestic initiatives. Conversely, as the expected total share of Danish renewable energy is expected to exceed the indicative trajectory in all years until 2020, Denmark is also prepared to make any excess renewable energy available to other countries in the years up to 2020.

According to the energy political agreement in the Danish Parliament from 22 March 2012, it is estimated that Denmark will exceed its 2020-target for share of renewable energy with approximately 6%-points, i.e. a 36% RES-share in 2020 is expected.

As far as participation in joint projects for offshore wind is concerned, the energy agreement is expected to result in establishment of new offshore wind capacity in Denmark, corresponding to 1500 MW, before 2020. None of these 1500 MW are considered to be established as joint projects.

2.5.2 Finland

According to the NREAP, Finland plans to meet the renewable energy obligations through domestic measures until 2020. However, the Finnish Government made a policy statement in November 2008 in its Long-Term Climate and Energy Strategy that if necessary, Finland can utilise the flexible mechanisms in the role of buyer or seller, depending on the costs of increasing the production of renewable energy in Finland and other Member States.

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2.5.3 Norway

Through the agreement with Sweden on a joint electricity certificate market, Norway is already using one of the cooperation mechanisms under the Renewables Directive. In accordance with Article 11 of the Directive, Norway has established a joint certificate system aimed at ensuring investments in electricity generation based on renewable sources until 2020. Apart from the certificate market cooperation with Sweden, Norway does not intend to use other cooperation mechanisms (cf. the government budget proposal for 2013).[8] This follows from the expectation that Norway will meet its national renewable energy target of 67.5% in 2020 through national measures and the certificate market, cf. the NREAP.

2.5.4 Sweden

The Swedish government stated in the government proposal (prop 2009/10:128) on the implementation of the EU-directive on renewable energy sources that it should be possible for other EU member states to finance investments on Swedish territory and in the Swedish economic zone (at sea) though common projects. There is a great potential for development of renewable energy in Sweden and offshore wind power could be suitable for joint projects. Issues relating to how the co-operation mechanisms could be used in a way that is good both for Sweden and other Member States are analysed on a regular basis both within the Swedish Government Offices and by the Swedish Energy Agency.

[8] Prop. 1S (2012-2013).

3 POSSIBLE USER COUNTRIES AND FRAMEWORK FOR JOINT PROJECTS

Meeting the 2020 targets in a cost-efficient manner may be challenging for some EU Member States, and some countries have explicitly stated that they want to use cooperation mechanisms either as host country or possible user country. For this purpose a number of legal and regulatory issues must be resolved and implemented through the contractual framework for joint projects. This framework must include an agreement between the Member States which specifies inter alia the project, the timeline and other clauses, financing mechanisms and reporting systems. The framework must also address important national considerations that are necessary to gain public acceptance.

In this chapter, we describe the status of Member States, Norway and Iceland in meeting the 2020 targets in the EU. On this basis, we identify a number of possible user countries that could potentially be willing to finance offshore wind in the Nordic region. Furthermore, we describe central elements of a possible governance and legal framework for joint projects. The description of this framework is based on the current EU Directives and national legislation, but is assumed to also continue after 2020 provided the main features of current EU renewables and climate policies are extended beyond 2020. As stated in the introduction, we described this framework for the purpose of illustrating a possible scenario where joint projects can be realised.

3.1 Meeting the 2020 targets: Status report

3.1.1 Overview of target per country

The RES Directive sets mandatory overall targets for the EU and its Member States; a 20% target for the EU's overall share of energy from renewable sources and a 10% target for energy from renewable sources in transport. It introduces a reporting and monitoring plan for Member States and provides mechanisms that allow national measures and cooperation between member states to meet their national target. The individual Member States' targets are based on a set of common calculation rules[9] and information submitted by Member States in a National Renewable Energy Action Plan (NREAP). A trajectory for every Member State leading up to the 2020 target is established and Member States have to report every two year on their progress (in National Reports).[10]

9 Art. 5-11.

10 See e.g., ECN report analysis on NREAPs, http://www.ecn.nl/units/ps/themes/renewable-energy/projects/nreap/ last visited 01/02/2013. There has been only 1 reporting period, that of 2009-2010. The next national reports are due by the end of this year for the period 2011-2012.

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Table 3: Renewables targets and reported progress per Member State

Member State	Share in 2005	Target for 2020	Reported progress in 2009-2010	Indicated surplus / deficit in 2009-2010
Austria	23.3	34.0	30.8	+
Belgium	2.2	13.0	5.1	+
Bulgaria	9.4	16.0	12.6	+
Cyprus	2.9	13.0	5.8	-
Czech Republic	6.1	13.0	8.3	+
Denmark	17.0	30.0	21.8	+
Estonia	18.0	25.0	24.0	+
Finland	28.5	38.0	33.1	+
France	10.3	23.0	12.8	+
Germany	5.8	18.0	11.3	+
Greece	6.9	18.0	9.7	+
Hungary	4.3	13.0	8.8	+
Ireland	3.1	16.0	5.5	=
Italy	5.2	17.0	10.1	+
Latvia	32.6	40.0	32.5	+
Lithuania	15.0	23.0	19.7	+
Luxembourg	0.9	11.0	3.0	=
Malta	0.0	10.0	0.9	+
the Netherlands	2.4	14.0	3.7	-
Poland	7.2	15.0	9.5	+
Portugal	20.5	31.0	24.6	+
Romania	17.8	24.0	22.4	+
Slovak Republic	6.7	14.0	10.2	+
Slovenia	16.0	25.0	19.9	+
Spain	8.7	20.0	13.5	+
Sweden	39.8	49.0	47.8	+
United Kingdom	1.3	15.0	3.3	=
Norway	60.1	67.5	N/A	N/A
Iceland	54	62	N/A	N/A

Source: NREAPs and National Progress reports

In the RES Directive the definition of 'use of energy from renewable sources' is broken down in three types; electricity (generation) (RES-E), cooling and heating (generation) (RES-C&H) and transport (usage) (RES-T). The targets and progress reports show sometimes a distorted image because they include the progress for RES-C&H and RES-T. Especially in RES-C&H a number of MS have reported a substantial increase in the final consumption of energy. The RES Directive allows Member States to use two types of measures; (national) support schemes[11] and (international) measures of cooperation.

Measures of cooperation include:

- Statistical transfer between Member States (all types of RES)
- joint projects between Member States (only for RES-E and RES C&H)
- Joint projects between Member States and third countries (only for RES-E)
- Joint Support Schemes (only for RES-E and RES C&H)

3.1.2 Which countries will meet their targets?

Member States (MS) have submitted three documents that is used as a basis for this analysis. Member States submitted a forecast by 31st of December 2009, a National Renewable Energy Action Plan (NREAP) by the 30th of June 2010 and the first national reports for the period 2009-2010 by the end of 2011.

In 2009, 10 Member States reported an expected surplus in 2020 (Spain and Germany largest). 5 Member States reported an expected deficit in 2020 (Italy largest). 13 Member States expected to exceed their interim targets, two Member States expected a deficit in their interim targets. 11 Member States would consider using cooperation measures: joint projects and statistical transfer. France, Greece, Italy and Spain may develop cooperation schemes with third countries. 3 Member States referred to offshore wind as an area for cooperation measures (Germany, Estonia and Ireland).

The NREAP submitted by the 30th of June 2010 described the national policies that are foreseen to reach the individual targets. It describes national support schemes and the intentions of governments.[12] The first national reports for the period 2009-2010 (see also figure 1) stated that two Member States had a deficit in meeting their interim target. 22 Member States had a surplus. One Member State (Sweden) has used a cooperation measure, the common green certificate market with Norway. 13 Member States have expressed interest in cooperation measures of which 9 are interested in selling a surplus. Three Member States have actively looked into cooperation measures (Luxembourg, Sweden and the Netherlands (expected from 2014)).

Public Statements on joint projects and cooperation mechanisms

A number of Member States have expressed interest in cooperation measures. This interest often relates to geographical location and/or type of renewable energy source. A few Member States focus on geographical area. For example Spain focusses on the Iberian Peninsula, Italy on south-east Europe and both of them on North Africa. Germany has expressed interest in the geographical area and the type of renewable energy source; solar power from North Africa. Ireland and Sweden have expressed interest in offshore wind energy, and both have (or expect) a surplus. Other Member States have expressed intentions on actively look into cooperation measures for the future: Sweden, UK, the Netherlands and Luxembourg, of which the last three expect (or are expected to have) a deficit in 2020.

Other information relevant for the analysis, but more difficult to quantify, are the effects of major policy changes, that have not yet been translated into submitted documents. For example, the phase-out of nuclear energy affects the need for German renewables resources to reach their

11 The most common national support schemes are Subsidies, Loans, Feed-in tariffs, Premiums, Quota System, Tax regulation, Net-metering, Tendering.

12 http://www.res-legal.eu/ for a website dedicated to the national support schemes.

target. Other relevant external effects like the financial crisis have reduced greenhouse gas emissions and the financial ability for Member States to meet their target.

