NORTHSEAGRID POLICY BRIEF

The role of support schemes for renewables in creating a meshed offshore grid

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Key Messages and Recommendations

- North Sea states' national support schemes for renewables are rather incompatible and represent a barrier to cooperation
- More coherent support approaches to offshore wind projects will be conducive to the creation of a meshed offshore grid in the North Sea
- Policymakers could resolve incompatibilities by prescribing common guidelines for national support schemes, focusing on common grid access rules and common price-setting mechanisms for certain renewable energy technologies
- The institutional procedure set out in the Commission's 2030 Climate and Energy package could enhance cooperation

[1] Comments by Leif Rehfeldt (Deutsche WindGuard), Arno Behrens (CEPS), Jaap Jansen (ECN), Jan De Decker (3E) and Paul Kreutzkamp (3E) are gratefully acknowledged.

1 Introduction

Recent discussions on the prospect of an interconnected offshore grid in Europe have gained momentum and reflect a general consensus that this type of infrastructure brings both financial and technical benefits to Europe's power system, possibly outweighing the costs of investment in certain cases.

"NorthSeaGrid" is a research project within the Intelligent Energy for Europe framework. Its objective is to analyse why **integrated infrastructure projects** that combine wind park connections and interconnections are not being built today. Within the scope of this project three concrete case studies are analysed that were selected together with the North Sea Countries' Offshore Grid Initiative (NSCOGI):

- Case I (German Bight): An interconnection between the Netherlands, Germany and Denmark integrating two German wind farms.
- Case II (Benelux-UK): Combining Dutch and Belgian offshore wind farm connections with an interconnector between the Benelux and the UK.
- Case III (UK-NO): An interconnector between the UK and Norway, picking up offshore generated wind power from a large British wind farm.

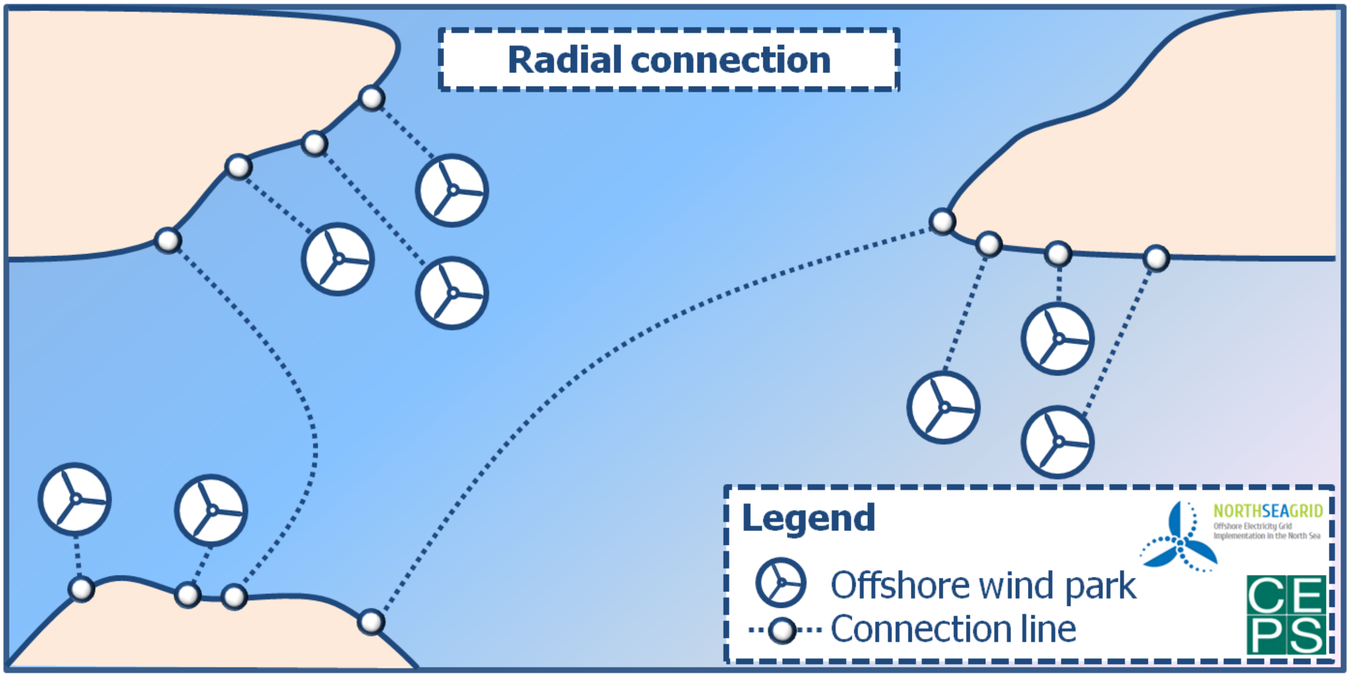
Integrated infrastructure projects, which bring socio-economic benefits, will only be realised when the regulatory frameworks allow for them and when the costs and benefits are distributed fairly among stakeholders. For the three cases cited above, the project consortium will carry out in-depth cost and benefit calculations; will study regulatory and financial barriers and will develop new cost-benefit allocation schemes, taking into account the role of all possible stakeholders.

