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Joint support schemes and efficient offshore investment: Market and transmission connection barriers and solutions

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Abstract

With the large potential for increase in installed offshore wind capacities especially at far-offshore locations, cooperation and coordination across countries can contribute to a more efficient expansion of renewable generation. Locations are often bordering areas between markets with different support schemes and rules for market access, market integration (incl. balancing responsibility) and development of transmission capacity. Countries that are not coordinating activities in such areas might trigger non-optimal connection solutions of wind projects. They might also find themselves competing for investment in a market with limited capital available. In both cases, the cost-efficiency of the renewable support policies decreases. Current EU legislation opens for cooperation mechanisms such as joint support schemes, joint projects and statistical transfers.

We investigate which of the cooperation and coordination possibilities are applicable and favourable in the offshore wind context and address the specific barriers for implementing joint support schemes. This includes supporting wind generation that is connected to a country different from the one that finances the support. More specifically, the benefits and disadvantages of tendering schemes, feed-in tariffs, feed-in premiums and quota schemes as joint support mechanisms are addressed. We illustrate consequences of possible joint support scheme solutions for wind generator revenue and infrastructure cost and draw conclusions regarding the cost-efficiency of the renewable policy. We discuss the risk implications for investors in wind energy and infrastructure projects. Depending on the specific design, an internationally coordinated support mechanism may not expose investors to political changes as much as a purely national scheme does. Other risks may increase.

Possible policy solutions are suggested for joint support schemes and joint projects. Furthermore, consequences for wind generator revenues and system cost are illustrated. The preliminary results point to a considerable potential benefit and there are promising solutions to overcome the barriers. For example, implementing a special cross-border offshore zone where a joint support scheme could be implemented is a promising option.

1. Introduction

Offshore wind power plays a key role for the deployment of renewable energy sources in a number of countries, expressed through the existing National Renewable Action Plans (NREAPs). The key challenges for the industry are cost decreases, which are mainly going to be achieved with technological development – which itself is fostered by a specified policy framework. Namely, this covers support schemes, connection regimes and broader aspects such as marine spatial planning. The WINDSPEED project is the latest example for the latter field and covers the North Sea (Veum et al., 2011). It extends earlier national approaches where possible areas for offshore wind power were designated and may play a role in increasing international collaboration in the future. This collaboration can consist of a many different facets, such as joint support schemes or joint projects under the EU Directive 2009/28/EC or the internationally coordinated connection of offshore wind farms. Ropenus/Grenaa Jensen (2009) provide an overview of benefits of collaboration and risk characteristics of single support schemes. Roggenkamp et al. (2010) are the first ones to illustrate a number of interesting connection constellations such as an offshore wind farm's connection to another than its home country, or it being connected to several countries. Implementing such possibilities can be beneficial, as the OffshoreGrid project (de Decker/Kreutzkamp, 2011) quantifies on a large scale. In addition, it states examples on benefits through combined connection of neighbouring wind farms and the incorporation of wind farms into cables (e.g. the considered CobraCable connection between the Netherlands and Denmark, closely touching German offshore wind farms). However, implementing such internationally combined solutions leaves a number of regulatory challenges such as incentives for the involved transmission system operators and offshore wind farm operators. If several neighbouring offshore wind farms with different national affiliations are to share transmission connections, a homogeneous policy framework may facilitate a number of issues: similar support scheme levels for one site are likely to be efficient, and useful connection responsibilities can facilitate the integration of the site's generation in an economic way.