3.1.3 Shortlist of possible user countries

Based on the documents submitted by the MS, the public statements made by the MS, the type of national support schemes and the like-mindedness of the countries, the analysis focuses on the following countries as possible user countries:

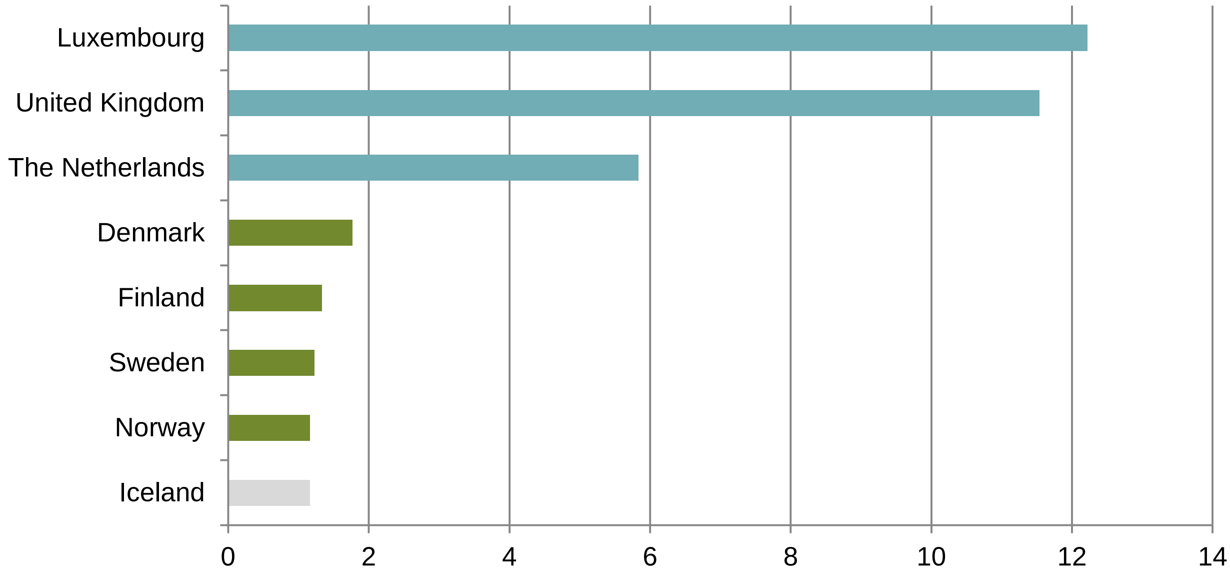
The Netherlands *– The Netherlands has reported a slight deficit in reaching their interim target. It has also communicated its interest in cooperation measures.*[13] *The Netherlands is geographically, politically and socially interesting for Nordic countries.*

Luxembourg *– Luxembourg has indicated, although no deficit is reported yet, a need for support from other countries. It will not be able to achieve its target nationally and although the country is small in absolute terms, their target is high. Luxembourg has expressed a willingness to use different cooperation measures.*[14]

United Kingdom *– the UK has expressed an expected need for cooperation measures in the near future and subsequently an interest in cooperation mechanisms.*[15]

The figure below illustrates the ratio of RES penetration of the 2020 target in relation to the 2005 situation for the Nordic countries as well as the possible user countries.

Figure 7: Ratio of 2020 target to 2005 penetration of the Nordics and possible user countries



Source: NREAPs and National Progress reports

13 The country's progress report states that they "may consider" using cooperation mechanisms (p. 52). See also note from the Dutch government, *Kamerbrief 5 april 2013, Informele energieraad 23-24 april 2013 / geannoteerde agenda*.

14 See p. 11 in *Progress report pursuant to Article 22 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources*.

15 See p. 30 in *First Progress Report on the Promotion and Use of Energy from Renewable Sources for the United Kingdom*.

3.2. Governance and legal requirements from user and host countries

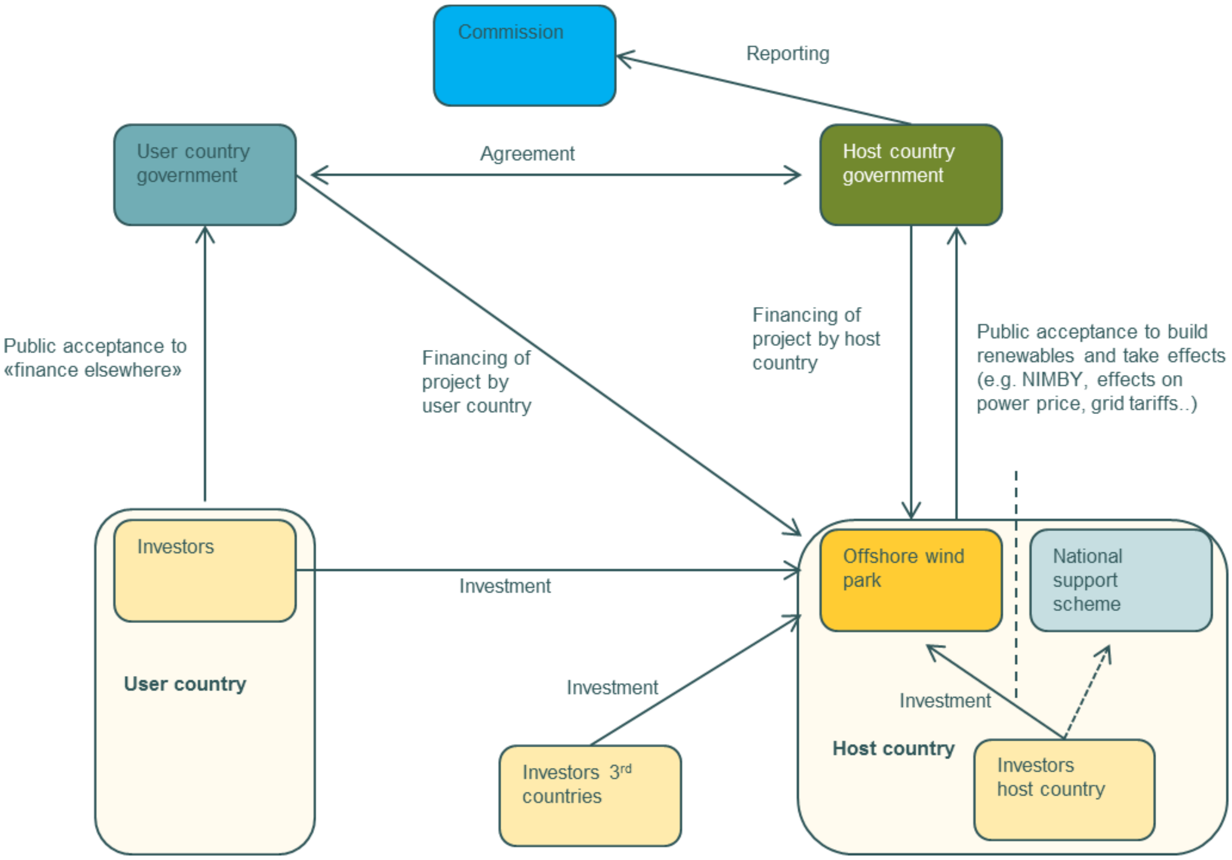
Presently, no joint projects have been realised. The RES Directive describes the possibility to set up a joint project but leaves the actual composition of joint projects to the Member States. Due to the lack of experience in the actual composition of a joint project, the governance or legal requirements (to which we often will refer to as barriers) for participating countries are all but clear. This limits the level of details we can and should go into in this study. We distinguish a number of governance or legal barriers that are relevant to the discussion. Under governance or legal requirements we refer to national and international regulatory systems, agreements between Member States, the project structure and the actors within the projects.

A few studies provide useful analyses of the possibilities of joint projects. Some projects have even touched upon the governance or legal requirements for joint projects.[16] In addition, the EU Commission has recently tendered a project for an analysis of measures of cooperation under the RES Directive.[17] For the purpose of our study (a non-exhaustive number of) governance or requirements (or barriers) to overcome will be described and analysed. The indicated legal requirements / barriers will be described according to the relationships depicted in figure 7. The arrows represent a relationship (contractual or legislative), public support / acceptance or an obligation between participants.

[16] Intelligent Energy Europe, *Design option for cooperation mechanisms between Member States under the new European Renewable Energy Directive*, D4 report RE-shaping, wwwreshaping-res-policy.eu; Intelligent Energy Europe, *Cost-Efficient and sustainable deployment of renewable energy sources towards the 20% target by 2020, and beyond*, D3.3 RES4Less, October 2012.

[17] http://ted.europa.eu/udl?uri=TED:NOTICE:313107-2012:TEXT:EN:HTML, last visited 15 May 2013.

Figure 8 Outline of legal / governance relationships for joint projects



3.1.4 The agreement between Member States

The basis for a joint project is the cooperation between Member States.[18] Such a type of cooperation would require an agreement between the Member States in question. Although the contents of such an agreement is open to the parties, common practice dictates that certain minimal legal requirements would be part of any agreement, e.g. negotiations, timeline, details of the cooperation, participation and possibly compliance.

In preparation of an agreement, negotiations between the Member States will be crucial. In the negotiations the parties will draft the legal framework of the agreement.

The timespan of a joint project is important. According to the RES Directive the counting of RES generation or consumption produced by a joint project is limited to 2020.[19] However, achieving a sufficient rate of return on offshore wind generation will depend on revenues over a longer period than the very few years from the time the first offshore joint project is implemented until 2020. The RES Directive does not limit the timespan (or operation period) of joint projects, but the time that the produced RES credits can be used for compliance of the user country's target under the Directive. It is possible, and assumable, that the period will be extended by the European Union beyond 2020. However, uncertainties about the timespan of a project doubtlessly affect the interest in setting up a joint project.

18 Art. 7 RES Directive 1st para.

19 Art. 7.4 RES Directive.

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A foreseeable component of the agreement between Member States is the details of the corporation; the project design. One can think of, e.g. the amount of renewable energy to be generated, the price for the RES credits, the type of financial reimbursement or support schemes. Important are the regulations and procedures for permits, development and construction of offshore wind generation,

The success of any project depends on the active participation of its participants. Joint projects have inextricably a financial element that requires investors. These can be governmental funds or private investors, but in any case, the importance of participation cannot be neglected. Therefore a joint project requires a description or even the commitment of the participants in the future project.

Normally, agreements or contracts have a compliance clause imbedded. Compliance will only have impact when the agreement actually dictates obligations to one of the parties. In case the agreement only describes an intention to cooperate in joint projects, often no direct obligations are apparent. Compliance is foreseen to ensure that parties deliver what they have agreed upon. Two types of compliance can be distinguished; compliance of the target under the RES Directive by Member States, and compliance based on the agreement between the Member States. The first type of compliance refers to the obligation of Member States to comply with their RES target by 2020. The joint project is an instrument to achieve the RES target and therefore this type of compliance can be deemed an integral part of the joint project agreement. The second type of compliance, based on the relationship between the Member States, requires clear definitions of the obligations of each Member State. In this context, one could think of the situation that a host country does not deliver the agreed upon amount of RES units or that financial compensation from a user country is not sufficient. Other issues that can be touched upon are conflict settlement or inclusion of third parties.

The agreement between Member States is, in our experience and based on interviews with stakeholders, not seen as a difficult barrier to overcome. In most situations the agreement will set up a framework for mutual cooperation. This can be, for example, a Memorandum of Understanding (MoU) between the Member States. The negotiations leading up to an agreement will take time and could be costly, but are essential to ensure necessary cooperation between Member States.