In this policy brief, we present the initial results of the regulatory analysis, focusing on support schemes for renewable energy sources (RES) and on how these schemes could represent a barrier or a driver for the realisation of integrated infrastructure projects.

2 Basics of grid connection design

When connecting an offshore wind park to the mainland, two design approaches are possible: a radial or a meshed approach; see Figure 1 and Figure 2. Here, different shores represent different countries and thus also different legislative frameworks, e.g. with regard to the financial support given to renewables – both in terms of absolute payments and the way in which support is granted.

Figure 1: Radial grid connection[2]

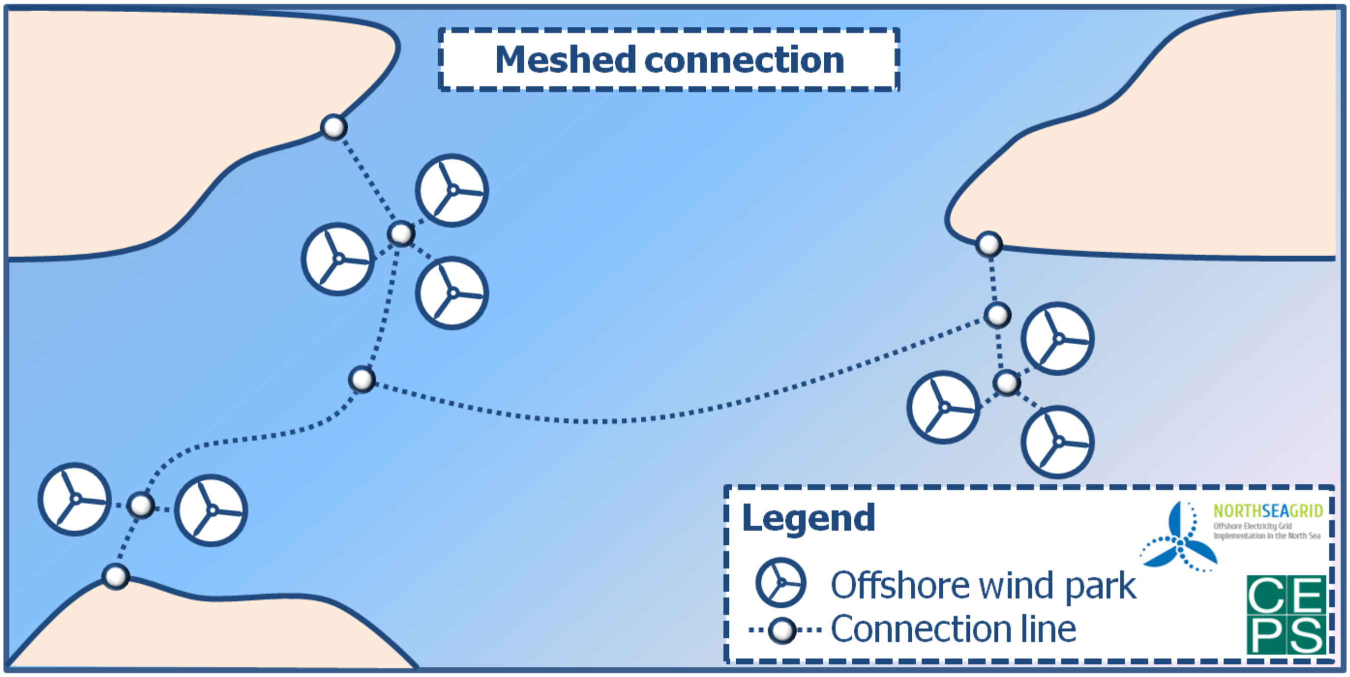


In the case of a radial connection, each offshore wind park is connected to the shore individually. This ensures that any electricity generated by the offshore wind park is transmitted to the connected shore (country) first. As also indicated, electricity may be exchanged between two different countries through a dedicated transmission line, i.e. a so-called interconnector. Currently, this is the usual design approach for connecting offshore wind parks to the coast. Depending on bilateral agreements between the connected countries, the corresponding electricity markets may be coupled. This allows for supply and demand to be combined across borders.