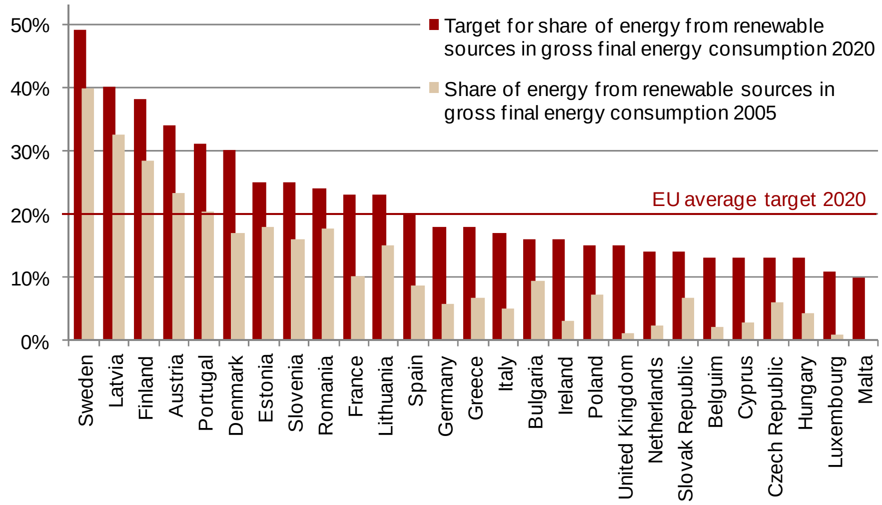
This paper addresses a number of these issues: its starting point is the current EU legislation on national renewable targets as well as on support schemes. We illustrate how these could be combined before turning towards possible barriers for implementation. Drawing on the previously discussed combination of policy schemes, we illustrate possibilities to overcome these barriers for 2 specific cases, namely for a tendering scheme for cross-border areas as well as for a tradable green certificate scheme for a larger geographic area. A risk evaluation for the involved actor follows before turning towards the discussion and conclusions.

2. EU legislation

The current EU legislation on renewable energy is dominated by EU Directive 2009/28/EC. For the first time, national targets for renewable energy have become binding. For each member state of the European Union, a 2020 target for the share of renewable energy in the final energy consumptions has been set, so that the average RES share over all countries will be 20% in 2020.

The specific target of each country is determined as required increase from the individual 2005 levels and a combination of few parameters, amongst them differences in income level.

Figure 1: Binding RES targets for EU member states in 2020, as percentage of final energy consumption



Source: own illustration, data from Directive 2009/28/EC

The differences in costs of RES production in the different countries have not been directly included in setting the targets. In some member states, the required investment in RES might be significantly more costly than in other member states. Therefore, there exist potential benefits from cooperation and joint implementation of national targets. This would reduce the overall compliance costs of the RES targets.

The EU Directive 2009/28/EC has opened up for a joint compliance with the individual targets through the utilisation of so-called cooperation mechanisms. Between EU member states, three cooperation options are defined:

- **Statistical transfers** of target accounting units of RES production from one country with ‘over-compliance’ to a country undersupplied with RES production
- **Joint projects** amongst EU member states, with a contractual arrangement between the participating countries on how to allocate the units of RES production accounting for target compliance
- **Joint support schemes** amongst EU member states, with a jointly implemented support in both countries and a contractual arrangement on how to allocate the target accounting units of RES production

The details for the specific implementation of these mechanisms have not been laid out yet.

As part of the monitoring process demanded in (Directive 2009/28/EC 2009), every EU member state has published their pathway on how to achieve their national RES target in form of a National Renewable Energy Action Plan (NREAP). This happened between July 2010 and

January 2011 (Beurskens/Hekkenberg 2011, p. 28). Currently, six EU member states have integrated the use of cooperation mechanisms in their NREAPs on quantitative basis. In total, the expected cross-border trade accounts for the very limited amount of ca. 0,4% of the expected EU renewables production in 2020 (own data analysis based on EC 2011).

The theoretical potential for statistical transfers is large, but only in a perfect market where all governments act strictly economically rational, do not exhibit risk-avoiding behaviour and have perfect foresight. In this case, those countries with future over-compliance could commit to statistical transfers sufficiently many years ahead. In practice, this might be for both the selling and the receiving party a too risky strategy to follow cost-efficiently (Jansen et al., 2011). Therefore, it is expected, for example by Klessmann et al. (2010) that statistical transfers will be used more or less as an opportunistic measure of straighten out arising short and long positions of renewable energy production towards 2020 rather than as a strategic measure with significant trading volume.