Only a few Member States have started negotiating, drafting and signing of any type of agreement within this context. The UK and Ireland signed an MoU in March 2013 to work closely together in trade of energy from renewable sources. Luxembourg and Lithuania signed a MoU in 2011 allowing statistical transfer and joint projects under the RES Directive.

3.1.5 National context

A joint project is based on an agreement between Member States, but the conditions at national level can be crucial to the design and success of a joint project. This applies to both the host country as well as the user country.

Whether the joint project is a total inter-state affair or if investors from the user country (or even third countries) are allowed to participate, the user country requires national acceptance by its population / electorate. The user country needs public support for long-time investments in RES generation in other countries. This is naturally a national affair, but may be an important barrier to overcome to successfully establish joint projects. Some factors that can influence this national acceptance are national RES potential and investor opportunities.

Any form of insurance of participation by national actors in a user country has to be in compliance with EU regulations on market competition. In addition, the project should probably ensure long term participation of other actors than those directly involved in the joint project, like industry, to increase national acceptance. An option to increase participation and national support is to ensure a broader cooperation than ‘just’ the joint project. The recently signed MoU between the UK and

Ireland provides an example of an intention to cooperate in the field of renewable energy and opening the possibility for joint projects.

For the host country, and possibly also for the user country, joint projects could affect a national support scheme that is in place. The country has to assess whether or not the joint project generation installation will be included in their national scheme. This could possibly lead to market discrepancies where a national system is based on a different market principle than the joint project, or double accounting.

3.1.6 Type of project (financing)

An important component for a joint project is the type of financing that the countries agree upon. The basis for a joint project is that one Member State invests in a RES installation in another Member State and in return counts the renewable energy produced by that installation against its national target. Although a number of joint project structures are possible, the most plausible option would be to have a joint project wherein the user country would include designated sites or installation for offshore wind development in the host country in its national support scheme. Whether the support scheme is a feed-in tariff, a premium tariff or a tender system, all would allow investors (nationally and internationally) to invest in the joint project. In such a construction the user country will be financing the joint project as any other national project. The host country will exclude the project's renewable energy generation from its national targets for the duration of the project.

Joint projects have direct and indirect effects that subsequently affect the costs. Financing of joint projects based on the national support scheme of the user country seems logical. However, the host country could be victim to indirect costs due to the increased generation of renewable energy. Although difficult to quantify beforehand, the Member States should agree on possible coverage of the indirect effects/costs.

3.1.7 Reporting

The host country has an obligation to report to the Commission on the joint project and annual reports on the progress of the joint project. Although this not constitute to a direct 'legal' barrier, the reporting does require the host country to use resources.

4 JOINT PROJECTS IN PRACTICE

The Baltic Sea has good and steady wind conditions, less salty waters and lower wave heights that allow for adapted turbine technology and lower investment and O&M costs than for comparable Nordic Sea projects. Baltic Sea projects will become very competitive and require the least additional support, Norwegian projects are among the most expensive Nordic offshore wind projects. Projects invested in 2019/2020 will still require support on top of the power price throughout their lifetime however. The biggest barriers for joint projects will be time to get the regulatory framework in place and the production online, uncertain demand as well as public acceptance in the user country to invest in another country.

In this chapter, we present a set of generic examples of Nordic offshore wind projects. With this starting point, we calculate the costs and revenue requirements of typical Nordic offshore wind projects. This is then used to analyse possible support mechanisms and various governance and legal conditions for realising joint projects in practice. Our analysis takes current support systems and 2020 targets as a starting point. As stated in the introduction, however, our purpose is to illustrate the opportunities for joint projects on the condition that EU renewables and climate policies are extended beyond 2020, including national renewables targets. In that perspective, the following analysis can be viewed as a scenario for the development of joint projects beyond 2020.

4.1 Case studies - overview

Rather than basing calculations on actual wind parks, we use generic site types for illustration. These generic projects are representative for the project pipeline in each of the Nordic countries and normalized to a wind park size of 200 MW. The CAPEX estimates are based on empirical data, assume that similar turbines are used in all wind parks and reflect the distance to shore and water depth which is representative. All investment cost estimates are made for seabed-mounted foundation, include an annual cost reduction potential and assume production start in 2019/2020.

Table 4 Overview of key data for Nordic offshore wind type example projects, seabed mounted foundations (values are given in real 2013 terms)

Windpark	Capacity [MW]	Production [GWh]	Distance to shore [km]	Water depth [m]	CAPEX estimate [MEUR]	CAPEX [MEUR/MW]
Type Norway North Sea	200	820	21	30-65	684	3.4
Type Sweden Baltic Sea	200	770	25	10-28	523	2.6
Type Finland Baltic Sea	200	720	11	4-18	461	2.3
Type Denmark Baltic Sea	200	800	26	17-28	540	2.7
Type Denmark North Sea	200	840	30	20-30	617	3.1

Source: THEMA Consulting Group

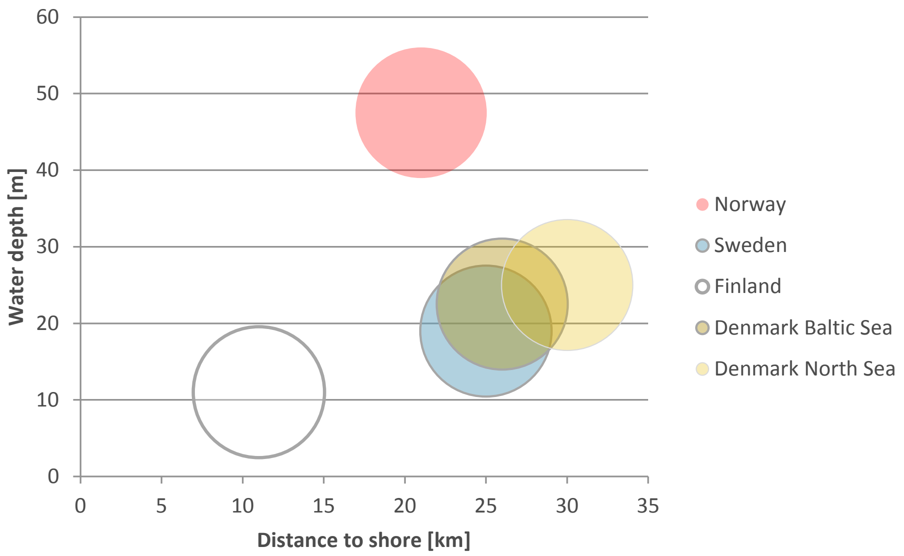
Furthermore, we assume certain technology improvements implying that the different wind conditions in the North Sea and the Baltic Sea can be used more efficiently than currently. Investment cost estimates for Baltic Sea conditions consider lower investment costs for adapted turbine technology, less salty water conditions and lower wave height.

Grid connection costs to land are included in the investment cost estimates in the reference case.

The Finnish offshore projects in our analysis are located near the shore and in shallow waters, which results in considerably lower investment and O&M costs, even if the wind resources are only average. On the other hand, typical Norwegian offshore projects can be assumed to have the best wind resources of the Nordic countries but deeper waters and higher foundation costs yield significantly higher investment costs.

Swedish Baltic Sea offshore wind and most Danish projects are typically located around 20-25 km offshore and at water depths of 10-28 meters, see Figure 9. Wind resources range from very good in the selected Baltic Sea sites to excellent in the North Sea sites. Investment costs for the typical Danish and Swedish projects invested in 2019/2020 are estimated to 2.6-2.7 MEUR/MW.

Figure 9 Nordic offshore wind farms - type projects for analysis



Source: THEMA Consulting Group

The O&M cost estimates are based on empirical data and adapted for distance to shore. Baltic Sea conditions such as lower wave height, the need for smaller special vessels and less salty water resulting in less corrosion than for a Nordic Sea project are reflected by lower a O&M cost.

4.2 Economics of Nordic offshore wind farms

The project economics are defined by the long-run marginal cost of the project on one hand and the income from the power market and support schemes on the other.

4.2.1 Income from the power market and existing Nordic support schemes

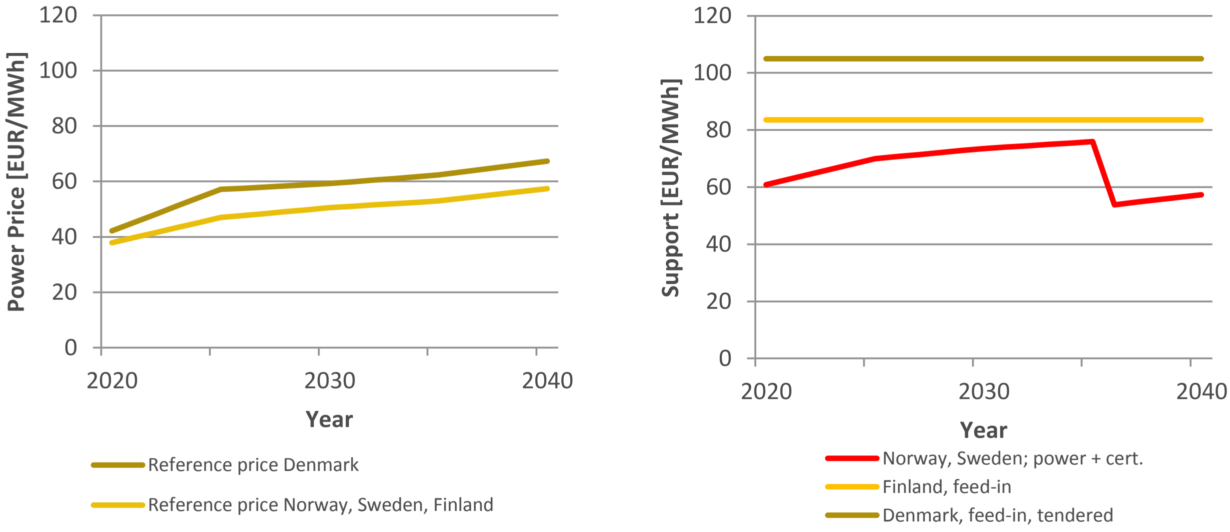
Income for Nordic offshore wind power projects consists of income from power market and income from support schemes, i.e., certificates in Norway and Sweden and feed-in tariffs Finland and Denmark.