In the **meshed grid case**, the **physical** connection to one shore and the interconnection between different shores are combined. In this approach, some of the offshore development zones and countries could be interconnected. This requires a coordinated grid design approach but may – under certain conditions – be more cost-efficient than building several individual connection lines for the offshore wind parks and separate inter-connectors next to these lines for cross-border electricity exchange. Moreover, it supports the completion of the Internal Electricity Market by inherently allowing for a more efficient combination of supply and demand across all inter-connected countries.

[2] Own illustration based on NSCOGI (2012).

Figure 2: Meshed grid connection[3]



It is worth pointing out that in the case of a meshed grid, as shown in Figure 2, electricity generated by an offshore wind farm will be fed **directly** into the electricity system of different countries. In order to facilitate the creation and operation of a meshed grid, it is necessary to ensure the cross-border compatibility of (inter alia) support schemes, balancing rules, commodity markets (including intra-day and balancing markets), congestion management (e.g. unconditional priority dispatch for renewables) and grid access rules for wind parks.

Below, we give an overview of the current situation in Belgium, Denmark, Germany, the Netherlands, Norway and the United Kingdom, and then pinpoint the incompatibilities between them.

3 Existing RES support schemes in North Sea countries

When the 2007-09 Climate and Energy Package was adopted, the EU decided to break down the EU renewables target into legally binding member state obligations, leaving the choice of support mechanisms to EU member states. As a result, different support schemes for renewables have evolved, showing great variations across different EU member states. In many cases, support schemes even vary greatly across different renewable energy technologies (e.g. offshore wind vs. small-scale photovoltaics). In the context of the NorthSeaGrid project, we will focus on the support given to operators of offshore wind parks, looking exclusively at the situation in the North Sea countries.

[3] Own illustration based on NSCOGI (2012).

For the purpose of this policy brief, we use the following attributes to differentiate the various support schemes for offshore wind:

- **Support scheme category**, i.e. green certificates (GC), a feed-in tariff (FiT) or a feed-in premium (FiP).
- **Determination of RES generators' income**, i.e. are tariffs/premiums set administratively or in a tendering process or is the revenue based on the market value of the sold electricity/certificates?
- **3rd party purchase obligation**, i.e. is there an obligation for a third party to buy the electricity generated by the offshore wind park?
- **Balancing obligation**, i.e. is the offshore wind park operator (financially) responsible for balancing forecast errors?
- **Grid access responsibility**, i.e. who is in charge of connecting the wind park to the shore?
- **Level of support**, e.g. payments in €/MWh.