The mechanism of joint projects gives member states the opportunity to develop projects outside their own borders if they enter into a project-specific or framework agreement with the member state hosting the projects. An advantage of joint projects is that less expensive RES solutions can be pursued by one country without having to agree on a joint support with the hosting country and without joint changes in regulation. A disadvantage is the potentially high transaction and administrative cost of establishing this measure on a project-by-project basis.

Joint support schemes can be established between member states who want to join forces in developing renewable energies. This joint support scheme can be designed for whole systems, a limited geographic area or limited to specific technologies. A well-designed joint support scheme is expected to require a large preparation and implementation effort. Agreements for the allocation of the eligible RES production are required, as well as the establishment of a common support fund and the amendment of national regulations. Joint support schemes are on the other hand the most promising mechanism from a strategic cooperation perspective, since they can involve significantly more RES production than joint projects. The joint support schemes will also be significantly better rooted in both member states' RES support and regulatory systems which diminish uncertainty.

Joint support schemes have to be based on a jointly agreed policy type. The most commonly used RES support policies are Feed-in tariffs (FIT), which are guaranteed prices, Feed-in premiums (FIP), which are guaranteed add-ons to market prices, and quota obligations systems with Tradable Green Certificates (TGC). Mostly for technologies with typically large installation sizes, such as offshore wind parks, Tendering processes are used to determine a cost-efficient, project-specific guaranteed feed-in tariff or comparable price premium scheme.

3. Barriers

EU member states will engage in cooperating on joint support schemes if they all benefit from it. A mutually beneficial situation can be achieved if the overall benefits are greater than the overall cost and if the costs and benefits can be distributed in a fair way. The challenge to design this fair distribution is probably the main barrier but that is because it has to deal with several effects arising from support schemes, power markets and infrastructure.

Klessmann (2009) describes the different elements of costs and benefits for each MS under a cooperation mechanism: The direct costs are the primary support cost for the produced RES electricity (i.e. Feed-in premiums). The direct benefit is the contribution to RES target compliance. There are also a number of indirect costs and benefits that must be addressed such as RES integration cost, effect on power prices, conventional generator income, employment and security of supply. Difficulties in quantifying these indirect costs and benefits may lead to certain barriers for the implementation of cooperation mechanisms. In some situations the secondary benefits will fall entirely on the country expanding its RES capacity and this could be effectively hindering the cooperation.

Especially local benefits (jobs, security, innovation, export options) are often mentioned as a significant element by political decision makers and they therefore form a barrier if they only affect one of the countries engaging in cooperation. The compensation for such indirect losses is very hard to quantify into a price premium on the RES-certificate transfer price.
Barriers also include the influence on domestic/regional power market prices. One market will be influenced by for example wind expansion with lower prices that will affect existing conventional producers. Supporting that development will be opposed by producers whereas consumers will support such a strategy. However, the investment will be influenced by decisions of producers and the option of securing connection to other markets with higher market prices could reduce the price decrease caused by adding capacity to the market.

Different RES support systems

There are considerable barriers related to difference in support system between countries, but just as important is the barrier from different levels of support.

Support system differences covers combinations of: feed-in tariffs, feed-in premiums, green certificates or tendering(auctions) and differences in the coverage of technologies with technology banding or technology specific support level.

Support levels create barriers as they are expressing the willingness of the population/government to pay for renewable expansion. Offshore wind support has been granted at quite different levels in neighbouring countries around the North Sea. The result is that investors have been moving to the areas of highest expected revenues mainly in the form of support. In a joint support scheme, the investors in the high support level market would oppose to a joint system as well as those that have to finance more RES expansion at higher costs (power consumers) in the low support level country might oppose to the joint system as well. Renewable industry, green development supporters and renewable investors in the high support level country would all oppose to the reduction of support levels despite that cooperation support can be reduced because cheaper options can be exploited and RES expansion in total would be at least the same.