Power price development. Massive investments in subsidized renewable energy generation capacity in all of the Nordic countries, nuclear upgrades and new build, combined with relatively low consumption growth will strengthen the Nordic power balance significantly towards 2020. This, combined with low CO_2 prices, results in relatively low power prices towards 2020. After

2020, we expect increased levels of interconnection, increasing CO_2 and fuel prices, and a tighter energy balance after 2030 as contributing factors to some price recovery.

We are using one single power price for Norway, Sweden and Finland since price differences in the respective price areas are not relevant for the illustrative purpose of this analysis. Since the Danish power system is strongly linked to the Continent and contains a share of coal fired power plants, Danish power prices are expected to be higher than for the other Nordic countries, see Figure 10. All prices are simulated by using our power market model THE-MA.[20]

Figure 10 Nordic reference power prices (left) and estimated and support levels (right) 2020-2040



Source: THEMA Consulting Group

Our reference power prices are based on the following assumptions:

- *Fuel prices: CO_2 prices rise after 2020*. Nordic power prices depend strongly on the fuel price development. For the period beyond forward markets we base our assumptions on a combination of IEA and EIA scenarios and own assessments. In our reference scenario we base prices until 2020 on current forward prices and assume an increasing CO_2 price towards 2040 as we expect global climate policies to become gradually tighter. For coal prices we expect a gradual increase from today's low level, due to demand increases and increased mining costs. We expect European gas prices to increase gradually towards 2040.
- *Generation: planned new renewable investments will be realized.* Renewable power generation will grow significantly due to support systems in place. We expect the goal of the common Swedish/Norwegian electricity certificate market to be reached by 2020 and subsequent growth in renewables to continue at a slower pace. Tender processes for new wind power in Denmark and feed-in tariffs in Finland will also lead to a significant increase in renewable power generation in the Nordic area towards 2020. In Finland, Olkiluoto 3 will come online in this period, further strengthening the supply side. A number of Swedish nuclear power plants reach their expected life time of 60 years after 2030. The first reactor we assume to be decommissioned is Oskarshamn 1 in 2032.
- *Consumption growth continues to be modest*. We forecast a modest growth in electricity demand in the Nordic market. Demand in households and the service sector has been

20 Power market model for Northwest Europe with hourly time resolution.

relatively flat for some time and we expect the trend to continue as energy efficiency improvements counterbalance population growth and increased number of electric appliances in the households. Growth in the industry sector is expected to be relatively modest, with the exception of the Norwegian petroleum sector which targets electrification.

- *Power balance will therefore stay strong between 2021 and 2030*. With a strong supply side and a weak demand side the power balance in the Nordic market is set to strengthen significantly towards 2020. The price effect of the strong power balance is however more than counterbalanced by an increase in fuel and CO_2 costs. We expect a new trading period for CO_2 allowances with a tighter cap after 2020, lifting the CO_2 price. Coal and gas prices are also assumed to increase.
- *Transmission capacity to increase significantly*: Within the Nordic market area we expect transmission capacity to increase e.g. between Norway and Denmark (Skagerak 4 in 2015), in addition to some internal grid re-enforcements. The cable between Norway and Germany (NordLink) is assumed to be commissioned by 2018[21] and the cable between Norway and the UK (NSN) to come online after 2020.

Price effects. In our reference scenario, a continued increase in fuel and CO_2 prices moves the power price in an upward direction after 2020, as do higher continental European power prices. The phase-out of Swedish nuclear capacity after 2030 weakens the power balance in the Nordic exchange area and puts an additional upward pressure on the Nordic power price. The large investment in “must run” renewable generation capacity changes the characteristics of the Nordic power market. The difference between summer and winter prices increases, as does the short term volatility. Consequently, the system price becomes more sensitive to the downside in wet years and less sensitive to the upside in dry years. In years with a large hydro surplus we can expect summer prices down at the level of variable costs (SRMC) of nuclear power.

Phasing in large amounts of offshore wind power in order to provide joint projects to other Member States will increase the Nordic power balance further and have a price-decreasing effect.

Main uncertainties. All drivers are, of course, important for price developments. Nevertheless, we consider some factors as more uncertain than others, and hence implying significant price risks.

Of all price risks, fuel prices and CO_2 prices are likely to imply the most substantial risk. New shale gas developments may put gas and coal prices under pressure, while increased global demand for fuels may increase fuel prices. And the recent decline in CO_2 prices contributes significantly to the relatively lower prices we observe in current spot and forward markets.

Around renewable investments, the road is fairly straight coming to 2020. The largest uncertainty for power prices lies beyond 2020, and the question for kind of renewable support and targets one will have after 2020.Also nuclear developments until 2020 are fairly known, despite the ongoing delays for Olkiluoto 3 in Finland. But after 2025/2030, the uncertainty increases, new build in Finland (Olkiluoto 4; Fennovoima) and Swedish nuclear replacements become uncertain. At the same time, due to age, some reactors may have to be decommissioned.

Demand developments are highly uncertain in the long run. Changes in power intensive industry can substantially alter the power balance. In this context, the framework for industry is crucial (general global developments, but also local policies as, for example, carbon compensation). And to what extent an increased level of electrification (transport, conversion) may be off-set by energy efficiency measures is unclear.

New transmission cables to the Continent and the UK are large and heavy infrastructure investments. But even if Statnett is willing to build new interconnectors, they need a counterpart. In this respect, the latest decision on NordLink, the cable to Germany, was only possible as the

21 Initially with somewhat reduced capacity.

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German KfW bank stepped in as a shareholder with capital, as Tennet itself is short of own capital. In addition, there are technical challenges, ranging from technical cable risk to challenges in the internal grids that may impact how many cables will become operational.

In the further analysis we address these uncertainties in the form of power prices with low and high fuel prices.

4.2.2 Project economics for Nordic offshore wind

The costs of offshore wind power are influenced by the physical characteristics of the wind farm including the water depth, distance from shore, wind speed and seabed. Lately, the costs of offshore wind seem to have flattened out after a substantial increase in many countries, driven both by underlying cost increases (commodity prices rises, currency fluctuations) and by more specific factors such as the move to deeper water sites, supply chain bottlenecks and sub-optimal reliability.

Long-run marginal costs for offshore wind

The long-run marginal costs of the type projects for each country were analysed on the basis of the assumed investment and O&M costs and full load hours for a production start in 2019/2020.

The economic life length of the offshore wind projects was set to 25 years, equalling current practice in the field. The reference discount rate was set to 10% in order to reflect the higher risk for an offshore wind investment compared to onshore, where a level of 7-9% would have been appropriate. The LRMC calculations do not include decommissioning costs or seabed rent and are made on a pre-tax basis.

We also ran sensitivities on investment and O&M costs (+/-10%), discount rate (+/-2%), full load hours (+10%,-5%) and economic life length (20 years instead of 25 years), resulting in a wider cost range for the type projects as depicted in figures 9-12. Furthermore, we analysed the long-run marginal costs of a project when the grid connection to land was not included.

Discussion of parameters/uncertainties:

- Financing costs will benefit from reduced risks as more capacity is installed and experiences gained, mitigating upward pressures
- Higher cost reduction for wind turbines is possible
    - Particularly increases in rated power and rotor size
- Stronger EUR might change the cost position of especially Swedish projects in a slightly negative direction
- The pace of technological development
- Maturity of the supply chains serving offshore wind developers

The necessary support levels for the projects are defined as the gap between the power price and the long-run marginal cost of the project. The minimum direct support level is needed in a scenario with a high power price (high fuel and CO_2 cost) for a project that does not have to pay for the grid connection to land. The highest support levels are needed in a scenario with low power prices (low fuel and CO_2 prices) and when the project has to bear the full connection cost to the grid.

Based on the five generic site types we have used in our analysis, there is a relatively balanced LRMC trade-off between shallow waters, close to shore sites with lower wind speed, and deeper water and/or further from shore sites with higher wind speed. This means that a potential move to deeper waters is not likely to yield higher LRMC levels when the greater energy production due to higher wind speed is taken into account.