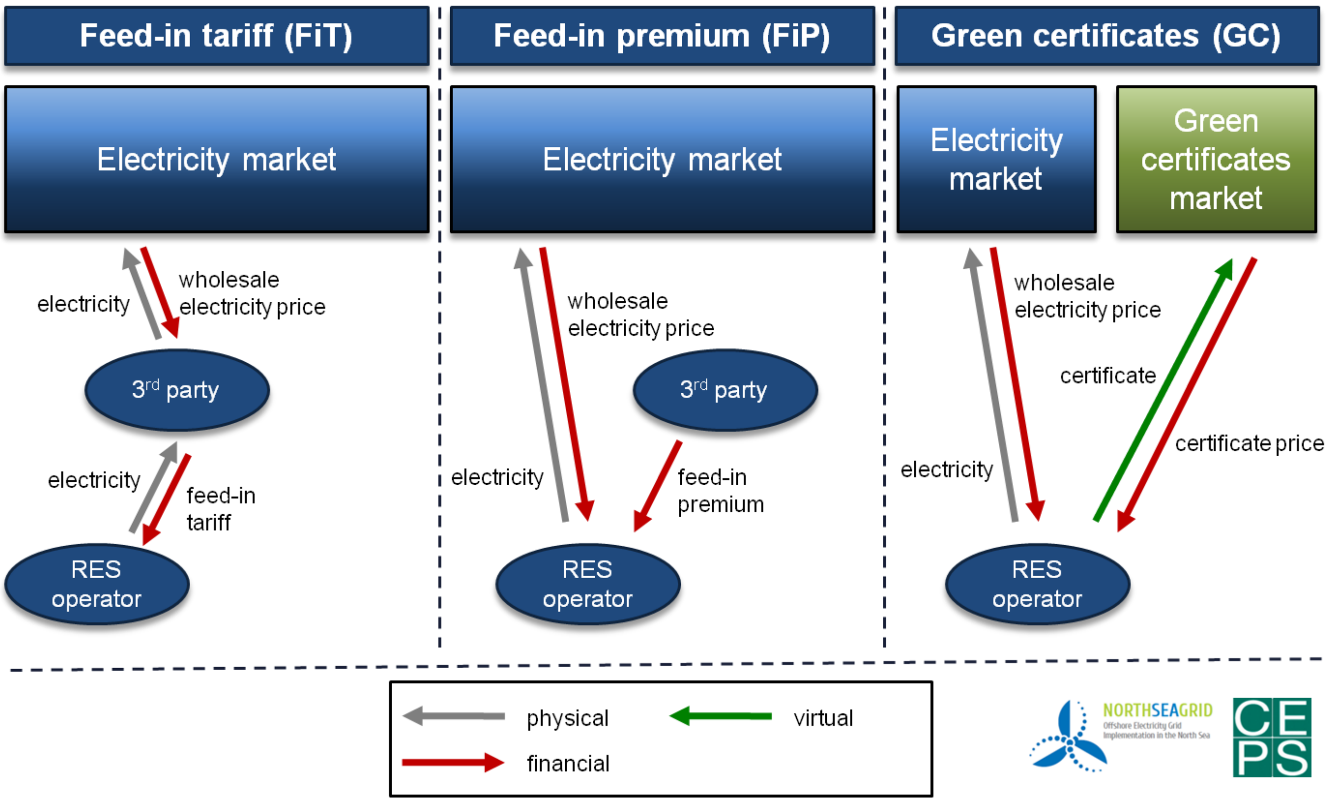
In all schemes, generators receive a so-called **operating aid**, i.e. remuneration for each MWh of electricity produced. Apart from that, the schemes vary widely. The main differences between the three support scheme categories currently in effect in the North Sea countries are illustrated in Figure 3. Most importantly, there is **an obligation to directly sell** the produced renewable electricity to markets **in a FiP or GC support scheme**. There is no such direct marketing obligation in a FiT scheme.

As a consequence, there is just one source of income in a FiT scheme (i.e. a fixed, time-invariant tariff). In contrast, there are two sources of income in a FiP and a GC scheme. For both these schemes, one source of income is the market value of the produced electricity. In a FiP scheme, the other source of income is a premium, which is paid on top of the wholesale electricity market price. In a GC scheme, RES generators are granted a certain number of so-called green certificates for the electricity they produce. These certificates can be sold to market participants who have to reach a certain share of renewable electricity in their portfolio ("quota"). Therefore, these green certificates have a value and represent the other source of income for RES generators.

A concise overview[4] of the situation in the above-mentioned countries is given in Table 1.

[4] A more in-depth description can be found in Held et al. (2014).

Figure 3: RES support scheme categories and overview on financial, physical and virtual flows[5]



Belgium, Norway and the UK currently apply support schemes based on green certificates (GC). This means that, in theory, the revenue stream of RES generators should be purely determined by the market. In reality, this is often not the case. In the Belgian scheme, the green certificates are sold to the Belgian transmission system operator (TSO) at the minimum price, which is guaranteed for 20 years. In the British case, the number of certificates granted depends (inter alia) on the technology, size and location of a renewable power plant and currently amounts to 1.5 GC per MWh electricity produced for offshore wind. By contrast, the GC scheme in Norway is technology-neutral and there is no guaranteed minimum certificate price. So far, no offshore wind parks have been deployed under the Norwegian scheme.

The other countries are applying schemes based on a feed-in tariff (FiT) or a feed-in premium (FiP). The UK is currently moving towards such a scheme, albeit named “Contract for Difference”. In all member states currently applying a FiP scheme (DE, DK, NL, UK), the premium is set in such a way that summing up both the sources of income (the feed-in premium and the market value of the sold electricity) will yield a previously defined contract base price, which is named “strike price” in the British case and “basisbedrag” in the Dutch case. Hence, all countries analysed in this paper are

[5] Own illustration.

applying a **floating**[6] FiP scheme, thus limiting the exposure to market prices and providing a stable long-term investment signal. It is worth noting that a floating FiP can give an efficient dispatch signal, e.g. to stop production in times of negative wholesale market prices. This is not the case in a FiT scheme.