Power market regulation, composition and price levels

Network regulation varies a great deal between member states from rate of return to incentive based price and revenue caps. The details in incentive regulation include numerous differences and the enforcement of regulation is not always effective. Network regulation assures incentives for networks to facilitate efficient connection of new technologies and network reinforcement (Ropenus et al., 2011). If national regulation allow networks to include reinforcement investments caused by renewable generation in their capital base and thereby revenue cap this cost will be borne by the network customers. In the case of a cooperation country receiving the RES credits the host country will require the receiving country to compensate also this cost, but the transfer to network customers seem very difficult to realise.

Power markets differ even though they are in many cases coupled and therefore prices to some extent are correlated. Differences in market concentration and technology composition create some barriers. The mix of technologies in power generation can be more or less flexible to adjust to short term changes in renewable generation. It can be an important barrier for increasing the renewable capacity in a country if the inflexibility of the generation capacity is combined with exposition to the *power market price* level and volatility differs and creates additional barriers. Price levels in some countries will not be affected very much from increasing or decreasing the renewable expansion. However countries where renewable expansion potentials are abundant and cheap could experience considerable changes in power prices and corresponding deterioration in profitability of existing conventional and renewable capacity. It is not necessarily easy to compensate the firms/producers that lose with the gain experienced by the consumers in terms of lower prices. At the same time the country facing the reduced prices will probably have to look for alternative ways of providing incentives for future investment in conventional capacity.

Generation mix might be quite substantially influenced by intensively exploiting one cheap renewable resource: first, expanding the technology itself and second, the general power price effect (reduced for low marginal costs RES as referred above) which makes the least efficient base load plants less profitable or even loss making. The generation mix might then be affected in a direction that is providing less security of supply for power and makes the sector more vulnerable to change in few or just one fuel price as natural gas.

Table 1 gives an overview of the main benefits and disadvantages of regulatory combinations and is based on the following assumptions:

- Statistical transfers do not require a support integration of the participating countries because the transfer takes place at a higher institutional level, i.e. between countries. One of the main issues in this context is to choose the pricing mechanism for the transfer (for an overview of different options, see e.g. Klessmann et al. (2010)).
- Joint projects refer to a narrowly defined offshore wind energy project in a specific geographic area. Participating countries, their current support schemes and levels as well as the quantity target to be met are defined in advance.
- Joint support schemes are considered for a larger geographic area and thus, potentially contain multiple projects. As for joint projects, participating countries, their current support schemes and levels as well as the quantity target to be met are defined in advance.

The main criterion of international policy collaboration for meeting national RES targets is that a certain quantity is met. Offshore wind energy is today supported by tendering schemes (e.g. Denmark), feed-in tariffs (e.g. Germany) or quota mechanisms (e.g. United Kingdom). In addition, quota mechanisms seem the natural approach for internationally harmonised schemes with a focus on efficiency: Norway and Sweden implement a technology-neutral TGC scheme from 2012 onwards and a quota scheme (Guarantees of Origin) has for a long time dominated the discussion about a possible harmonised European support scheme. Based on these considerations, we choose to focus on two options that seem to have most practical relevance for our further analysis: a) a tendering solution for a joint project and b) a TGC scheme as a joint support scheme for a larger area. For both, we assume that they are technology-specific for offshore wind power and that the support is the only attainable support within the given geographic area. In other words, the combination of location and technology is exempt from the applying national support scheme to avoid undesirable effects from overlapping schemes.

Table 1: Combinations of cooperation schemes and support schemes - main benefits and disadvantages

	Statistical transfers	Joint projects	Joint support scheme
Feed-in tariff, price premium	• Ex-post tool 'above' national support schemes • Pricing / burden sharing • Costs of total period represented in transfer for 2020 only • Penalty for non-compliance	• Attractive if support level lower than the level of the country financing the project • Resulting quantity unknown	• Attractive if joint level lower than participating countries' levels • Resulting quantity unknown • Geographical distribution of projects and related national affiliation uncertain in advance
Tendering		• Narrowly defined conditions • Quantity target set, price results from competition	• Quantity target set, price results from competition • Geographical distribution of projects and related national affiliation uncertain in advance (network connection difficult)
Tradable Green Certificates		• If specifically established for the joint projects, then market liquidity too low • If integrated into the existing system of the financing country, then market distortion problem	• Quantity target set, price results from competition • Geographical distribution of projects and related national affiliation uncertain in advance (network connection difficult) • Steadily rising quota demand provides a reasonable market size for the industry

4. Case studies

Based on the above discussed considerations, we have investigated two specific cases, one on joint projects involving a tendering scheme, and a second one on a joint support scheme involving a quota obligation with tradable green certificates specifically established for the defined area.