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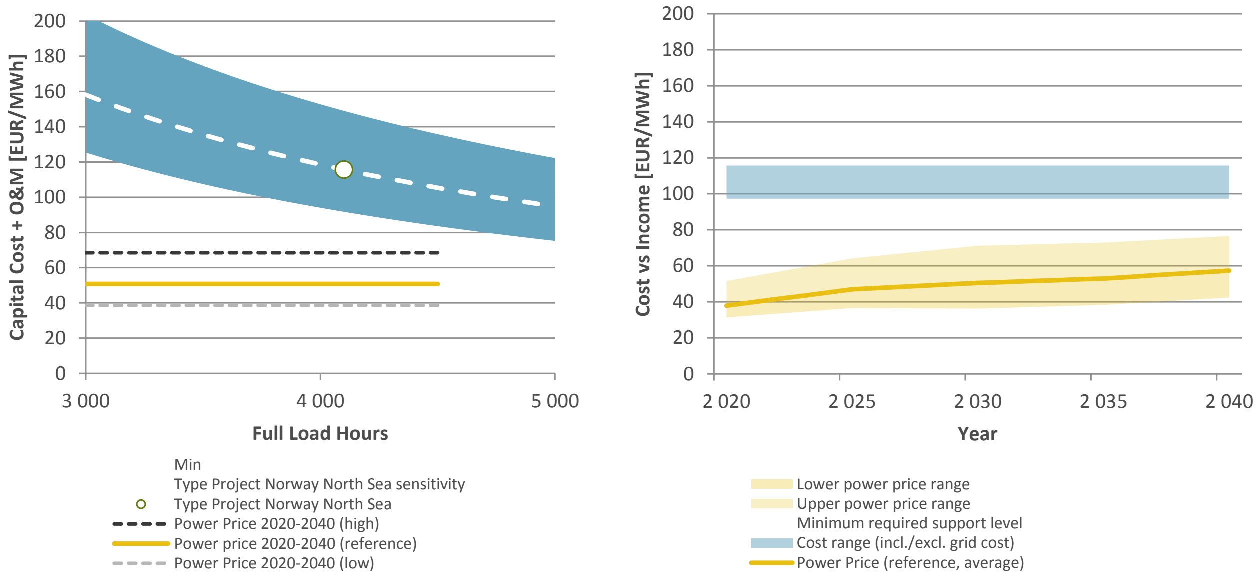
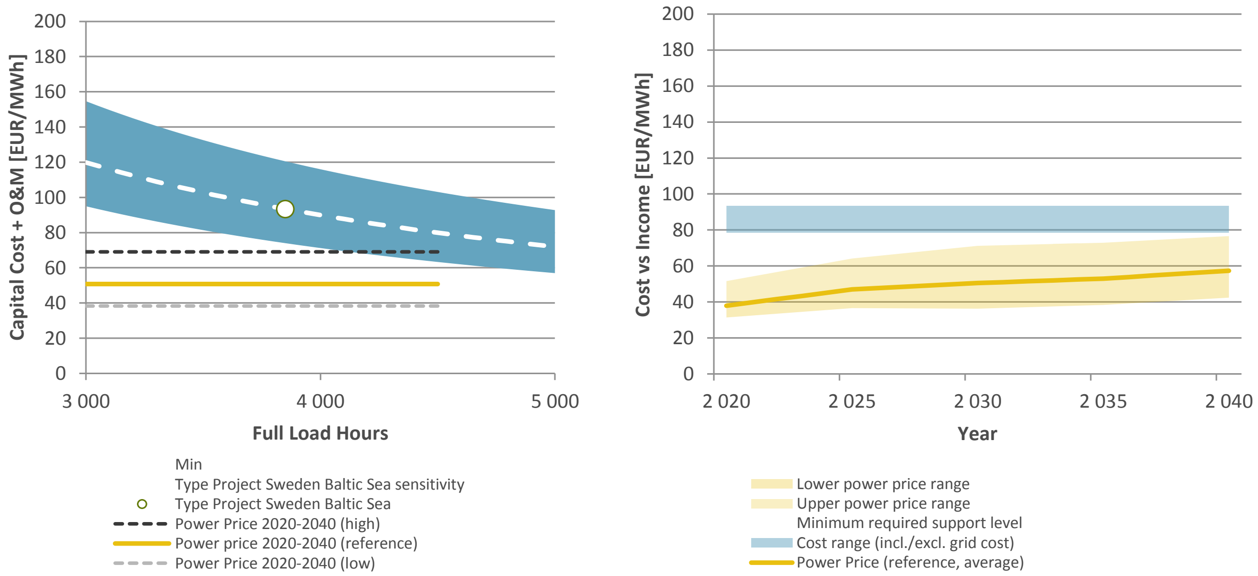
Figure 11 Cost range and gap to power for a typical offshore wind project in Norway



Source: THEMA Consulting Group

Norway. With an LRMC level of 116 EUR/MWh (including grid connection costs), the Norwegian type project shows the highest long-run marginal cost of all four type projects in the Nordic countries. Even without grid connection costs, the project LRMC is 97 EUR/MWh, too high to be realized under the current support scheme with green certificates.

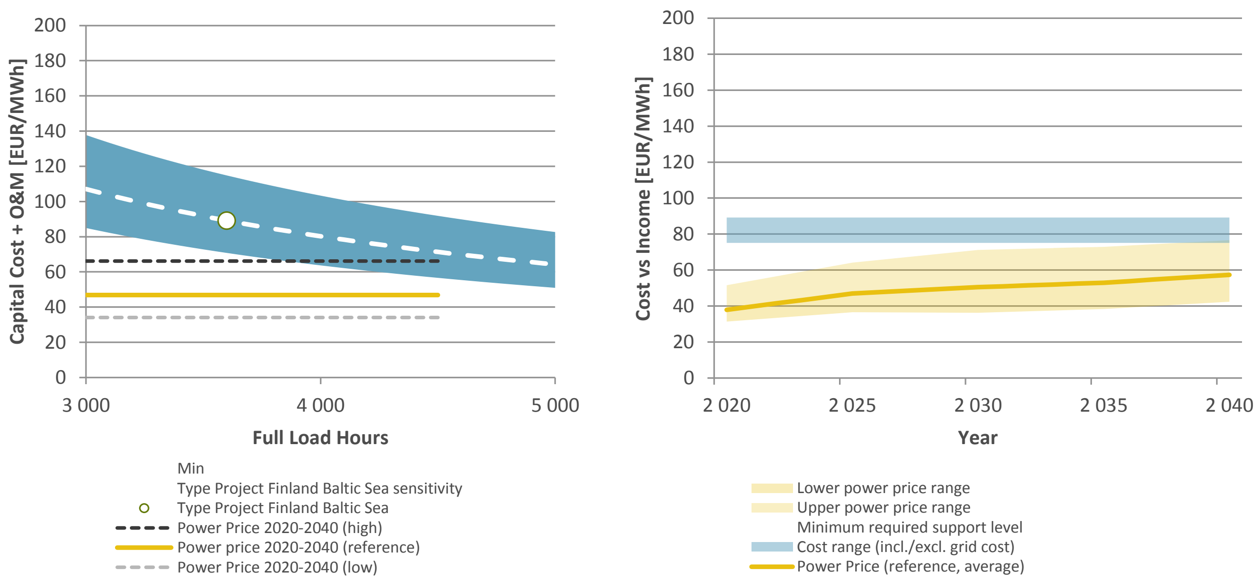
Figure 12 Cost range (left) and gap to power price (right) for a typical offshore wind project in Sweden



Source: THEMA Consulting Group

Sweden. The Swedish type project shows a long-run marginal cost of 93 EUR/MWh including grid connection costs and 78 EUR/MWh without grid connection costs. This means that no offshore wind parks would be built under the current green certificate support scheme.

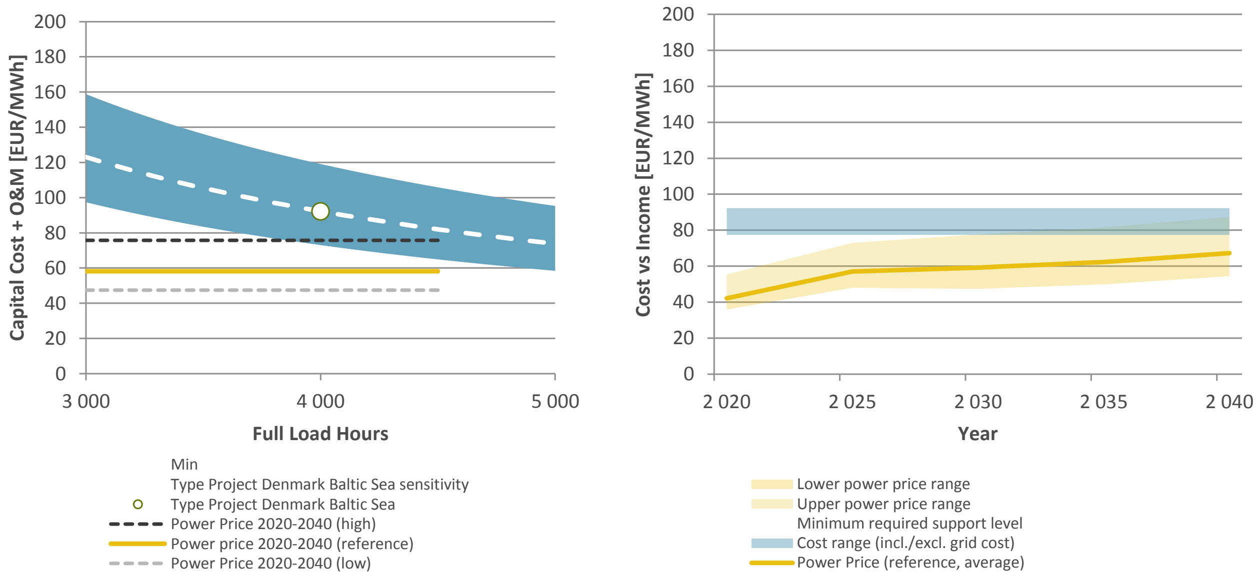
Figure 13 Cost range (left) and gap to power price (right) for a typical offshore wind project in Finland



Source: THEMA Consulting Group

Finland. The Finnish type project shows a long-run marginal cost of 89 EUR/MWh including grid connection costs and 75 EUR/MWh without grid connection costs. This means that no offshore wind parks would be built under the current support scheme which yields a maximum support of 83.5 EUR/MWh.

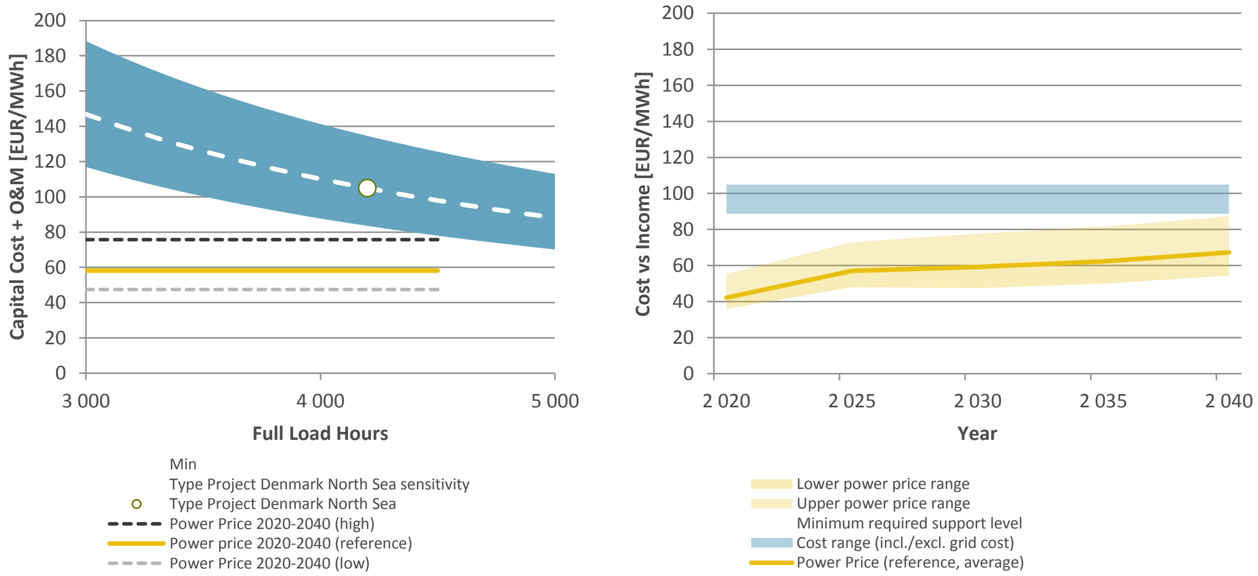
Figure 14 Cost range (left) and gap to power price (right) for a typical Baltic Sea offshore wind project in Denmark



Source: THEMA Consulting Group

Denmark. The Danish Baltic Sea type project shows a long-run marginal cost of 92 EUR/MWh including grid connection costs and 77 EUR/MWh without grid connection costs.