Table 1: Overview of existing RES support schemes in Europe

	BE	DK	DE	NL	NO	UK
Support scheme category	GC	FiP	FiT or FiP	FiP	GC	GC, FiP
Determination of RES generators' income	Administrative setting and market-based	Tendering and market-based	Administrative setting and market-based	Tendering and market-based	Market-based	Administrative setting and market-based
3rd party purchase obligation	Yes, TSO[7]	No	Yes, TSO (FiT only)	No	No	No
Balancing obligation	Yes	Yes	Optional (FiP only)	Yes	Yes	Yes
Grid access responsibility	Project developer	TSO / project developer	TSO	Project developer	Project developer	OFTO[8]
Level of support[9] (in €/MWh)	90 or 107[10]	69-140[11]	150 or 190, then 35[12]	140-160[13]	23[14]	50 (GC) or 184 (FiP)[15]

[6] The alternative would be a fixed FiP. In that case, the premium itself is fixed ex ante, increasing the long-term exposure to market prices.
[7] The Belgian TSO Elia has an obligation to buy green certificates but not to buy electricity.
[8] Offshore Transmission Owner.
[9] For countries applying a GC scheme, adding the market value of the electricity sold to the GC price will yield the total income of a RES generator. Exchange rates: December 2013.
[10] Minimum GC price as of 2013, as stated by Royal Decree of 30 July 2013 concerning the establishment of a system of guarantees of origin for electricity produced from renewable energy sources. Installations with a capacity of less than 216 MW receive the higher price.
[11] Result of three tenders (from 2008-2011).
[12] Initial compensation as of 2014 granted for 12 or 8 years respectively, as stated by § 31 EEG (Renewable Energy Act). After this period, the tariff amounts to €35/MWh.
[13] Result of several tenders.
[14] Average GC price as of 2012 (NVE 2013). Green certificates are granted for a period of 15 years.
[15] Buy-out GC price as of 2013/2014 (Ofgem 2013) and draft strike price as of 2014 (DECC 2013).

A major difference between these FiP schemes is the way in which the contract base price is determined. In the Netherlands, it is the result of a tendering process. Offshore wind project developers submit bids for their desired contract base price under which they would be willing to invest. Successful tenderers will receive this remuneration for the next 15 years. However, the annually remunerated production volume is capped at 4,000 full-load hours. Denmark is following a similar approach to the Netherlands. There is a tendering procedure with the remunerated production volume being capped at 50,000 full-load hours in total, i.e. roughly 12 years assuming an average annual production of 4,000 full-load hours. In Germany and the UK, the contract base price is currently set administratively. German producers also have the option to choose the FiT scheme with the feed-in tariff being set administratively.

All countries are imposing a balancing obligation upon medium and large generators, including renewable producers.[16] Balancing responsible parties may seek to mitigate day-ahead forecast errors on intra-day markets. Any remaining errors will then be balanced by the grid operator, resulting in an obligation to pay for the balancing costs.

For the grid access, there are essentially two approaches. Half of the countries impose the responsibility (and the costs) to connect an offshore wind park with the grid on project developers; the other half does not and typically leaves this task to the grid operator. In the British case, the TSO then delegates this task to a third party.

The most striking difference between the various support schemes is, however, the level of support. Depending on the country, the payment for producing one MWh electricity in a FiP scheme can vary from between roughly €69 (Denmark) and €190 (Germany).[17] Imposing additional responsibilities will clearly create additional costs. The level of support is therefore usually adapted to cover these additional costs. This may explain some but not all of the financial differences between the various support schemes. The national target itself and the technologies needed to meet that target also have a strong impact on the required level of support. Countries with an ambitious RES target typically require the deployment of multiple and sometimes less mature renewable energy technologies. Therefore, the required level of support needed to trigger the deployment of these technologies will likely be higher than in countries with a less ambitious RES target.

[16] Currently, producers in Germany are able to avoid this obligation by choosing the FiT scheme. However, the vast majority of wind park operators in Germany choose the FiP scheme. Here, the wind park operator is in charge of balancing.
[17] Initial compensation paid for 8 years. After that, generators receive €35/MWh for 12 years.

4 Incompatible RES support schemes: a barrier for cooperation and thus a barrier for a meshed grid

The various RES support schemes currently in effect in the North Sea states have been designed from a purely national perspective. As a consequence, it is currently not possible for an offshore wind park operator in e.g. Denmark to obtain RES support from e.g. Germany. At first glance, this approach is understandable given the fact that every member state has to reach its own national RES target in 2020.