4.1 Case 1: Joint projects – tendering for specific locations

The main properties of this case are that two countries engage in a common project at a narrowly defined location. A specific amount of wind energy is to be installed in this location and a tendering mechanism is chosen as support scheme. The tendering design follows the Danish design: the contract is awarded to the bidder requiring the lowest support level, a guaranteed price per MWh. However, this is not a simple feed-in tariff where daily operations are administered by a third party, but a variable price premium filling the gap between the average power market price over a period of 3 months and the awarded tendering price level. For everyday operations, the offshore wind farm operator is himself responsible of forecasting and selling the generation as well as managing imbalances. We assume furthermore that the joint project is physically connected to one of the contract states in a first step. Thus, the other contract state participates only via the support mechanism. Figure 2 illustrates the joint project solution between two countries in comparison with a standard national solution.

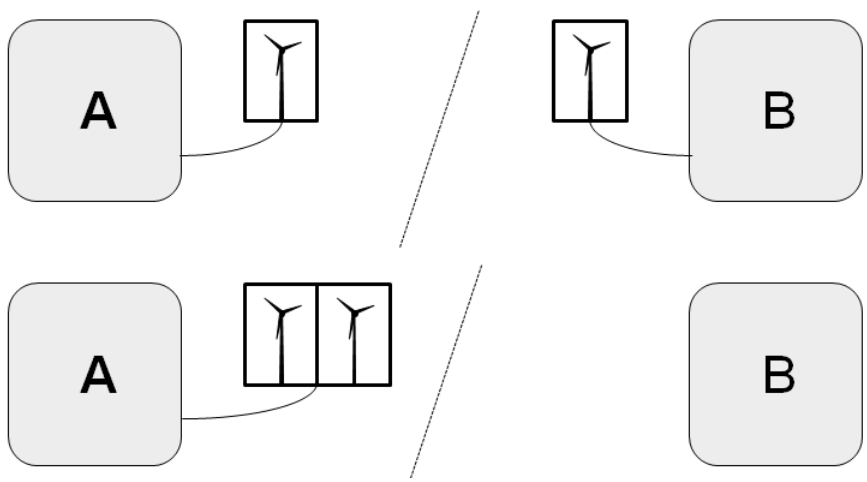


Figure 2: Standard national solution (above) and possible outcome under a joint project (below)

For the country supporting cheaper RES generation sited abroad, the expectable benefits due to a better wind site with possibly shallower water and closer to shore are quite straightforward. Opportunity cost of building an inland project is the main benchmark indicator. For the country to which the connection is established, the following cost and benefit elements are relevant and may be subject to the intergovernmental project contract:

- increase in interconnection investment
- increase in national grid reinforcement costs
- increased reserves costs
- merit-order-effect lowering power prices
- site blocking for possible future extensions/meeting future national targets

In addition, the share of additional benefits as employment effects during construction as well as operation and maintenance of the offshore wind farm may change between countries due to the different siting. Another aspect that has not been highlighted above is the risk of transmission failures over longer time periods. Regarding this, the regulatory incentives of the connecting country become crucial. It needs to be agreed whether this risk of transmission failure is to be shared among countries or whether the transmission operator has to compensate the offshore wind farm as well as the involved countries for foregone benefits.

It is inherent to the system that making available sites for third-country access blocks these sites for a later national development. In other words, if binding targets are agreed e.g. for 2030, the most favourable locations will be blocked already. This risk aspect may also be reflected in the contractual agreement between countries.