Figure 15: Cost range (left) and gap to power price (right) for a typical North Sea offshore wind project in Denmark



Source: THEMA Consulting Group

The North Sea type project shows a long-run marginal cost of 105 EUR/MWh including grid connection costs and 89 EUR/MWh without grid connection costs, i.e. about 13 EUR/MWh above the Baltic Sea type project. Since the Danish support system includes a tendering process for a feed-in tariff and recent projects showed support levels in the above range, Danish offshore wind projects are currently the only Nordic offshore wind projects that can be realized with the help of the existing national support scheme.

Gap analysis - What support is needed from possible user countries? Figure 16 summarizes the necessary support levels for projects in the four Nordic countries defined as the projects LRMC minus power price. The power prices used are the average of THEMA's reference prices for 2020-2040 in the respective countries. High and low power prices reflect sensitivities for high and low fuel and CO_2 prices. With fuel and CO_2 prices expected to increase towards 2040 and giving an upward drive to Continental and Nordic power prices, the high end of support levels are expected in the early phase of the projects. Increasing power prices will result in a significant decrease in necessary support levels over time.

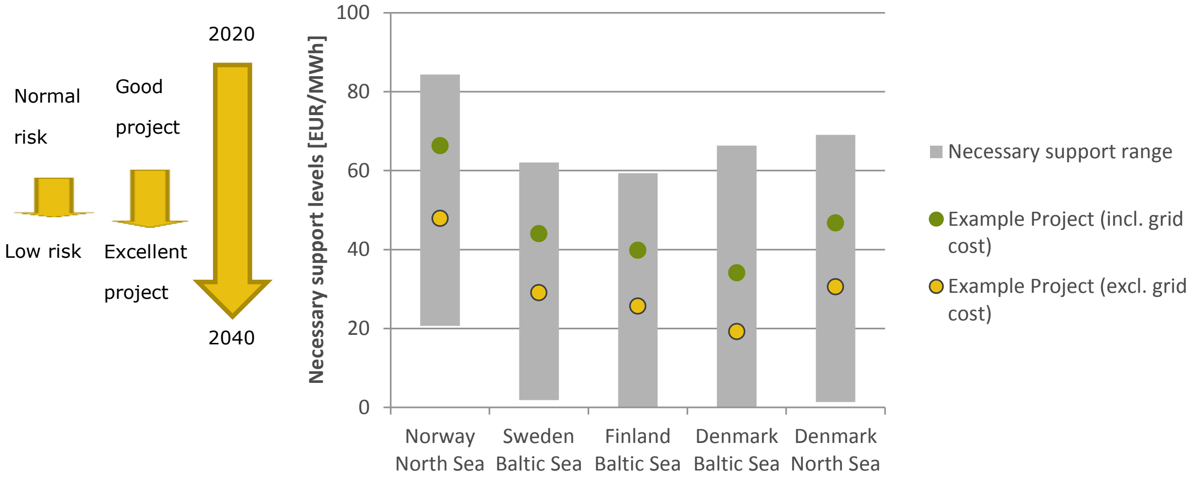
Despite excellent wind resources, Norwegian offshore wind needs the highest support levels due to high investment costs for foundations in deep water in connection with a low expected power price. Our type project would require an average direct support level of 66 EUR/MWh if grid-to-land investments are paid by the project and about 48 EUR/MWh if the grid-to-land investments are paid by the government.

Our Swedish type project would require an average direct support level of 44 EUR/MWh if grid-to-land investments are paid by the project and about 29 EUR/MWh if the grid-to-land investments are paid by the government. Necessary Swedish wind support levels decline from 62 to 2 EUR/MWh during 2020-2040.

Finnish projects profit from reasonable investment costs and low O&M costs due to closeness to shore and lower water depth while wind resources are good. Our Finnish type project would require an average direct support level of 40 EUR/MWh if grid-to-land investments are paid by the project and about 26 EUR/MWh if the grid-to-land investments are paid by the government.

In Denmark, we find the lowest necessary support levels of the Nordic countries. One reason is the excellent wind resources in combination with shallow waters. The other reason is the strong link of the Danish power system to the Continental thermal dominated power system, which gives the highest power prices in the Nordic countries which reduces the need for additional support on top of the power price. Our Danish Baltic Sea type project would require an average direct support level of 34 EUR/MWh if grid-to-land investments are paid by the project and about 19 EUR/MWh if the grid-to-land investments are paid by the government. The Nordic Sea type project will require an average support level of 47 EUR/MWh incl. grid cost and 31 EUR/MWh without.

Figure 16 Necessary support levels for offshore wind in the Nordic countries 2020-2040



Source: THEMA Consulting Group

Even with high fuel costs and consequently high power prices, the average necessary support levels are significant. Over time, the need for support is expected to decline in all countries due to an increase in power prices. Still, typical projects invested in 2019/2020 will require support on top of the power price throughout their entire lifetime. Only the very best Baltic Sea projects will be able cover their costs approaching 2040 without additional support.

4.2.3 RES costs in potential user countries

Table 5 below shows an overview of the support schemes and the support levels in three potential user countries.

Table 5 Support schemes in possible user countries

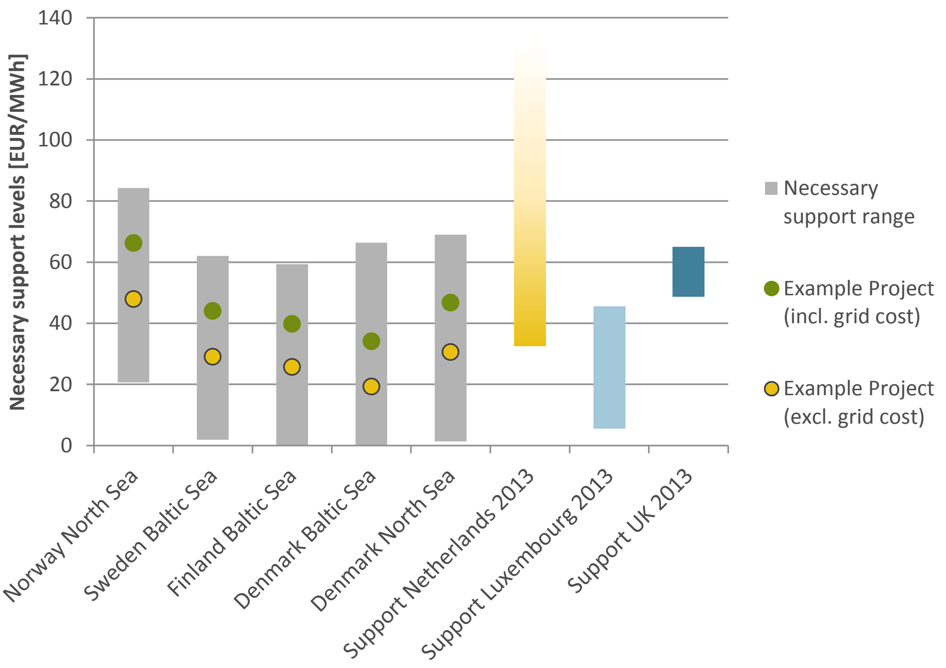
The Netherlands	Luxembourg	United Kingdom
Premium tariff scheme (SDE+ 2013)[22] • Guarantee of difference up to electricity price for fossil fuels generation • € 3 Billion budget • Premium varies from 87.50 EUR/MWh to a maximum of 187,50 EUR/MWh for offshore wind generation. Tax incentives • Extra write-off for RES investments • Environmental tax exemption • 'Green project' loans • Loan against reduced interest rate (1%)	Feed-in tariff (FIT) • Focus on photovoltaic generation • 15 year guarantee. The price for RES wind (onshore, excl. offshore) generation is 82.7 EUR/MWh Income tax exemption for photovoltaic generation for consumers Subsidies that promote RES generation. • RES fund Direct investment	Feed-in tariff (FIT) Onshore and offshore wind: feed-in premium, sliding • Generation below 50 kW • 50 kW - 5 MW choice A quota system (Renewable Obligation Scheme) • Generators over 5 MW • Noncompliance opt for buy-out • Offshore wind generation will cease to be eligible after 20 years or 2037 Levy (tax) on the usage of generation from non-renewable sources

Figure 17 below compares the required support level for Nordic offshore wind need with currently provided support levels in the three potential user countries Netherlands, Luxembourg and the UK. This shows, that excellent Nordic offshore wind parks – especially if grid connection is not included in the costs – could also be viable under other countries support schemes, if not already now, so at least beyond 2020, assuming increasing power prices.

With Dutch - stepwise tendered - support levels ranging from 32.5 EUR/MWh to 132.5 EUR/MWh and assuming ROC levels in the UK ranging from 39-52 GBP/MWh, good Nordic offshore projects could also be profitable under the support schemes in the Netherlands and the UK. Only the technology-specific onshore wind feed-in tariff in Luxembourg appears too low to support Nordic offshore wind projects.

[22] In the previous SDE+ scheme, that was open until December 2012, off-shore wind premium tariffs varied between 88 to 188 EUR/MWh. Funding was provided for a maximum of 3200 full load hours per year for offshore wind generation.