However, it is legally possible for an EU member state to cooperate with another EU member state or even with a third country outside the EU in order to reach its individual 2020 target. With the adoption of the EU Directive 2009/28/EC, three options for intra-European cooperation mechanisms have been introduced, inter alia so-called “joint projects” enabling the cooperation partners to share the output of a RES plant between member states. So far, not one joint project has been realised. But such joint projects may very well represent a driver for the creation of a meshed offshore grid.

Agreeing on a **common approach in terms of responsibilities** that are **imposed on RES generators** is a mandatory first step to ensure compatibility. This step has to be taken before selecting a support scheme category or defining the level of support. As stated, the number of responsibilities imposed on RES generators has a strong impact on the level of support required to trigger deployment. On the other hand, it is not necessary to prescribe a full convergence of national support schemes to facilitate the creation of a meshed offshore grid. Defining compatible responsibilities for grid access and balancing would already facilitate integrating offshore wind parks in the planning process of new inter-connection lines (where that is beneficial). Planning an integrated infrastructure project connecting wind parks in the German Bight more efficiently for both Germany and Denmark, for example, is unnecessarily complicated since German and Danish regulations for grid access and balancing are not compatible.

For the realisation of joint projects, several other compatibility issues need to be tackled. First, cooperating member states have agreed on a compatible mechanism to determine the income of a offshore wind operators, i.e. either administrative setting or tendering. As of today, a joint project between the Netherlands and Denmark would be easier to realise than a joint project between Germany and Denmark, because both the Danish and Dutch support schemes make use of tendering to determine the overall support, whereas the German approach is to set tariffs administratively. Another compatibility issue is related to market integration. If a RES generator chooses the FiT scheme in Germany, a third party is obliged to purchase the renewable electricity produced. In that case, it is the TSO and not the RES generator that is in charge of market integration. It is therefore unclear who would be in charge of market integration in a joint project between Germany and the Netherlands, for example. On the positive side, **nearly all North Sea countries already apply a market-based support scheme**, i.e. generators are obliged to sell their electricity production directly to the market. Germany has announced that direct marketing will soon become mandatory.

Finally, the approach of national support schemes does not take account of the evolution of market coupling in North-Western Europe. As of 4 February 2014, all electricity markets in North-Western Europe are coupled. Market coupling essentially means moving away from national electricity markets where foreign producers have to explicitly acquire inter-connector capacities in order to sell electricity to a neighbouring country. In the case of coupled markets, inter-connector capacities are implicitly allocated in such a way that the most efficient combination of demand and supply is created – irrespective of the country – greatly facilitating cross-border electricity exchange. The market region of North-Western Europe currently covers all states analysed in this policy brief as well as France, Sweden and Finland.

The market value of renewable electricity generated by offshore wind parks within this North-Western European market region might very well converge in the medium term – provided that inter-connector capacity is not scarce. On the other hand, the convergence of support levels for offshore wind projects is disconnected from this development due to the approach of national support schemes with different remuneration setting mechanisms.

5 Conclusions and outlook

Innovative grid solutions with offshore wind parks that are connected to several states face major regulatory and market challenges, also because there are diverse national renewable support schemes. Today's national RES support schemes are somewhat incompatible with one another and thus represent a barrier for (EU member) states to cooperate. Policymakers could resolve incompatibilities by prescribing common European framework guidelines for national RES support schemes, focusing on **common grid access rules** and **common price-setting mechanisms** for certain renewable energy technologies.[18] This would facilitate the realisation of joint projects, which in turn might become a driver for the creation of a meshed offshore grid. The convergence of support schemes, market rules and grid codes will be conducive to the creation of a meshed offshore grid.

In this context, the proposed 2030 Climate and Energy framework can be seen as a chance to encourage intra-European cooperation and regional initiatives. In its communication on the framework, the European Commission proposed to increase the share of renewable energy to at least 27% of the EU's energy consumption by 2030. In contrast to the 2007-2009 Energy and Climate package, there is only an EU-level target for renewables with currently no intention to break down this target into national targets.[19] Instead, the Commission proposes a coordinated planning process for the coherent implementation of climate and energy measures. This institutional *novum* could become a driver for enhanced cooperation between member states.

[18] It is expected that the new "Guidelines on Energy and Environmental Aid 2014-2020" will set such a framework as discussed in Genoese and Egenhofer (2014).
[19] cf. European Commission (2014) and Jansen (2014).

6 References

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