The OffshoreGrid project (de Decker/Kreutzkamp, 2011) has shown that combined connection solutions are beneficial even if one of the wind farms gets delayed by several years. We estimate that the increase in offshore connection cable investment can be quantified fairly easily, but that building larger transmission connections due to the possible later connection of additional wind farms (for joint projects) may be difficult to negotiate due to sunk-cost characteristics. In contrast to that, the increase in national grid reinforcement costs and increased reserve procurement costs as well as the merit-order effect are harder, if not impossible, to quantify. The difficulty with regard to the merit-order effect arises from its ex-post character: in a stable system, it can be assessed from an ex-post point of view. However, taking investments over a longer time into account, the extension of RES generation has an effect on the composition of the power plant portfolio and alters the merit order curve (Wissen/Nicolosi, 2007).

Finally, an important aspect that has not been covered in the literature until now is the security of supply property for a certain price level that is inherent to tendering/FIT mechanisms: if an the income level for a share of national generation is guaranteed, this absorbs customers partially from fossil fuel price fluctuations. When tendering a wind park based on a guaranteed income level composed of the market price and the premium, the customers pay this fixed level. If power market prices rise, the premium is reduced accordingly and vice versa. This provides security of supply characteristics to customers: the wind park’s share of electricity generation in the national generation portfolio comes at a guaranteed price. Under the novel situation of tendering a wind park connected to another country, this characteristic trait of the support scheme is lost. Fossil fuel prices in both countries correlate, but depending on the countries’ generation structures, they are more or less prone to these fluctuations. Let us assume that a country has a high dependency on fossil fuels and both fuel and electricity prices rise. The country supports an extraterritorial wind farm under a guaranteed price support scheme. The wind farm is connected to a country that is less exposed to the price increases, which is why the premium stays relatively high. Thus, the country's electricity consumers are subject to both the higher power prices and the high support. Of course, this mechanism can also work vice versa.

4.2 Case 2: Joint Support Schemes – Tradable Green Certificates for a larger area

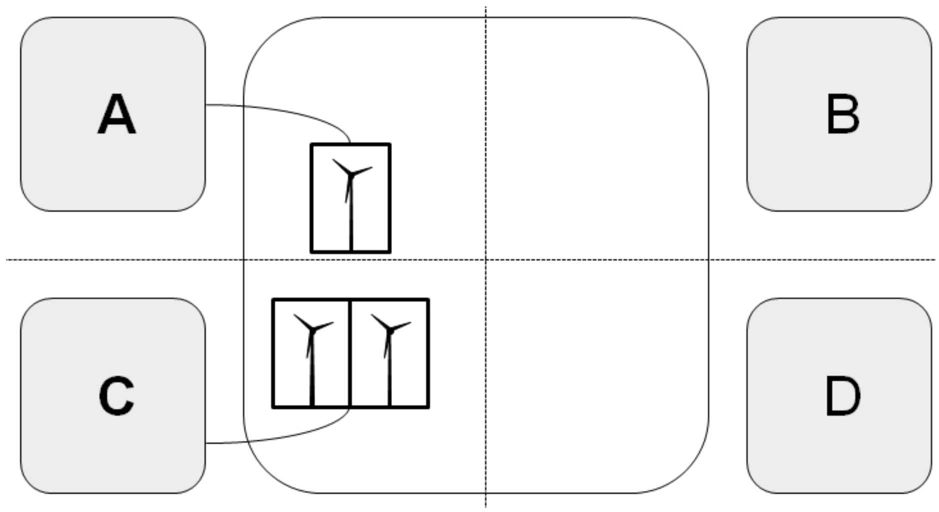


Figure 3: Possible setup in an offshore-TGC scheme of four countries

Figure 3 displays the possible outcome under a TGC scheme between the countries A-D. In this example, resulting offshore wind farms are only built in the sectors of the countries A and C. The idea of a TGC scheme between several countries has e.g. been addressed in Grenaa Jensen and Morthorst (2007). Their main points are that in comparison to national schemes, distortions in the conventional power sector can lead to higher CO2 emissions. In addition, it can be expected that a common TGC market works best if other market structures such as the power market are already integrated. This condition is fulfilled for the Swedish-Norwegian market to be established from 2012 onwards.