Figure 17 Comparison of required Nordic support level 2020-2040 and current user country support



Source: THEMA Consulting Group

4.3 Possible support from user countries

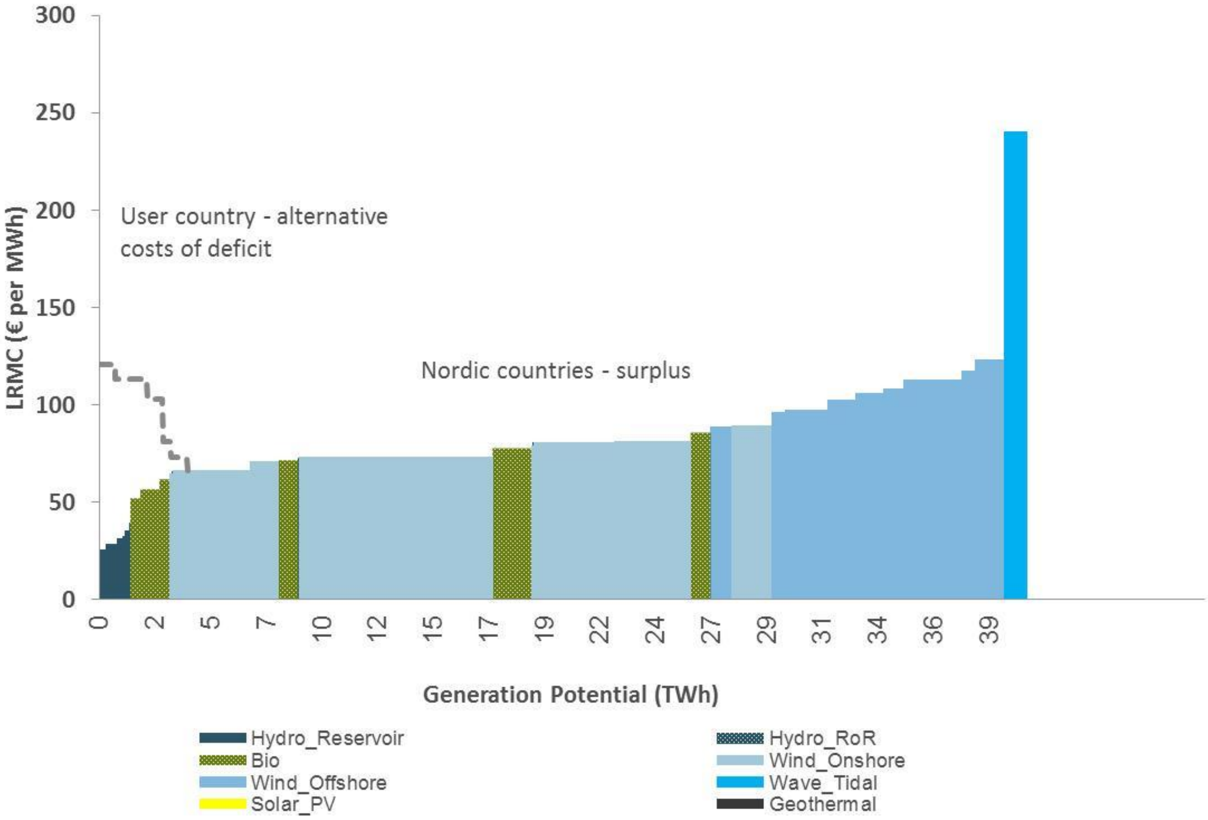
The Member states have the options to reach their RES by trading-off costs and targets between the electricity sector (RES-E), the heating and cooling sector (RES-C&H) and the transport sector (RES-T). This means, since we have been focusing on the electricity sector, that we assume that the trade-offs between the sectors are within small ranges and not impacting our conclusions.

Within the electricity sector, any surplus potential from European countries constitutes a potential for joint mechanisms (including statistical transfer) and thus competes with the Nordic surplus potential in the joint mechanism "market". This is especially true for the expected bio power surplus in Eastern Europe (mainly Romania[23]), Figure 18 shows the estimated Nordic surplus curve in 2020, consisting mainly of wind on- and offshore, and to a lesser extent hydro- and bio power capacity.

We focus the analysis on the competitiveness of Nordic offshore wind power, despite the existence of cheaper potentials from hydro, bio and onshore wind, which provide around 42 TWh of surplus potential. This is of course in line with the targets of the study stated initially. The assumption may be justified by considering that the Nordic countries may want to reserve cheaper potentials for meeting possible renewables targets beyond 2020.

23 Res4less.eu 2011.

Figure 18 Nordic supply curve surplus as of 2020 vs. deficit in an EU country (illustrative)



Source: THEMA Consulting Group

This estimated Nordic host country surplus can be matched with the possible user countries' need for RES purchases. This need is defined by the potential user countries limitations to reach its RES-E projections. The user country's willingness to pay for joint projects is defined by the country's alternative costs to reach its renewable target, including trade-offs with its heating and cooling as well as its transport sector. Assessment of trade-off is a highly complex optimization including many less known variables.

In our analysis we simplify and assume that the potential user country wants to explicitly reach its national projection for RES-E. Furthermore, we assume that all host countries' renewable surplus would be offered as joint projects and that no national technology limits apply. The cheapest surpluses in the Nordic area consist of hydro power projects which can be realized in Norway and Sweden[24] and some bio projects, mainly in Sweden. Sweden also has a large pipeline of onshore wind projects, much larger than the volume target set in the Certificate market. This onshore wind forms the majority of the surplus potential until 2020. In the cost range of 90-120 EUR/MWh we find current offshore wind projects which could be realized until 2020, given the right support mechanisms are put into place.[25] The high-cost potential consists of wave-power, which very soon will come into a trial phase with a Fortum project on the Swedish west coast.

The willingness to pay is defined by the alternative cost to reach the host country's national projection by national measures. This is reflected by the long-run marginal costs of the technologies which realistically can be developed until 2020. In Figure 18, the estimated Nordic surplus supply curve is compared with the alternative costs for a potential user country to reach

24 On top of 7 TWh we assume to be realized 2012-2020 in the Swedish-Norwegian Certificate system.

25 We do assume, that grid connection would be possible for these within the timeframe to 2020.

the last 5 TWh of its national RES target (the most expensive ones) by national measures alone. Assuming that the most cost-efficient user country RES-E investments are developed first, the majority of the assumed user country deficit in our example has a cost level of around 75-120 EUR/MWh (Figure 18). Flipping this deficit cost curve, we get user country demand as shown in the figure. The intersection with the supply curve at around 65-70 EUR/MWh (onshore wind) indicates a potential average price level for a joint project of this volume.

A potential user country will not only have the option of a joint project with Nordic, but also other countries. Nordic offshore thus faces competition from other countries potential surplus, especially a potential bio surplus in Eastern Europe. Within offshore wind, competition can be expected from e.g. Estonia and Ireland and potentially Belgium.

4.4 Integrating joint projects into national support systems

Integration of joint projects into national support systems can be roughly viewed from two perspectives; from the possible user country and from the host country. In joint projects the possible user country is the financing party, making integration of joint projects into their national support system interesting. From a host country perspective, however, the situation is slightly more difficult. If an installation does not count towards the national target, an exemption might interfere with the principles behind its national support system. In addition to the integration of support systems into one of the countries' national systems, the countries can set up an entirely separate support system.

4.4.1 From user country perspective

As described above, one of the most plausible options would be to have a joint project wherein the user country would include designated sites or installations for offshore wind development in the host country in the user country's national support scheme. In such a construction the user country will be financing the joint project as any other national project but with a difference that the location for the offshore wind generation is in another country. The host country will exclude the project's RES production from its national targets for the duration of the project. When applying this type of structure, the user country could integrate the joint project into its national support system. Integrating the financing of a joint project within their national support scheme would additionally stimulate national participation and transparency in the user country.

National support systems vary in application and coverage; some systems relieve investors afterwards, others stimulate investments beforehand. Coverage is often related to the RES potential of the country, e.g. Luxembourg has a primary focus on photovoltaic generation mostly because of its lack of potential for other types of renewable energy generation. The described possible user countries all have a type of a tariff guarantee national support scheme (feed-in or premium). Integration of a joint project in a national guarantee support of a possible user country could therefore be an interesting structure to build upon in the future. Other types of support systems, e.g. a certificates scheme or tax exemptions, appear less suitable for such a construction. This is mostly due to those schemes (or support systems) being technology neutral or characterised by ex post remuneration of investment. In particular, technology neutral support systems cannot ensure promotion of a specific technology like offshore wind.

4.4.2 Host country perspective

Integrating joint projects in the support system of a host country seems difficult, because the financing responsibility lies with the user country. For the reasons explained in the previous paragraph – the suggested approach with a guarantee support system from the user country – the host country has to ensure that the installation is excluded from its national RES account and most probably, from their national support system. Double funding should be prevented.

In any type of structure or framework contract the limitations and the effects of the joint project on the national support system of the host country should be considered.

4.4.3 Setting up a separate support system

In addition to integrating the joint project into one of the national support schemes, the countries can opt for a type of separate support scheme. This option comes very close to the option of the RES Directive for setting up a joint support scheme, but distinguishes itself in the fact that the host country has a more passive role and 'merely' provides the site or installation.

This option raises a number of legal and economic issues, for instance the risk of overlapping jurisdictions and mechanism design that must fit with the electricity markets involved and other national support systems. Creating a separate support system for joint projects can be done, but is more complex and probably less efficient than using a suitable national support system in the user country.

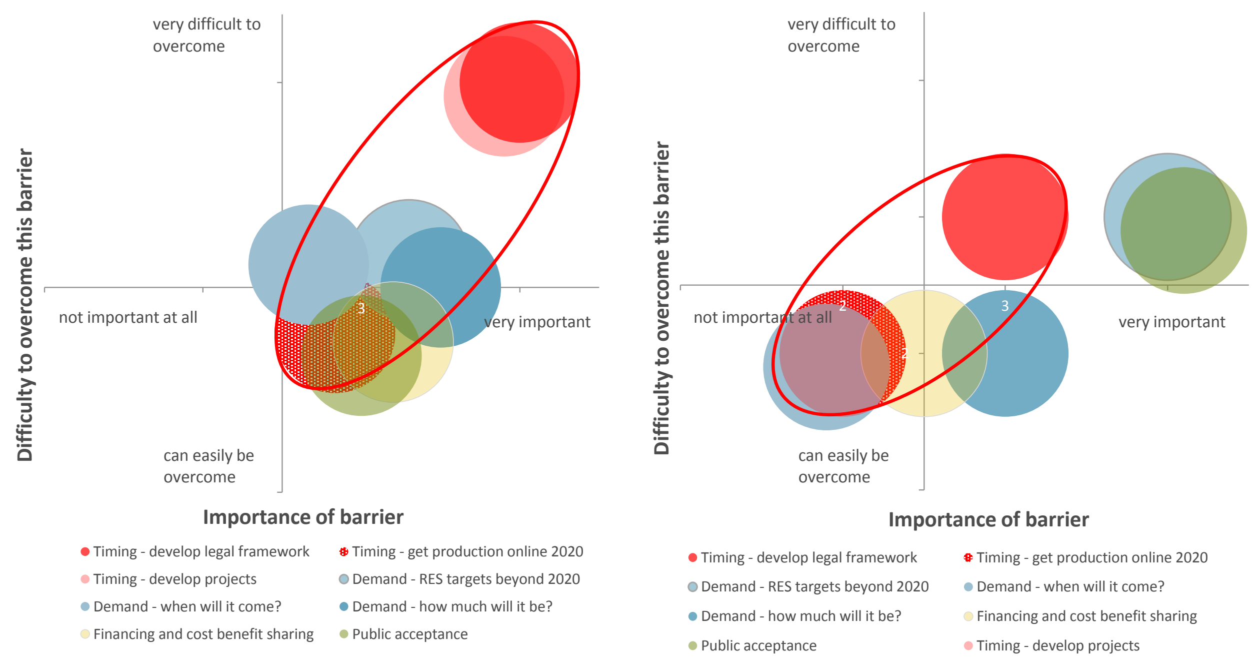
4.5 Barriers for joint projects

We have identified four main barriers to joint projects:

- Timing
- Demand from user countries will be uncertain until it is almost too late
- Many alternative measures for the user country to reach the RES target
- Public acceptance in both user and host country

The figure below shows a high-level evaluation of the barriers for joint projects as provided by workshop participants in a follow-up survey conducted by THEMA Consulting Group, as well as interviews with possible user country representatives. In the following, we discuss the barriers in more detail.

Figure 19: Barriers from a host country (left) and user country (right) point of view



Source: THEMA Consulting Group

Barriers for host countries

From a host country point of view, time to develop the legal framework for joint projects and time to develop the projects themselves are the most important barriers and the ones most difficult to overcome, cf. the upper right hand corner of the figure above (the host country perspective).

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Offshore wind power projects take 4-7 years to get online after final permission is granted and investment decision taken. In order to get projects online before 2020, that leaves only two years from today to develop the legal framework and come to an agreement on one or several specific joint projects. In order to be able to deliver towards the 2020 targets, a framework for joint projects must probably be in place by 2015 at the very latest.

Another major concern for a potential host country is the uncertainty of demand, particularly the overall level. User country demand – the deficit it will likely face by 2020 – will not be known with reasonable certainty before 2016/2017, underlining the time squeeze and importance of putting the legal framework in place as a pre-condition as quickly as possible. Uncertainty about RES targets after 2020 and the volume and duration of the RES-E deficit are also important to consider, since there are alternative measures for e.g. short-term deficits (statistical transfer) as well as the option for user countries to trade-off between its transport, RES-C&H (cooling and heating) and RES-E sector.

Public acceptance for side effects in the host country, such as decreased power prices for producers which generates less tax income or the need for investments in additional transmission capacity to export parts of the generated strong power balance are seen as important but can be overcome.

Barriers for user countries

In user countries, timing is much less in focus than in potential host countries. Many countries believe or state that they will meet their national goals. If they also believe that short-term options such as statistical transfer will be available, their current incentives to engage in development of the legal framework for joint projects might be weaker than for potential host countries. In addition, potential user countries may expect to be able to choose from all relevant European surplus projects, including projects which both can be cheaper and faster to build than Nordic Offshore wind.

We expect the biggest concerns for user countries to be about future RES targets (when cost-effective national options may be exhausted) and public acceptance for investments outside national borders. It is likely that Member States will attempt to link industrial policy decisions to joint projects, provided that this is in line with EU competition law and state aid guidelines.

5 RAISING AWARENESS OF JOINT PROJECTS

Host country governments and authorities, project developers, investors and branch organisations need to better understand the realistic potential for joint projects and their mechanism. In order to raise awareness in potential user countries, host countries must be in the driver's seat, both in their own country and abroad. We propose to create a Nordic Project Bank for joint projects (NPBJP) preferably for all possible joint projects, regardless of technology, and actively promoting these projects towards potential user countries.

Raising awareness in host countries. Member states, authorities, project developers, investors and branch organisations need to better understand the realistic potential for joint projects, the regulatory framework and the risks associated. We recommend information about these topics via presentations at larger national energy conferences and using the channels of both Nordic bodies and national Energy Agencies, in the form of a standardized information package based on the results from this and previous projects.

It should be made possible for project developers to formally signal their interest in participating in joint projects to the National Energy Agencies, and thus have their project included in the NPBJP.

Continuous information exchange with colleagues in possible user countries about likely deficit/surplus and planned changes in support schemes will be especially important for host country governments.

Raising awareness in possible user countries. Ideally, one would like to see a European market platform for joint mechanisms where potential host countries offer their supply potential and provide information on costs (incl. transaction cost), while potential user countries signal their deficit volumes and willingness to pay.

In order to allow the realization of offshore wind projects until 2020, the legal and contractual framework should be in place as soon as possible. The upcoming EU Commission guidance (on the implementation of cooperation mechanisms) should allow for acceleration and some standardization of this process.

An alternative to stimulate joint projects possibilities and mitigate first mover risks, is for example to widen statistical transfer cooperation agreements between Member States to allow (assessments of) joint project options too. This could also provide a perspective beyond 2020, depending on EU renewables policies and targets after that date. Most of the current agreements to work together include such a possibility.

As a first step, increasing transparency for available Nordic Offshore wind as joint projects can support the communication process with potential user countries. A possible way forward would be to establish a “Nordic Project Bank” for offshore wind as joint projects. The Project Bank can contain an overview of available projects, their volume, earliest production start, cost and required support levels, other relevant project data and the contact information of the project manager. This project could, in the beginning, only include Swedish offshore wind projects, as Sweden is the only Nordic country currently stating an active interest in joint projects. At a later stage, the Project Bank may be extended to include other Nordic countries and technologies as well.

There can also be a role for Nordic cooperation in developing a regulatory framework for joint projects, even if the individual countries currently have different attitudes towards using the mechanism in practice.

Article 24 of the Directive 2009/28/EC on Renewable Energy requires the European Commission to establish an online public Transparency Platform. The aim of the platform is to facilitate and promote cooperation between Member States, in particular concerning statistical transfers and joint projects.[26] The Transparency Platform may also be used to inform about Nordic offshore wind (of course along with other opportunities in the Nordic region and Member States in general).

Raising awareness of joint projects also means raising a sense of urgency. The time window in order to create the regulatory framework is short. A clear statement of political will – on behalf of those Nordic countries interested in promoting joint projects, not necessarily the Nordic region as a whole – is a requirement in that respect.

26 http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm

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6 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis, we draw the following conclusions:

- Meeting the 2020 RES targets in the EU in a cost-efficient manner will likely require cooperation mechanisms, of which joint projects constitute a potentially important policy instrument. Indeed, we find that several member states have expressed interest in utilising such mechanisms, either as host country or possible user country.
- Nordic offshore wind will not play a major role in meeting the national Nordic 2020 targets except for Denmark, even though some offshore wind projects have been built and will be built before 2020. However, Nordic offshore wind represents an interesting option in a European context with regard to cost levels and potentials. This applies in particular to projects in the Baltic Sea region and the Danish North Sea, where costs are expected to be lower than elsewhere in the Nordic region. The analysis shows that current support levels available in selected EU Member States would be sufficient to make at least the most competitive Nordic offshore wind projects profitable.
- A legal and regulatory framework for joint projects can be designed that meets both EU criteria and national requirements.
- A main barrier for Nordic offshore wind as joint projects is the timing. If joint projects are to count towards the 2020 targets, there is little time to implement the necessary regulatory framework and get the projects operational. The renewables policies beyond 2020 are as yet uncertain. The timing issue is complicated even further if it is necessary to reinforce the transmission grid, which can entail lengthy decision processes and discussions on cost allocation, and hence further delays.
- Another barrier relates to public acceptance in both the host country and the user country. Sourcing money from the user country to investments in other countries may be controversial. From the host country perspective, the impact on power prices and network costs, as well as environmental concerns (both the wind farms themselves and possible transmission grid reinforcements), are key issues.
- A support system for joint projects is easiest to implement if it is integrated in an existing system in the possible user country, provided the system is based on tendering and/or feed-in tariffs that can be used to target specific technologies. A separate system for joint projects is more complex in practice, both for legal and economic reasons. Using the host country support system is not feasible, particularly not in the case of the technology-neutral Norwegian-Swedish Certificate market.
- Finally, Nordic offshore wind will have to compete against other options such as possible surplus in and thus joint projects with other countries, statistical transfer or projects in the heating sector.

In summary, Nordic offshore wind may play a role in meeting the 2020 RES targets, but there are many obstacles and risks. Given that there is a political desire to promote Nordic offshore wind as joint projects – even though it is likely that the Nordic countries have different ambitions in this area – policy action is therefore needed. We make the following recommendations:

- Awareness should be raised in the possible user countries through a clear statement of the political will to use cooperation mechanisms for promoting offshore wind. This is mainly a task for the individual countries and not the Nordic region as a whole, given the different ambitions.
- As a joint Nordic effort, a common source of information for possible user countries – the Nordic Project Bank for joint projects – can be established. The Project Bank can contain data on inter alia potential projects, cost estimates, contact information for developers and investors and information on regulatory procedures. The Project Bank could, in the

beginning, only include Swedish offshore wind projects, as Sweden is the only Nordic country currently stating an active interest in joint projects. At a later stage, the Project Bank may be extended to include other Nordic countries and technologies if they wish so.

- Finally, the Nordic countries may cooperate on creating standard legal and contractual frameworks for joint projects. This may be integrated with the project bank.

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