Regarding the case put forward here, two crucial differences are that firstly, a *technology-specific* TGC scheme is in the focus of the discussion. Secondly, countries with neighbouring offshore areas do not necessarily share onshore borders as well, which is a traditional prerequisite for integrated power markets. Existing offshore HVDC connections have a rather low capacity in relation to total market sizes. Permission procedures and other administrative burdens do not have to be identical between countries, but should have similar procedures and time horizons to ensure that they do not deteriorate investment decisions.

It is an obvious benefit that offshore wind parks are a large-scale technology with professional participants only. Transaction costs can for this reason expected to be low. Market liquidity may however be an issue during the start phase of such a support scheme. Furthermore, the erection of offshore wind parks and respective transmission lines has some bulk characteristics. This feature is not fully compatible with increasing the quota demand steadily. A centrally coordinated approach allows harvesting gains from combined transmission connection that account for a considerable share of total cost (de Decker/Kreutzkamp, 2011). A quota banking permission may help to partially overcome the bulk characteristics, but not the siting/transmission coordination issue.

5. Discussion and conclusions

Support policies that utilise cooperation potentials and are integrating several countries would immanently lead to a more efficient deployment, i.e. of the best wind resources first. In other words, a stronger clustering than under the current national approach can be expected. This benefit should be put into perspective relative to the possible benefits of large-scale spatial levelling: a comparatively even geographic distribution of fluctuating generation leads to less total output variations than a local clustering. A number of the presented considerations will gain more relevance if post-2020 renewable energy goals are agreed upon because the choice of far-offshore locations by several countries can lead to more collaboration opportunities. Accordingly, ensuring the flow of the offshore wind power towards the country with highest power prices may be more deciding than low transmission investment cost. When establishing joint projects or joint support schemes, it should be encouraged to consider alternative connection options other than to the national affiliation of the offshore sector. An intergovernmental agreement seems an ideal opportunity to foster the least-cost connection into planned interconnectors and/or to high-price markets. Joint mechanisms require a political agreement where price or quantity targets are set. In order to increase planning and investment security, it is important that the agreed prices and quantities constitute firm commitments with liabilities for all participating countries. It would be devastating for the cooperation between the countries and therewith the overall wind deployment if political changes in one country could unilaterally affect the functioning of the joint mechanism. We advocate therefore binding international contracts without opt-out clauses. Changes and renegotiations of the joint mechanism should always be a matter of unanimous decisions by all participating parties. Even national measures that could possibly effect the functioning of the joint mechanism, such as connection charges, should be subject to agreement between participating parties, especially whenever changes are considered. Under both regarded cases discussed in this paper, it seems beneficial if governmental bodies are in charge of marine spatial planning and the first steps of site assessments, e.g. with regard to environmental constraints. This ensures that only a smaller number of sites is considered, which is beneficial for infrastructure cost. Here, the two regarded combinations exhibit different characteristics: for the tendering mechanism, the necessary grid connection can be planned quite precisely and the generation of the joint project could be considered reliably also as a part of a larger infrastructure, e.g. an offshore grid. Under a tradable green certificate scheme, however, neither the locations nor the timing of expectable installations are known. This can be expected to increase infrastructure cost considerably.

In conclusion, the new cooperation schemes facilitate a more efficient attainment of EU RES targets for 2020. Statistical transfers are the option that requires least coordination between national policy schemes but at the same time being the option that offers the least security for RES development. By contrast, the analysed technology-specific cases of a) tendering mechanism for a joint project and b) quota mechanism as a joint support scheme call for a firmer and more detailed integration of national approaches. Both have the potential to be beneficial, especially if the above outlined criteria are followed. In the comparatively short time until 2020, it seems more realistic to coordinate joint projects based on tendering than to setup a quota scheme. The latter may however become a more relevant long-term option if post-2020 targets are defined.

6. Acknowledgements

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